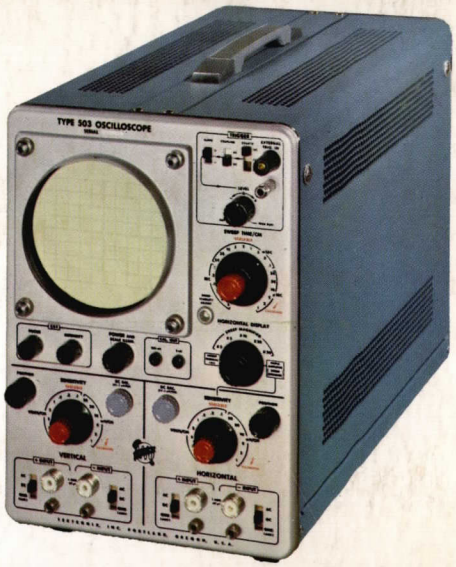


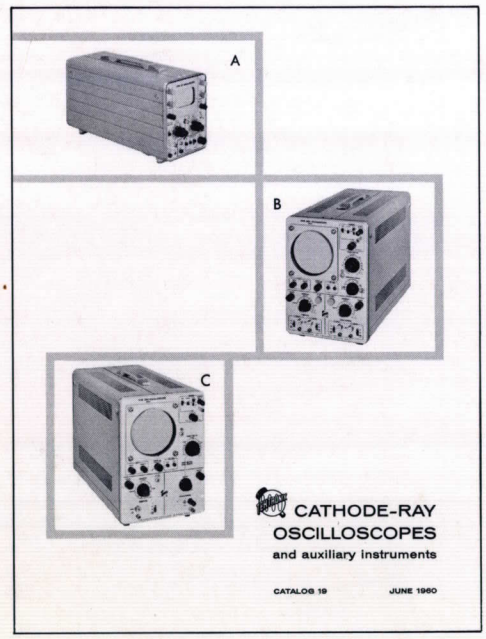
CATHODE-RAY OSCILLOSCOPES

and auxiliary instruments

CATALOG 19 JUNE 1960

OUR CONTINUING CREED

is that of serving Tektronix customers with products and policies that are unexcelled in the electronics industry and limited only by the current state of the art.



COVER—Three of the twelve new instruments included in this catalog: (A) Type 321 Transistorized Oscilloscope, (B) Type 503 X-Y Oscilloscope, and (C) Type 504 General-Purpose Oscilloscope. Other new instruments: Pulse-Sampling System (includes Type N Plug-In Unit, Type 110 Pulse Generator and Trigger Takeoff, Type 111 Pretrigger Pulse Generator, and Type 113 Delay Cable), Type Q Strain-Gage Plug-In Unit, Type S Diode-Recovery Plug-In Unit, Type Z Differential Comparator Plug-In Unit, Type 516 Dual-Trace Oscilloscope, and Type 1121 Wide-Band Amplifier.

INDEX BY INSTRUMENT TYPE

TYPE		PAGE
A	Wide-Band Preamplifier	D-2
B	High-Gain Preamplifier	D-2
C-A	Dual-Trace Preamplifier	D-4
D	Differential Preamplifier	D-6
E	Low-Level Preamplifier	D-6
FM122	Frame-Mount Preamplifier	M-6
G	Differential Preamplifier	D-8
H	High-Gain Preamplifier	D-8
K	Fast-Rise Preamplifier	D-10
L	High-Gain Preamplifier	D-10
N	Pulse Sampling Unit	D-12, E-4
P	Test Unit	D-12
Q	Transducer Unit	D-14
R	Transistor-Risetime Unit	D-16
RM15	Rack-Mount Oscilloscope	H-17
RM16	Rack-Mount Oscilloscope	G-8
RM17	Rack-Mount Oscilloscope	G-13
*RM31A	Rack-Mount	C-5
*RM32	Rack-Mount	C-9
*RM33	Rack-Mount	C-13
*RM35A	Rack-Mount	C-19
*RM41A	Rack-Mount	C-25
*RM43	Rack-Mount	C-29
*RM45A	Rack-Mount	C-35
RM122	Rack-Mount Preamplifier	M-6
RM181	Rack-Mount Time-Mark Generator	P-5
RM503	Rack-Mount Oscilloscope	H-9
RM504	Rack-Mount Oscilloscope	H-13
RS16	Rack-Mount Oscilloscope	G-9
S	Diode Recovery Unit	D-18
T	Time-Base Unit	D-20
Z	Differential-Comparator Unit	D-20
21	Time-Base Unit	C-42, Q-10
22	Time-Base Unit	C-42, Q-10
80	Preamplifier	C-52
81	Plug-In Adapter	C-52
105	Square-Wave Generator	L-2
107	Square-Wave Generator	L-4
110	Pulse Generator and Trigger Takeoff	E-6
111	Pretrigger Pulse Generator	E-8
113	Delay Cable	E-9
122	Preamplifier	M-4
123	Preamplifier	M-7

TYPE		PAGE
126	Power Supply	N-8
127	Power Supply	D-22
128	Power Supply	Q-6
130	L-C Meter	N-2
160A	Power Supply	N-4
161	Pulse Generator	N-6
162	Waveform Generator	N-6
163	Pulse Generator	N-8
180A	Time-Mark Generator	P-2
181	Time-Mark Generator	P-4
190A	Sine-Wave Generator	P-6
310A	Portable Oscilloscope	G-2
316	Portable Oscilloscope	G-6
317	Portable Oscilloscope	G-10
321	Transistorized Oscilloscope	G-14
360	Monitor	N-10
500A	Scope-Mobile	Q-2
500/53A	Scope-Mobile	Q-2
502	Dual-Beam Oscilloscope	H-2
503	X-Y Oscilloscope	H-6
504	DC to 450 KC Oscilloscope	H-10
515A	General-Purpose Oscilloscope	H-14
516	Dual-Trace Oscilloscope	H-18
524AD	Television Oscilloscope	J-2
525	Waveform Monitor	J-6
526	Vectorscope	J-10
*531A	DC to 15 MC	C-2
*532	DC to 5 MC	C-6
*533	DC to 15 MC—100-x Magnifier	C-10
*535A	DC to 15 MC—Sweep Delay	C-14
*536	DC to 10 MC—X-Y	C-18
*541A	DC to 30 MC	C-22
*543	DC to 30 MC—100-x Magnifier	C-26
*545A	DC to 30 MC—Sweep Delay	C-30
*551	DC to 25 MC—Dual Beam	C-36
*555	DC to 30 MC—Dual Beam—Sweep Delay	C-40
570	Electron-Tube Characteristic-Curve Tracer	K-2
575	Transistor Characteristic-Curve Tracer	K-8
*581	DC to 100 MC	C-46
*585	DC to 100 MC—Sweep Delay	C-47
1121	Amplifier	M-2

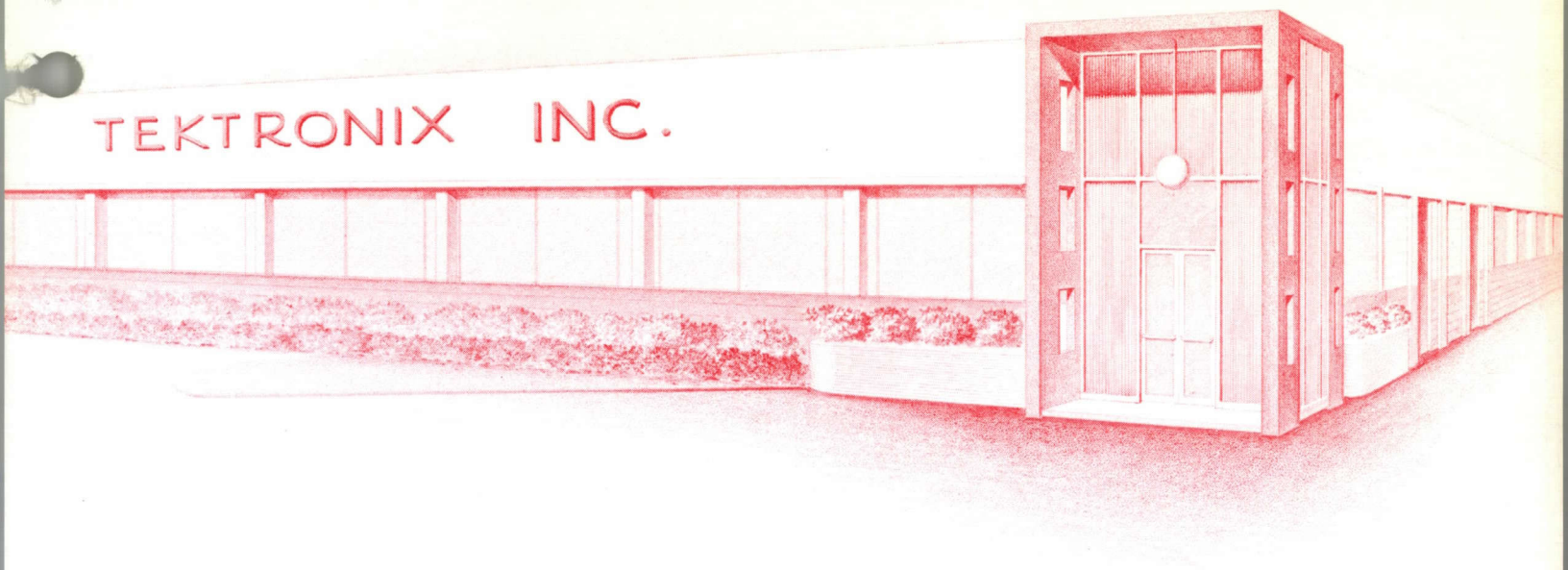
*OSCILLOSCOPES WITH PLUG-IN UNIT FEATURE.

(ACCESSORIES BY DESCRIPTION on other side)

ACCESSORIES BY DESCRIPTION

	PAGE
Adapters, binding post	Q-9
gain set	Q-10
Attenuators	Q-7
Base, fan for Type 310 and 310A	Q-7
Bezel	Q-8
Boards, transistor mounting	Q-11
Cabinet, plug-in storage	Q-7
Cables, coaxial	Q-9
Connector, deflection plate	Q-8
Cradle, rack-mount	Q-9
Extensions, plug-in	Q-10
Filters, light	Q-11
Fixture, test	Q-7
Frame, mounting	Q-9
Graticules, unruled	Q-11

	PAGE
Heads, attenuator	Q-5, Q-6
Head, capacitor-coupler	Q-6
Hoods, viewing	Q-8
Plug-In, blank	Q-9
Plug-In, TU-2	Q-6
Probes, P170CF	Q-4
P500CF	Q-5
P510A	Q-4
P6000-P6005	Q-3
P6014	Q-4
Standardizer	Q-10
Standards	Q-10
Terminations	Q-7
Tips, probe	Q-5



About the Company . . .

Tektronix was organized in 1946 to manufacture cathode-ray oscilloscopes. To an unusual degree, Tektronix oscilloscopes have met with the approval of the ultimate user, enabling the company to grow by expanding its product lines and services.

Throughout this continuing growth period Tektronix is striving to produce instruments with the quality and utility demanded by the fast-moving electronic industry. High employee morale, fostered by an employee-management relations program that gives employees a voice in company operations, a fair share of company profits, and steady year around employment, contributes greatly to this aim.

Realizing the complexity of the modern cathode-ray oscilloscope, Tektronix continually strives to provide the best in field maintenance help, and the utmost speed in replacement parts service. Helping to keep existing Tektronix instruments in efficient operation is as much a responsibility as developing new instruments to meet the future needs of the industry. Tektronix is making every effort to continue serving its customers with the highest quality in both product and service.

Tektronix, Inc., an Oregon Corporation, Beaverton, Oregon, U. S. A.

CONTENTS

INTRODUCTION

General Information for U.S. and Canada A-4
Field Office List for U.S. and Canada A-5
General Information for Overseas Customers A-6
Overseas Representatives A-7
Export Shipping Weights and Volumes A-8

GENERAL REFERENCE DATA

Reference Chart B-2
Tektronix Field Services B-5
Description of Cathode-Ray Tube Phosphors B-6
How to Calculate Writing Rate B-7
Dimensions of Rack-Mounting Oscilloscopes B-8

OSCILLOSCOPES WITH PLUG-IN PREAMPLIFIERS

TYPE		PAGE
531A	DC to 15 MC	C-2
RM31A	Rack-Mounting Model	C-5
532	DC to 5 MC	C-6
RM32	Rack-Mounting Model	C-9
533	DC to 15 MC—100-x Magnifier	C-10
RM33	Rack-Mounting Model	C-13
535A	DC to 15 MC—Sweep Delay	C-14
RM35A	Rack-Mounting Model	C-19
536	DC to 10 MC—X-Y	C-18
541A	DC to 30 MC	C-22
RM41A	Rack-Mounting Model	C-25
543	DC to 30 MC—100-x Magnifier	C-26
RM43	Rack-Mounting Model	C-29
545A	DC to 30 MC—Sweep Delay	C-30
RM45A	Rack-Mounting Model	C-35
551	DC to 25 MC—Dual Beam	C-36
555	DC to 30 MC—Dual Beam—Sweep Delay	C-40
581	DC to 100 MC	C-46
585	DC to 100 MC—Sweep Delay	C-47
80	Plug-In	C-52
81*	Plug-In Adapter	C-52

PLUG-IN UNITS FOR TEKTRONIX OSCILLOSCOPES

A	Wide-Band DC	D-2
B	Wide-Band High-Gain	D-2
C-A	Dual-Trace DC	D-4
D	High-Gain DC Differential	D-6
E	Low-Level AC Differential	D-6
G	Wide-Band DC Differential	D-8
H	Wide-Band High-Gain DC	D-8
K	Fast-Rise DC	D-10
L	Fast-Rise High-Gain	D-10
N*	Pulse Sampling Unit	D-12
P	Fast-Rise Test Unit	D-12
Q*	Transducer and Strain Gage Unit	D-14
R	Transistor-Risetime Unit	D-16
S*	Diode Recovery Unit	D-18
T	Time-Base Generator	D-20
Z*	Differential-Comparator Unit	D-20
127	Power Supply	D-22

PULSE SAMPLING SYSTEM

Introduction		E-2
N*	Pulse Sampling Unit	E-4
110*	Pulse Generator and Trigger Takeoff	E-6
111*	Pretrigger Pulse Generator	E-8
113*	Delay Cable	E-9
Measurement Applications		E-10

HIGH-SPEED OSCILLOSCOPES

517A	High Speed	F-2
507	Surge Testing	F-6

3-INCH PORTABLE OSCILLOSCOPES

310A	DC to 4 MC	G-2
316	DC to 10 MC	G-6
RM16	Rack-Mounting Model	G-8
RS16	Special Rack-Mounting Model	G-9
317	DC to 10 MC—9 KV	G-10
RM17	Rack-Mounting Model	G-13
321*	DC to 5 MC—Transistorized	G-14

GENERAL-PURPOSE OSCILLOSCOPES

502	200 μv/cm Dual Beam	H-2
503*	DC to 450 KC—X-Y	H-6
RM503*	Rack-Mounting Model	H-9
504*	DC to 450 KC	H-10
RM504*	Rack-Mounting Model	H-13
515A	DC to 15 MC	H-14
RM15	Rack-Mounting Model	H-17
516*	DC to 15 MC—Dual Trace	H-18

TELEVISION OSCILLOSCOPES

524AD	Television	J-2
525	Waveform Monitor	J-6
526	Vectorscope	J-10

*** NEW INSTRUMENTS**

CHARACTERISTIC-CURVE TRACERS

TYPE		PAGE
570	Electron Tube	K-2
575	Transistor	K-8

SQUARE-WAVE AND PULSE GENERATORS

105	Square-Wave	L-2
107	Square-Wave	L-4
110*	Pulse Generator and Trigger Takeoff	L-6
111*	Pretrigger Pulse Generator	L-8

AMPLIFIERS

1121*	Amplifier	M-2
122	Preamplifier	M-4
RM122	Rack-Mounting Model	M-6
FM122	Frame-Mounting Model	M-6
123	Preamplifier	M-7

SPECIAL INSTRUMENTS

TYPE		PAGE
130	L-C Meter	N-2
160A	Power Supply	N-4
161	Pulse Generator	N-6
162	Waveform Generator	N-6
163	Pulse Generator	N-8
126	Power Supply	N-8
360	Monitor	N-10

TIME-MARK AND SINE-WAVE GENERATORS

180A	Time Mark	P-2
181	Time Mark	P-4
RM181	Rack-Mounting Model	P-5
190A	Sine Wave	P-6

ACCESSORIES

500A	Scope-Mobile	Q-2
500/53A	Scope-Mobile	Q-2
P170CF	Cathode-Follower Probe	Q-4
P500CF	Cathode-Follower Probe	Q-5
P510A	Attenuator Probe	Q-4
P6000-P6005†	High-Performance Probes	Q-3
P6014†	High-Voltage Probe	Q-4
Attenuators, Terminations		Q-7
Bezel		Q-8
Hoods, Viewing		Q-8
Miscellaneous		Q-6 to Q-12
TU-2†	Test Unit	Q-6

*** NEW INSTRUMENTS**

† NEW ACCESSORIES

UNITS and ABBREVIATIONS

used in this Catalog

Unit	Name	Abbreviation
10^6 cycles	megacycles	mc
10^6 ohms	megohms	meg
10^3 cycles	kilocycles	kc
10^3 ohms	kilohms	k
10^{-2} meter	centimeter	cm
10^{-3} second	millisecond	msec
10^{-3} meter	millimeter	mm
10^{-6} second	microsecond	μsec
10^{-6} farad	microfarad	μf
10^{-9} second	nanosecond	nsec
10^{-12} farad	picofarad	pf
10^{-12} second	picosecond	psec

Frequency-response quotations are at the 3 db-down points unless otherwise stated.

GENERAL INFORMATION

ORDERING PROCEDURES FOR UNITED STATES AND CANADA

(Overseas Customers please see pages A-6, A-7, and A-8)

Terms and Shipment

For domestic orders, placed in accordance with the normal Tektronix marketing practices, our terms are net thirty days. Shipping delay may be prevented by establishing credit at the time of placing your order. When desirable, COD shipments can be arranged. Normally all prices and quotations are f.o.b. factory.

Unless otherwise specified on your order, shipment will be made via Motor Freight. If another carrier is specified, shipment will be made at full valuation unless your order instructs differently. In case air shipment and full valuation are desired, please specify whether Air Express or Air Freight. Lacking specification, Air Freight and full valuation will be chosen.

Delivery

Acceptance of purchase orders is indicated by our acknowledgment, and estimated shipment time is given from date of acknowledged acceptance. Every effort is made to meet the estimated shipment date, but there is the possibility that circumstances beyond our control might make it impossible to meet the quoted schedules.

Field Maintenance

To help assure adequate instrument-maintenance facilities for our customers, Tektronix has established Field Engineering Offices and Repair Centers at strategic points in the United States and Canada. Tektronix Field Offices are listed on the facing page. Those offices having fully equipped instrument repair shops are marked with an asterisk. Your own Tektronix Field Office will process all orders for repair parts promptly, and provide emergency parts service when needed to restore an instrument to operating condition. Your Field Office will also arrange for fast service with necessary recalibration or repair work on your instruments at a nearby Repair Center.

Tektronix repair and replacement-part service is geared directly to the field, therefore all requests for repairs and replacement parts should be directed to the Tektronix Field Office or Representative in your area. This procedure will assure you the fastest possible service. Please include instrument Type number and Serial number with all requests for parts or service.

It is standard practice for Tektronix to incorporate improvements in production instruments as they are developed in our laboratories. When it is feasible to add such improvements in the field, modification kits are made available to those who wish to modernize their own instruments. Ask your Field Engineer about possible modifications for your older instruments.

Special-Instrument Service

Many Tektronix Instruments can be supplied with such specials as painted panels, altered specification ranges, special connectors, and other features. Please consult your Field Engineer for prices, delivery schedules, and special ordering information.

Warranty

All Tektronix instruments are warranted against defective materials and workmanship for one year. Tektronix transformers, manufactured in our own plant, are warranted for the life of the instrument.

Any questions with respect to the warranty mentioned above should be taken up with your Tektronix Field Engineer.

IMPORTANT—Our General Office and Factory mailing address has changed since our previous catalog issue. Please see top of facing page for our new address.

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
Southern New Mexico Area: Enterprise 678

ATLANTA* Tektronix, Inc., 3272 Peachtree Road, N.E., Atlanta 5, Georgia TWX: AT 358 ..... CEdar 3-4484

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 ..... SPring 7861

CHICAGO* Tektronix, Inc., 400 Higgins Road, Park Ridge 15, Illinois TWX: 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, 7-1240
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 ..... Ploneer 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

KANSAS CITY Tektronix, Inc., 5920 Nall, Mission, Kansas TWX: MSN 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, 3-9409

Encino Tektronix, Inc.,, 17418 Ventura Blvd., Encino, California TWX: VNYS 7037 ..... STate 8-5170

***West L. A.** Tektronix, Inc., 11681 San Vicente Blvd., West Los Angeles 49, California ..... BRadshaw 2-1563
TWX: W L A 6698 ..... GRanite 3-1105

MINNEAPOLIS Tektronix, Inc., 3100 W. Lake Street, Minneapolis 16, Minnesota TWX: MP 983..WAlnut 7-9559, 7-8932

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 Ploneer 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

PALO ALTO* Tektronix, Inc., 701 Welch Road, Palo Alto, California TWX: PAL AL 112 ..... DAvenport 6-8500

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 ..... BElmont 4-9375

POUGHKEEPSIE* Tektronix, Inc., 8 Raymond Avenue, Poughkeepsie, New York ..... GRover 1-3620

SAN DIEGO Tektronix, Inc., 3045 Rosecrans Street, San Diego 10, California TWX: SD 6341 .... ACademy 2-0384

SEATTLE Hawthorne Electronics, 112 Administration Bldg., Boeing Field, Seattle, Washington
TWX: SE 798 ..... 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**

GENERAL INFORMATION

EXPORT ORDERING PROCEDURES FOR OVERSEAS CUSTOMERS

(Domestic and Canadian Customers please see pages A-4 and A-5)

HOW TO ORDER TEKTRONIX INSTRUMENTS

We at Tektronix wish to make our instruments available to our overseas friends at fair prices and under uniform sales conditions. We also believe that personal assistance in ordering and the servicing of instruments after receipt are as important as the sale of the instrument. For this reason, we have established authorized Tektronix Representatives in many overseas countries. These representatives have been chosen for their ability to provide such services. To receive full benefit of their assistance, please contact the authorized Tektronix Representative in your country. He will be pleased to help you. A list of Tektronix overseas representatives is on the opposite page.

ORDERING PROCEDURE FOR COUNTRIES NOT LISTED

If an authorized Tektronix Representative has not been established in your country, please address us as follows:

If your place of business is in a European country, address Tektronix, Inc., Victoria Avenue, St. Sampson's, Guernsey, Channel Islands.

If you are located in any other country, address Tektronix, Inc., Export Department, Post Office Box 500, Beaverton, Oregon, U.S.A.

We will be happy to make recommendations as to specific instruments to suit your application. If you request a quotation, we will issue a proforma invoice indicating our prices and sales conditions in accordance with the explanations below.

Delivery

When we issue our **proforma invoice,** we will indicate the time required from the date the order is received until the goods are shipped. When your purchase order is received, we will reconfirm the delivery time in our purchase order **acknowledgment.** Every effort will be made to meet the delivery date quoted. However, it is possible that circumstances beyond our control will delay shipments. To prevent delays, we suggest you follow carefully all instructions in our proforma invoice or our acknowledgment.

Prices

All Tektronix price quotations are based on a single FOB Portland list price in U.S. dollars. We do not have a special Export price. It is our firm desire to make our instruments available to users the world over at a single base price, to which the only additions are freight and forwarder's charges, duty, taxes, insurance and currency exchange costs, depending on the destination and the method of transportation. There is never an additional charge involved in placing an order through an authorized Tektronix Representative.

Point of Sale

Normally all Tektronix sales are FOB Portland, Oregon, U.S.A. We shall be pleased, however, to quote and ship on an FAS, CIF, C&F, etc. basis, if you request it.

Method of Payment

Our terms of payment for all orders which are received directly from overseas customers are cash in advance or irrevocable letter of credit. Our proforma invoice will provide further details to assist you in establishing the letter of credit.

Documents

When we issue our proforma invoice, or our purchase order acknowledgment, we will indicate the documents which are required to ship your order. Many of these documents such as import certificates and letters of credit have fixed time limits. It is essential that they be sent to us promptly. Otherwise, shipment of your order may be considerably delayed due to expiration of such documents.

SHIPPING METHOD

Shipment is always made in accordance with your request. Please make sure that your requests for quotations and your orders show the shipping method (air, vessel, etc.) you wish.

Packaging

Tektronix instruments are packaged in two ways.

(1) **Domestic packaging**—Each instrument is packaged in its special carton of 600 lb. test double wall kraft board.

(2) **Export packaging**—The Domestic Package (1) is wrapped in special waxed paper. This is then enclosed in an additional 350 lb. test waterproof carton, which is sealed with water repellent tape.

For air shipments, we invariably ship in our Domestic Package. This gives the instrument complete protection, yet adds the minimum amount of weight. There is no charge for Domestic Packaging. For vessel shipment we use our Export Package. There is a flat charge of $5.00 per carton for Export Packaging.

WARRANTY AND SERVICE

Warranty

All Tektronix instruments are warranted against defective materials and workmanship for one year from date of shipment. Tektronix transformers, made in our own plant, are warranted for the life of the instrument.

Service

If you require service, replacement parts or other help, notify your authorized Tektronix Representative. Field maintenance is part of the service he provides. Be sure to indicate the instrument type number and the serial number. You will be informed of the procedure to follow. If there is no representative in your country, notify Tektronix Guernsey or Tektronix Export Department as explained at the top of this page.

PLEASE DO NOT RETURN INSTRUMENTS OR PARTS BEFORE RECEIVING DIRECTIONS.

Replacement parts for instruments under warranty will be shipped by vessel prepaid C.I.F. port of unloading. If air shipment is requested, we will pay one-half the shipping charges. The other half will be invoiced to you C.I.F. airport of destination.

TEKTRONIX, INC.

Victoria Avenue, St. Sampson's, Guernsey, Channel Isles

Telephone: CENTRAL 3767 CABLE: TEK GUERNSEY TELEX 41-93

Tektronix Overseas Representatives

AUSTRALIA	Electronic Industries Imports Pty. Ltd., Box 192C, G.P.O., Melbourne C.1., Australia FJ-4161/8
	Electronic Industries Imports Pty. Ltd., 90 Grote St., Adelaide, S. A., Australia LA-5295
	Electronic Industries Imports Pty. Ltd., 376 Ann St., Brisbane, Q'land, Australia B-6462
	Electronic Industries Imports Pty. Ltd., 68 Railway Pde., West Perth, W.A., Perth, Australia BA-8587/9686
	Electronic Industries Imports Pty. Ltd., 121 Crown Street, East Sydney, Australia FL-5041
AUSTRIA	Inglomark Markowitsch & Co., Mariahilfer Strasse 133, Wien 15, Austria 54-75-85-SERIE
BELGIUM	Regulation-Mesure, S.P.R.L., 22 rue Saint-Hubert, Bruxelles 15, Belgium 70.79.89
BRAZIL	Consulting & Suppliers Company for South America Inc., 61 Broadway, New York 6, New York BOwling Green 9-0610/11
	Importacao Industria E Comercio Ambriex S.A., Av. Graca Aranha 226-601/6 Rio De Janeiro, Brazil 42-7990, 42-7291
	Palmar Ltda., Rua 7 de Abril 252, Sao Paulo, Brazil 34-4497
CUBA	Laboratorios Meditron, 41#1063 entre Kohly y 32, Alturas del Vedado, Habana, Cuba F-5970
DENMARK	Tage Olsen A/S, Centrumgaarden, Room 133, 6D, Vesterbrogade, Kobenhavn V, Denmark Palae 1369, Palae 1343
FINLAND	Into O/Y, 11 Meritullinkatu, Helsinki, Finland 62 14 25, 35 125
FRANCE	Maurice I. Parisier & Co., 741-745 Washington St., New York 14, N. Y. ..... ALgonquin 5-8900
	Relations Techniques Intercontinentales, 134 Avenue de Malakoff, Paris 16, France Passy 08-36, Kleber 54-82
GREECE	Marios Dalleggio, 2, Rue Alopekis, Athens (K), Greece 70.669
INDIA	Electronic Enterprises, 46, Karani Building, Opp. Cama Baug., New Charni Road, Bombay 4, India 75376
ISRAEL	Landseas Products Corp., 48 West 48th Street, New York 36, New York ..... COlumbus 5-8323
	Landseas Eastern Co., Ltd., P. O. Box 2554, 22 Maze St., Tel Aviv, Israel 66890
ITALY	Silverstar Ltd., 21 Via Visconti di Modrone, Milano, Italy 790.555
	Silverstar, Ltd., 12, Via Paisiello, Roma, Italy 868.046
	Silverstar, Ltd., c/o SICAR S.p.A., 3 Corso Matteotti, Torino, Italy 524.021 524.071
JAPAN	Midoriya Electric Co., Ltd., 3, 2-Chome, Kyobashi, Chuo-ku, Tokyo, Japan 561-9256
MEXICO	Cotesa, Apartado 2250, Mexico 1, D.F., Mexico 46-44-21
NETHERLANDS	C. N. Rood, n.v., 11-13 Cort van der Lindenstraat, Rijswijk, Z. H., Netherlands ..... The Hague 98.51.53
NORWAY	Morgenstierne & Company, Colletts Gate 10, Oslo, Norway 60 17 90
PORTUGAL	Equipamentos de Laboratorio Lda., Rua Pedro Nunes, 47, Lisboa, Portugal 733436/733437
PUERTO RICO	International General Electric, P. O. Box 9387, Santurce, Puerto Rico
SWEDEN	Erik Ferner AB, Snormakarvagen 35, Box 56, Bromma, Sweden ..... Stockholm 25 28 70
SWITZERLAND	Omni Ray AG, Dufourstrasse 56, Zurich 8, Switzerland ..... (051) 34-44-30
UNION OF SOUTH AFRICA	Protea Holdings, Ltd., Nucleonics Division, 9, Newton St. (P. O. Box 7793) Wemmer, Johannesburg, Union of South Africa 33.2211
UNITED KINGDOM	Livingston Laboratories Ltd., Retcar Street, London N.19, England ..... Archway 6251
URUGUAY	Compania Uruguaya De Rayos X y Electromedicina S. A. Mercedes 1300, Yaguaron 1449, Montevideo, Uruguay 8 58 29
WEST GERMANY	Rohde & Schwarz Vertriebs-GmbH., Hohe Strasse 160-168, Koeln, West Germany 23 30 06
	Rohde & Schwarz Vertriebs-GmbH., Augsburger Strasse 40, Berlin W30, West Germany 91 27 62
	Rohde & Schwarz Vertriebs-GmbH., Koernerstrasse 34, Hamburg, West Germany 27 41 41
	Rohde & Schwarz Vertriebs-GmbH., Kriegsstrasse 39, Karlsruhe, West Germany 2 52 02
	Rohde & Schwarz Vertriebs-GmbH., Brienner Strasse 43, Muenchen 2, West Germany 59 52 65

Other OVERSEAS areas please write or cable directly to the Export Department, P. O. Box 500, Beaverton, Oregon, U.S.A.

Printed in USA

APPROXIMATE SHIPPING WEIGHTS AND VOLUMES

Type	Net Wt. in lbs.	Domestic Packed in lbs.	Export Packed Weight lbs.	Export Packed Weight Kgs.	Export Packed Volume Cu. Ft.
105	37	49	61	28	5
107	12	19	33	15	4
108	7	13	14	6	1
110	18	22	40	18	4
111	8	15	32	15	4
112	36	49	79	36	8
113	43	59	75	34	6
121	21	24	43	20	4
1121	18	25	34	17	2
122	5½	9	16	7	1
FM122	5½	9	16	7	1
RM122	6	12	21	10	2
126	11	20	50	23	5
127	51	75	105	48	9
128	8	13	16	7	1
130	9	17	34	16	4
160 Series					
160A	21	27	47	21	4
161	3½	7	14	6	1
162	3½	7	14	6	1
163	3½	7	14	6	1
360	9	17	32	15	4
180A	31	43	58	26	5
181	17½	24	42	19	4
RM181	18	33	41	19	6
190A	24	36	55	25	5
310A	23½	30	50	23	4
316	34	42	55	25	4
RM16	45	65	89	40	9
RS16	38	66	97	44	10
317	34	42	55	25	4
RM17	40	66	90	40	9
321	17	28	38	17	4
502	56	71	92	41	8
503	31	43	59	26	6
RM503	27	49	73	34	9
504	29	41	57	26	6
RM504	25	47	71	32	9
507	129	169	212	96	21
515A	46	58	74	34	6
RM15	57	75	99	45	9
516	40	61	77	36	6
517A	190	235	281	128	22
524AD	61	80	100	45	8

Type	Net Wt. in lbs.	Domestic Packed in lbs.	Export Packed Weight lbs.	Export Packed Weight Kgs.	Export Packed Volume Cu Ft.
525	54	73	115	52	9
526	45	71	96	43	9
531A	62	77	98	45	8
RM31A	79	98	122	55	9
532	55	73	94	43	8
RM32	72	91	115	52	9
533	62	77	98	45	8
RM33	79	98	122	55	9
535A	66	81	102	46	8
RM35A	83	102	126	57	9
536	60	78	99	45	8
541A	62	77	98	45	8
RM41A	79	98	122	55	9
543	64	79	100	45	8
RM43	81	100	124	56	9
545A	67	82	103	46	8
RM45A	85	104	128	58	9
551	98	126	159	72	12
555	122	151	188	84	13
A	4½	10	15	7	1
B	5	11	15	7	1
C-A	5½	12	15	7	1
D	5½	12	16	7	1
E	5	11	15	7	1
G	5	11	15	7	1
H	4½	11	14	6	1
K	4½	11	14	6	1
L	5	11	14	6	1
N	9	13	16	7	1
P	4	10	13	6	1
Q	5	12	15	7	1
R	8	14	17	8	1
S	4	10	13	6	1
T	5½	12	15	7	1
Z	6	12	15	7	1
570	75	96	116	53	8
575	70	84	104	47	8
581	68	88	108	49	8
585	74	91	110	50	8
Domestic					
500A	35	53			
500/53A	35	53			
Export					
500A	42	50	57	26	8
500/53A	42	50	57	26	8

GENERAL REFERENCE DATA

REFERENCE CHART B-2
TEKTRONIX FIELD SERVICES B-5
DESCRIPTION OF CATHODE-RAY TUBE PHOSPHORS B-6
HOW TO CALCULATE WRITING RATE B-7
DIMENSIONS OF RACK-MOUNTING OSCILLOSCOPES . . B-8

MAIN SPECIFICATIONS of TEKTRONIX OSCILLOSCOPES

Type 530-Series Oscilloscopes

	Vertical Frequency Response (with Type K Unit)	Signal Delay	Calibrated Sweep Range	Sweep Magnifier	Sweep Delay	Accelerating Potential	Price (without plug-in units)	Complete Specifications
TYPE 531A General Purpose	dc to 15 mc	Yes	0.1 μsec/cm to 5 sec/cm	5x	None	10 kv	$995	Page C-2
TYPE 532 General Purpose	dc to 5 mc	No	1 μsec/cm to 5 sec/cm	5x	None	4 kv	$875	Page C-6
TYPE 533 General Purpose	dc to 15 mc	Yes	0.1 μsec/cm to 5 sec/cm	2, 5, 10, 20, 50, 100x	None	10 kv	$1100	Page C-10
TYPE 535A General Purpose	dc to 15 mc	Yes	0.1 μsec/cm to 5 sec/cm	5x	1 μsec to 10 sec	10 kv	$1400	Page C-14
Type 536 X-Y Curve Tracer	dc to 11 mc	No	See Type T Time-Base Gen.		None	4 kv	$1050	Page C-18

Plug-In Preamplifiers for Type 530-Series,

Risetime of Combination — Plugged into Type

	Calibrated Deflection Factor	531A, 533, and 535A	532	536	541A, 543, 545A 555, 581, 585*	551	
TYPE A Wide-Band DC	0.05 v/cm to 20 v/cm	25 nsec	70 nsec	35 nsec	18 nsec	20 nsec	
TYPE B Wide-Band High-Gain	5 mv/cm to 0.05 v/cm	35 nsec	70 nsec	40 nsec	30 nsec	30 nsec	
	0.05 v/cm to 20 v/cm	25 nsec		35 nsec	18 nsec	20 nsec	
TYPE C-A Dual-Trace DC	0.05 v/cm to 20 v/cm	23 nsec	70 nsec	35 nsec	15 nsec	16 nsec	
TYPE D High-Gain DC Differential	1 mv/cm to 50 v/cm	0.18 μsec	0.18 μsec	0.18 μsec	0.18 μsec	0.18 μsec	
TYPE E Low-Level AC Differential	50 μv/cm to 10 mv/cm	6 μsec	6 μsec	6 μsec	6 μsec	6 μsec	
TYPE G Wide-Band DC Differential	0.05 v/cm to 20 v/cm	25 nsec	70 nsec	35 nsec	18 nsec	20 nsec	
TYPE H DC Coupled High-Gain Wide-Band	0.005 v/cm to 20 v/cm	31 nsec	70 nsec	37 nsec	23 nsec	25 nsec	
TYPE K Fast-Rise DC	0.05 v/cm to 20 v/cm	23 nsec	70 nsec	31 nsec	12 nsec	14 nsec	
TYPE L Fast-Rise High-Gain	5 mv/cm to 2 v/cm	23 nsec	70 nsec	35 nsec	15 nsec	17 nsec	
	0.05 v/cm to 20 v/cm	23 nsec		31 nsec	12 nsec	14 nsec	
TYPE N Pulse Sampling	10 mv/cm	0.6 nsec	0.6 nsec	0.6 nsec	0.6 nsec	0.6 nsec	
TYPE Q Strain Gage	10 μstrain/in to 10,000 μstrain/in	60 μsec	60 μsec	60 μsec	60 μsec	60 μsec	
TYPE R Transistor Risetime	0.5 ma/cm to 100 ma/cm	23 nsec	70 nsec	35 nsec	12 nsec	14 nsec	
TYPE S Semiconductor Diode Recovery	0.05 v/cm and 0.5 v/cm						
TYPE T Time-Base Generator							
TYPE Z Differential Comparator	0.05 v/cm to 25 v/cm	35 nsec	70 nsec	40 nsec	27 nsec	27 nsec	

* Type 81 Plug-In Adapter is required for use with Types 581 and 585

CHART

for Convenience in Making Preliminary Comparisons

Type 540-Series, and Type 550-Series Oscilloscopes

	Vertical Frequency Response (with Type K Unit)	Signal Delay	Calibrated Sweep Range	Sweep Magnifier	Sweep Delay	Accelerating Potential	Price (without plug-in units)	Complete Specifications
TYPE 541A Fast-Rise	dc to 30 mc	Yes	0.1 μsec/cm to 5 sec/cm	5x	None	10 kv	$1200	Page C-22
TYPE 543 Fast-Rise	dc to 30 mc	Yes	0.1 μsec/cm to 5 sec/cm	2, 5, 10, 20, 50, 100x	None	10 kv	$1275	Page C-26
TYPE 545A Fast-Rise	dc to 30 mc	Yes	0.1 μsec/cm to 5 sec/cm	5x	1 μsec to 10 sec	10 kv	$1550	Page C-30
TYPE 551 Dual-Beam	dc to 25 mc	Yes	0.1 μsec/cm to 5 sec/cm	5x	None	10 kv	$1800	Page C-36
TYPE 555 Dual-Beam	dc to 30 mc	Yes	0.1 μsec/cm to 5 sec/cm	5x	0.5 μsec to 50 sec	10 kv	$2600	Page C-40

Type 540-Series, and Type 550-Series Oscilloscopes

Passband of Combination — Plugged into Type

	531A, 533, and 535A	532	536	541A, 543, 545A 555, 581, 585*	551	Input Capacitance	Price	Complete Specifications
	dc to 14 mc	dc to 5 mc	dc to 10 mc	dc to 20 mc	dc to 18 mc	47 pf	$90	Page D-2
	2 c to 10 mc	2 c to 5 mc	2 c to 9 mc	2 c to 12 mc	2 c to 12 mc	47 pf	$135	Page D-2
	dc to 14 mc	dc to 5 mc	dc to 10 mc	dc to 20 mc	dc to 18 mc			
	dc to 15 mc	dc to 5 mc	dc to 10 mc	dc to 24 mc	dc to 22 mc	20 pf	$250	Page D-4
	dc to 2 mc	dc to 2 mc	dc to 2 mc	dc to 2 mc	dc to 2 mc	47 pf	$155	Page D-6
	0.06 cycles to 60 kc	0.06 cycles to 60 kc	0.06 cycles to 60 kc	0.06 cycles to 60 kc	0.06 cycles to 60 kc	50 pf	$175	Page D-6
	dc to 14 mc	dc to 5 mc	dc to 10 mc	dc to 20 mc	dc to 18 mc	47 pf	$185	Page D-8
	dc to 11 mc	dc to 5 mc	dc to 9.5 mc	dc to 15 mc	dc to 14 mc	47 pf	$185	Page D-8
	dc to 15 mc	dc to 5 mc	dc to 11 mc	dc to 30 mc	dc to 25 mc	20 pf	$135	Page D-10
	3 c to 15 mc	3 c to 5 mc	3 c to 10 mc	3 c to 24 mc	3 c to 22 mc	20 pf	$200	Page D-10
	dc to 15 mc	dc to 5 mc	dc to 11 mc	dc to 30 mc	dc to 25 mc			
	600 mc	600 mc	600 mc	600 mc	600 mc	Input Impedance 50 ohms	$600	Page D-12 Page E-4
	dc to 6 kc	dc to 6 kc	dc to 6 kc	dc to 6 kc	dc to 6 kc	Adjustable	$300	Page D-14
							$300	Page D-16
							$250	Page D-18
							$235	Page D-20
	dc to 10 mc	dc to 5 mc	dc to 9 mc	dc to 13 mc	dc to 13 mc	27 pf	$525	Page D-22

REFERENCE CHART

(Continued)

MAIN SPECIFICATIONS of TEKTRONIX OSCILLOSCOPES for Convenience in Making Preliminary Comparisons

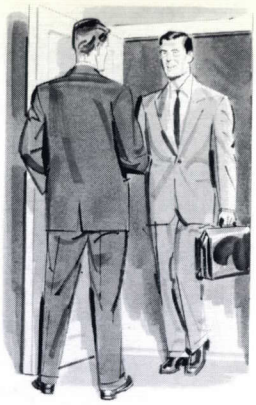
Type 580-Series Oscilloscopes

	Vertical Frequency Response (with Type 80 Unit)	Risetime	Basic Deflection Factor	Signal Delay	Calibrated Sweep Range	Sweep Magnifier	Sweep Delay	Accelerating Potential	Price (without plug-in units)	Complete Specifications
TYPE 581	dc to Approx. 100 mc	3.5 nsec	0.1 v/cm	Yes	0.05 μsec/cm to 2 sec/cm	5x	None	10 kv	$1375	Page C-46
TYPE 585	dc to Approx. 100 mc	3.5 nsec	0.1 v/cm	Yes	0.05 μsec/cm to 2 sec/cm	5x	1 μsec to 10 sec	10 kv	$1675	Page C-47

Oscilloscopes without Plug-In Preamplifiers

	Calibrated Deflection Factor	Risetime	Vertical Passband	Signal Delay	Calibrated Sweep Range	Sweep Magnifier	Accelerating Potential	Price	Complete Specifications
TYPE 310A 3″ Portable	0.01 v/div to 0.1 v/div	0.1 μsec	2 c to 3.5 mc	No	0.5 μsec/div to 0.2 sec/div	5x	1.8 kv	$625	Page G-2
	0.1 v/div to 50 v/div	90 nsec	dc to 4 mc						
TYPE 316 3″ Portable	0.01 v/div to 0.1 v/div	35 nsec	2 c to 10 mc	Yes	0.2 μsec/div to 2 sec/div	5x	1.8 kv	$750	Page G-6
	0.1 v/div to 50 v/div	35 nsec	dc to 10 mc						
TYPE 317 Daylight 3″ Portable	0.01 v/div to 0.1 v/div	35 nsec	2 c to 10 mc	Yes	0.2 μsec/div to 2 sec/div	5x	9 kv	$800	Page G-10
	0.1 v/div to 50 v/div	35 nsec	dc to 10 mc						
TYPE 321 TRANSISTORIZED 3″ Portable	0.01 v/div to 20 v/div	70 nsec	dc to 5 mc	No	0.5 μsec/div to 0.5 sec/div	5x	4 kv	$785	Page G-14
TYPE 502 Dual-Beam and X-Y Curve Tracer	200 μv/cm to 20 v/cm	3.5 μsec diminishing to 0.35 μsec	dc to 100 kc increasing to dc to 1 mc	No	1 μsec/cm to 5 sec/cm	2, 5, 10, and 20x	3 kv	$825	Page H-2
TYPE 503 Differential X-Y Curve-Tracer	1 mv/cm to 20 mv/cm	0.75 μsec	dc to 450 kc	No	1 μsec/cm to 5 sec/cm	2, 5, 10, 20, and 50x	3 kv	$625	Page H-6
TYPE 504 General Purpose	5 mv/cm to 20 v/cm	0.75 μsec	dc to 450 kc	No	1 μsec/cm to 0.5 sec/cm	None	3 kv	$525	Page H-8
TYPE 507 Surge Test	Approximately 50 v/cm to 500 v/cm	5 nsec		No	0.02 μsec/cm to 50 μsec/cm	None	24 kv	$3000	Page F-6
TYPE 515A General Purpose	0.05 v/cm to 20 v/cm	23 nsec	dc to 15 mc	Yes	0.2 μsec/cm to 2 sec/cm	5x	4 kv	$800	Page H-12
TYPE 516 Dual-Trace	0.05 v/cm to 20 v/cm	23 nsec	dc to 15 mc	Yes	0.2 μsec/cm to 2 sec/cm	5x	4 kv	$1000	Page H-16
TYPE 517A High-Speed	0.05 v/cm	7 nsec		Yes	0.01 μsec/cm to 20 μsec/cm	None	24 kv	$3500	Page F-2
TYPE 524AD Television	0.015 v/cm to 50 v/cm	35 nsec	dc to 10 mc	Yes	0.1 μsec/cm to 0.01 sec/cm	3 and 10x	4 kv	$1250	Page J-2
TYPE 525 TV-Waveform Monitor	0.015 v/cm with 1 x, 2 x, 5 x step attenuator		Flat, Low-Pass High-Pass, IRE	No	Field and Line Rates	5 and 25x	4 kv	$1100	Page J-6
TYPE 526 Television Vectorscope							4 kv	$1800	Page J-10
TYPE 570 Electron Tube Curve Tracer							4 kv	$995	Page K-2
TYPE 575 Transistor Curve Tracer							4 kv	$975	Page K-8

TEKTRONIX FIELD SERVICES

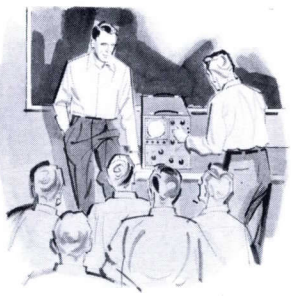


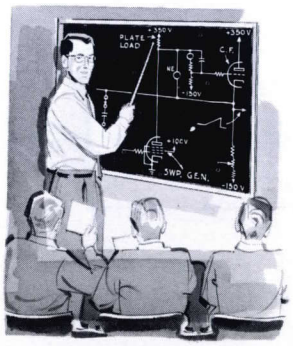
Tektronix Customers are urged to take advantage of the many field services available to them through Tektronix Field-Engineering Offices, Engineering Representatives, and Overseas Engineering Organizations. Some of these services are described below.

Ordering—There are many types of oscilloscopes, each designed for a specific application area. Your Field Engineer can help you select the one best suited to your present and future needs, and he will be happy to arrange a demonstration of the instrument.....in your application if you so desire.

If you are a Purchasing Agent or Buyer, your Field Engineer or his secretary can help you with information on prices, terms, shipping estimates, and best method of transportation on instruments, accessories, and replacement parts.

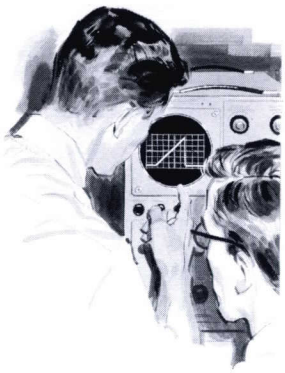
Operation—Your Tektronix Oscilloscope can be most useful to you when you are familiar with all control functions. Your Field Engineer will be glad to demonstrate the use of your instrument in various applications to help you become more familiar with its operation. If your instrument is to be used by several engineers, your Field Engineer will be happy to conduct informal classes on its operation in your laboratory.



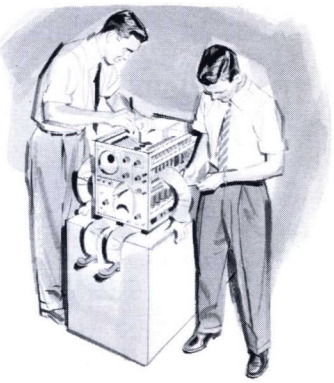


Maintenance—Tektronix willingly assumes much of the responsibility for continued efficient operation of the instruments it manufactures. If you should experience a stubborn maintenance problem, your Field Engineer will gladly help you isolate the cause. Often a telephone discussion with him will help you get your instrument back into operation with minimum delay. If yours is a large laboratory, your Field Engineer can be of service to your maintenance engineers by conducting informal classes on test and calibration procedures, trouble-shooting techniques, and general maintenance.

If you are responsible for the maintenance of a large quantity of Tektronix Instruments, ask your Field Engineer about the free factory training course in maintenance and calibration.



Applications—Perhaps the answers you need in a specific application can be obtained faster and easier through use of your Tektronix Oscilloscope. Your Field Engineer can help you find out, and if use of your oscilloscope is indicated, help you with procedures. He may also be able to suggest many time-saving uses for your oscilloscope in routine checks and measurements.



Instrument Reconditioning—An older Tektronix Oscilloscope, properly reconditioned, can give you many additional years of service. Your Field Engineer will gladly explain the advantages and limitations of factory reconditioning, and make the necessary arrangements if you decide in favor of it.

Many major repair and recalibration jobs can be performed at a nearby Field Repair Station. Ask your Field Engineer about this at-cost service to Tektronix customers.

Communications—Your Field Engineer is a valuable communication link between you and the factory. He knows the exact person to contact in each circumstance, and he can reach that person fast and easily. Let him help speed your communications with the factory on any problem related to your Tektronix Instruments.

DESCRIPTION OF CATHODE-RAY-TUBE PHOSPHORS

The catalog description of each oscilloscope gives the kind of phosphor that is normally provided in the crt. In general, your oscilloscope can be provided, on order, with any commercially available phosphor.

Phosphors, other than those of short persistance, may display an initial fluorescence of one color, followed by a phosphorescence of the same or another color. The following table describes some of the phosphors we can provide in your crt. We welcome your inquiries.

PHOSPHOR	FLUORESCENCE	PHOSPHORESCENCE	PERSISTENCE
P1	Green	Green	Medium
P2	Blue-green	Green	Long
P 4*	White	White	Medium
P5	Blue		Very short
P7*	Blue-white	Yellow	Long
P11	Blue		Short
P12	Orange	Orange	Medium long
P 13**	Red	Red	Medium
P14*	Purple	Orange	Medium long
P15	Blue-green		Extremely short
P16	Violet and near ultra-violet		Extremely short
P17*	Green	Green	Long
P19**	Orange	Orange	Extremely long
P 20	Yellow	Yellow	Medium short
P 23*	Yellow	Yellow	Medium
P24	Blue		Extremely short
P 25	Orange	Orange	Medium
P 27	Red	Red	Medium

*Double-layer types.

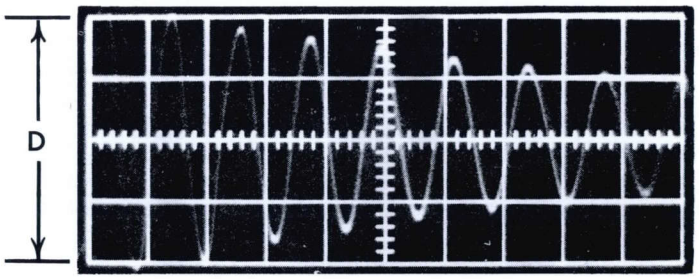
**Readily susceptible to burning. Recommended only for aluminized CRTS.

HOW TO CALCULATE WRITING RATE

The writing rate of which an oscilloscope is capable is usually taken to mean the maximum spot speed (usually in centimeters per microsecond) at which a satisfactory photograph can be taken. The result depends not only upon the characteristics and adjustments of the oscilloscope, but also upon the photographic equipment and processes used. The illustration below shows one way in which writing rate can be calculated. There is displayed a single trace of damped sine wave whose frequency is such that the rapidly rising and falling portions of the first cycle or two fail to photograph. The writing-rate capability of the oscilloscope is determined as follows: Starting from the left, find the first rapidly rising or falling portion of the damped sine wave which is photographed in its entirety. Let D represent the vertical distance in centimeters between the peaks which are connected by this portion. If D is three or more times as great as the horizontal distance occupied by one cycle, the writing rate in centimeters per microsecond is given closely by:

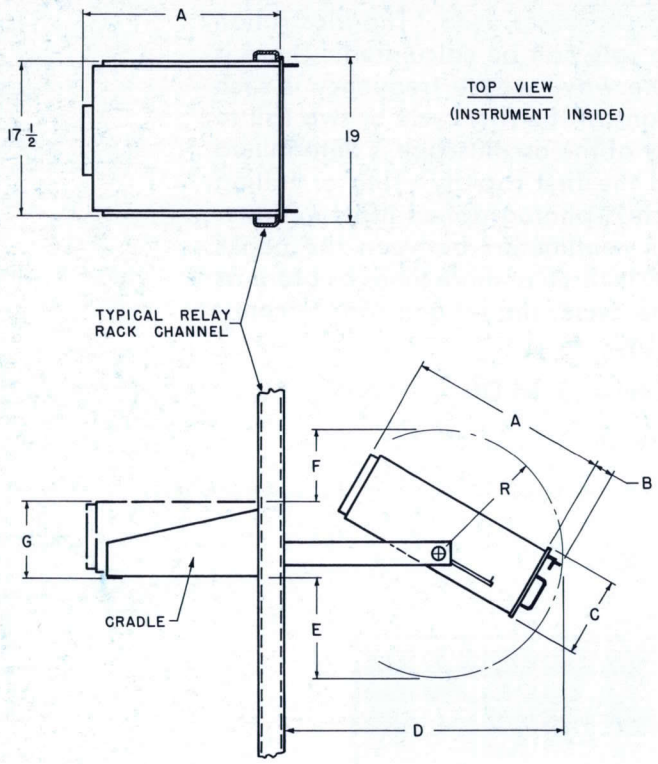
$$\text{Maximum writing rate} = 3.14\,Df$$

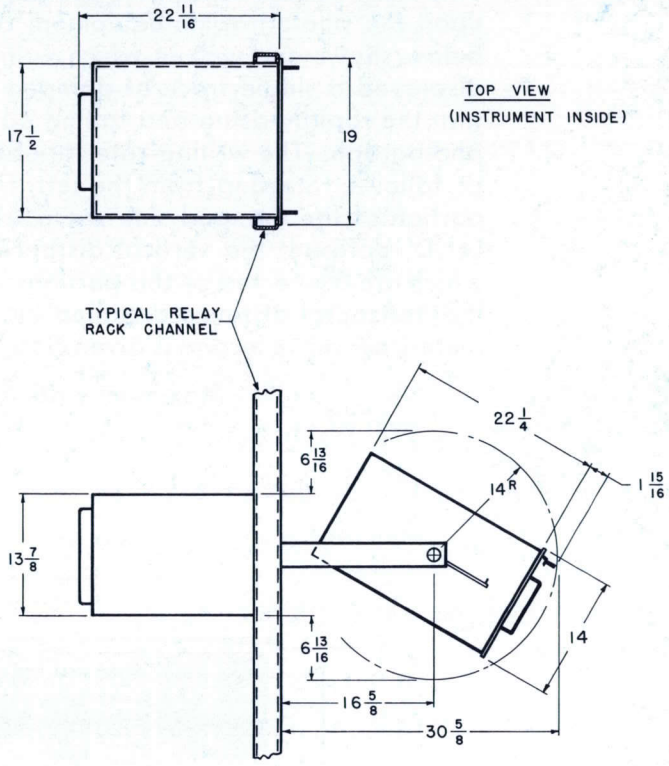
where f is the frequency of the damped wave in megacycles.



Although the writing rate is an important characteristic of the oscilloscope, it does not completely describe the ability of the oscilloscope to present detailed information. It is also important to consider the available resolution in conjunction with screen size. It is convenient to present these latter data in terms of the number of spot widths contained in the length and in the height of the useful graticule area.

MOUNTING DIMENSIONS





INST.	A	B	C	D	E	F	G	R
RM15	22 5/16	1 3/8	8 3/4	30 1/4	10 3/8	8 3/8	9 1/16	13 3/4
RM16	17 9/16	1 3/4	7	21 1/2	9 1/4	8 1/8	7 1/16	12 3/8
RM17	17 9/16	1 3/4	7	21 1/2	9 1/4	8 1/8	7 1/16	12 3/8
127	21 1/2	1 3/4	8 3/4	29 1/4	9 5/8	5 7/8	9 1/16	12 3/4
526	17 7/8	2	8 3/4	22 1/4	9 1/2	5	9 1/16	11 7/8

OSCILLOSCOPES WITH PLUG-IN PREAMPLIFIERS

including Rack-Mounting Models

TYPE 531A C-2
TYPE RM31A C-5
TYPE 532 . . . . . C-6
TYPE RM32 . . . . . C-9
TYPE 533 . . . . . C-10
TYPE RM33 . . . . . C-13
TYPE 535A C-14
TYPE RM35A C-19
TYPE 536 . . . . . C-18
TYPE 541A C-22
TYPE RM41A C-25
TYPE 543 . . . . . C-26
TYPE RM43 . . . . . C-29
TYPE 545A C-30
TYPE RM45A C-35
TYPE 551 . . . . . C-36
TYPE 555 . . . . . C-40
TYPE 581 . . . . . C-46
TYPE 585 . . . . . C-47

5/60

MAIN FEATURES

Easy Operation

Single knob control for Sweep Range, Amplitude Calibrator, and Horizontal Display.

Increased Vertical Response

Passband and Risetime with Type K unit, dc to 15 mc, 23 nsec.

Wide Sweep Range

0.1 μsec/cm to 12 sec/cm. 5-x magnifier increases calibrated rate to 0.02 μsec/cm.

Versatile Triggering Circuitry

Amplitude-level selection with preset or manual stability control, and fully-automatic triggering.

10-KV Accelerating Potential

Bright display at low repetition rates.

Horizontal Input Amplifier

6-cm Linear Vertical Deflection

Balanced Delay Network.

GENERAL DESCRIPTION

The Type 531A is a wide-range laboratory oscilloscope that is easier to operate, performs better, is even more reliable than its predecessor, the Type 531. Functionally grouped controls with convenient direct-reading single-knob selectors and dependable trigger settings combine to provide easy operation. Greater dependability and longer life have been attained through the use of frame-grid dual triodes and silicon-diode rectifiers. The dc-to-15 mc main vertical amplifier provides for a high degree of versatility through Tektronix Type A to Z Plug-In Preamplifiers. These plug-in preamplifiers are available for conversion to possible future requirements.

A very practical initial combination is the Type 531A Oscilloscope with a Type C-A Dual-Trace Plug-In Unit. This arrangement covers both dual-trace and single-trace applications with passband requirements from dc to 15 mc at sensitivities as high as 0.05 v/cm. Later, if the need arises, additional plug-in units can be purchased at reasonable cost for wide-band high-gain, millivolt-sensitivity, microvolt-sensitivity, and dc-differential uses.

VERTICAL-DEFLECTION SYSTEM

Frequency specifications are at 3 db down

DC-Coupled Output Amplifier—The wide-band dc-coupled amplifier has a risetime of 23 nsec with a Type C-A, K, L, or R unit plugged in. It is factory adjusted for optimum transient response.

The Type 531A vertical deflection system is designed for use with any one of the Tektronix Type A to Z Plug-In Preamplifiers. In order to operate the Type 531A, one of the preamplifiers must be plugged in.

Plug-In Preamplifiers

For Wide-Band Applications—

Type A—DC to 14 mc, 25-nsec risetime at 0.05 v/cm to 50 v/cm.

or **Type B**—DC to 14, 25-nsec risetime at 0.05 v/cm to 50 v/cm—2 cycles to 10 mc, 35-nsec risetime at 5 mv/cm to 0.05 v/cm.

For maximum frequency response and risetime—

Type K—DC to 15 mc, 23-nsec risetime at 0.05 to 40 v/cm.

or **Type L**—DC to 15 mc, 23-nsec risetime at 0.05 to 40 v/cm—3 cycles to 15 mc, 23-nsec risetime at 5 mv to 4 v/cm.

For dual trace operation—

Type C-A—DC to 15 mc, 23-nsec risetime at 0.05 to 50 v/cm.

For high DC sensitivity—

Type H—DC to 11 mc, 31-nsec risetime at 5 mv/cm to 50 v/cm.

For differential input applications—

Wide band: **Type G**—DC to 14 mc, 25-nsec risetime at 0.05 to 50 v/cm.

High DC sensitivity: **Type D**—DC to 350 kc at 1 mv/cm, increasing to 2 mc at 50 mv/cm.

For low-level applications—

Type E—0.06 cycles to 20 kc at 50 μv/cm, increasing to 60 kc at 0.5 mv/cm.

For transistor risetime checking—

Type R—23-nsec risetime.

For repetitive high-speed pulse applications—

Type N—0.6-nsec risetime (corresponding to approximately 600 mc).

For transducer and strain gage applications—

Type Q—Sensitivity 10 microstrain/div., dc to 6 kc.

For high waveform resolution and precise amplitude measurement applications via the slide-back technique —**Type Z.**

Balanced Delay Network—Ample signal delay is provided by a balanced (push-pull) delay network to permit observation of the leading edge of the waveform that triggers the sweep.

DC—15 MC OSCILLOSCOPE

Direct Input to CRT—An aperature in the side of the cabinet permits direct connection to the cathode-ray-tube deflection plates.

HORIZONTAL-DEFLECTION SYSTEM

A Miller runup sweep generator is used in the Type 531A. Inverse feedback in the timing circuitry assures excellent linearity. Characteristics of the circuitry make possible the wide range of 0.02 μsec/cm to 12 sec/cm.

Calibrated Sweep Rates—Twenty-four direct-reading calibrated sweep rates are provided: 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50 μsec/cm, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50 msec/cm, 0.1, 0.2, 0.5, 1, 2, 5 sec/cm. In addition, a vernier (uncalibrated) control provides for continuous adjustment from 0.1 μsec/cm to 12 sec/cm. An indicator light warns the operator when the sweep is uncalibrated. Calibration of the fixed sweep rates will typically be within 1% of full scale, and in all cases within 3%.

Sweep Magnifier—5-x magnifier increases the calibrated sweep time to 0.02 μsec/cm. Sweep magnification is obtained by increasing the gain of the sweep output amplifier by a factor of five. The center 2 cm of the normal trace is expanded to fill the screen. Any one-fifth of the magnified sweep can be displayed on the screen by rotating the HORIZONTAL POSITION control. Accurate 5-x magnification is obtained on all ranges.

DC-Coupled Unblanking—DC coupling is provided for the unblanking waveform, assuring uniform bias on the cathode-ray tube for all sweep times and repetition rates.

Triggering Facilities — Versatile triggering circuitry provides for complete manual control, preset stability control, and fully-automatic triggering.

Amplitude-Level Selection—Adjustable amplitude-level and stability controls provide for triggering the sweep at a selected amplitude level on the triggering waveform. Triggering source can be internal, external, or the line frequency, either ac-coupled or dc-coupled. The triggering point can be on either the rising or falling slope of the triggering waveform.

Preset Stability—Same as above, except the stability control is preset to the optimum triggering point and requires no readjustment.

Automatic Triggering—Automatic level-seeking trigger circuit provides dependable triggering for most applications. One simple setting assures positive sweep-triggering by signals of widely differing amplitudes, shapes, and repetition rates. No trigger control need be touched until a different type of operation is desired. Range of automatic operation is between 60 cycles and 2 megacycles, approximately. In the absence of an input signal the sweep is automatically triggered at about a 50-cycle rate, providing a reference trace on the screen.

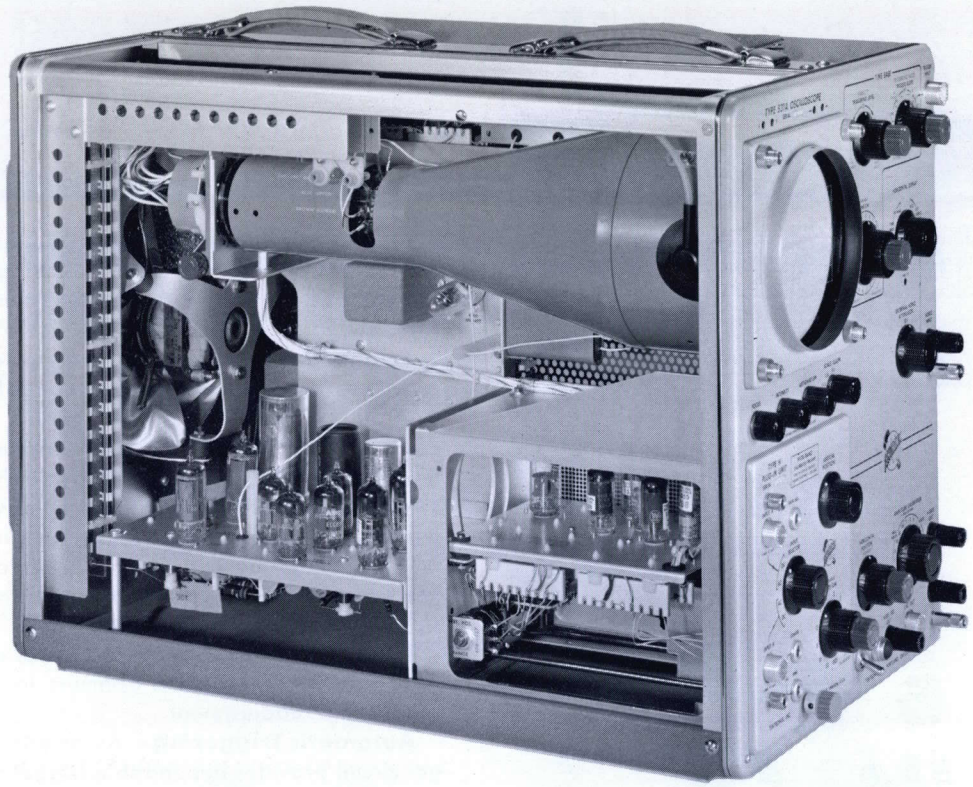
High-Frequency Sync—Assures a steady display of sine-wave signals up to approximately 30 megacycles. Requires a signal large enough to cause about 2 cm deflection, or an external signal of about 2 v.

Trigger Requirements—Internal triggering—a signal large enough to cause 2-mm deflection. External triggering—a signal of 0.2 v to 10 v.

Horizontal Input Amplifier—DC-coupled external connection to the sweep-output amplifier is through a front-panel connector. Combination of a step attenuator and variable attenuator makes the horizontal deflection factor continuously variable from 0.2 v/cm to approximately 15 v/cm. Passband is dc to 240 kc. Input impedance is approximately 47 pf paralleled by 1 megohm.

OTHER CHARACTERISTICS

Accelerating Potential—10-kv accelerating potential assures bright display when using fast sweeps at low repetition rates, and in single-sweep applications. The T533P__, a Tektronix cathode-ray tube is used in the Type 531A. The T533P__ is a 5" flat-faced metallized precision tube with a helical post-accelerating anode. It provides a full 6-cm x 10-cm viewing area. For best results over the wide sweep range of the Type 531A,



a P2 phosphor is normally furnished with the instrument.

Regulated Power Supply—Electronic regulation compensates for line-voltage variations between 105 and 125 v or 210 and 250 v, and for current-demand differences among the plug-in preamplifiers.

Amplitude Calibrator—A square-wave calibration voltage is available through a front-panel coaxial connector. Eighteen direct reading fixed steps—0.2, 0.5, 1, 2, 5, 10, 20, 50 millivolts, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50, and 100 volts peak-to-peak are provided by the single knob control. Accuracy is within 3%. Square-wave frequency is approximately 1 kc.

Dual-Trace Blanking—A blanking voltage is available to eliminate switching transients from the display when a dual-trace plug-in unit is operated in its chopped mode. The blanking voltage can be applied to the crt cathode by means of a switch located on the back panel of the instrument. (Type 53/54C Units under serial number 14078 will require a minor modification).

Output Waveforms—A 20-v positive gate of the same duration as the sweep and a 150-v sweep-sawtooth waveform are available at front-panel binding posts via cathode followers. The vertical signal is brought out to a front-panel terminal for external applications.

Access to Interior—Three-piece cabinet design provides easy access to the interior of the instrument. Cabinet sides are held in place by two quick-opening fasteners, and can be removed in a matter of seconds.

Alignment of Cathode-Ray Tube—Should adjustment of the cathode-ray tube alignment become necessary, an easily accessible knob, located on the rear support bracket of the crt, provides smooth positive control of the crt alignment.

Beam Position Indicators—Two pairs of indicator lights show direction of the electron beam when the spot is not on the screen.

Illuminated Graticule—An edge-lighted graticule is marked in centimeter squares with two-millimeter baseline divisions for convenience in making time and amplitude measurements. Illumination is controlled by a front-panel knob.

ELECTRON TUBES AND SEMICONDUCTORS

* denotes "or equivalent"

Vertical		
Input amplifiers	2	12BY7A
Driver CF and beam-indicator amplifiers	2	6DJ8
Output amplifiers	2	6197
Trigger-pickoff amplifier		6DJ8
Trigger-pickoff and vertical-signal-out CF's		6DJ8
Horizontal		
Trigger-input amplifier		6DJ8
Trigger multivibrator		6DJ8
Stability CF and holdoff CF		6DJ8
Holdoff CF and unblanking CF		6DJ8
Sweep-gating multivibrator and CF		6DJ8
Sweep-gating multivibrator		12BY7A
Clipping diode		T12G*
Disconnect diodes		6AL5
Sawtooth-out and + gate-out CF's		6DJ8
Alternate-trace-sync amplifier and dual-trace-blanking amplifier		6DJ8

Miller-runup sweep generator		6CL6
Runup CF		6DJ8
Horizontal-input CF and horizontal-driver CF		6DJ8
Horizontal-output amplifiers and CF's	2	6DJ8
High-frequency-capacitance driver		6CL6
External-horizontal input and DC-level CF's		12AU7
External-horizontal amplifier		6DJ8
Power Supplies		
Rectifiers	16	1N1566*
Voltage reference		5651
Regulator amplifiers	5	6AU6
Series regulators	2	12AX7
Series regulators	4	12B4
Comparator amplifiers	2	6080
High-voltage oscillator		6AU5
High-voltage rectifiers	5	5642
Error-signal amplifiers		12AU7
Miscellaneous		
Calibrator multivibrator and CF		12AU7
Calibrator multivibrator		6AU6
Cathode-ray tube		T533P2

MECHANICAL SPECIFICATIONS

Ventilation—Safe operating temperature is maintained by filtered, forced-air ventilation. A minimum of 2" of unobstructed clearance around the instrument is recommended for adequate ventilation.

Construction—Aluminum-alloy chassis and three-piece cabinet.

Finish—Photo-etched anodized panel, blue wrinkle-finished cabinet.

Dimensions—24" long, 13" wide, 16¾" high.

Weight: Net—62 pounds
Shipping—77 pounds approx.

Power Requirements—105-125 v or 210-250 v, 50-60 cycles, 455 watts with Type C-A unit plugged in.

Type 531A, without plug-in units **$995**

Includes: 2—10-x attenuator probes
2—Binding-post adapters (013-004)
1—Test lead (012-031)
1—Green filter (378-514)
1—3-conductor power cord (161-010)
1—Instruction manual

Optional Phosphors

P2 crt phosphor normally furnished,
P1, P7, P11 optional . . . . . No extra charge

Several other phosphors can be furnished on special order.

Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).

RM31A RACK-MOUNTING MODEL

GENERAL DESCRIPTION

The Type RM31A is a mechanically rearranged Type 531A Oscilloscope for mounting in a standard 19" rack. The instrument mounts to the rack on slide-out tracks. It can be pulled forward, tilted, and locked in any of seven positions for servicing convenience. Electrical characteristics of the instrument are the same as described for the Type 531A Oscilloscope.

MECHANICAL SPECIFICATIONS

Ventilation—Filtered, forced-air ventilation maintains safe operating temperature.

Construction—Aluminum-alloy chassis, and cabinet. Slide-out mounting.

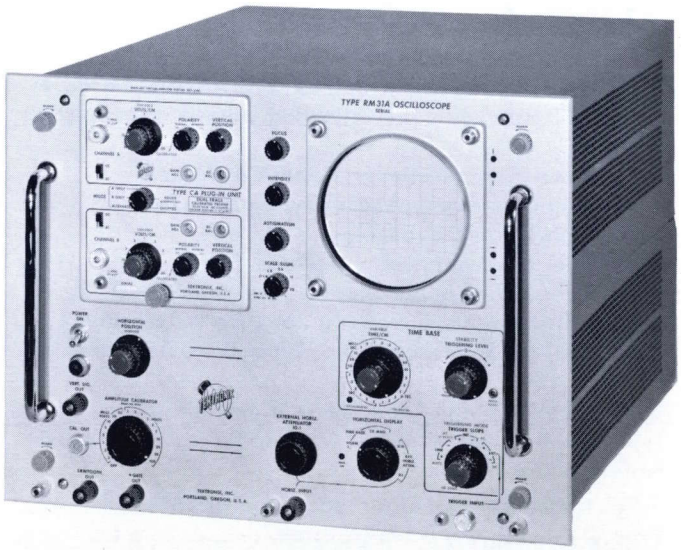
Finish—Photo-etched anodized panel, blue wrinkle-finished cabinet.

Dimensions—14" high, 19" wide, 22½" rack depth. Please see page B-8 for complete mounting dimensions.

Weight: Net—79 pounds
Shipping—98 pounds approx.

Type RM31A, without plug-in units **$1095**

Includes: 2—10-x attenuator probes
2—Binding-post adapters (013-004)
1—Test lead (012-031)
1—Green filter (378-514)



1—3 conductor power cord (161-010)
1—Set, mounting hardware
1—Instruction manual

Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).

MAIN FEATURES

DC-Coupled Vertical Amplifier

Passband with wide-band plug-in units—dc to 5 mc.
Risetime with wide-band plug-in units—0.07 μsec.

8-cm Linear Vertical Deflection

Wide Sweep Range

0.2 μsec/cm to 12 sec/cm.

Versatile Triggering Circuitry

Amplitude-level selection with preset or manual stability control, and fully-automatic triggering.

Horizontal Input Amplifier

Vertical Beam-Position Indicators

DC-Coupled Unblanking

GENERAL DESCRIPTION

The Tektronix Type 532 is designed for users who do not need the high-speed sweeps, high writing rate, and wide passband of the Type 531A. Simplified circuitry eases vacuum-tube loading, lower accelerating potential reduces possibility of screen damage at very-slow sweep speeds and makes possible greater linear vertical deflection. The Type 532 has all the precision and stability you expect in Tektronix oscilloscopes. Signal-handling versatility of the Tektronix Type A to Z Plug-In Preamplifier Units is available in the Type 532, within the dc-to-5 mc passband of its main vertical amplifier. It is an instrument that will give lasting satisfaction in the many laboratory applications within its capabilities.

VERTICAL DEFLECTION SYSTEM

Frequency specifications are at 3 db down

DC-Coupled Output Amplifier—The vertical amplifier of the Type 532 is designed to be used with any one of the Tektronix Type A to Z Plug-In Preamplifiers. The passband of the Type 532 is less than 3 db down at 5 mc, adjusted for optimum transient response with the wide-band-preamplifier units plugged in. Frequency response of the wide-band units is limited to that of the main-unit vertical amplifier, but the overall response is not materially affected when plug-in units with passbands of 2 mc and lower are used. The main-unit deflection factor is 0.1 v/cm with balanced input.

In order to operate the Type 532, one of the Type A to Z preamplifiers must be plugged in.

Plug-In Preamplifiers

Type 532 frequency response and risetime is dc to 5 mc, 0.07 μsec with the following plug-in units except as noted:

For general applications—Type A or Type K
For high gain applications—Type B or Type L
For high dc gain applications—Type H
For dual trace applications—Type C-A
For differential applications—Type G, Type D: dc to 350 kc at 1 mv/cm increasing to 2 mc as sensitivity is decreased to 50 mv/cm, and Type E: 0.06 cycles to 60 kc
For repetitive high-speed pulse applications—Type N—0.6-nsec risetime (corresponding to approximately 600 mc).
For transducer and strain gage applications—Type Q—Sensitivity 10 microstrain/div., dc to 6 kc.
For high waveform resolution and precise amplitude measurement applications via the slide-back technique—Type Z.

Direct Input to CRT—An aperture in the side of the cabinet permits direct connection to the crt deflection plates.

HORIZONTAL DEFLECTION SYSTEM

The sweep generator in the Type 532 is a Miller run-up type. Excellent sweep linearity results from use of inverse feedback in the timing circuits. Characteristics of the circuitry make possible the wide sweep range of 0.2 μsec/cm to 12 sec/cm.

Calibrated Sweep Rates—The Type 532 has twenty-one calibrated sweep rates. The main sweep control has seven positions; 1, 10, 100 μsec/cm,. . . 1, 10, 100 millisec/cm,. . . 1 sec/cm. Three multiplier switch positions of 1, 2, and 5 for each of the main sweep steps provide a total of 21 calibrated sweep rates. The remaining three positions on the multiplier switch of 1 to 2.5, 2 to 5, and 5 to 12 provide continuously variable sweep rates from 1 μsec/cm to 12 sec/cm. Calibration accuracy of the fixed sweep rates will typically be within 1% of full scale, and in all cases within 3%. The 5-x magnifier applied to the 1 μsec/cm sweep extends the calibrated sweep range to 0.2 μsec/cm.

Sweep Magnifier—Sweep magnification is obtained by effectively increasing the gain of the sweep output amplifier by a factor of five. The center 2 cm of the normal trace is expanded to 10 cm. Any one-fifth of the magnified sweep can be displayed on the screen by means of the HORIZONTAL POSITION control. Ac-

DC—5 MC OSCILLOSCOPE

curacy is within 3% except on the 1 μsec/cm range, where accuracy is within 5%.

DC-Coupled Unblanking—The unblanking waveform is dc coupled to the grid of the crt to assure uniform unblanking bias for all sweep speeds and repetition rates.

Triggering Facilities—Versatile triggering circuitry provides for complete manual control, preset stability control, and fully-automatic triggering.

Amplitude-Level Selection—Adjustable amplitude-level and stability controls are provided for triggering the sweep at a selected amplitude level on the triggering waveform. Trigger source can be external, internal, or the line frequency, either ac-coupled or dc-coupled. The triggering point can be on either the rising or falling slope of the triggering waveform.

Preset Stability—Same as above, except the stability control is preset to the optimum triggering point and requires no readjustment.

Automatic Triggering—Automatic level-seeking trigger circuit provides dependable triggering for most applications. One simple setting assures positive sweep-triggering by signals of widely differing amplitudes, shapes, and repetition rates. No trigger controls need be touched until a different type of operation is desired. Range of automatic operation is between 60 cycles and 2 megacycles, approximately. In the absence of an input signal the sweep is automatically triggered at about a 50-cycle rate, providing a reference trace on the screen.

Trigger Requirements—Internal triggering—a signal large enough to cause 2 mm deflection. External triggering—a signal of 0.2 v to 100 v.

Horizontal Input Amplifier—DC-coupled external connection to the sweep amplifier is through a front-panel terminal. Combination of a step attenuator and variable amplifier-gain control makes the horizontal deflecton factor continuously variable from 0.2 v/cm to approximately 15 v/cm. Passband is dc to 300 kc. Input impedance is approximately 40 pf paralleled by 1 megohm.

Delayed Gate—A delayed gate voltage of approximately 20 v amplitude is available at the front panel. The amount of delay from the start of the sweep is continuously adjustable throughout the sweep duration.

OTHER CHARACTERISTICS

Cathode-Ray Tube—4-kv accelerating potential is applied to the Tektronix Type T52P___ cathode-ray tube. The T52P___ is a 5" flat-faced precision tube with a helical post-accelerating anode, providing 8 cm of linear vertical deflection. A P-2 phosphor, providing best results over the wide sweep range, is normally supplied. P1, P7, and P11 are available as optional phosphors. Some other phosphors are available on special order.

Access to Interior—Three piece cabinet design provides easy access to the interior of the instrument. Cabinet sides are held in place by two quick-opening fasteners, and can be removed in a matter of seconds.

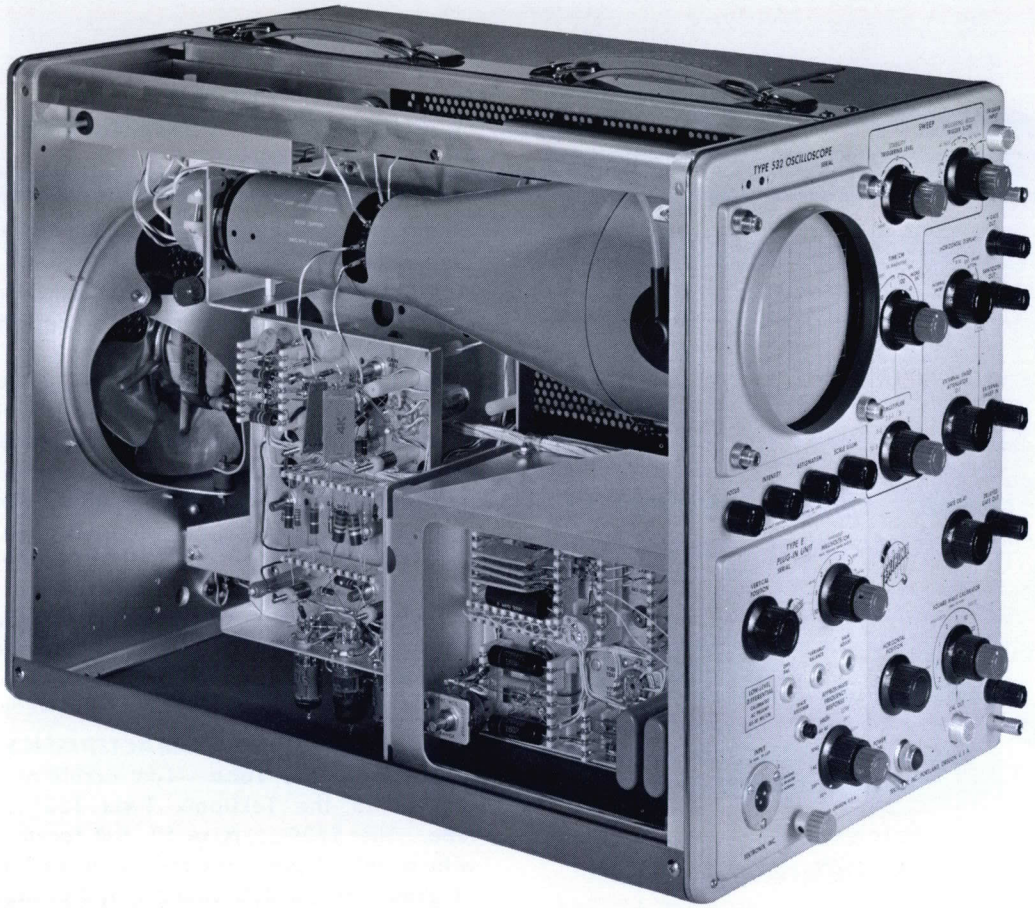
Alignment of Cathode-Ray Tube—Should adjustment of the cathode-ray tube alignment become necessary, an easily accessible knob, located on the rear support bracket of the crt, provides smooth positive control of the crt alignment.

Amplitude Calibrator—A square-wave calibration voltage is available through a front-panel coaxial connector. Eighteen fixed voltages, 0.2, 0.5, 1, 2, 5, 10, 20, 50, 100 millivolts, 0.2, 0.5, 1, 2, 5, 10, 20, 50, 100 volts peak-to-peak are provided. Accuracy is within 3%. Square-wave frequency is approximately 1 kc.

Output Waveforms—Front-panel connectors provide a positive-gate voltage of the same duration at the sweep, the positive-going sweep sawtooth waveform, and a positive delayed gate. The vertical signal is brought out to a front-panel terminal for external applications.

Regulated Power Supply—Electronic regulation compensates for line-voltage variations between 105 and 125 v or 210 and 250 v, and for current-demand differences among the Plug-In Preamplifiers.

TYPE 532



Beam-Position Indicators—A pair of indicator lights shows the vertical direction of the electron beam when the spot is not on the screen.

Illuminated Graticule—An edge-lighted graticule is marked in centimeters with two-millimeter baseline divisions for convenience in making time and amplitude measurements. Illumination is controlled by a front-panel control.

ELECTRON TUBE COMPLEMENT

Vertical		
Input amplifiers	2	12AU6
Output amplifiers		6BQ7A
Amplifiers CF's		6CL6
Beam-indicator amplifier and trigger-pick-off CF		6BQ7A
Vertical-signal-out CF		6AU6
Horizontal		
Trigger-input amplifier		6U8
Trigger multivibrator		6U8
Sweep-gating multivibrator and CF		6BQ7A
Sweep-gating multivibrator		6AU6
Alternate-trace-sync amplifier and + gate-out CF		6AN8
Disconnect diodes		6AL5
Miller-runup sweep generator		6AU6
Sweep generator CF and holdoff CF		6BQ7A
Holdoff CF and stability CF		6BQ7A
Sawtooth-out CF and delayed-gate-out CF		12AU7
Delayed-gate pickoff		6AU6
Horizontal-input CF and horizontal-driver CF		6BQ7A
Horizontal-output amplifier		6BQ7A
External horizontal-input CF and amplifier		6BQ7A
Power Supplies		
Rectifiers	5	5V4
Comparators	2	6AU6
Comparators	2	12AX7
Regulator amplifiers	2	6AU6
Series regulator	4	12B4
Series regulator		6080
Voltage reference		5651
High-voltage oscillator		6AQ5
High-voltage rectifiers	3	5642
Error-signal amplifier		12AU7
Miscellaneous		
Calibrator multivibrator and CF		6BQ7A
Calibrator multivibrator		6AU6
Cathode-ray tube		T52P2

MECHANICAL SPECIFICATIONS

Ventilation—Filtered, forced-air ventilation assures safe operating temperature. A minimum of 2" of unobstructed clearance around the instrument is recommended for adequate ventilation.

Construction—Aluminum-alloy chassis and three-piece cabinet.

Finish—Photo-etched anodized panel, blue wrinkle-finished cabinet.

Dimensions—24" long, 13" wide, 16¾" high.

Weight: Net—55 pounds
Shipping—73 pounds approx.

Power Requirements—105-125 v or 210-250 v, 50-60 cycles, 475 watts with Type D unit plugged in.

Type 532, without plug-in units **$875**

Includes: 2—10-x attenuator probes
2—Binding-post adapters (013-004)
1—Test lead (012-031)
1—Green filter (378-514)
1—3-conductor power cord (161-010)
1—Instruction manual

Optional Phosphors

P2 phosphor normally furnished.
P1, P7, P11 optional. . . . . .No extra charge

Recommended Additional Accessories

For special test accessories for this instrument, please see the Catalog Test Accessory Section.

Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).

RM32 RACK-MOUNTING MODEL

GENERAL DESCRIPTION

The Type RM32 is a mechanically rearranged Type 532 Oscilloscope for mounting in a standard 19" rack. The instrument mounts to the rack on slide-out tracks. It can be pulled forward, tilted, and locked in any of seven positions for servicing convenience. Electrical characteristics of the instrument are the same as described for the Type 532 Oscilloscope.

MECHANICAL SPECIFICATIONS

Ventilation—Filtered, forced-air ventilation maintains safe operating temperature.

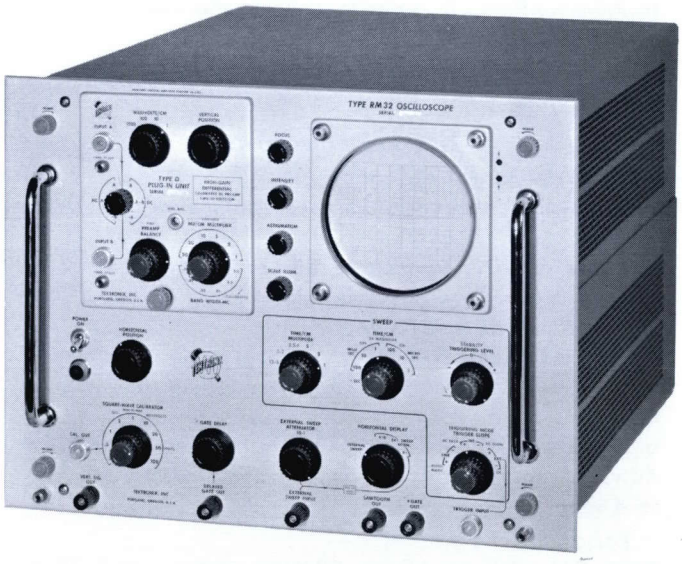
Construction—Aluminum-alloy chassis, and cabinet. Slide-out mounting.

Finish—Photo-etched anodized panel, blue wrinkle-finished cabinet.

Dimensions—14" high, 19" wide, 22½" rack depth. Please see page B-8 for complete mounting dimensions.

Weight: Net—72 pounds
Shipping—91 pounds approx.

Type RM32, without plug-in units **$975**



Includes: 2—10-x attenuator probes
1—Test lead (012-031)
1—Green filter (378-514)
1—3 conductor power cord (161-010)
1—Set, mounting hardware
1—Instruction manual

Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).

TYPE 533 DC—15 MC,

MAIN FEATURES

Easy Operation

Sweep Magnification— 2, 5, 10, 20, 50, and 100 Times

Preset Triggering— Eliminates triggering adjustments in most applications.

24 Calibrated Direct-Reading Sweep Rates— Sweep range continuously variable (uncalibrated) from 0.02 μsec/cm to 15 sec/cm.

Single Sweep Operation— Lockout-Reset Circuitry for one-shot recording.

High Writing Rate—10-kv accelerating potential assures bright trace for operation in single-sweep applications, and with low sweep repetition rates.

Versatility

Type A to Z Plug-In Preamplifiers—Wide Band, Dual Trace, Low Level, Differential, and others for specialized applications.

High Performance

DC-to-15 MC Main Vertical Amplifier

GENERAL DESCRIPTION

The Type 533 is a dependable laboratory oscilloscope with special features that make it extremely versatile and easy to operate. The dc-to-15 mc main vertical amplifier provides for a wide range of application coverage through Tektronix Type A to Z Plug-In Preamplifiers. Six different degrees of sweep magnifications are available. Sweep lockout and high writing rate are combined for best results in one-shot recording.

Operating convenience results from functionally-grouped controls, a single-knob direct-reading sweep selector, and fiddle-free triggering settings. Other useful features are warning lights for uncalibrated sweep-rate and sweep-magnifier settings, beam-position indicators, and built-in blanking for switching transients in dual-trace operation.

VERTICAL-DEFLECTION SYSTEM

Frequency specifications are at 3 db down

DC-Coupled Output Amplifier—The dc-to-15 mc output amplifier is factory adjusted for optimum transient response. Risetime is 23 nsec with a Type C-A, K, L, or R unit plugged in.

The Type 533 vertical deflection system is designed for use with any one of the Tektronix Type A to Z Plug-In Preamplifiers. In order to operate the Type 533, one of the preamplifiers must be plugged in.

Type 533 passband and risetime with the following plug-in units:

Plug-In Preamplifiers

For Wide Band Applications—

Type A—DC to 14 mc, 25-nsec risetime at 0.05 v/cm to 50 v/cm.

or **Type B**—DC to 14 mc, 25-nsec risetime at 0.05 v/cm to 50 v/cm—2 cycles to 10 mc, 35-nsec risetime at 5 mv/cm to 0.05 v/cm.

For maximum frequency response and risetime—

Type K—DC to 15 mc, 23-nsec risetime at 0.05 to 40 v/cm.

or **Type L**—DC to 15 mc, 23-nsec risetime at 0.05 to 40 v/cm—3 cycles to 15 mc, 23-nsec risetime at 5 mv to 4 v/cm.

For dual trace operation—

Type C-A—DC to 15 mc, 23-nsec risetime at 0.05 to 50 v/cm.

For high DC sensitivity—

Type H—DC to 11 mc, 31-nsec risetime at 5 mv/cm to 50 v/cm.

For differential input applications—

Wideband: **Type G**—DC to 14 mc, 25-nsec risetime at 0.05 to 50 v/cm.

High DC sensitivity: **Type D**—DC to 350 kc at 1 mv/cm, increasing to 2 mc at 50 mv/cm.

For low-level applications—

Type E—0.06 cycles to 20 kc at 50 μv/cm, increasing to 60 kc at 0.5 mv/cm.

For transistor risetime checking—

Type R—23-nsec risetime.

For repetitive high-speed pulse applications—

Type N—0.6-nsec risetime (corresponding to approximately 600 mc).

For transducer and strain gage applications—

Type Q—Sensitivity 10 microstrain/div., dc to 6 kc.

For high waveform resolution and precise amplitude measurement applications via the slide-back technique —**Type Z.**

Balanced Delay Network—Ample signal delay is provided by a balanced (push-pull) delay network to permit observation of the leading edge of the waveform that triggers the sweep.

Direct Input to CRT—An opening in the side of the cabinet permits direct connection to the cathode-ray tube deflection plates.

HORIZONTAL-DEFLECTION SYSTEM

A Miller runup type sweep generator is used in the Type 533. Inverse feedback in the timing circuitry assures excellent linearity. Characteristics of this circuitry

100-X MAGNIFIER, OSCILLOSCOPE

make possible the wide range of 0.02 μsec/cm to 15 sec/cm.

Calibrated Sweep Rates—Twenty-four direct-reading calibrated sweep rates are provided: 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50 μsec/cm, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50 msec/cm, 0.1, 0.2, 0.5, 1, 2, 5 sec/cm. In addition, a vernier (uncalibrated) control provides for continuous adjustment from 0.1 μsec/cm to 15 sec/cm. An indicator light warns the operator when the sweep is uncalibrated. Calibration of the fixed sweeps is within 3%.

Sweep Magnifier—Six degrees of sweep magnification are provided: 2, 5, 10, 20, 50, and 100 times. Any ten centimeters of a magnified sweep can be displayed. When the magnified sweep does not exceed the maximum calibrated rate of 0.02 μsec/cm, accuracy is within 5% of the displayed portion. An indicator light warns the operator when the maximum calibrated rate is being exceeded.

Single-Sweep Operation—Lockout-reset circuitry provides for one-shot recording. After a single sweep is triggered, the sweep circuit is automatically locked out until manually reset. When reset, the sweep will fire on the next trigger received, then automatically lock out until the operator presses the RESET button.

DC-Coupled Unblanking—DC coupling is provided for the unblanking waveform, assuring uniform bias on the cathode-ray tube for all sweep times and repetition rates.

Triggering Facilities—Versatile triggering circuitry provides for complete manual control, preset stability control, and fully-automatic triggering.

Amplitude-Level Selection—Adjustable amplitude-level and stability controls provide for triggering the sweep at a selected amplitude level on the triggering waveform. Triggering source can be internal, external or the line frequency, either ac-coupled or dc-coupled. The triggering point can be on either the rising or falling slope of the triggering waveform.

Preset Stability—Same as above, except the stability control is preset to the optimum triggering point and requires no readjustment.

Automatic Triggering—Automatic level-seeking trigger circuit provides dependable triggering for most applications. One simple setting assures positive sweep-triggering by signals of widely differing amplitudes, shapes, and repetition rates. No trigger control need be touched until a different type of operation is desired. Range of automatic operation is between 60 cycles and 2 megacycles, approximately. In the absence of an input signal the sweep is automatically triggered at about a 50-cycle rate, providing a reference trace on the screen.

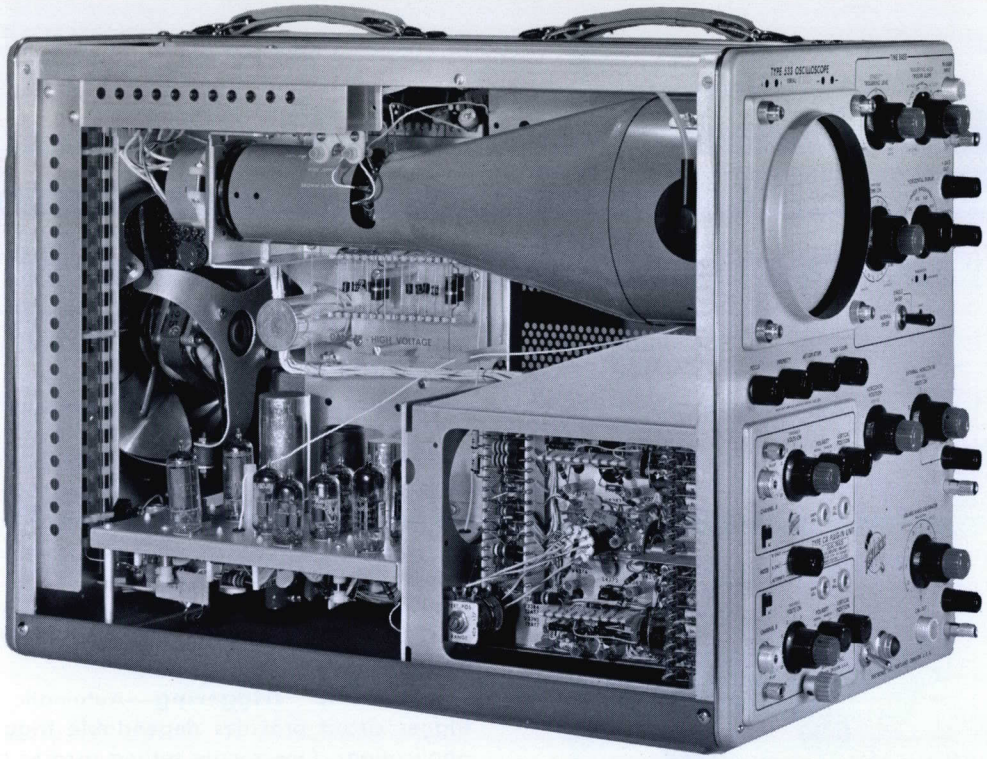
High-Frequency Sync—Assures a steady display of sine-wave signals up to approximately 30 megacycles. Requires a signal large enough to cause about 2 cm of deflection, or an external signal of about 2 v.

Trigger Requirements—Internal triggering—a signal large enough to cause 2-mm deflection. External triggering—a signal of 0.2 v to 10 v.

Horizontal Input—An external signal can be applied to the horizontal deflection plates through the dc-coupled horizontal amplifier via a front-panel connector. Three calibrated sensitivity steps are provided: 0.1, 1, and 10 v/cm. A variable control provides for continuous adjustment from 0.1 to approximately 100 v/cm. Horizontal amplifier passband is dc to 500 kc. Input impedance is approximately 45 pf paralleled by 1 megohm.

OTHER CHARACTERISTICS

Accelerating Potential—10-kv accelerating potential assures bright display when using fast sweeps at low repetition rates, and in single-sweep applications. A new Tektronix cathode-ray tube, the T533P__ is used in the Type 533. It is a 5" flat-faced metallized precision tube with helical post-accelerating anode that provides a full 6-cm x 10-cm viewing area. For best results over the wide sweep range of the Type 533, a



P2 phosphor is normally furnished with the instrument. P1, P7, and P11 phosphors are available as optional phosphors. Some other phosphors are available on special order.

Regulated Power Supply—Electronic regulation compensates for line-voltage variations between 105 and 125 v, or 210 and 250 v, and for current-demand differences among the plug-in preamplifiers.

Amplitude Calibrator—A square-wave calibration voltage is available through a front-panel connector. Eighteen fixed steps— 0.2, 0.5, 1, 2, 5, 10, 20, 50, 100 millivolts, 0.2, 0.5, 1, 2, 5, 10, 20, 50 and 100 volts peak-to-peak are provided. Accuracy is within 3%. Square-wave frequency is approximately 1 kc.

Dual-Trace Blanking—A blanking voltage is available to eliminate switching transients from the display when a dual-trace plug-in unit is operated in its chopped mode. The blanking voltage can be applied to the crt cathode by means of a switch located on the back panel of the instrument. (Type 53/54C Units under serial number 14078 will require a minor modification).

Output Waveforms—A 20-v positive gate of the same duration as the sweep and a 150-v sweep-sawtooth waveform are available at front-panel binding posts via cathode followers. The vertical signal is brought out to a front-panel terminal for external applications.

Access to Interior—Three-piece cabinet design provides easy access to the interior of the instrument. Cabinet sides are held in place by two quick-opening fasteners, and can be removed in a matter of seconds.

Alignment of Cathode-Ray Tube—Should adjustment of the cathode-ray tube alignment become necessary, an easily accessible knob, located on the rear support bracket of the crt, provides smooth positive control of the crt alignment.

Beam-Position Indicators—Two pairs of indicator lights show direction of the electron beam when the spot is not on the screen.

Illuminated Graticule—An edge-lighted graticule is marked in centimeter squares with two-millimeter baseline divisions for convenience in making time and amplitude measurements. Illumination is controlled by a front-panel knob.

ELECTRON TUBES AND SEMICONDUCTORS

* denotes "or equivalent"

Vertical		
Input amplifiers	2	12BY7A
Driver CF and beam-indicator amplifier	2	6DJ8
Output amplifiers	2	6197
Trigger-pickoff amplifiers		6DJ8
Trigger-pickoff CF and vertical-signal-out CF's		6DJ8
Horizontal		
Trigger-input amplifier		6DJ8
Trigger multivibrator		6DJ8
Lockout multivibrator		6AU6
Lockout multivibrator and holdoff CF		6DJ8
Holdoff CF and unblanking CF		6DJ8
Sweep-gating multivibrator and CF		6DJ8
Sweep-gating multivibrator		12BY7A
Sawtooth-out and + gate-out CF's		6DJ8
Disconnect diodes		6AL5
Miller-runup sweep generator		12AU6
Runup CF		6DJ8

Horizontal-input CF		12AU6
Horizontal drivers	2	6DK6
Horizontal-output amplifiers and CF's	2	6BA8
High-frequency-capacitance driver		6DK6
External-horizontal preamplifier		6DJ8
Power Supplies		
Rectifiers	18	2N2070*
Voltage reference		5651
Regulator amplifiers.	5	6AU6
Comparators	2	12AX7
Series regulators	4	12B4
Series regulators	2	6080
High-voltage oscillator		6AU5
High-voltage rectifiers	5	5642
Error-signal amplifiers		12AU7
Miscellaneous		
Calibrator multivibrator		6AU6
Calibrator multivibrator and CF		12AU7
Alternate-trace-sync and dual-trace blanking amplifiers		6DJ8
Cathode-ray tube		T533P2

MECHANICAL SPECIFICATIONS

Ventilation— Safe operating temperature is maintained by filtered, forced-air ventilation. A minimum of 2" of unobstructed clearance around the instrument is recommended for adequate ventilation.

Construction— Aluminum-alloy chassis and three-piece cabinet.

Finish—Photo-etched anodized panel, blue wrinkle-finished cabinet.

Dimensions— 24" long, 13" wide, 16¾" high.

Weight: Net—62 pounds
Shipping—77 pounds approx.

Power Requirements— 105-125 v or 210-250 v, 50-60 cycles, 500 watts maximum.

Type 533, without plug-in units **$1100**

Includes: 2—10-x attenuator probes
2—Binding-post adapters (013-004)
1—Test lead (012-031)
1—Green filter (378-514)
1—3-conductor power cord (161-010)
1—Instruction manual

Optional Phosphors

P2 crt phosphor normally furnished.
P1, P7, P11 optional . . . . . No extra charge

Price f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).

RM33 RACK-MOUNTING MODEL

GENERAL DESCRIPTION

The Type RM33 is a mechanically rearranged Type 533 Oscilloscope for mounting in a standard 19" rack. The instrument mounts to the rack on slide-out tracks. It can be pulled forward, tilted, and locked in any of seven positions for servicing convenience. Electrical characteristics of the instrument are the same as described for the Type 533 Oscilloscope.

MECHANICAL SPECIFICATIONS

Ventilation—Filtered, forced-air ventilation maintains safe operating temperature.

Construction—Aluminum-alloy chassis, and cabinet. Slide-out mounting.

Finish—Photo-etched anodized panel, blue wrinkle-finished cabinet.

Dimensions—14" high, 19" wide, 22½" rack depth. Please see page B-8 for complete mounting dimensions.

Weight: Net—79 pounds
Shipping—98 pounds approx.

Type RM33, without plug-in units **$1200**

Includes: 2—10-x attenuator probes
2—Binding-post adapters (013-004)
1—Test lead (012-031)

1—Green filter (378-514)
1—3-conductor power cord (161-010)
1—Set, mounting hardware
1—Instruction manual

Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).

TYPE 535A DC—15 MC

MAIN FEATURES

Easier Operation
Simplified panel layout.
Color-correlated controls.

Two Kinds of Sweep Delay
Triggered (jitter free)—delayed sweep is started by signal under observation.
Conventional—delayed sweep is started by delayed trigger.

Greater Calibrated Delay Range
1 μsec to 10 sec, continuously adjustable (2 μsec/cm to 1 sec/cm).

DC-to-15 MC Vertical Amplifier
All Tektronix Type A to Z Plug-In Preamplifiers can be used for signal-handling versatility.

Two Time-Base Generators

TIME BASE A—0.1 μsec/cm to 5 sec/cm in 24 calibrated steps, continuously variable from 0.1 μsec/cm to 12 sec/cm. 5-x magnifier increases calibrated range to 0.02 μsec/cm. Single-sweep provision for one-shot applications.

TIME BASE B—Also functions as delay generator. 18 calibrated steps from 2 μsec/cm to 1 sec/cm.

GENERAL DESCRIPTION

The Tektronix Type 535A is a DC-to-15 MC Oscilloscope with a wide range of sweep delay. It is easier to operate and offers higher performance than its predecessor, the Type 535.

Color-correlated controls contribute greatly to ease of operation. Other contributing factors to easy operation of the Type 535A are simplified panel layout and horizontal display control, single-knob sweep and calibrator controls, and internal triggering for sweep delay.

Greater reliability has been achieved through use of the new frame-grid twin triodes, and a change to silicon diodes in the power supplies. Performance improvement includes an extra 5 mc in vertical response and wider range of sweep delay.

APPLICATIONS

In addition to the usual applications for a highly versatile DC-to-15 MC Oscilloscope, sweep delay makes it possible to:

1. Make accurate incremental measurements along a complex waveform.
2. Make accurate phase-angle measurements between two signals, up to frequencies of 1 mc.
3. Display separate channels of a PTM system with effects of time jitter removed, determining pulse amplitude and shape under conditions of modulation.
4. Measure pulse-to-pulse interval and amount of jitter on computer signals or any train of pulses.
5. Make accurate time-difference measurements between pulse-in and pulse-out through an amplifying system.
6. Display any selected individual line of a television composite signal.
7. Measure time displacement, wave shape, and amplitude of individual channels in a telemetering system.
8. Utilize calibrated sweep magnification up to the highest practical limit.

Plus many more-specialized applications.

VERTICAL-DEFLECTION SYSTEM

Frequency specifications are at 3 db down

DC-Coupled Output Amplifier—The wide-band dc-coupled amplifier has a risetime of 23 nsec with a Type C-A, K, L, or R unit plugged in. It is factory adjusted for optimum transient response.

The Type 535A vertical deflection system is designed for use with any one of the Type A to Z Plug-In Preamplifiers. In order to operate the Type 535A, one of the preamplifiers must be plugged in.

Plug-In Preamplifiers

For wide-band applications—
Type A—DC to 14 mc, 25-nsec risetime at 0.05 v/cm to 50 v/cm.
or **Type B**—DC to 14 mc, 25-nsec risetime at 0.05 v/cm to 50 v/cm—2 cycles to 10 mc, 35-nsec risetime at 5 mv/cm to 0.05 v/cm.

For maximum frequency response—
Type K—DC to 15 mc, 23-nsec risetime at 0.05 to 40 v/cm.
or **Type L**—DC to 15 mc 23-nsec risetime at 0.05 to 40 v/cm—3 cycles to 15 mc, 23-nsec risetime at 5 mv/cm to 4 v/cm.

For dual-trace operation—
Type C-A—DC to 15 mc, 23-nsec risetime at 0.05 to 50 v/cm.

For high DC sensitivity—
Type H—DC to 11 mc, 31-nsec risetime at 5 mv to 50 v/cm.

For differential-input applications—
Wide band: **Type G**—DC to 14 mc, 25-nsec risetime at 0.05 to 50 v/cm.

OSCILLOSCOPE with SWEEP DELAY

High DC sensitivity: **Type D**—DC to 350 kc at 1mv/cm, increasing to 2 mc at 50 mv/cm.

For low-level applications—
Type E—0.06 cycles to 20 kc at 50 μv/cm, increasing to 60 kc at 0.5 mv/cm.

For transistor risetime checking—
Type R—23-nsec risetime.

For repetitive high-speed pulse applications—
Type N—0.6-nsec risetime (corresponding to approximately 600 mc).

For transducer and strain gage applications—
Type Q—Sensitivity 10 microstrain/div., dc to 6 kc.

For high waveform resolution and precise amplitude measurement applications via the slide-back technique —**Type Z.**

Balanced Delay Network—Ample signal delay is provided by a balanced (push-pull) delay network to permit observation of the leading edge of the waveform that triggers the sweep.

Direct Input CRT—An opening in the side of the cabinet permits direct connection to the cathode-ray-tube deflection plates.

HORIZONTAL-DEFLECTION SYSTEM

The Type 535A has two time-base generators. TIME BASE A is identical to the time-base generator in the Tektronix Type 531A. TIME BASE B functions as a delay generator. The signal to be observed can be displayed on either time base in the following ways: TIME BASE B normal, TIME BASE B with trace brightening during the period that TIME BASE A is running, TIME BASE A delayed by TIME BASE B, TIME BASE A normal, and TIME BASE A single sweep.

TIME BASE A Calibrated Sweeps—Twenty-four direct-reading calibrated steps are provided: 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50 μsec/cm, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50 msec/cm, 0.1, 0.2, 0.5, 1, 2, 5 sec/cm. In addition, a vernier (uncalibrated) control provides for continuous adjustment from 0.1 μsec/cm to 12 sec/cm. An indicator light warns the operator when the sweep is uncalibrated. Calibration of the fixed sweeps is within 3%.

Single Sweep—(TIME BASE A only) A RESET push-button arms the sweep to fire on the next trigger to arrive. After firing once, the sweep is locked out and cannot fire again until rearmed by pressing the RESET button. The READY light indicates when the sweep is armed to fire on the next trigger.

TIME BASE B Calibrated Sweeps—Eighteen direct-reading calibrated steps are provided: 2, 5, 10, 20, 50 μsec/cm, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50 msec/cm, 0.1, 0.2, 0.5, and 1 sec/cm. A sweep-length control adjusts the sweep length from 4 cm to 10 cm for the purpose of changing the sweep repetition rate. Variable sweep repetition rate makes TIME BASE B useful as a repetition-rate generator over the range of 0.1 cycles to 40 kc.

Sweep Magnifier—5-x magnifier increases the calibrated sweep time to 0.02 μsec/cm. Sweep magnification is obtained by increasing the gain of the sweep output amplifier by a factor of five. The center 2 cm of of the normal trace is expanded to fill the screen. Any one-fifth of the magnified sweep can be displayed on the screen by rotating the HORIZONTAL POSITION control. Accurate 5-x magnification is obtained on all ranges, for both time bases.

DC-Coupled Unblanking—DC coupling is provided for the unblanking waveforms, assuring uniform bias on the cathode-ray tube for all sweep times and repetition rates.

Triggering Facilities—Versatile triggering circuitry provides for complete manual control, preset stability control, and fully-automatic triggering. Triggering fac-

ilities are identical for both time bases, except that TIME BASE A has two additional modes: H.F. SYNC and AC LF (low-frequency) REJECT.

Amplitude-Level Selection—Adjustable amplitude-level and stability controls provide for triggering the sweep at a selected amplitude level on the triggering waveform. Triggering source can be internal, external, or the line frequency, either ac-coupled or dc-coupled. The triggering point can be on either the rising or falling slope of the triggering waveform.

Preset Stability—Same as above, except the stability control is preset to the optimum triggering point and requires no readjustment.

Automatic Triggering—Automatic level-seeking trigger circuit provides dependable triggering for most applications. One simple setting assures positive sweep-triggering by signals of widely differing amplitudes, shapes, and repetition rates. No trigger control need be touched until a different type of operation is desired. Range of automatic operation is between 60 cycles and 2 megacycles, approximately. In the absence of an input signal the sweep is automatically triggered at about a 50-cycle rate, providing a reference trace on the screen.

Low-Frequency Reject—(TIME BASE A only) Prevents low-frequency components, such as hum, from interfering with stable triggering.

High-Frequency Sync—(TIME BASE A only) Assures a steady display of sine-wave signals up to approximately 30 megacycles. Requires a signal large enough to cause about 2 cm deflection, or an external signal of about 2 v.

Trigger Requirements—Internal Triggering—a signal large enough to cause 2-mm deflection. External triggering—a signal of 0.2 v to 10 v.

Horizontal Input Amplifier—DC-coupled external connection to the sweep-output amplifier is through a front-panel connector. Combination of a step attenuator and variable attenuator makes the horizontal deflection factor continuously variable from 0.2 v/cm to approximately 15 v/cm. Passband is dc to 240 kc. Input impedance is approximately 47 pf paralleled by 1 megohm.

SWEEP DELAY

Sweep delay for TIME BASE A over the range of 1 μsec to 10 sec is derived from TIME BASE B by means of a pick-off circuit. A delayed trigger is generated at the pick-off point, which can be adjusted to any point on the sawtooth waveform generated by TIME BASE B. The DELAY-TIME MULTIPLIER, a ten-turn calibrated control, is used in conjunction with the TIME/CM switch for TIME BASE B to select the pick-off point and indicate the amount of delay. Accuracy of the fifteen calibrated time/cm steps from 2 μsec/cm to 0.1 sec/cm is within 1%. Accuracy of the three remaining steps, 0.2, 0.5, and 1 sec/cm, is within 3%. For extreme accuracy any or all steps can be adjusted to an external standard. Incremental accuracy of the ten-turn control is within 0.2%.

Triggered Operation—When the triggering controls of TIME BASE A are adjusted so that the delayed trigger from TIME BASE B arms the sweep but does not start it, the next signal to arrive will start the sweep. Thus the delayed sweep is actually started by the signal under observation, resulting in a steady display even when time jitter or time modulation is present in the signal.

Conventional Operation—When the triggering controls of TIME BASE A are adjusted to permit the delayed trigger to start the sweep, the delayed sweep starts precisely at the pick-off point, its start delayed the amount of time indicated by the TIME BASE B time/cm switch and the DELAY-TIME MULTIPLIER. Any time modulation or time jitter on the signal will be magnified in proportion to the amount of sweep expansion, however jitter introduced by the delay and pick-off circuitry is less than one part in 20,000, making extremely large magnifications practical.

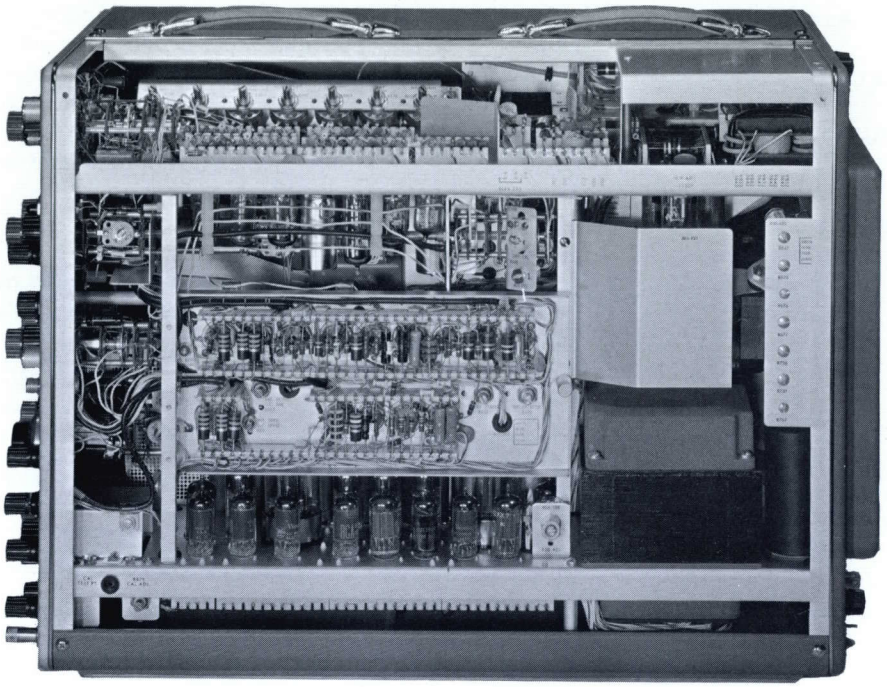
Trace Brightening—When the signal is displayed on TIME BASE B with the HORIZONTAL DISPLAY switch in the "B" INTENSIFIED BY "A" position, the unblanking pulse of TIME BASE A is added to that of TIME BASE B. Therefore the period of operation of TIME BASE A appears as a brightened portion on the display. This trace brightening serves to indicate both the point-in-time relationship between the delayed sweep and the original display, and the degree of magnification that will be achieved when the display is transferred to TIME BASE A.

OTHER CHARACTERISTICS

Accelerating Potential—10-kv accelerating potential assures bright display when using fast sweeps at low repetition rates, and in single-sweep applications. The T533P__, a Tektronix cathode-ray tube, is used in the Type 535A. The T533P__ is a 5" flat-faced metallized precision tube with a helical post-accelerating anode. It provides a full 6-cm x 10-cm viewing area. For best results over the wide sweep range of the Type 535A, a P2 phosphor is normally furnished with the instrument.

Regulated Power Supply—Electronic regulation compensates for line-voltage variations between 105 and 125 v or 210 and 250 v, and for curent-demand differences among the plug-in preamplifiers.

Amplitude Calibrator—A square-wave calibration voltage is available through a front-panel coaxial connector. Eighteen direct readings fixed steps—0.2, 0.5, 1, 2, 5, 10, 20, 50 millvolts, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50, 100 volts peak-to-peak are provided by the



single knob control. Accuracy is within 3%. Square-wave frequency is approximately 1 kc.

Dual-Trace Blanking—A blanking voltage is available to elimate switching transients from the display when a dual-trace plug-in unit is operated in its chopped mode. The blanking voltage can be applied to the crt cathode by means of a switch located on the back panel of the instrument. (Type 53/54C Units under serial number 14078 will require a minor modification).

Output Waveforms—A 20-v positive gate of the same duration as the sweep and a 150-v sweep-sawtooth waveform are available from TIME BASE A at front-panel binding posts via cathode followers. A 20-v positive gate and the delayed trigger from TIME BASE B are also available at front-panel connectors. The vertical signal is brought out to a front-panel terminal for external applications.

Access to Interior—Three-piece cabinet design provides easy access to the interior of the instrument. Cabinet sides are held in place by two quick-opening fasteners, and can be removed in a matter of seconds.

Alignment of Cathode-Ray Tube—Should adjustment of the cathode-ray tube alignment become necessary, an easily accessible knob, located on the rear support bracket of the crt, provides smooth positive control of the crt alignment.

Beam Position Indicators—Two pairs of indicator lights show direction of the electron beam when the spot is not on the screen.

Illuminated Graticule—An edge-lighted graticule is marked in centimeter squares with two-millimeter baseline divisions for convenience in making time and amplitude measurements. Illumination is controlled by a front-panel knob.

ELECTRON TUBES and SEMICONDUCTORS

* denotes "or equivalent"

Vertical Amplifier		
Vertical-input amplifier	2	12BY7
CF and beam-position amplifiers	2	6DJ8
Output amplifiers	2	6197
Trigger amplifiers		6DJ8
Trigger CF and vertical-signal out		6DJ8
Time-Base A Generator		
Trigger amplifier		6DJ8
Trigger shaper		6DJ8
Sweep-gating multivibrator and CF		6DJ8
Sweep-gating multivibrator		12BY7
Unblanking and hold-off CF		6DJ8
Sawtooth and gate CF		6DJ8
Lockout multivibrator		6AU6
Hold-off CF and lockout multivibrator		6DJ8
Delay-trigger amplifier		6AU6
Clamp		T12G*
Disconnect diodes		6AL5
Miller runup sweep generator		6CL6
Runup CF		6DJ8
Time-Base B Generator		
Trigger amplifier		6DJ8
Trigger shaper		6DJ8
Stability CF and hold-off CF		6DJ8
Sweep-gating multivibrator and CF		6DJ8
Sweep-gating multivibrator		6AU6
Unblanking CF and gate CF		6DJ8
Disconnect diodes		12AL5
Miller runup sweep generator		12AU6
Runup CF and hold-off CF		6DJ8

Horizontal Amplifiers and Delay		
Input and driver CF		6DJ8
Sweep amplifiers and CF	2	6DJ8
Current booster		6CL6
External-input amplifier		6DJ8
Delay trigger		6DJ8
Delay pick-off	2	6AU6
Delay-trigger CF and current control		6DJ8
Power Supplies		
Comparators	2	12AX7
Voltage reference		5651
Regulator amplifiers	5	6AU6
Series regulators	4	12B4
Series regulators	2	6080
Rectifiers	16	1N1566*
Error-signal amplifiers		12AU7
High-voltage oscillator		6AU5
High-voltage rectifiers	5	5642
Miscellaneous		
Calibrator multivibrator		6AU6
Calibrator multivibrator and CF		12AU7
Alternate-trace sync amplifier and trace blank		6DJ8
Cathode-ray tube		T533P2

MECHANICAL SPECIFICATIONS

Ventilation—Safe operating temperature is maintained by filtered, forced-air ventilation. A minimum of 2" of unobstructed clearance around the instrument is recommended for adequate ventilation.

Construction—Aluminum-alloy chassis and three-piece cabinet.

Finish—Photo-etched anodized panel, blue wrinkle-finished cabinet.

Dimensions—24" long, 13" wide, 16 ¾" high.

Weight: Net—66 pounds
Shipping—81 pounds approx.

Power Requirements—105-125 v or 210-250 v, 50-60 cycles, 550 watts maximum.

Type 535A, without plug-in units **$1400**

Includes: 2—10-x attenuator probes
2—Binding-post adapters (013-004)
1—Test lead (012-031)
1—Green filter (378-514)
1—3 conductor power cord (161-010)
1—Instruction manual

Optional Phosphors

P2 crt phosphor normally furnished.
P1, P7, P11 optional . . . . . No extra charge
Several other phosphors can be furnished on special order.

Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).

TYPE 536 DC—10 MC,

MAIN FEATURES

Identical Deflection Characteristics

Vertical and horizontal risetimes—31 nsec with Type K Units plugged in.

Uniform phase-shift characteristics.

Curve Tracing

The Type 536 is useful for curve tracing with two related varying voltages over a wide frequency range.

Wide Application Range

All Type A to Z Plug-In Preamplifiers can be used with both deflection systems.

General-Purpose Utility

Plug-In Time-Base Generator is available for horizontal deflection in usual oscilloscope applications.

GENERAL DESCRIPTION

The Type 536 is an unusually practical instrument, combining a wide-band "X-Y" oscilloscope with an excellent general-purpose laboratory oscilloscope. Two carefully-designed main amplifiers and a Tektronix cathode-ray tube with equal X and Y deflection characteristics are the basic components.

With two of the same wide-band preamplifiers plugged in, the horizontal and vertical deflection systems are almost identical. Relative phase shift is less than one degree to 15 mc, and, by means of a front-panel control, phase balance can be obtained at any frequency to over 25 mc.

With the Time-Base Plug-In Unit, Type T, plugged into the horizontal amplifier, and one of the Type A to Z wide-band units plugged into the vertical amplifier, the Type 536 functions as a general-purpose oscilloscope. It almost matches the performance characteristics of the Tektronix Type 531 in sweep range and triggering facilities, and has the same signal-handling versatility through currently-available Plug-In Preamplifiers.

RM35A RACK-MOUNTING MODEL

GENERAL DESCRIPTION

The Type RM35A is a mechanically rearranged Type 535A Oscilloscope for mounting in a standard 19" rack. The instrument mounts to the rack on slide-out tracks. It can be pulled forward, tilted, and locked in any of seven positions for servicing convenience. Electrical characteristics of the instrument are the same as described for the Type 535A Oscilloscope.

MECHANICAL SPECIFICATIONS

Ventilation—Filtered, forced-air ventilation maintains safe operating temperature.

Construction—Aluminum-alloy chassis, and cabinet. Slide-out mounting.

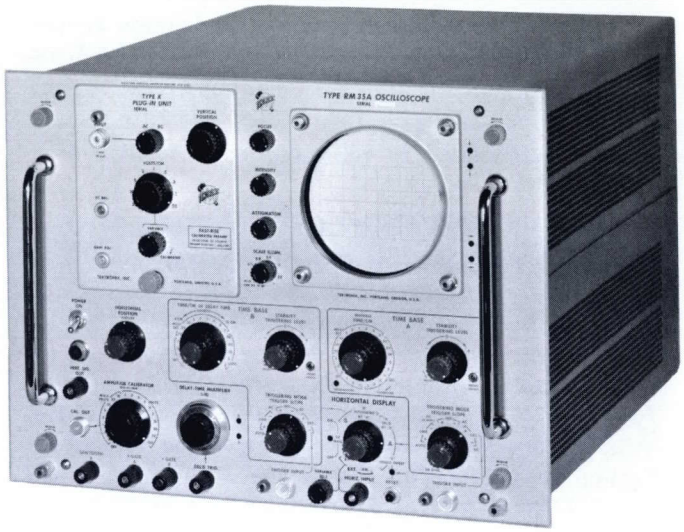
Finish—Photo-etched anodized panel, blue wrinkle-finished cabinet.

Dimensions—14" high, 19" wide, 22½" rack depth. Please see page B-8 for complete mounting dimensions.

Weight: Net—83 pounds
Shipping—102 pounds approx.

Type RM35A, without plug-in units **$1500**

Includes: 2—10-x attenuator probes
2—Binding-post adapters (013-004)
1—Test lead (012-031)
1—Green filter (378-514)



1—3-conductor power cord (161-010)
1—Set, mounting hardware
1—Instruction manual

Prices f.o.b. factory (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).

X-Y, OSCILLOSCOPE

APPLICATIONS

In curve-tracing applications the Type 536 extends the range of familiar techniques to today's higher-frequency problems. Differential input, a feature that eliminates the need for a common XY terminal, is available in the wide-band Type G Plug-In Preamplifier. Since differential input is needed for accuracy in many curve-tracing applications, a pair of Type G Units is recommended for this work.

Some applications for a wide-band "X-Y" oscilloscope are:

1. Examination of semiconductor diode characteristics—volts vs. amperes plot.
2. Determination of ferromagnetic material characteristics.
3. Linear amplifier distortion measurement.
4. Limiting or expanding-amplifier performance measurements.
5. Displaying pressure vs. volume diagrams.
6. Analyzing amplitude selector type circuits such as Schmitt, diode pick-off, etc.
7. Checking regulated power supply performance.

8. Measurement of voltage coefficient of resistors.
9. Performance tests of various modulation systems such as AM, suppressed carrier, FM, PTM, PAM, etc.
10. Performance tests of demodulators for above modulation systems.
11. Determination of various gating circuits characteristics.
12. Function generator — $y = f(x)$.

VERTICAL AND HORIZONTAL DEFLECTION SYSTEMS

Frequency specifications are at 3 db down

Identical Amplifiers—Both main amplifiers have excellent transient response with risetimes of 31 nsec with Type K units plugged in. One of the Type A to Z Preamplifiers must be plugged in to make the vertical-deflection system function. Either one of the Type A to Z Preamplifiers or a Type T Time-Base Unit must be plugged in to make the horizontal-deflection system function.

Deflection characteristics with Type G Units plugged in are:

Passbands—dc to 10 mc.

Risetimes—35 nsec.

Deflection factors—0.05 v/div maximum, 9 calibrated steps from 0.05 v/div to 20 v/div; continuously-variable adjustment between steps.

Relative phase shift—less than one degree to 15 mc, less than two degrees to 17 mc, less than five degrees to 23 mc—provided amplifiers are not overdriven by the input signals.

Amplifier phasing control—phase balance can be obtained at any frequency to over 25 mc provided amplifiers are not overdriven by the input signals.

Deflection capability—five divisions of deflection can be obtained at 20 mc without overdriving the input amplifiers.

Type 536 passband and risetime with the following plug-in units:

Type A—DC to 10 mc, 35 nsec.

Type B—DC to 10 mc, 35 nsec at 0.05 v/div to 50 v/div. . . .2 cycles to 9 mc, 0.04 μsec at 5 mv/div to 0.05 v/div.

Type C-A—DC to 10 mc, 35 nsec.

Type D—DC to 350 kc at 1 mv/div, increasing to 2 mc at 50 mv/div.

Type E—0.06 cycles to 60 kc.

Type G—DC to 10 mc, 35 nsec.

Type H—DC to 9.5 mc, 37 nsec.

Type K—DC to 11 mc, 31 nsec.

Type L—DC to 11 mc, 31 nsec at 0.05 to 40 v/div . . . .3 cycles to 10 mc, 35 nsec at 0.005 to 4 v/div.

For repetitive high-speed pulse applications—
Type N—0.6-nsec risetime (corresponding to approximately 600 mc).

For transducer and strain gage applications—
Type Q—Sensitivity 10 microstrain/div., dc to 6 kc.

For high waveform resolution and precise amplitude measurement applications via the slide-back technique —Type Z

Please refer to specifications of individual plug-in units for sensitivity and other characteristics. Descriptions of the plug-in units can be found immediately following the plug-in oscilloscopes.

HORIZONTAL-DEFLECTION SYSTEM

Time-Base Presentation—For conventional oscilloscope operation, the Type T Time-Base Generator must be plugged into the horizontal system. Specifications of the Type 536 horizontal-deflection system with the Type T Unit are as follows:

Calibrated Sweep Rates—Twenty-two sweep rates from 0.2 μsec/div to 2 sec/div.

5-x Sweep Magnifier—Increases calibrated sweep rate to 0.04 μsec/div.

Versatile Trigger Selection—Positive or negative slope, external or line voltage, ac-coupling or dc-coupling through triggering circuits.

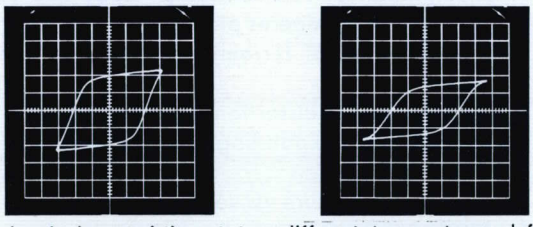
Amplitude-Level Selection—With preset or manual stability control.

Automatic Triggering—Stable triggering regardless of shape, frequency, or amplitude or triggering waveform.

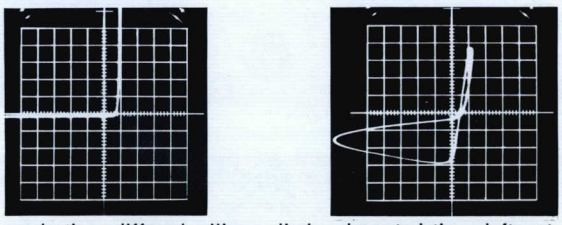
High-Frequency Sync—Synchronizes with sine-wave signals in frequency range of 5 mc to 15 mc.

Please refer to specifications of the Type T Time-Base Generator for complete specifications.

All characteristics of the horizontal deflection system are the same as those of the vertical deflection system when the same type of Plug-In Preamplifier is plugged into both systems. Descriptions of all Type A to Z Plug-In



Ferrite bead characteristics at two different temperatures—left, at 25°C; right, at equilibrium temperatures due to self heating. Type 536 with two Type G Units, driving frequency 1 mc.



High-conduction diffused silicon diode characteristics—left, at 60 cycles; right, at 2 mc. Type 536 with two Type G Units, horizontal calibration 1 v/div; vertical calibration 100 ma/div; zero current and voltage at center of screen.

Units can be found immediately following the plug-in oscilloscope descriptions.

OTHER CHARACTERISTICS

Phasing Adjustments—Provided the amplifiers are not overdriven by the input signals, relative phase shift with Type K Plug-In Preamplifiers is less than 1 degree from dc to 15 mc. Phase-shift balance can be obtained at any frequency to 30 mc with a front-panel AMPLIFIER PHASING control.

Cathode-Ray Tube—A Tektronix cathode-ray tube, T536P___, is used in the Type 536. Deflection factor is approximately the same for both horizontal and vertical deflection plates. The T536P___ crt provides a 10-by-10 division (3⅛" x 3⅛") viewing area. Accelerating potential is approximately 4 kv. For best results over the wide sweep range, a P2 phosphor is normally furnished with the instrument.

Access to Interior—Three-piece cabinet design provides easy access to the interior of the instrument. Cabinet sides are held in place by two quick-opening fasteners, and can be removed in a matter of seconds.

Alignment of Cathode-Ray Tube—Should adjustment of the cathode-ray tube alignment become necessary, an easily accessible knob, located on the rear support bracket of the crt, provides smooth positive control of the crt alignment.

Regulated Power Supply—Electronic regulation compensates for line-voltage variations between 105 and 125 v, or 210 and 250 v and for current-demand differences among the plug-in units.

Amplitude Calibrator—A square-wave voltage is available through a front-panel coaxial connector. Eighteen fixed voltage steps—0.2, 0.5, 1, 2, 5, 10, 20, 50, 100 millivolts, 0.2, 0.5, 1, 2, 5, 10, 20, 50, and 100 volts peak-to-peak are provided. Accuracy is within 3%. Square-wave frequency is approximately 1 kc.

Beam-Position Indicators—Two pairs of indicator lights show direction of the electron beam when the spot is not on the screen.

Output Waveforms—The vertical and horizontal signals are brought out to front-panel terminals for external applications.

Intensity Modulation—A front-panel switch selects the desired method of intensity modulation. . . internal dc-coupled unblanking (for T unit) or external ac-coupling or dc-coupling to the crt grid.

Illuminated Graticule—An edge-lighted graticule is marked in 10 by 10 divisions with one-fifth division baseline markings. Illumination can be adjusted by a front-panel control.

ELECTRON TUBES AND SEMICONDUCTORS

* denotes "or equivalent"

Vertical input amplifiers	2	12BY7
Cathode followers	2	6DJ8
Vertical output amplifiers	2	6360
Beam position amplifier and vertical signal out CF		6DJ8
Horizontal input amplifier	2	12BY7
Cathode followers	2	6BQ7A
Horizontal output amplifiers	2	6360
Beam position amplifier and horizontal signal out CF		6DJ8
Calibrator multivibrator and CF		6BQ7A
Calibrator multivibrator		6AU6
Rectifiers	12	1N2070*
Voltage reference		5651
Comparators	2	12AX7
Regulator amplifiers	4	6AU6
Series regulators	4	6080
High-voltage oscillator		6AQ5
Shunt regulator and dc comparator		12AU7
High-voltage rectifiers	3	5642
Intensity modulation CF		6BQ7A
Cathode-ray tube		T536P2

MECHANICAL SPECIFICATIONS

Ventilation—Filtered, forced-air ventilation assures a safe operating temperature. A minimum 2" of unobstructed clearance around the instrument is recommended for adequate ventilation.

Construction—Aluminum-alloy chassis and cabinet.

Finish—Photo-etched anodized panel and blue wrinkle-finished cabinet.

Dimensions—24" long, 13" wide, 16¾" high.

Weight: Net—60 pounds
Shipping—78 pounds approx.

Power Requirements—105-125 v or 210-250 v, 50-60 cycles, 625 watts with two Type K Units plugged in.

Type 536, without plug-in units **$1050**

Includes: 2—10-x attenuator probes
2—Binding-post adapters (013-004)
1—Test lead (012-031)
1—Green filter (378-514)
1—3-conductor power cord (161-010)
1—Instruction manual

Optional Phosphors

P2 phosphor normally furnished.
P1, P7, P11 optional . . . . . No extra charge
Some other phosphors can be furnished on special order.

Rack Mount Adapter

A cradle mount to adapt the Type 536 Oscilloscope for rack mounting is available. It consists of a cradle to support the instrument in any standard 19" relay rack and a mask to fit around the regular instrument panel. Tektronix blue wrinkle finish. Rack height requirements 17½".

ORDER PART NO. 040-182 . . . . . $45.00
Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).

MAIN FEATURES

Easy Operation
Single knob control for Sweep Range, Amplitude Calibrator, and Horizontal Display.

Excellent Transient Response
Main-unit vertical-amplifier risetime —10 nsec.

Wide Range of Vertical-Amplifier Characteristics
Instant convertibility through interchangeable plug-in preamplifiers.

Wide Sweep Range
0.02 μsec/cm to 12 sec/cm.

Versatile Triggering Circuitry
Amplitude-level selection with preset or manual stability control, and fully-automatic triggering.

10-kv Accelerating Potential

Full 4 cm x 10 cm Linear Deflection

Balanced 0.2 μsec Delay Network

GENERAL DESCRIPTION

The Type 541A is an improved high-speed laboratory oscilloscope with excellent performance capabilities. Greater dependability and longer life have been attained through the use of frame-grid dual triodes and silicon-diode rectifiers. In combination with the Type K Plug-In Unit, the Type 541A offers a vertical-amplifier passband of dc to 30 mc and a risetime of 12 nanoseconds. Wide sweep range, high accelerating potential, and full four centimeters of vertical deflection fully complement the extended vertical-amplifier range, and the convertibility provide by plug-in preamplifiers adds immensely to its value.

VERTICAL DEFLECTION SYSTEM

Frequency specifications are at 3 db down

DC-Coupled Output Amplifier—The wide-band fast-rise dc-coupled output amplifier has a risetime of 12 nsec with a Type K, L, or R unit plugged in. It is factory adjusted for optimum transient response.

The Type K Fast-Rise Plug-In Preamplifier, developed for Type 541A and Type 545A Oscilloscopes, provides a maximum deflection factor of 0.05 v/cm, with 12-nanosecond risetime, dc-to-30 mc passband, and 20 pf input capacitance. (Frequency response is down 3 db ±½ db at 30 mc, 6 db at approximately 41 mc, 12 db at approximately 55 mc.)

The Type 541A vertical deflection system is designed to be used with any of the Type A to Z Plug-In Preamplifiers. In order to operate the Type 541A, one of the preamplifiers must be plugged in.

Plug-In Preamplifiers

For fast-rise applications—
Type K—DC to 30 mc, 12-nsec risetime at 0.05 v/cm to 40 v/cm,

Or **Type L**—DC to 30 mc, 12-nsec risetime at 0.05 v/cm to 40 v/cm—3 cycles to 24 mc, 15-nsec risetime at 5 mv/cm to 4 v/cm.

For dual-trace applications—
Type C-A—DC to 24 mc, 15-nsec risetime at 0.05 v/cm to 50 v/cm.

For high DC sensitivity—
Type H—DC to 15 mc, 23-nsec risetime at 5 mv/cm to 50 v/cm.

For differential input applications—
Wideband: **Type G**—DC to 20 mc, 18-nsec risetime at 0.05 v/cm to 50 v/cm.
High DC sensitivity: **Type D**—DC to 350 kc at 1 mv/cm, increasing to 2 mc at 50 mv/cm.

Low-Level: **Type E**—0.06 cycles to 20 kc at full gain, increasing to 60 kc at 0.5 mv/cm.

For transistor risetime checking—
Type R—12-nsec risetime.

For semiconductor diode recovery-testing applications—
Type S—Test pulse risetime, 3 nsec.

For repetitive high-speed pulse applications—
Type N—0.6-nsec risetime (corresponding to approximately 600 mc).

For transducer and strain gage applications—
Type Q—Sensitivity; 10 microstrain/div., dc to 6 kc.

For high waveform resolution and precise amplitude measurement applications via the slide-back technique —**Type Z.**

Type A and B plug-in units can be used with the Type 541A Oscilloscope. However, Type K or L units will be prefered by most users because of their superior transient-response characteristics.

Type A—DC to 20 mc, 18-nsec risetime at 0.05 v/cm to 50 v/cm.

Type B—DC to 20 mc, 18-nsec risetime at 0.05 v/cm to 50 v/cm. 2 cycles to 12 mc, 30-nsec risetime at 5 mv/cm to 0.05 v/cm.

DC—30 MC OSCILLOSCOPE

Probes—Two low-capacitance probes (10-x atten.) are supplied with the instrument. Input capacitance of the Type 541A-Type K combination with probes is 11.5 pf, maximum deflection factor is 0.5 v/cm. Excellent transient response is retained, as the probes introduce no overshoot or ringing, but frequency response is down an additional 1 db at 30 mc.

Balanced Delay Network — A signal delay of 0.2 μsec is introduced by the balanced (push-pull) delay network. Permits observation of the leading edge of the waveform that triggers the sweep.

Direct Input To CRT—An opening in the side of the cabinet permits direct connection to the deflection plates.

HORIZONTAL DEFLECTION SYSTEM

The horizontal deflection system of the Type 541A is essentially the same as that of the Tektronix Type 531A. Sweep generator used in the Type 541A is the Miller-runup type. Inverse feedback in the timing circuitry assures excellent linearity. Characteristics of this circuitry provide a sweep range of 0.02 μsec/cm to 12 sec/cm.

Calibrated Sweep Rates—Twenty-four direct-reading calibrated sweep rates are provided: 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50 μsec/cm, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50 msec/cm, 0.1, 0.2, 0.5, 1, 2, 5 sec/cm. In addition, a vernier (uncalibrated) control provides for continuous adjustment from 0.1 μsec/cm to 12 sec/cm. An indicator light warns the operator when the sweep is uncalibrated. Calibration of the fixed sweeps is within 3%.

Sweep Magnifier—5-x magnifier increases the calibrated sweep time to 0.02 μsec/cm. Sweep magnification is obtained by increasing the gain of the sweep output amplifier by a factor of five. The center 2 cm of the normal trace is expanded to the left and right of center to fill the screen. Any one-fifth of the magnified sweep can be displayed on the screen by rotating the HORIZONTAL POSITION control. Accurate 5-x magnification is obtained on all ranges.

DC-Coupled Unblanking—The unblanking waveform is dc-coupled to the grid of the cathode-ray tube, assuring uniform bias for all sweep speeds and repetition rates.

Triggering Facilities—Versatile triggering circuitry provides for complete manual control, preset stability control, and fully-automatic triggering.

Amplitude-Level Selection—Adjustable amplitude-level and stability controls provide for triggering the sweep at a selected amplitude level on the triggering waveform. Trigger source can be internal, external, or the line frequency, either ac-coupled or dc-coupled. The triggering point can be on either the rising or falling slope of the triggering waveform.

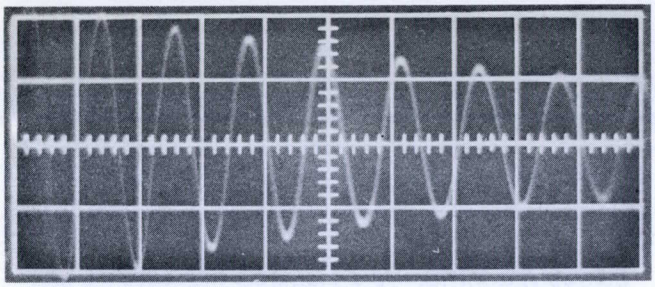
Preset Stability—Same as above, except the stability control is preset to the optimum triggering point and requires no readjustment.

Automatic Triggering—Automatic level-seeking trigger circuit provides dependable triggering for most applications. One simple setting assures positive sweep-triggering by signals of widely differing amplitudes, shapes, and repetition rates. No trigger controls need be touched until a different type of operation is desired. Range of automatic operation is between 60 cycles and 2 megacycles, approximately. In the absence of an input signal the sweep is automatically triggered at about a 50-cycle rate, providing a reference trace on the screen.

High Frequency Sync—Assures a steady display of sine-wave signals up to approximately 30 megacycles. Requires a signal large enough to cause about 2 cm deflection, or an external signal of about 2 v.

Trigger Requirements—Internal triggering—a signal large enough to cause a 2-mm deflection. External triggering—a signal of 0.2 v to 10 v.

Single Sweep Recording



20 megacycle damped oscillation shows 250-cm/μsec writing rate of the Type 541A Oscilloscope with a T543P11 crt. Recorded on 35 mm Tri-X film at f1.9 with 4.2 to 1 reduction, developed 26 minutes in D-19 at 68°F.

Horizontal Input Amplifier—DC-coupled external connection to the sweep-output amplifier is through a front-panel connector. Combination of a step attenuator and variable attenuator makes the horizontal deflection factor continuously variable from 0.2 v/cm to approximately 15 v/cm. Passband is dc to 240 kc. Input impedance is approximately 47 pf paralleled by 1 megohm.

OTHER CHARACTERISTICS

Cathode-Ray Tube—10-kv accelerating potential assures bright displays when using fast sweeps at low repetition rates, and in single-sweep applications. The Type 541A uses the Tektronix Type T543P__ cathode-ray tube. The T543P__ is a 5" flat-faced metallized precision tube with helical post-accelerating anode. It provides a linear 4-cm x 10-cm viewing area. For best results over the wide sweep range of the Type 541A, a P2 screen is normally furnished with the instrument.

Access to Interior—Three-piece cabinet design provides easy access to the interior of the instrument. Cabinet sides are held in place by two quick-opening fasteners, and can be removed in a matter of seconds.

Alignment of Cathode-Ray Tube—Should adjustment of the cathode-ray tube alignment become necessary, an easily accessible knob, located on the rear support bracket of the crt, provides smooth positive control of the crt alignment.

Regulated Power Supply—Electronic regulation compensates for line-voltage variations between 105 and 125 v, or 210 and 250 v, and for current-demand differences between the plug-in preamplifiers.

Amplitude Calibrator—A square-wave calibration voltage is available through a front panel coaxial connector. Eighteen direct readings fixed steps—0.2, 0.5, 1, 2, 5, 10, 20, 50 millivolts, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50, 100 volts peak-to-peak are provided by the single knob control. Accuracy is within 3%. Square wave frequency is approximately 1 kc.

Dual-Trace Blanking—A blanking voltage is available to eliminate switching transients from the display when a dual-trace plug-in unit is operated in its chopped mode. The blanking voltage can be applied to the crt cathode by means of a switch located on the back panel of the instrument. (Type 53/54C Units under serial number 14078 will require a minor modification).

Output Waveforms—A 20-v positive gate voltage of the same duration as the sweep, and a 150-v sweep sawtooth waveform are available at front-panel binding posts via cathode followers. The vertical signal is brought out to a front-panel terminal for external applications.

Beam Position Indicators—Two pairs of indicator lights show the direction of the crt electron beam when the spot is not on the screen.

Illuminated Graticule—An edge-lighted graticule is marked in centimeter squares with two-millimeter baseline divisions for convenience in making measurements in time and amplitude. Illumination of the graticule is controlled by a front-panel knob.

ELECTRON TUBES AND SEMICONDUCTORS

* denotes "or equivalent"

Vertical input amplifiers	2	12BY7A
Beam position amplifiers		12AU7
Driver CF	2	6DJ8
Output amplifiers	12	6DK6
Trigger amplifiers	2	6DK6
Trigger CF and vert. sig. out		6DJ8
Trigger amplifier		6DJ8
Trigger shaper		6DJ8
Stability and hold-off CF		6DJ8
Hold-off and unblanking CF		6DJ8
Clamping diode		T12G*
Sweep-gating multivibrator and CF		6DJ8
Sweep-gating multivibrator		12BY7
Disconnect diodes		6AL5
Gate-out and sawtooth-out CF		6DJ8
Dual-trace blanking and trigger amplifiers		6DJ8
Sweep generator		6CL6
Sweep generator CF		6DJ8
External horizontal and dc level CF		12AU7
External horizontal amplifier		6DJ8
Horizontal input and driver CF.		6DJ8
Horizontal amplifier and CF	2	6DJ8
Sweep start compensator		6CL6
Calibrator multivibrator		6AU6
Calibrator multivibrator and CF		12AU7
Voltage rectifiers	16	1N1566*
Voltage reference		5651
Comparator amplifiers	2	12AX7
Regulator amplifiers	5	6AU6

Series regulator	4	12B4
Series regulators	2	6080
High-voltage oscillator		6AU5
Regulator		12AU7
High-voltage rectifiers	5	5642
Cathode-ray tube		T543P2

MECHANICAL SPECIFICATIONS

Ventilation—Filtered forced-air ventilation maintains safe operating temperatures. A minimum 2" of unobstructed clearance around the instrument is recommended for adequate ventilation.

Construction—Aluminum-alloy chassis and three-piece cabinet.

Finish—Photo-etched anodized panel, blue wrinkle-finished cabinet.

Dimensions—24" long, 13" wide, 16¾" high.

Weight: Net—62 pounds
Shipping—77 pounds approx.

Power Requirements—105-125 v or 210-250 v 50-60 cycles, 520 watts maximum.

Type 541A, without plug-in units **$1200**

Includes: 2—10-x attenuator probes
2—Binding-Post adapters (013-004)
1—Test lead (012-031)
1—Green filter (378-514)
1—3-Conductor power cord (161-010)
1—Instruction manual

Optional Phosphors

P2 crt phosphor normally furnished.
P1, P7, P11 optional. . . . . .No extra charge
Several other phosphors can be furnished on special order.

Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).

RM41A RACK-MOUNTING MODEL

GENERAL DESCRIPTION

The Type RM41A is a mechanically rearranged Type 541A Oscilloscope for mounting in a standard 19" rack. The instrument mounts to the rack on slide-out tracks. It can be pulled forward, tilted, and locked in any of seven positions for servicing convenience. Electrial characteristics of the instrument are the same as described for the Type 541A Oscilloscope.

MECHANICAL SPECIFICATIONS

Ventilation—Filtered, forced-air ventilation maintains safe operating temperature.

Construction—Aluminum-alloy chassis, and cabinet. Slide-out mounting.

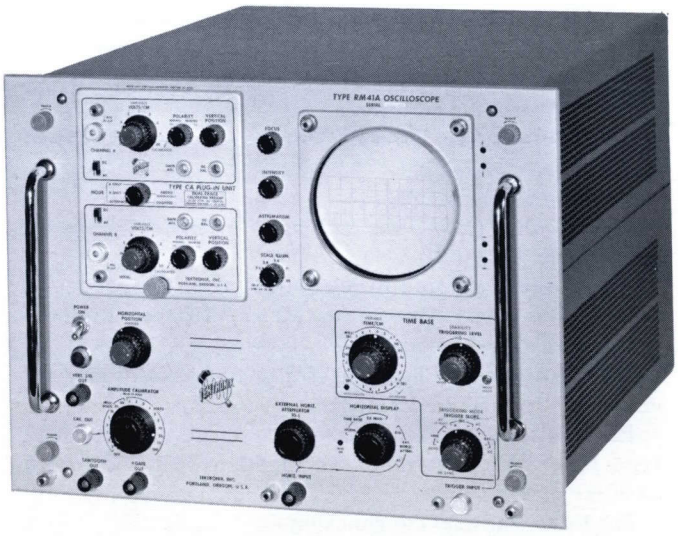
Finish—Photo-etched anodized panel, blue wrinkle-finished cabinet.

Dimensions—14" high, 19" wide, 22½" rack depth. Please see page B-8 for complete mounting dimensions.

Weight: Net—79 pounds
Shipping—98 pounds approx.

Type RM41A, without plug-in units **$1300**

Includes: 2—10-x attenuator probes
2—Binding-post adapters (013-004)
1—Test lead (012-031)
1—Green filter (378-514)



1—3-Conductor power cord (161-010)
1—Set, mounting hardware
1—Instruction manual

Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).

TYPE 543 DC—30 MC,

MAIN FEATURES

Easy Operation

Sweep Magnification—2, 5, 10, 20, 50, and 100 Times

Preset Triggering—Eliminates triggering adjustments in most applications.

24 Calibrated Direct-Reading Sweep Rates—Sweep range continuously variable (uncalibrated) from 0.02 μsec/cm to 15 sec/cm.

Single Sweep Operation—Lockout-Reset Circuitry for one-shot recording.

High Writing Rate—10-kv accelerating potential assures bright trace for operation in single-sweep applications, and with low sweep repetition rates.

Versatility

Type A to Z Plug-In Preamplifiers—Wide Band, Dual Trace, Low Level, Differential, and others for specialized applications.

High Performance

DC-to-30 MC Vertical Response—With Fast-Rise Plug-In Preamplifiers.

GENERAL DESCRIPTION

The Type 543 is a fast-rise laboratory oscilloscope with new versatility and convenience features. Its applications capabilities extend over the complete range provided by the Tektronix Type A to Z Plug-In Preamplifiers. Simplified controls make it easy to operate. The wide range of sweep magnification and the single-sweep lockout feature add to both versatility and operating convenience.

With the exception of the vertical amplifier and cathode-ray tube, the Type 543 is almost identical to the Tektronix Type 533.

VERTICAL-DEFLECTION SYSTEM

Frequency specifications are at 3 db down

DC-Coupled Output Amplifier—The Type 543 output amplifier has a risetime of 12 nsec with a Type K, L, or R unit plugged in. It is factory adjusted for optimum transient response. In order to operate the Type 543, one of the Type A to Z Plug-In-Preamplifier Units must be plugged in.

Plug-In Preamplifiers

For maximum frequency response—
Type K—DC to 30 mc, 12-nsec risetime; 0.05 to 40 v/cm.
Or **Type L**—DC to 30 mc, 12-nsec risetime at 0.05 to 40 v/cm . . . 3 cycles to 24 mc, 15-nsec risetime at 5 mv/cm to 4 v/cm.

For dual-trace operation—
Type C-A—DC to 24 mc, 15-nsec risetime; 0.05 to 50 v/cm.

For high DC sensitivity—
Type H—DC to 15 mc, 23-nsec risetime; 5 mv/cm to 50 v/cm.

For differential-input applications—
Wide-Band: **Type G**—DC to 20 mc, 18-nsec risetime; 0.05 to 50 v/cm.
High DC sensitivity: **Type D**—DC to 350 kc at 1 mv/cm, increasing to 2 mc at 50 mv/cm.

For low-level applications—
Type E—0.06 cycles to 20 kc at 50 μv/cm, increasing to 60 kc at 0.5 mv/cm.

For transistor risetime checking—
Type R—12-nsec risetime.

For semiconductor diode recovery-testing applications—
Type S—Test pulse risetime, 3 nsec.

For repetitive high-speed pulse applications—
Type N—0.6-nsec risetime (corresponding to approximately 600 mc).

For transducer and strain gage applications—
Type Q—Sensitivity; 10 microstrain/div., dc to 6 kc.

For high waveform resolution and precise amplitude measurement applications via the slide-back technique—**Type Z.**

Type A and B plug-in units can be used with the Type 543 Oscilloscope. However, Type K or L units will be prefered by most users because of their superior transient-response characteristics.
Type A—DC to 20 mc, 18-nsec risetime at 0.05 v/cm to 50 v/cm.
Type B—DC to 20 mc, 18-nsec risetime at 0.05 v/cm to 50 v/cm, 2 cycles to 12 mc, 30-nsec risetime at 5 mv/cm to 50 v/cm.

Probes—Two low-capacitance 10-x attenuator probes are supplied with the Type 543. 10-x probes introduce no overshoot or ringing, but frequency response is down an additional 1 db at 30 mc.

Balanced Delay Network—Ample signal delay is provided by a balanced (push-pull) delay network to permit observation of the leading edge of the waveform that triggers the sweep.

Direct Inputs To CRT—An opening in the side of the cabinet permits direct connection to the cathode-ray tube deflection plates.

100-X MAGNIFIER, OSCILLOSCOPE

HORIZONTAL-DEFLECTION SYSTEM

A Miller-runup type sweep generator is used in the Type 543. Inverse feedback in the timing circuitry assures excellent linearity. Characteristics of this circuitry make possible the wide range of 0.02 μsec/cm to 15 sec/cm.

Calibrated Sweep Rates—Twenty-four direct-reading calibrated sweep rates are provided: 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50 μsec/cm, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50 msec/cm, 0.1, 0.2, 0.5, 1, 2, 5 sec/cm. In addition, a vernier (uncalibrated) control provides for continuous adjustment from 0.1 μsec/cm to 15 sec/cm. An indicator light warns the operator when the sweep is uncalibrated. Calibration accuracy of the fixed sweeps is within 3%.

Sweep Magnifier—Six degrees of sweep magnification are provided: 2, 5, 10, 20, 50, and 100 times. Any ten centimeters of a magnified sweep can be displayed. When the magnified sweep does not exceed the maximum calibrated rate of 0.02 μsec/cm, accuracy is within 5% of the displayed portion. An indicator light warns the operator when the maximum calibrated rate is being exceeded.

Single-Sweep Operation—Lockout-reset circuitry provides for one-shot recording. After a single sweep is triggered, the sweep circuit is automatically locked out until manually reset. When reset, the sweep will fire on the next trigger received, then automatically lock out until the operator presses the RESET button.

DC-Coupled Unblanking—DC coupling is provided for the unblanking waveform, assuring uniform bias on the cathode-ray tube for all sweep times and repetition rates.

Triggering Facilities—Versatile triggering circuitry provides for complete manual control, preset stability control, and fully-automatic triggering.

Amplitude-Level Selection—Adjustable amplitude-level and stability controls provide for triggering the sweep at a selected amplitude level on the triggering waveform. Triggering source can be internal, external, or the line frequency, either ac-coupled or dc-coupled. The triggering point can be on either the rising or falling slope of the triggering waveform.

Preset Stability—Same as above, except the stability control is preset to the optimum triggering point and requires no readjustment.

Automatic Triggering — Automatic level-seeking trigger circuit provides dependable triggering for most applications. One simple setting assures positive sweep-triggering by signals of widely differing amplitudes, shapes, and repetition rates. No trigger control need be touched until a different type of operation is desired. Range of automatic operation is between 60 cycles and 2 megacycles, approximately. In the absence of an input signal the sweep is automatically triggered at about a 50-cycle rate, providing a reference trace on the screen.

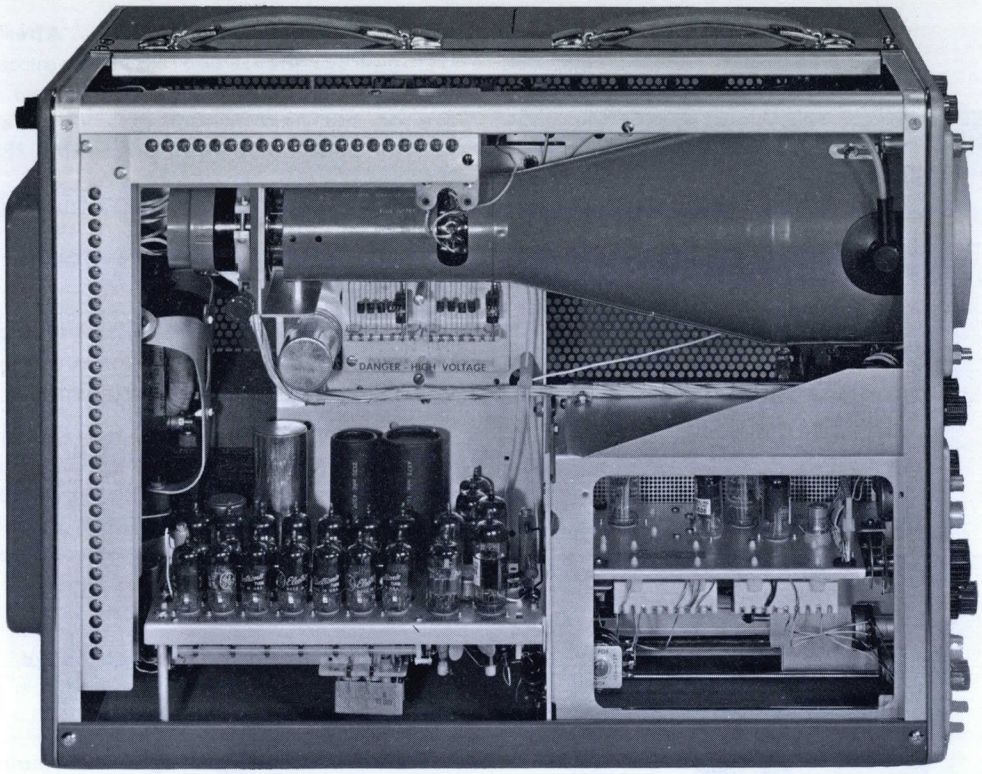
High-Frequency Sync—Assures a steady display of sine-wave signals up to approximately 30 megacycles. Requires a signal large enough to cause about 2 cm of deflection, or an external signal of about 2 v.

Trigger Requirements — Internal triggering — a signal large enough to cause 2-mm deflection. External triggering—a signal of 0.2 v to 10 v.

Horizontal Input—An external signal can be applied to the horizontal deflection plates through the dc-coupled horizontal amplifier via a front-panel connector. Three calibrated sensitivity steps are provided: 0.1, 1, and 10 v/cm. A variable control provides for continuous adjustment from 0.1 to approximately 100 v/cm. Horizontal amplifier passband is dc to 500 kc. Input impedance is approximately 45 pf paralleled by 1 megohm.

OTHER CHARACTERISTICS

Accelerating Potential—10-kv accelerating potential assures bright display when using fast sweeps at



low repetition rates, and in single-sweep applications. A Tektronix manufactured cathode-ray tube, the T543P__, is used in the Type 543. It is a 5" flat-faced metallized precision tube with helical post-accelerating anode that provides a 4-cm x 10-cm viewing area. For best results over the wide sweep range of the Type 543, a P2 phosphor is normally furnished with the instrument. P1, P7, and P11 phosphors are available as optional phosphors. Some other phosphors are available on special order.

Regulated Power Supply—Electronic regulation compensates for line-voltage variations between 105 and 125 v or 210 and 250 v, and for current-demand differences among the plug-in preamplifiers.

Amplitude Calibrator—A square-wave calibration voltage is available through a front-panel connector. Eighteen fixed steps— 0.2, 0.5, 1, 2, 5, 10, 20, 50, 100 millivolts, 0.2, 0.5, 1, 2, 5, 10, 20, 50 and 100 volts peak-to-peak are provided. Accuracy is within 3%. Square-wave frequency is approximately 1 kc.

Dual-Trace Blanking—A blanking voltage is available to eliminate switching transients from the display when a dual-trace plug-in unit is operated in its chopped mode. The blanking voltage can be applied to the crt cathode by means of a switch located on the back panel of the instrument. (Type 53/54C Units under serial number 14078 will require a minor modification).

Output Waveforms—A 20-v positive gate of the same duration as the sweep and a 150-v sweep-sawtooth waveform are available at front-panel binding posts via cathode followers. The vertical signal is brought out to a front-panel terminal for external applications.

Access to Interior—Three-piece cabinet design provides easy access to the interior of the instrument. Cabinet sides are held in place by two quick-opening fasteners, and can be removed in a matter of seconds.

Alignment of Cathode-Ray Tube—Should adjustment of the cathode-ray tube alignment become necessary, an easily accessible knob, located on the rear support bracket of the crt, provides smooth positive control of the crt alignment.

Beam-Position Indicators—Two pairs of indicator lights show direction of the electron beam when the spot is not on the screen.

Illuminated Graticule—An edge-lighted graticule is marked in centimeter squares with two-millimeter baseline divisions for convenience in making time and amplitude measurements. Illumination is controlled by a front-panel knob.

ELECTRON TUBE AND SEMICONDUCTORS

* denotes "or equivalent"

Vertical input amplifiers	2	12BY7A
Beam-position amplifiers		12AU7
Driver cathode followers		6DJ8
Output amplifiers	12	6DK6
Trigger amplifiers	2	6DK6
Trigger CF and vertical signal out		6DJ8
Sweep generator		12AU6
Sweep generator CF		6DJ8

Disconnect diode		6AL5
Unblank and holdoff CF		6DJ8
Trigger inverter		6DJ8
Holdoff CF & lockout multivibrator		6DJ8
Lockout multivibrator		6AU6
Horizontal input CF		12AU6
Driver amplifiers	2	6DK6
Output amplifier and CF	2	6BA8
Capacitance driver		6DK6
Positive multivibrator and CF		6DJ8
Negative multivibrator		12BY7A
Sawtooth and gate CF		6DJ8
External horizontal amplifier		6DJ8
Trigger shaper		6DJ8
Cal multivibrator		6AU6
Cal output CF & multivibrator		12AU7
Dual-trace blanking and trigger amplifier		6DJ8
High-voltage oscillator		6AU5
High-voltage rectifiers	5	5642
Regulator		12AU7
Voltage reference		5651
Series regulators	2	6080
Regulator amplifiers	5	6AU6
Comparator amplifiers	2	12AX7
Series regulators	4	12B4
Cathode-ray tube		T543P2

MECHANICAL SPECIFICATIONS

Ventilation—Safe operating temperature is maintained by filtered, forced-air ventilation. A minimum of 2" of unobstructed clearance around the instrument is recommended for adequate ventilation.

Construction—Aluminum-alloy chassis and three-piece cabinet.

Finish—Photo-etched anodized panel, blue wrinkle-finished cabinet.

Dimensions—24" long, 13" wide, 16¾" high.

Weight: Net—64 pounds
Shipping—79 pounds approx.

Power Requirements—105-125 v or 210-250 v, 50-60 cycles, 530 watts maximum.

Type 543, without plug-in units **$1275**

Includes: 2—10-x attenuator probes
2—Binding-post adapters (013-004)
1—Test lead (012-031)
1—Green filter (378-514)
1—3-Conductor power cord (161-010)
1—Instruction manual

Optional Phosphors

P2 crt phosphor normally furnished,
P1, P7, P11 optional . . . . . .No extra charge

RM43 RACK-MOUNTING MODEL

GENERAL DESCRIPTION

The Type RM43 is a mechanically rearranged Type 543 Oscilloscope for mounting in a standard 19" rack. The instrument mounts to the rack on slide-out tracks. It can be pulled forward, tilted, and locked in any of seven positions for servicing convenience. Electrical characteristics of the instrument are the same as described for the Type 543 Oscilloscope.

MECHANICAL SPECIFICATIONS

Ventilation—Filtered, forced-air ventilation maintains safe operating temeperature.

Construction—Aluminum-alloy chassis, and cabinet. Slide-out mounting.

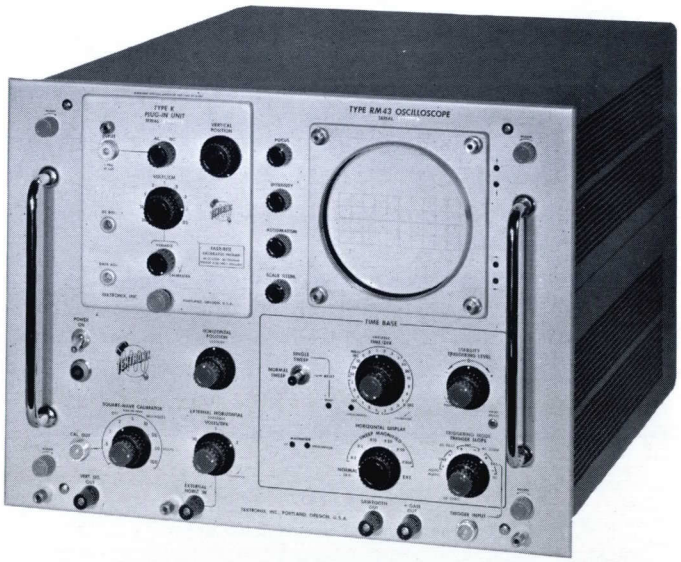
Finish—Photo-etched anodized panel, blue wrinkle-finished cabinet.

Dimensions—14" high, 19" wide, 22½" rack depth. Please see page B-8 for complete mounting dimensions.

Weight: Net—81 pounds
Shipping—100 pounds approx.

Type RM43, without plug-in units **$1375**

Includes: 2—10-x attenuator probes
2—Binding-post adapters (013-004)
1—Test lead (012-031)



1—Green filter (378-514)
1—3-Conductor power cord (161-010)
1—Set, mounting hardware
1—Instruction manual

Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).

TYPE 545A DC—30 MC

MAIN FEATURES

Easier Operation
Simplified panel layout.
Color-correlated controls

Two Kinds of Sweep Delay
Triggered (jitter free)—delayed sweep is started by signal under observation.
Conventional—delayed sweep is started by delayed trigger.

Greater Calibrated Delay Range
1 μsec to 10 sec, continously adjustable (2 μsec/cm to 1 sec/cm).

DC-to-30 MC Main Vertical Amplifier
12-nsec risetime with Type K Preamplifier.
All Tektronix Type A to Z Plug-In Preamplifiers can be used for signal-handling versatility.

Two Time-Base Generators
TIME BASE A—0.1 μsec/cm to 5 sec/cm in 24 calibrated steps, continuously variable from 0.1 μsec/cm to 12 sec/cm. 5-x magnifier increases calibrated range to 0.02 μsec/cm. Single-sweep provision for one-shot applications.
TIME BASE B—Also functions as delay generator. 18 calibrated steps from 2 μsec/cm to 1 sec/cm.

GENERAL DESCRIPTION

The Type 545A is a versatile laboratory instrument that incorporates features of two popular Tektronix Oscilloscopes. It has both the vertical and horizontal deflection characteristics of the Type 541A, as well as the sweep-delay capabilities of the Type 535A.

In addition to improvements in performance, the Type 545A is easier to operate than its predecessor, the Type 545. Color-correlated controls, single direct-reading controls for sweep time and amplitude calibrator, and internal triggering for sweep delay all contribute to operator convenience. Durability has been improved too, through use of new frame-grid triodes and silicon rectifiers.

APPLICATIONS

In addition to the usual applications for a highly versatile DC-to-30 MC Oscilloscope, sweep delay makes it possible to:

1. Make accurate incremental measurements along a complex waveform.
2. Make accurate phase-angle measurements between two signals, up to frequencies of 1 mc.
3. Display separate channels of a PTM system, with effects of time jitter removed, determining pulse amplitude and shape under conditions of modulation.
4. Measure pulse-to-pulse intervals and amount of jitter on computer signals or any train of pulses.
5. Make accurate time-difference measurements between pulse-in and pulse-out through an amplifying system.
6. Display any selected individual line of a television composite signal.
7. Measure time displacement, wave shape, and amplitude of individual channels in a telemetering system.
8. Utilize calibrated sweep magnification up to the highest practical limit.

Plus many more-specialized applications.

VERTICAL-DEFLECTION SYSTEM

Frequency specifications are at 3 db down

DC-Coupled Output Amplifier—The fast-rise dc-coupled amplifier has a risetime of 12 nsec with a Type K, L, or R unit plugged in. It is factory adjusted for optimum transient response.

The Type 545A vertical deflection system is designed for use with any one of the Type A to Z Plug-In Preamplifiers. In order to operate the Type 545A, one of the preamplifiers must be plugged in.

Plug-In Preamplifiers

For fast-rise applications—
Type K—DC to 30 mc, 12-nsec risetime at 0.05 v/cm to 40 v/cm.

or **Type L**—DC to 30 mc, 12-nsec risetime at 0.05 v/cm to 40 v/cm,—3 cycles to 24 mc, 15-nsec risetime at 5 mv/cm to 4 v/cm.

For dual-trace appliciations—
Type C-A—DC to 24 mc, 15-nsec risetime at 0.05 v/cm to 50 v/cm.

For high DC sensitivity—
Type H—DC to 15 mc, 23-nsec risetime at 5 mv/cm to 50 v/cm.

For differential input applications—
Wideband: **Type G**—DC to 20 mc, 18-nsec risetime at 0.05 v/cm to 50 v/cm.

High DC sensitivity: **Type D**—DC to 350 kc at 1 mv/cm, increasing to 2 mc at 50 mv/cm.

Low-Level: **Type E**—0.06 cycles to 20 kc at full gain, increasing to 60 kc at 0.5 mv/cm.

OSCILLOSCOPE with SWEEP DELAY

For transistor risetime checking—
Type R—12-nsec risetime.

For semiconductor diode recovery-testing applications—
Type S—Test pulse risetime, 3 nsec.

For repetitive high-speed pulse applications—
Type N—0.6-nsec risetime (corresponding to approximately 600 mc).

For transducer and strain gage applications—
Type Q—Sensitivity; 10 microstrain/div., dc to 6 kc.

For high waveform resolution and precise amplitude measurement applications via the slide-back technique —**Type Z.**

Type A and B plug-in units can be used with the Type 545A oscilloscope. However, Type K or L units will be preferred by most users because of their superior transient-response characteristics.

Type A—DC to 20 mc, 18-nsec risetime at 0.05 v/cm to 50 v/cm.

Type B—DC to 20 mc, 18-nsec risetime, 0.05 v/cm to 50 v/cm,—2 cycles to 12 mc, 30-nsec risetime, 5 mv/cm to 0.05 v/cm.

Probes—Two low-capacitance probes (10-x atten.) are supplied with the instrument. Input capacitance of the Type 545-K combination with probes is 11.5 pf. Excellent transient response is retained, as the probes introduce no overshoot or ringing, but frequency response is down an additional 1 db at 30 mc.

Balanced Delay Network—A signal delay of 0.2 μsec is introduced by a balanced (push-pull) delay network. Signal delay permits observation of the leading edge of the waveform that triggers the sweep.

Direct Input to CRT—An opening in the side of the cabinet permits direct connection to the cathode-ray-tube deflection plates.

HORIZONTAL-DEFLECTION SYSTEM

The Type 545A has two time-base generators. TIME BASE A is identical to the time-base generator in the Tektronix Type 541A. TIME BASE B functions as a delay generator. The signal to be observed can be displayed on either time base in the following ways: TIME BASE B normal, TIME BASE B with trace brightening during the period that TIME BASE A is running, TIME BASE A delayed by TIME BASE B, TIME BASE A normal, and TIME BASE A single sweep.

TIME BASE A Calibrated Sweeps—Twenty-four direct-reading calibrated steps are provided: 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50 μsec/cm, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50 msec/cm, 0.1, 0.2, 0.5, 1, 2, 5 sec/cm. In addition, a vernier (uncalibrated) control provides for continuous adjustment from 0.1 μsec/cm to 12 sec/cm. An indicator light warns the operator when the sweep is uncalibrated. Calibration of the fixed sweeps is within 3%.

Single Sweep—(TIME BASE A only) A RESET push-button arms the sweep to fire on the next trigger to arrive. After firing once, the sweep is locked out and cannot fire again until rearmed by pressing the RESET button. The READY light indicates when the sweep is armed to fire on the next trigger.

TIME BASE B Calibrated Sweeps—Eighteen direct-reading calibrated steps are provided: 2, 5, 10, 20, 50 μsec/cm, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50 msec/cm, 0.1, 0.2, 0.5, and 1 sec/cm. A sweep-length control adjusts the sweep length from 4 cm to 10 cm for the purpose of changing the sweep repetition rate. Variable

sweep repetition rate makes TIME BASE B useful as a repetition-rate generator over the range of 0.1 cycles to 40 kc.

Sweep Magnifier—5-x magnifier increases the calibrated sweep time to 0.02 μsec/cm. Sweep magnification is obtained by increasing the gain of the sweep output amplifier by a factor of five. The center 2 cm of the normal trace is expanded to fill the screen. Any one-fifth of the magnified sweep can be displayed on the screen by rotating the HORIZONTAL POSITION control. Accurate 5-x magnification is obtained on all ranges, for both time bases.

DC-Coupled Unblanking—DC coupling is provided for the unblanking waveforms, assuring uniform bias on the cathode-ray tube for all sweep times and repetition rates.

Triggering Facilities—Versatile triggering circuitry provides for complete manual control, preset stability control, and fully-automatic triggering. Triggering facilities are identical for both time bases, except that TIME BASE A has two additional modes: H.F. SYNC and AC LF REJECT (low frequency reject).

Amplitude-Level Selection—Adjustable amplitude-level and stability controls provide for triggering the sweep at a selected amplitude level on the triggering waveform. Triggering source can be internal, external, or the line frequency, either ac-coupled or dc-coupled. The triggering point can be on either the rising or falling slope of the triggering waveform.

Preset Stability—Same as above except the stability control is preset to the optimum triggering point and requires no readjustment.

Automatic Triggering—Automatic level-seeking trigger circuit provides dependable triggering for most applications. One simple setting assures positive sweep-triggering by signals of widely differing amplitudes, shapes, and repetition rates. No trigger control need be touched until a different type of operation is desired. Range of automatic operation is between 60 cycles and 2 megacycles, approximately. In the absence of an input signal the sweep is automatically triggered at about a 50-cycle rate, providing a reference trace on the screen.

Low-Frequency Reject—(TIME BASE A only) Prevents low-frequency components, such as hum, from interfering with stable triggering.

High-Frequency Sync—(TIME BASE A only) Assures a steady display of sine-wave signals up to approximately 30 megacycles. Requires a signal large enough to cause about 2 cm deflection, or an external signal of about 2 v.

Trigger Requirements—Internal Triggering—a signal large enough to cause 2-mm deflection. External Triggering—a signal of 0.2 v to 10 v.

Horizontal Input Amplifier—DC-coupled external connection to the sweep-output amplifier is through a front-panel connector. Combination of a step attenuator and variable attenuator makes the horizontal deflection factor continuously variable from 0.2 v/cm to approximately 15 v/cm. Passband is dc to 240 kc. Input impedance is approximately 47 pf paralleled by 1 megohm.

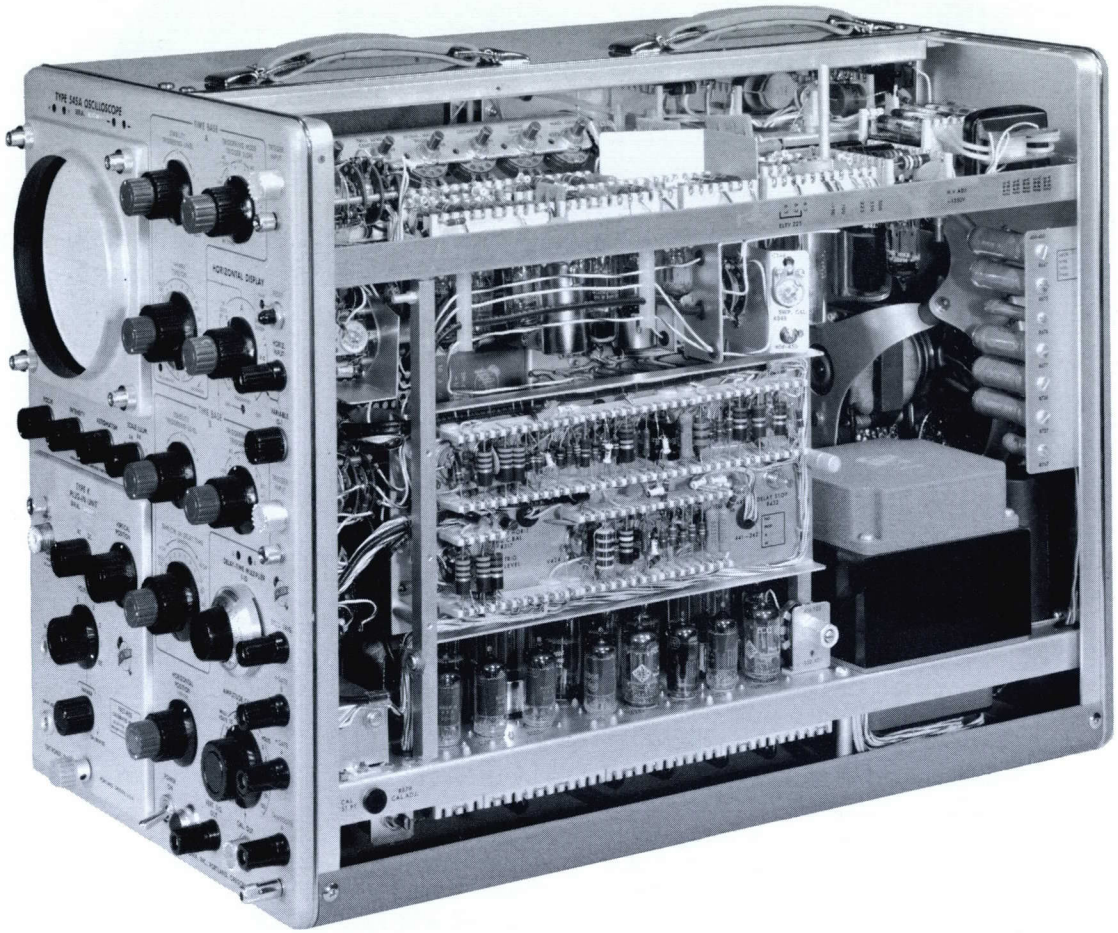
SWEEP DELAY

Sweep delay for TIME BASE A over the range of 1 μsec to 10 sec is derived from TIME BASE B by means of a pick-off circuit. A delayed trigger is generated at the pick-off point, which can be adjusted to any point on the sawtooth waveform generated by TIME BASE B. The DELAY-TIME MULTIPLIER, a ten-turn calibrated control, is used in conjunction with the TIME/CM switch for TIME BASE B to select the pick-off point and indicate the amount of delay. Accuracy of the fifteen calibrated time/cm steps from 2 μsec/cm to 0.1 sec/cm is within 1%. Accuracy of the remaining three steps, 0.2, 0.5, and 1 sec/cm, is within 3%. For extreme accuracy any or all steps can be adjusted to an external standard. Incremental accuracy of the ten-turn calibrated control is within 0.2%.

Triggered Operation—When the triggering controls of TIME BASE A are adjusted so that the delayed trigger from TIME BASE B arms the sweep but does not start it, the next signal to arrive will start the sweep. Thus the delayed sweep is actually started by the signal under observation, resulting in a steady display even when time jitter or time modulation is present in the signal.

Conventional Operation—When the triggering controls of TIME BASE A are adjusted to permit the delayed trigger to start the sweep, the delayed sweep starts precisely at the pick-off point, its start delayed the amount of time indicated by the TIME BASE B time/cm switch and the DELAY-TIME MULTIPLIER. Any time modulation or time jitter on the signal will be magnified in proportion to the amount of sweep expansion, however jitter introduced by the delay and pick-off circuitry is less than one part in 20,000, making extremely large magnifications practical.

Trace Brightening—When the signal is displayed on TIME BASE B with the HORIZONTAL DISPLAY switch



in the "B" INTENSIFIED BY "A" position, the unblanking pulse of TIME BASE A is added to that of TIME BASE B. Therefore the period of operation of TIME BASE A appears as a brightened portion on the display. This trace brightening serves to indicate both the point-in-time relationship between the delayed sweep and the original display, and the degree of magnification that will be achieved when the display is transferred to TIME BASE A.

OTHER CHARACTERISTICS

Accelerating Potential—10-kv accelerating potential assures bright display when using fast sweeps at low repetition rates, and in single-sweep applications. The T543P__, a Tektronix cathode-ray tube, is used in the Type 545A. The T543P__ is a 5" flat-faced metallized precision tube with a helical post-accelerating anode. It provides a full 4-cm x 10-cm viewing area. For best results over the wide sweep range of the Type 545A, a P2 phosphor is normally furnished with the instrument.

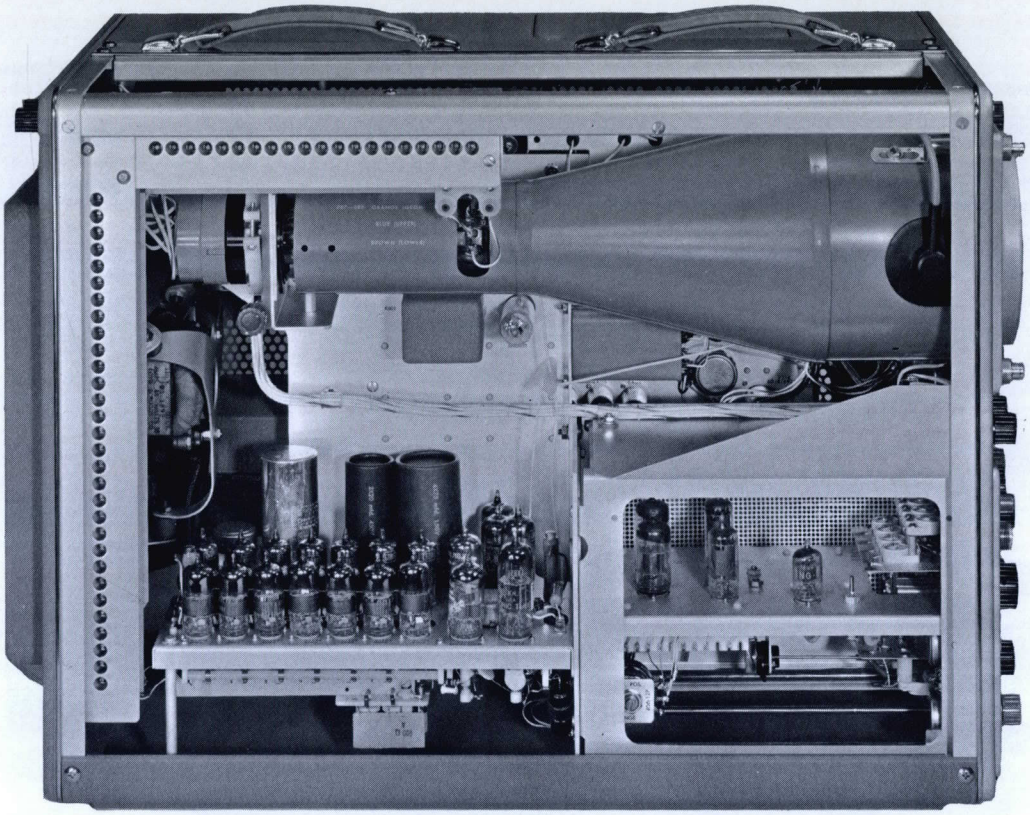
Regulated Power Supply—Electronic regulation compensates for line-voltage variations between 105 and 125 v or 210 and 250, and for current-demand differences among the plug-in preamplifiers.

Amplitude Calibrator—A square-wave calibration voltage is available through a front-panel coaxial connector. Eighteen direct reading fixed steps —0.2, 0.5, 1, 2, 5, 10, 20, 50 millivolts, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50, 100 volts peak-to-peak are provided by the single knob control. Accuracy is within 3%. Square-wave frequency is approximately 1 kc.

Dual-Trace Blanking—A blanking voltage is available to eliminate switching transients from the display when a dual-trace plug-in unit is operated in its chopped mode. The blanking voltage can be applied to the crt cathode by means of a switch located on the back panel of the instrument. (Type 53/54C Units under serial number 14078 will require a minor modification).

Output Waveforms—A 20-v positive gate of the same duration as the sweep and a 150-v sweep-sawtooth waveform are available from TIME BASE A at front-panel binding posts via cathode followers. A 20-v positive gate and the delayed trigger from TIME BASE B are also available at front-panel connectors. The vertical signal is brought out to a front-panel terminal for external applications.

TYPE 545A



Access to Interior—Three-piece cabinet design provides easy access to the interior of the instrument. Cabinet sides are held in place by two quick-opening fasteners, and can be removed in a matter of seconds.

Alignment of Cathode-Ray Tube—Should adjustment of the cathode-ray tube alignment become necessary, an easily accessible knob, located on the rear support bracket of the crt, provides smooth positive control of the crt alignment.

Beam Position Indicators—Two pair of indicator lights show direction of the electron beam when the spot is not on the screen.

Illuminated Graticule—An edge-lighted graticule is marked in centimeter squares with two-millimeter baseline divisions for convenience in making time and amplitude measurements. Illumination is controlled by a front-panel knob.

ELECTRON TUBES and SEMICONDUCTORS

* denotes "or equivalent"

Vertical Amplifier

Vertical-input amplifiers	2	12BY7A
Driver amplifiers	2	6DJ8
Trigger-pick-off amplifiers	2	6DK6
Trigger CF and vert. sig. out CF		6DJ8
Indicator amplifiers		12AU7
Output amplifiers	12	6DK6

Time-Base A Generator

Trigger amplifier	6DJ8
Trigger shaper	6DJ8
Sweep-gating multivibrator and CF	6DJ8
Sweep-gating multivibrator	12BY7
Unblank and hold-off CF	6DJ8
Sawtooth and gate CF	6DJ8
Lockout multivibrator	6AU6
Hold-off CF and lockout multivibrator	6DJ8
Delayed-trigger amplifier	6AU6
Clamp	T12G*
Disconnect diodes	6AL5
Miller runup	6CL6
Runup CF	6DJ8

Time-Base B Generator

Trigger amplifier	6DJ8
Trigger shaper	6DJ8
Stability CF and hold-off CF	6DJ8
Sweep-gating multivibrator and CF	6DJ8
Sweep-gating multivibrator	6AU6
Unblanking CF and gate CF	6DJ8
Disconnect diodes	12AL5
Miller runup	12AU6
Runup CF and hold-off CF	6DJ8

Horizontal Amplifiers and Delay

Input and driver CF		6DJ8
Sweep amplifiers and CF	2	6DJ8
Current booster		6CL6
External-input amplifier		6DJ8
Delay trigger		6DJ8
Delay pick-off	2	6AU6

Delay-trigger CF and current control		6DJ8
Power Supplies		
Comparators	2	12AX7
Voltage reference		5651
Regulator amplifiers	5	6AU6
Series regulators	4	12B4
Series regulators	2	6080
Rectifiers	16	1N1566*
Error-signal amplifiers		12AU7
High-voltage oscillator		6AU5
High-voltage rectifiers	5	5642
Miscellaneous		
Calibrator multivibrator		6AU6
Calibrator multivibrator and CF		12AU7
Alternate-trace sync amplifier and trace blank		6DJ8
Cathode-ray tube		T543P2

MECHANICAL SPECIFICATIONS

Ventilation—Safe operating temperature is maintained by filtered, forced-air ventilation. A minimum of 2" of unobstructed clearance around the instrument is recommended for adequate ventilation.

Construction—Aluminum-alloy chassis and three-piece cabinet.

Finish—Photo-etched anodized panel, blue wrinkle-finished cabinet.

Dimensions—24" long, 13" wide, 16 ¾" high.

Weight: Net—67 pounds
Shipping—82 pounds approx.

Power Requirements—105-125 v or 210-250 v, 50-60 cycles, 600 watts maximum.

Type 545A, without plug-in units **$1550**

Includes: 2—10-x attenuator probes
2—Binding-post adapters (013-004)
1—Test lead (012-031)
1—Green filter (378-514)
1—3-Conductor power cord (161-010)
1—Instruction manual

Optional Phosphors

P2 crt phosphor normally furnished,
P1, P7, P11 optional . . . . . No extra charge
Several other phosphors can be furnished on special order.

Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).

RM45A RACK-MOUNTING MODEL

GENERAL DESCRIPTION

The Type RM45A is a mechanically rearranged Type 545A Oscilloscope for mounting in a standard 19" rack. The instrument mounts to the rack on slide-out tracks. It can be pulled forward, tilted, and locked in any of seven positions for servicing convenience. Electrical characteristics of the instrument are the same as described for the Type 545A Oscilloscope.

MECHANICAL SPECIFICATIONS

Ventilation—Filtered, forced-air ventilation maintains safe operating temperature.

Construction—Aluminum-alloy chassis, and cabinet. Slide-out mounting.

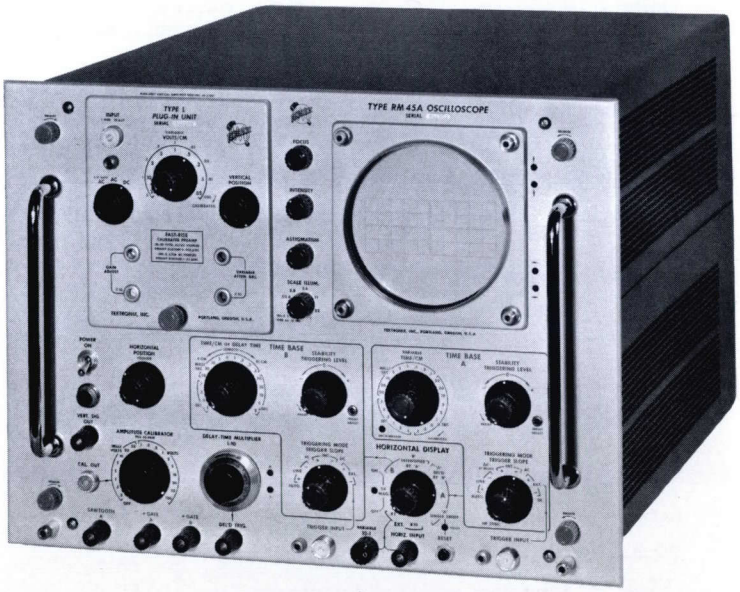
Finish—Photo-etched anodized panel, blue wrinkle-finished cabinet.

Dimensions—14" high, 19" wide, 22½" rack depth. Please see page B-8 for complete mounting dimensions.

Weight: Net—85 pounds
Shipping—104 pounds approx.

Type RM45A, without plug-in units **$1650**

Includes: 2—10-x attenuator probes
2—Binding-post adapters (013-004)



1—Test lead (012-031)
1—Green filter (378-514)
1—3-Conductor power cord (161-010)
1—Set, mounting hardware
1—Instruction manual

Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).

TYPE 551 DC—25 MC

MAIN FEATURES

Wide-Band Vertical Amplifiers
Main-unit risetimes—12 nsec.
Passbands and risetimes with Type K units—dc to 25 mc, 14 nsec.

Signal-Handling Versatility
All Tektronix Type A to Z Plug-In Preamplifiers can be used in both channels.

0.2-μsec Delay Networks

Wide Sweep Range
0.02 μsec/cm to 12 sec/cm.

Single Sweeps
Lockout-reset circuitry.

Complete Triggering
Fully-automatic or amplitude-level selection with preset or manual stability control.

10-kv Accelerating Potential
Brighter display for fast sweeps and low repetition rates.

GENERAL DESCRIPTION

The Type 551 uses a new Tektronix two-gun cathode-ray tube with two pairs of vertical-deflection plates. A single pair of horizontal-deflection plates is common to both electron beams. The two wide-band main amplifiers of the Type 551 are designed for Tektronix Type A to Z Plug-In Preamplifiers, providing a high degree of signal-handling versatility in both channels. Both electron beams are simultaneously deflected horizontally at any one of many sweep rates provided by an accurately-calibrated time-base generator.

The Type 551 can be used as a single-beam oscilloscope as well as a dual-beam instrument. In addition, a three-channel or four-channel display is available through use of the time-sharing characteristics of Type C-A Dual-Trace Plug-In Units in one or both amplifiers. Other available Type A to Z Plug-In-Preamplifier Units extend the working range of the Type 551 into applications requiring high dc-coupled sensitivity, differential input, and narrow-band microvolt sensitivity.

VERTICAL-DEFLECTION SYSTEMS

Frequency specifications are at 3 db down

Two DC-Coupled Main Amplifiers — Risetime of both main amplifiers is 14 nsec with Type K, L, or R units plugged in. They are factory adjusted for optimium transient response. A Type A to Z Plug-In Preamplifier must be plugged into both channels for instrument operation.

Type K Plug-In Preamplifiers provide nine calibrated deflection factors from 0.05 v/cm to 20 v/cm at dc-to-25 mc passbands, 14-nsec risetimes. A wide variety of vertical-deflection characteristics is available through the use of another of the Type A to Z Plug-In Preamplifiers in one or both vertical channels.

Plug-In Preamplifiers

For maximum frequency response—
Type K—DC to 25 mc, 14-nsec risetime; 0.05 to 40 v/cm.

or **Type L**—DC to 25 mc, 14-nsec risetime; 0.05 to 40 v/cm . . . 3 cycles to 22 mc, 17-nsec risetime; 5 mv/cm to 4 v/cm.

For dual-trace operation on either or both beams—
Type C-A—DC to 22 mc, 16-nsec risetime; 0.05 to 50 v/cm.

For high DC sensitivity—
Type H—DC to 14 mc, 25-nsec risetime; 0.05 to 50 v/cm.

For differential-input applications—
Wideband: **Type G**—DC to 18 mc, 20-nsec risetime; 0.05 to 50 v/cm.

High DC sensitivity: **Type D**—DC to 350 kc at 1 mv/cm, increasing to 2 mc at 50 mv/cm.

Low-level: **Type E**—0.06 cycles to 20 kc at 50 μv/cm, increasing to 60 kc at 0.5 mv/cm.

For transistor risetime checking—
Type R—14-nsec risetime

For semiconductor diode recovery-testing applications—
Type S—Test pulse risetime, 3 nsec.

For repetitive high-speed pulse applications—
Type N—0.6-nsec risetime (corresponding to approximately 600 mc).

For transducer and strain gage applications—
Type Q—Sensitivity; 10 microstrain/div., dc to 6 kc.

For high waveform resolution and precise amplitude measurement applications via the slide-back technique —**Type Z.**

Type A and B plug-in units can be used with the Type 551 Oscilloscope. However Type K or L units will be preferred by most users because of their superior transient-response characteristics.

DUAL-BEAM OSCILLOSCOPE

Type A—DC to 18 mc, 20-nsec risetime; 0.05 to 50 v/cm.

Type B—DC to 18 mc, 20-nsec risetime; 0.05 to 50 v/cm . . . 2 cycles to 12 mc, 30-nsec risetime; 5 mv/cm to 0.05 v/cm.

Probes—Four 10-x attenuation low-capacitance probes are supplied with the instrument. Input capacitance of the Type 551-K combination with probes is 11.5 pf. Excellent transient response is retained, as the probes introduce no overshoot or ringing, but frequency response is down an additional 1 db at 30 mc.

Balanced Delay Network — A signal delay of 0.2 μsec is introduced into each channel by the balanced (push-pull) delay networks. Permits observation of the leading edge of the waveform that triggers the sweep.

Direct Input to CRT—An opening in the side of the cabinet permits direct connection to the deflection plates.

HORIZONTAL-DEFLECTION SYSTEM

Both electron beams of the Type 551 are simultaneously deflected by the same sweep sawtooth voltage. Sweep generator used in the Type 551 is the Miller runup type. Inverse feedback in the timing circuitry assures excellent linearity. Characteristics of this circuitry provide an extremely wide sweep range of 0.02 μsec/cm to 12 sec/cm.

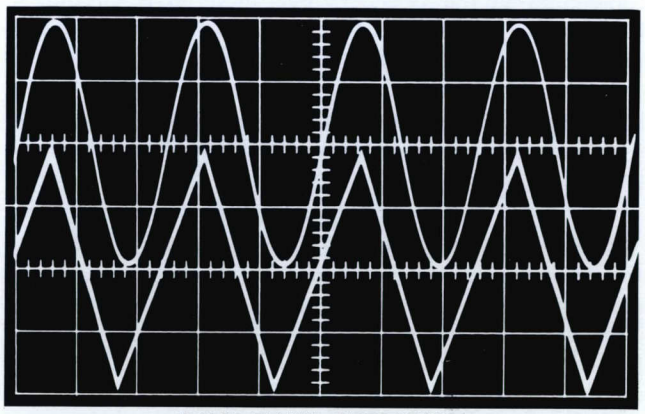
Calibrated Sweeps—The Type 551 has single-knob selection of 24 calibrated sweeps: 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50 μsec/cm, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50 msec/cm, 0.1, 0.2, 0.5, 1, 2, and 5 sec/cm. In addition, a vernier (uncalibrated) control provides for continuous adjustment of the sweep rate from 0.1 μsec/cm to 12 sec/cm. Calibration accuracy of the fixed sweeps is within 3%.

Sweep Magnifier—5-x magnifier increases the calibrated sweep time to 0.02 μsec/cm. Sweep magnification is obtained by increasing the gain of the sweep output amplifier by a factor of five. The center 2 cm of the normal display is expanded to the left and right of center to fill the screen. Any one-fifth of the magnified sweep can be displayed on the screen by rotating the HORIZONTAL POSITION control. Accuracy is within 5% of the displayed portion of the magnified sweep.

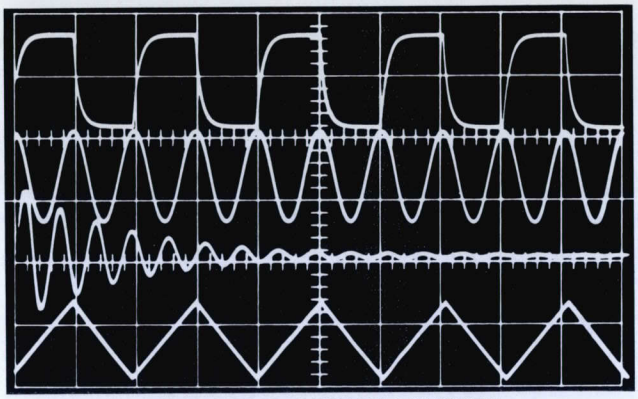
Single Sweep — The Type 551 has a single-sweep mode of operation. A front-panel RESET pushbutton arms the sweep to fire on the next received trigger. After firing once, the sweep is locked out until rearmed by pressing the RESET pushbutton. The READY light indicates when the sweep is armed to fire on the next received trigger.

DC-Coupled Unblanking — The unblanking waveform is coupled to the grid of the cathode-ray tube, assuring uniform bias for all sweep and repetition rates.

Amplitude-Level Selection — Adjustable amplitude-level and stability controls are provided for triggering the sweep at a selected amplitude level on the triggering waveform. Trigger source can be internal, external, or the line frequency, either ac-coupled or dc-



DUAL-BEAM OPERATION



DUAL-BEAM OPERATION WITH DUAL-TRACE PLUG-IN UNITS

coupled. The triggering point can be on either the rising or falling slope of the triggering waveform.

Triggering Facilities — Versatile triggering circuitry provides for complete manual control, preset stability control, and fully-automatic triggering. The sweep can be triggered internally from either channel.

Preset Stability — Same as above, except the stability control is preset to the optimum triggering point and requires no readjustment.

Automatic Triggering — Automatic level-seeking trigger circuit provides dependable triggering for most applications. One simple setting assures positive sweep-triggering by signals of widely differing amplitudes, shapes, and repetition rates. No trigger controls need be touched until a different type of operation is desired. Range of automatic operation is between 60 cycles and 2 megacycles, approximately. In the absence of an input signal the sweep is automatically triggered at about a 50-cycle rate, providing a reference trace on the screen.

High Frequency Sync — Assures a steady display of sine-wave signals up to approximately 30 megacycles. Requires a signal large enough to cause about 2 cm of deflection, or an external signal of about 2 v.

Trigger Requirements — Internal triggering — a signal large enough to cause a 2-mm deflection. External triggering—a signal of 0.2 v to 10 v.

Horizontal Input Amplifier — DC-coupled external connection to the sweep-output amplifier is through a front-panel connector. An attenuator makes the horizontal deflection factor continuously variable from 0.2 v/cm to approximately 50 v/cm. Passband is dc to approximately 400 kc at maximum sensitivity. Input impedance is approximately 40 pf paralleled by 100 kilohms.

OTHER CHARACTERISTICS

Cathode-Ray Tube — 10-kv accelerating potential assures bright displays when using fast sweeps at low repetition rates, and in single-sweep applications. The Type 551 uses the Tektronix Type T551P__ cathode-ray tube. The T551P__ is a 5" flat-faced metallized precision dual-beam tube with helical post-accelerating anode. It provides a linear 4-cm x 10-cm viewing area, each beam, with at least 2-cm overlap. For best results over the wide sweep range of the Type 551, a P2 screen is normally furnished with the instrument.

Access to Interior—Three-piece cabinet design provides easy access to the interior of the instrument. Cabinet sides are held in place by two quick-opening fasteners, and can be removed in a matter of seconds.

Alignment of Cathode-Ray Tube—Should adjustment of the cathode-ray tube alignment become necessary, an easily accessible knob, located on the rear support bracket of the crt, provides smooth positive control of the crt alignment.

Separate Power Supply — A separate unit supplies power to the Type 551 indicator unit through an interunit cable. Electronic regulation compensates for line-voltage variations between 105 and 125 v or 210 and 250 v, and for current-demand differences among the plug-in preamplifiers.

Amplitude Calibrator — A square-wave calibration voltage is available through a front-panel coaxial connector. Eighteen fixed voltages — 0.2, 0.5, 1, 2, 5, 10, 20, 50, 100 millivolts, 0.2, 0.5, 1, 2, 5, 10, 20, 50, and 100 volts peak-to-peak are provided. Accuracy is within 3%. Square-wave frequency is about 1 kc.

Output Waveforms — A 20-v positive gate voltage of the same duration as the sweep, and a 150-v sweep sawtooth waveform are available at front-panel binding posts via cathode followers.

Beam Position Indicators—Indicator lights show the direction of each electron beam when it is not on the screen.

Illuminated Graticule — An edge-lighted graticule is marked in centimeter squares with two-millimeter baseline divisions for convenience in making measurements in time and amplitude. Illumination of the graticule is controlled by a front-panel knob.

ELECTRON TUBES AND SEMICONDUCTORS

* denotes "or equivalent"

Vertical		
Vertical input amplifiers	4	12BY7A
Driver amplifiers	4	6DJ8
Trigger-pick-off amplifiers	4	6DK6
Trigger CF's and indicator amplifiers	2	6DJ8
Indicator amplifiers		6DJ8
Output amplifiers	24	6DK6
Horizontal		
Trigger input amplifier		6DJ8
Trigger shaper		6DJ8
Sweep-gating multivibrator		12BY7A
Sweep-gating multivibrator & CF		6DJ8
Clipping diode		T12G*
Disconnect diodes		6AL5
Miller-runup sweep generator		6CL6
Sweep generator C.F.		6DJ8
Holdoff driver and unblanking CF		6DJ8
Holdoff CF and lockout multivibrator		6DJ8
Lockout multivibrator		6AU6
Gate-out and sawtooth-out CF		6DJ8

External horizontal-input CF and amplifier		6DJ8
Horizontal-input CF and driver CF		6DJ8
Horizontal amplifiers and CF's	2	6DJ8
Current booster		6CL6
Power Supply		
Rectifiers	16	1N2070*
Series regulators	5	6080
Series regulators	2	12B4
Regulator amplifiers	5	6AU6
Comparators	2	12AX7
Voltage reference		5651
High-voltage oscillator		6AU5
High-voltage recitifiers	5	5642
Regulator amplifier		12AU7
Miscellaneous		
Calibrator multivibrator		6AU6
Calibrator multivibrator and CF		12AU7
Alternate-trace sync amplifier and dual-trace amplifier		6AU6
Isolation diodes		T12G*
Cathode-ray tube		T551P2

MECHANICAL SPECIFICATIONS

Ventilation — Filtered forced-air ventilation maintains safe operating temperatures. A minimum 2" of unobstructed clearance around the instruments is recommended for adequate ventilation.

Construction — Aluminum-alloy chassis and three-piece cabinets.

Finish—Photo-etched anodized panels, blue wrinkle-finished cabinets.

Dimensions — Indicator Unit; 24" long, 13" wide, 16¾" high. Power Unit, 17½" long, 13" wide, 10" high.

Weight—Indicator Unit: Net—52 pounds
Shipping—73 pounds appr.
Power Unit: Net—46 pounds
Shipping—53 pounds appr.

Power Requirements—105-125 v or 210-250 v, 50-60 cycles, 900 watts maximum.

Type 551, without plug-in units **$1800**

Includes: 4—10-x atten. probes
1—Power-supply unit
2—Binding-post adapters (013-004)
1—Inter-unit cable (012-032)
1—Test lead (012-031)
1—Green filter (378-514)
1—3-conductor power cord (161-010)
1—Instruction manual

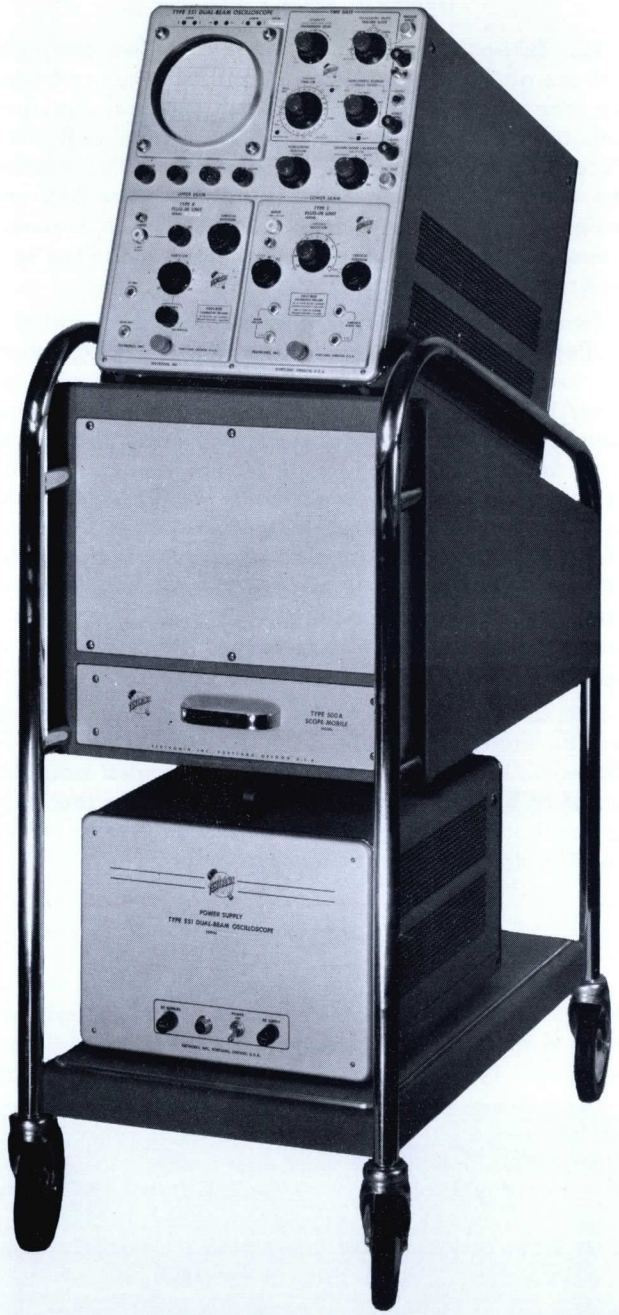
Optional Phosphors

P2 crt phosphor normally furnished.
P1, P7, P11 optional .....No extra charge
Some other phosphors can be furnished on special order.

Rack Mount Adapter

A cradle mount to adapt the Type 551 Oscilloscope and its power supply for rack mounting is available. It consists of two cradles and two masks. The cradles, one each for the indicator and power supply units, support the instruments in any standard 19" relay rack. The two masks fit around the regular instrument panels of the two units. Rack height requirements; Indicator mask 17½", Power Supply mask 12½". Tektronix blue-wrinkle finish.

ORDER PART NO. 040-183 ..... $85.00



Type 500A Scope-Mobile **$100**
(as shown with Type 551)

Type 500/53A Scope-Mobile **$110**
(with plug-in storage cradles)

Complete descriptions of the above Scope-Mobiles will be found in the Accessory section.

Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).

TYPE 555 DC—30 MC

MAIN FEATURES

Independent Electron Beams

Separate vertical and horizontal deflection of both beams.

Fast-Rise Main Vertical Amplifiers

Passbands—dc to 30 mc with Type K Units.
Risetimes—12 nsec with Type K Units.
Heater supplies regulated for stable operation.
All Tektronix Type A to Z Plug-In Preamplifiers can be used in both vertical channels for signal-handling versatility.

Wide-Range Time-Base Generators

Either time-base generator can be used to deflect either or both beams.
Sweep ranges—0.1 μsec/cm to 12 sec/cm. 5-x magnifiers increase sweep times to 0.02 μsec/cm.

Sweep Delay—Two modes of operation

Triggered—Delayed sweep started by signal under observation.
Conventional—Delayed sweep started by delayed trigger.
Delay range—0.5 μsec to 50 sec in 24 calibrated steps, with continuous calibrated adjustment between steps.

High Writing Rate

10-KV accelerating potential porvides bright traces at low repetition rates and in one-shot application.

GENERAL DESCRIPTION

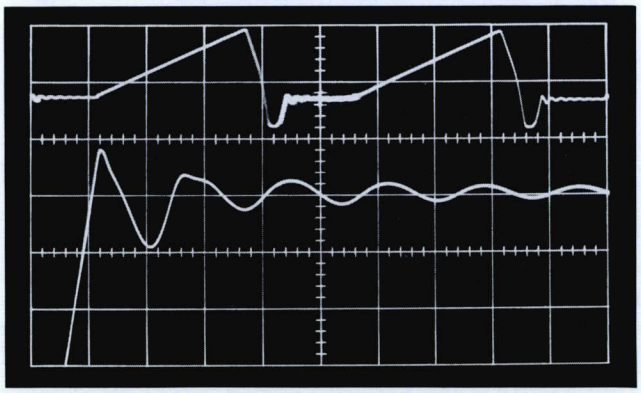
The Tektronix Type *555* is essentially two complete fast-rise oscilloscopes with a common dual-gun cathode-ray tube of a new Tektronix design. This new dual-gun cathode-ray tube has two pairs of vertical-deflection plates and two pairs of horizontal-deflection plates. The two fast-rise main amplifiers of the Type *555* are designed for Tektronix Type A to Z Plug-In Preamplifiers, providing a high degree of signal handling versatility in both channels.

Two Plug-In Time-Base Units provide horizontal deflection for both upper and lower beams. In operation the two beams can be deflected simultaneously at either the same sweep rate, or at two different sweep rates, using TIME BASE A for one beam and TIME BASE B for the other beam. Also, the two beams can be deflected simultaneously using either TIME BASE A for both beams or TIME BASE B for both beams. Furthermore, either beam can be used separately, deflected by either TIME BASE A or TIME BASE B. In addition, the start of the sweep sawtooth of TIME BASE B can be accurately delayed over a wide range, with TIME BASE A functioning as the delay generator.

The plug-in feature of the time-base units offers a real advantage in maintenance. By means of a plug-in extension a time-base unit can be operated partially out of its housing, thus facilitating any service that may be required by that unit. The Time-Base Plug-In Extension TEK #013-013 is furnished as an accessory.

APPLICATIONS

The Type *555* is an extremely versatile instrument, capable of all applications for both single-beam and dual-beam oscilloscopes in the dc-to-30 mc category. Type A to Z Plug-In Preamplifiers provide for many specialized applications, further increasing the instrument's versatility. Applications involving accurate sweep delay are adequately provided for, including means for a steady display of signals with inherent jitter. In addition, the Type *555* is valuable in all applications where it is desirable or necessary to display the same signal simultaneously on two different time bases, as in plasma pinch-effect studies, wind tunnel studies, computer storage research, and investigations in many other fields.



Same signal displayed simultaneously on slow sweep (upper beam) and fast sweep (lower beam) shows both coarse and fine structure of waveform.

VERTICAL-DEFLECTION SYSTEMS

Frequency specifications are at 3 db down

Two DC-Coupled Main Amplifiers—Risetime of both main amplifiers is 12 nsec with Type K, L or R units plugged in. They are factory adjusted for optimum transient response. Type A to Z Plug-In Preamplifiers must be plugged into both channels for instrument operation. Tektronix Type K Plug-In Preamplifiers provide nine calibrated deflection factors from 0.05 v/cm to 20 v/cm at dc-to-30 mc passbands. A wide variety of vertical-deflection characteristics is available through the use of other Type A to Z Plug-In Preamplifiers. A three-channel or four-channel display is available through use of the time sharing characteristics of the

DUAL-BEAM OSCILLOSCOPE with SWEEP DELAY

Type C-A Dual-Trace Plug-In Preamplifier in one or both channels.

Plug-In Preamplifiers

For maximum frequency response—

Type K—DC to 30 mc, 12-nsec risetime; 0.05 to 40 v/cm.

Or **Type L**—DC to 30 mc, 12-nsec risetime at 0.05 to 40 v/cm . . . 3 cycles to 24 mc, 15-nsec risetime at 5 mv/cm to 4 v/cm.

For dual-trace operation on either or both beams—

Type C-A—DC to 24 mc, 15-nsec risetime; 0.05 to 50 v/cm.

For high DC sensitivity—

Type H—DC to 15 mc, 23-nsec risetime; 5 mv/cm to 50 v/cm.

For differential-input applications—

Wide-Band: **Type G**—DC to 20 mc, 18-nsec risetime; 0.05 to 50 v/cm.

High DC sensitivity: **Type D**—DC to 350 kc at 1 mv/cm, increasing to 2 mc at 50 mv/cm.

For low-level applications—

Type E—0.06 cycles to 20 kc at 50 μv/cm, increasing to 60 kc at 0.5 mv/cm.

And for transistor risetime checking—

Type R—12-nsec risetime.

For semiconductor diode recovery-testing applications—

Type S—Test pulse risetime, 3 nsec.

For repetitive high-speed pulse applications—

Type N—0.6-nsec risetime (corresponding to approximately 600 mc).

For transducer and strain gage applications—

Type Q—Sensitivity; 10 microstrain/div., dc to 6 kc.

For high waveform resolution and precise amplitude measurement applications via the slide-back technique —**Type Z.**

Type A and B plug-in units can be used with the Type 555 Oscilloscope. However Type K or L units will be preferred by most users because of their superior transient-response characteristics.

Type A—DC to 20 mc, 18-nsec risetime; 0.05 to 50 v/cm.

Type B—DC to 20 mc, 18-nsec risetime; 0.05 to 50 v/cm . . . 2 cycles to 12 mc, 30-nsec risetime; 5 mv/cm to 0.05 v/cm.

Probes—Four low-capacitance probes (10-x attenuation) are supplied with the instrument. Input capacitance of the Type 555-K combination with probes is 11.5 pf. Excellent transient response is retained, as the probes introduce no overshoot or ringing, but frequency response is down an additional 1 db at 30 mc.

Balanced Delay Network—A signal delay of 0.2 μsec is introduced into each channel by the balanced (push-pull) delay networks. Signal delay permits observation of the leading edge of the waveform that triggers the sweep.

HORIZONTAL-DEFLECTION SYSTEMS

The horizontal deflection systems of the Type 555 are provided with plug-in time-base units. Miller runup type sweep generators are used in the time-base units, with inverse feedback in the timing circuits to assure

excellent linearity. Characteristics of these circuits provide the extremely wide sweep ranges of 0.1 μsec/cm to 12 sec/cm. Two plug-in time-base units are furnished with the instrument: one Type 21, and one Type 22. When used in the "B" position, sweeps generated by the Type 22 can be delayed a selected amount by a pick-off circuit in the Type 555. The pick-off point can be adjusted to any point along the sawtooth generated by the time-base unit in the "A" position.

Either beam can be deflected by either time-base unit, and both beams can be deflected simultaneously by either time-base unit.

TYPE 21 TIME-BASE PLUG-IN UNIT—has single knob selection of 24 calibrated sweep rates: 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50 μsec/cm, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50 msec/cm, 0.1, 0.2, 0.5, 1, 2, and 5 sec/cm. In addition, a vernier (uncalibrated) control provides for continuous adjustment of the sweep rate from 0.1 μsec/cm to 12 sec/cm. An indicator light warns the operator when the sweep is uncalibrated. Calibration accuracy of the fixed sweep rates will typically be within 1% of full scale, and in all cases within 3%.

Single Sweep—A RESET pushbutton arms the sweep to fire on the next received trigger. After firing once the sweep is locked out until rearmed by pressing the RESET button. The READY light indicates when the sweep is armed to fire on the next received trigger.

Trigger Facilities—Selective triggering circuitry provides for amplitude-level selection, fully-automatic triggering, and free-running sweeps. Trigger source can be internal from either channel, external, or line frequency, either ac-coupled or dc-coupled.

Amplitude-Level Selection—Adjustable amplitude-level control provides for triggering the sweep at a selected amplitude level on either the rising or falling slope of the triggering waveform. This mode of operation also provides for triggering on high-frequency sine waves (up to 10 mc).

Automatic Triggering — Automatic level-seeking trigger circuit provides dependable triggering for most applications. One simple setting assures positive sweep-triggering by signals of widely differing amplitudes, shapes, and repetition rates. No trigger controls need to be touched until a different type of operation is desired. Range of automatic operation is between 50 cycles and 2 megacycles, approximately. In the absence of an input signal the sweep is automatically triggered at about a 45 cycle rate, providing a reference trace on the screen.

Trigger Requirements—For sine wave frequencies up to 2 mc, an internal signal large enough to cause a 2 mm deflection or an external signal of 0.2 v to 10 v will trigger the oscilloscope. Larger amplitudes are required for frequencies above 2 mc, increasing to approximately 2 cm of signal at 10 mc internally. Proportionally larger signals are also required externally.

Sweep Magnifier—5-x magnifier increases the calibrated sweep time to 0.02 μsec/cm. Sweep magnification is obtained by increasing the gain of the sweep output amplifier by a factor of five. The center 2 cm of the normal display is extended to the left and right of center to fill the screen. Any one-fifth of the magnified sweep can be displayed on the screen by rotating the HORIZONTAL POSITION control. Accuracy is within 5% of the displayed portion of the magnified sweep.

TYPE 22 TIME BASE UNIT—Identical to Type 21, with the additional facilities for sweep delay.

Horizontal-Input Amplifiers—DC-coupled external connection to the sweep-output amplifiers is through rear-panel connectors. Combination of step attenuators and variable attenuators makes the horizontal deflection factor continuously variable from 0.2 v/cm to approximately 20 v/cm. Passbands are dc to 240 kc. Input impedances are approximately 47 pf paralleled by 1 megohm.

SWEEP DELAY

TIME BASE A can be used to delay the start of any TIME BASE B sweep. A pick-off circuit in the Type 555 permits starting the TIME BASE B sweep at any point along the sawtooth generated by TIME BASE A. With either a Type 21 or Type 22 Time-Base Unit in the "A" position, a calibrated delay range of 0.5 μsec to 50 sec is available.

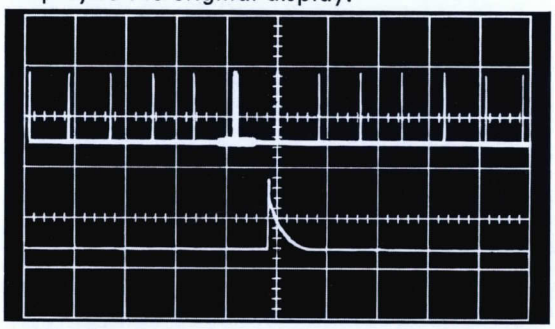
Triggered Operation—In this mode of operation the start of the delayed sweep is held off until the arrival of the first signal after a selected delay time has elapsed. Because the delayed sweep is actually triggered by the signal under observation, the display is completely jitter-free. A rock-steady display is thus provided for time-modulated pulses and signals with inherent jitter.

Conventional Operation—In this mode of operation the start of the delayed sweep is held off until the precise instant the selected amount of delay has elapsed. Any time-modulation or inherent jitter on the signal will be magnified in proportion to the amount of sweep expansion, however, jitter introduced by the delay and pick-off circuitry is less than one part in 20,000, making extremely large magnifications practical with jitter-free signals.

Sweep magnification, up to a practical limit of about 10,000-times, is readily accomplished by introducing

the signal into both vertical channels simultaneously, so that it will deflect both beams. The signal is first displayed on either beam, making certain that TIME BASE A is used to deflect that beam at the desired sweep rate. TIME BASE B is then used to deflect the other beam, and is switched to the proper SWEEP FUNCTION position for conventional sweep delay. Operating TIME BASE B at a faster rate than TIME BASE A provides the magnification, with both the original display and the magnified display appearing on the screen. For example, if TIME BASE A is operating at 50 μsec/cm and TIME BASE B at 1 μsec/cm, the magnification is 50 times.

Trace Brightening—The unblanking pulse of TIME BASE B is added to that of TIME BASE A, so that a portion of the display on the beam deflected by TIME BASE A is brightened. This trace brightening indicates the exact portion appearing on the magnified display, and shows the point-in-time relationship of the magnified display to the original display.



Simultaneous display of pulse chain (upper beam) and sixth pulse on expanded delayed sweep (lower beam). Portion of original display that appears on faster delayed sweep is identified by trace brightening.

Delay Range—The calibrated range of sweep delay, 0.5 μsec to 50 sec, is derived from the time-base unit in TIME BASE A. The 24 calibrated steps are the same as described for the Type 21 Time-Base Unit. Calibration accuracy is within 3%. A ten-turn precision potentiometer permits accurate delay-time adjustment to any value within the calibrated range of 0.5 μsec to 50 sec. Incremental accuracy of this control is within 0.2% on all ranges from 1 μsec to 50 sec.

For extreme accuracy, any of the calibrated steps can be adjusted to the accuracy of an external standard.

OTHER CHARACTERISTICS

Cathode-Ray Tube—10-kv accelerating potential assures bright displays when using fast sweeps at low repetition rates, and single-sweep applications. The Type 555 uses the new Tektronix Type T555P__ cathode-ray tube. The T555P__ is a 5" flat-faced metallized precision dual-beam tube with separate vertical and horizontal deflection plates for each beam. It provides a linear 4-cm by 10-cm viewing area, each beam, with at least 2-cm overlap. For best results over the wide sweep ranges of the Type 555, a P2 phosphor is normally furnished with the instrument. P1, P7 and P11 are available as optional phosphors. Some other phosphors are available on special order.

Regulated DC and Heater Supplies—A separate unit supplies power to the Type 555 indicator unit through an interconnecting cable. To compensate for line-voltage variations, and for current-demand differences among the plug-in preamplifiers, all dc supplies are electronically regulated. All heaters in the indicator unit and heaters of the amplifiers in the power supply are also regulated for stable operation and longer tube life. Stable operation is insured over line-voltage variations between 105 and 125 v or 210 and 250 v.

Amplitude Calibrator—A square-wave calibration voltage is available through a front-panel coaxial connector. Eighteen fixed voltages—0.2, 0.5, 1, 2, 5, 10, 20, 50, 100, 200, 500 millivolts, 1, 2, 5, 10, 20, 50, 100 volts peak-to-peak are provided. Accuracy is within 3%. Square-wave frequency is about 1 kc.

Dual-Trace Blanking—A blanking voltage is available to eliminate switching transients from the display when a dual-trace plug-in unit is operated in its chopped mode. The blanking voltage can be applied to the crt cathode by means of a switch located on the back panel of the instrument. (Type 53/54C Units under serial number 14078 will require a minor modification).

Other Output Waveforms—A positive gate of approximately 20 v and a positive-going sawtooth of approximately 150 v are available through front-panel binding posts from both time base units. The delayed trigger, amplitude about 5 v, is also available through a front-panel coaxial connector.

Beam Position Indicators—Indicator lights show the direction of each electron beam when it is not on the screen.

Trace Rotation—A screw-driver adjustment is provided for magnetic rotation of the cathode-ray tube traces for purposes of their horizontal alignment with the graticule lines.

Illuminated Graticule—An edge-lighted graticule is marked in centimeter squares with two-millimeter baseline divisions for convenience in making measurements in time and amplitude. Illumination of the graticule is controlled by a front-panel knob.

ELECTRON TUBES AND SEMICONDUCTORS

* denotes "or equivalent"

Vertical Amplifiers

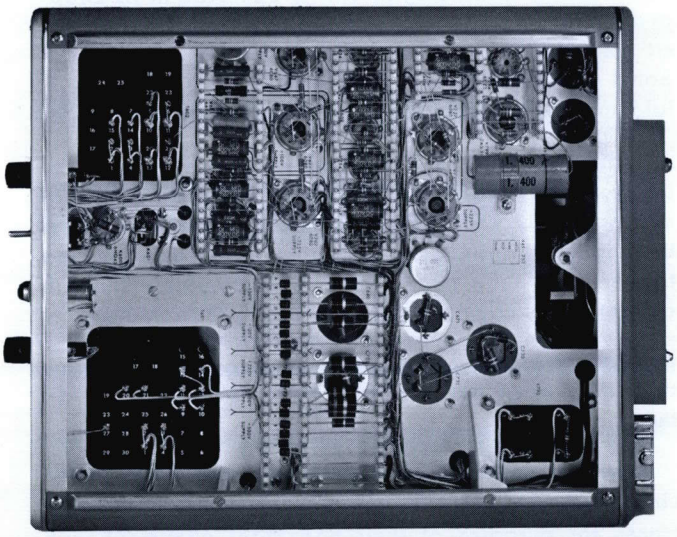
Input amplifiers	4	12BY7A
Grid-line drivers	4	6DJ8

TYPE 555

Distributed amplifiers	24	6DK6
Trigger-pick-off amplifiers	4	6DK6
Trigger-pick-off CF		6DJ8
Indicator amplifiers	2	6DJ8

Time-Base Generators

Trigger amplifiers	2	6DJ8
Trigger shapers	2	6DJ8
Sweep-gating multivibrator	2	6DJ8
Sweep-gating multivibrator	2	12BY7A
Miller runup	2	12AU6
Runup CF	2	6DJ8
Runup on-off diodes	2	12AL5
Unblank & gate CF	2	6DJ8
Sawtooth & holdoff CF	2	6DJ8
Holdoff CF & lockout multivibrator	2	6DJ8



Lockout multivibrator	2	6AU6
Delay-trigger amplifier		6AU6
Clamp	2	T12G*

Horizontal Amplifiers and Delay

Input and driver CF	2	6DJ8
Sweep amplifiers and CF	4	6DJ8
Current boosters	2	6CL6
Delay-trigger shaper		6DJ8
Delay pick-off	2	6AU6
Delay-trigger CF & current control		6DJ8
Unblanking mixer		6AU6
External-input amplifiers	2	6DJ8

Power Supplies

Comparators	2	12AX7
Voltage reference		5651
Regulator amplifiers	5	6AU6
Series regulators	5	6080
Series regulators	2	12B4
Heater regulator amplifiers		6CZ5
Heater voltage control		2AS15
Rectifiers	17	1N1566
Error signal amplifiers	2	12AU7
High-voltage Oscillators	2	6CZ5
High-voltage Recitifiers	6	5642

Miscellaneous

Calibrator multivibrator		6AU6
Calibrator multivibrator & CF		12AU7
Dual-trace sync. amp. & blanking	2	6DJ8
Cathode-ray tube		T555P2

MECHANICAL SPECIFICATIONS

Ventilation—Filtered forced-air ventilation maintains safe operating temperatures. A minimum 2" of unobstructed clearance around the instruments is recommended for adequate ventilation.

Construction—Aluminum-alloy chassis and three-piece cabinets.

Finish—Photo-etched anodized panels, blue wrinkle-finished cabinets.

Dimensions—Indicator Unit: 24" long, 13" wide, 20" high. Power Supply Unit: 17½" long, 13" wide, 10" high.

Weight—Indicator Unit: Net. 68 pounds
Shipping, 87 pounds appr.
Power Unit: Net, 54 pounds
Shipping, 64 pounds appr.

Power Requirements—105-125 v or 210-250 v, 50-60 cycles, 1050 watts maximum.

Type 555, without plug-in preamplifiers **$2600**

Includes: 1—Type 21 Time-Base Plug-In Unit.
1—Power Supply unit.
1—Type 22 Time-Base Plug-In Unit.
1—Time-base plug-in extension (013-013).
4—Probes (10-x atten.).
1—Inter-unit cable (012-032).
2—Binding-post adapters (013-004).
1—Test lead (012-031).
1—Green filter (378-514).
1—3-conductor power cord (161-010).
1—Instruction manual.

Optional Phosphors

P2 crt phosphor normally furnished.
P1, P7, P11 optional .....No extra charge

Type 500A Scope-Mobile **$100**
(as shown with Type 555)

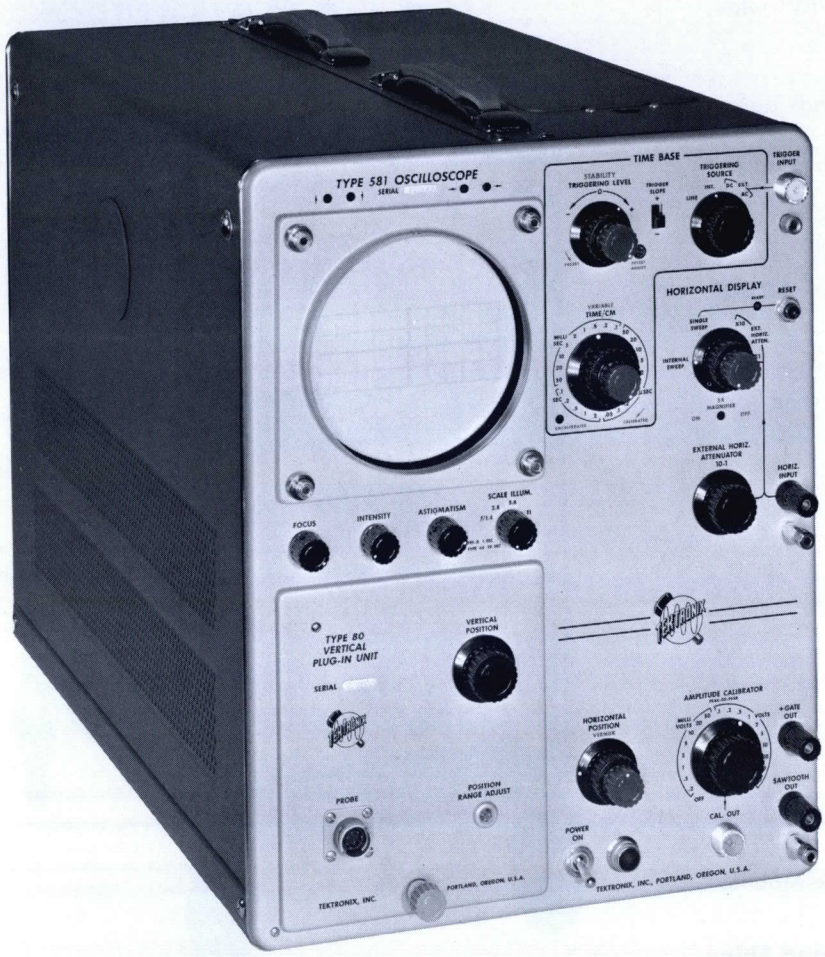
Type 500/53A Scope-Mobile **$110**
(with plug-in storage cradles)

Complete descriptions of the above Scope-Mobiles will be found in the Accessory section.

Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).

TYPE 581 AND 585

RISETIME—3.5 NANOSECONDS



TYPE 581

GENERAL DESCRIPTION

The Type 581 Oscilloscope is a dependable laboratory instrument with many of the capabilities needed for rapid advancement of the electronic art. Features included for high speed pulse applications are its 3.5-nsec risetime, its 0.1-volts/cm sensitivity, and its 10-nsec/cm sweep-time. Some of the features included for general-purpose laboratory work are slow sweeps, highly adaptable triggering, and dc-coupled vertical-deflection system. Versatility of the Type 581 is further enhanced by the plug-in preamplifier feature.

Note: The Type 585 Oscilloscope is similar to the Type 581 Oscilloscope except for addition of a second time-base generator. Otherwise, both instruments have the same characteristics. **In this presentation, the information marked by color pertains to the Type 585 Oscilloscope only.** All other information, unless designated specifically, concerns both the Type 581 and Type 585 Oscilloscopes.

CHARACTERISTICS

Fast-Rise Vertical Amplifier

Passband—dc to about 100 mc (at 3 db down).

Sensitivity—basic deflection factor is 0.1 volt/cm (with Type 80 Plug-In Unit and Type P80 Probe).

Versatility—designed for plug-in preamplifiers (with Type 81 Plug-In Adapter, present Tektronix "A" to "Z" Plug-In Units can be used without loss of passband or sensitivity).

High-Speed Sweeps

Range—50 nsec/cm to 2 sec/cm in 24 calibrated steps. A vernier control (uncalibrated) permits continuously variable adjustment between steps and to over 5 sec/cm. Calibrated accuracy is typical within 1%, and in all cases within 3%, of the indicated sweep rate.

Triggering—Adaptable circuitry provides for amplitude-level selection with preset or manual stability control and fully-automatic triggering: ac or dc-coupled, rising or falling slope, internal or external source or line frequency.

Magnification—5-X Magnifier extends calibrated range to ten nsec/cm.

Single Sweep Operation—Lockout-reset circuitry permits one-shot recording.

10-KV Accelerating Potential

OSCILLOSCOPES

CONVENIENCE PLUS PERFORMANCE

Flexible Sweep Delay

Range—Sweep delay is continuously variable from 1 microsecond to over 10 seconds. Actual delay steps are within 1% of the indicated delay, from 2 μsec/cm to 0.1 sec/cm, and within 3%, from 0.2 sec/cm to 1 sec/cm. Incremental delay accuracy is within 0.2%.

Jitter—1 part in 20,000.

Operation—In triggered operation, the signal under observation starts the delayed sweep. In conventional operation, a delayed trigger starts the delayed sweep.

APPLICATIONS

In addition to the usual applications of a dc to 100 mc general-purpose oscilloscope, the addition of sweep delay enables the user to:

1. Make accurate incremental measurements along a complex waveform.
2. Display separate channels of a PTM system, with effects of time jitter removed, determining pulse amplitude and shape under conditions of modulation.
3. Measure pulse-to-pulse intervals and amount of jitter on computer signals or any train of pulses.
4. Determine accurate time-difference measurements between pulse-in and pulse-out through an amplifying system.
5. Select any individual line of a television composite signal.
6. Show time displacement, wave shape, and amplitude of individual channels in a telemetering system.
7. Utilize effective calibrated sweep magnification up to the highest practical limit.

TYPE 585
GENERAL DESCRIPTION

The Type 585 Oscilloscope has all features of the Type 581 plus a second time-base generator. This generator, designated TIME BASE B, functions as a sweep-delay generator and permits all of the specialized applications listed at the left. These are in addition to the general-purpose laboratory work and high-speed pulse measurement applications that are possible with the Type 581. The extremely versatile Type 585 will give lasting satisfaction in the many, many applications within its wide-range of capabilities.

VERTICAL-DEFLECTION SYSTEM

DC-Coupled Output Amplifier—The main vertical amplifier consists of a two-stage distributed amplifier, a balanced, fixed delay line, and a twin-pentode output stage. Passband is dc to approximately 100 mc (at 3 db down) with a Type 80 Plug-In unit plugged in and a Type P80 probe. It is factory adjusted for optimum transient response. Designed for use with Tektronix plug-in units, the oscilloscope will not function unless one of these units is plugged into the preamplifier compartment. In addition, a probe must be used.

Type 80 Plug-In Unit and Type P80 Probe

To retain the passband from dc to 100 mc, the rise-time of 3.5 nsec, and the basic sensitivity of 0.1 volt/cm, the Type 580-Series Oscilloscopes require the Type 80 Plug-In Unit and the Type P80 Probe. If other combinations of plug-in units and probes are used, the specifications will differ. The instrument, plug-in, and probe are adjusted as a unit for optimum performance. When a plug-in or probe are interchanged with other instruments the combination of instrument, plug-in, and probe must be readjusted as a unit to obtain accurate results.

Type 81 Plug-In Adapter

Versatility of the oscilloscope is further enhanced by the Type 81 Plug-In Adapter. This handy adapter fits into the preamplifier compartment quickly and easily, accepts any Tektronix "A" to "Z" Plug-In Unit, and retains the basic sensitivity and passband of the unit.

Balanced Delay Network—A push-pull network provides ample signal delay. This delay permits observation of the leading edge of the sweep-triggering waveform.

HORIZONTAL-DEFLECTION SYSTEM

The Type 581 has one time-base generator, with provision for single sweep operation.

The Type 585 has two time-base generators, Time Base A and Time Base B. Time Base A is identical to the Miller-runup type Time Base sweep generator in the Type 581. Time Base B functions as a delay generator or as a conventional sweep generator. The signal to be observed can be displayed in the following ways: Time Base B normal, Time Base B with trace brightening during the period that Time Base A runs, Time Base A delayed by Time Base B, Time Base A normal and Time Base A single sweep.

Single Sweep Operation—(TIME BASE A only in Type 585). Lockout reset circuitry permits one-shot recording. The RESET button controls operation of the single sweep. With the stability control fully clockwise, a single sweep runs immediately each time the RESET button is pressed. With the time base set for triggered operation, the single sweep does not occur when the RESET button is pressed until a proper trigger signal occurs. Instead the READY lamp lights. When a proper trigger signal occurs, the single sweep runs, the READY light goes out. Each time the RESET button is pressed, the procedure is repeated.

Sweep Range—(TIME BASE A). Sweep time is calibrated in steps of 0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, and 50 μsec/cm . . . . 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, and 50 msec/cm . . . . 0.1, 0.2, 0.5, 1, and 2 sec/cm. A vernier control provides for continuous adjustment between the 24 steps, and to over 5 sec/cm, uncalibrated. Calibrated accuracy is typically within 1%, and in all cases within 3%, of the indicated sweep rate.

Sweep Magnifier—When the 5-X Magnifier is used, the center two-centimeter portion of the displayed waveform is expanded to ten centimeters. The HORIZONTAL POSITION control has sufficient range to cover any one-fifth of the magnified sweep. The magnifier applied to the 0.05 μsec/cm sweep extends the calibrated range to 0.01 μsec/cm. Accuracy of the displayed portion of the magnified sweep is within 5% of the figured sweep rate. The 5-X Magnifier operates on all ranges for both time bases.

Sweep Range—(TIME BASE B). Sweep time is calibrated in steps of 2, 5, 10, 20, and 50 μsec/cm . . . . 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, and 50 msec/cm . . . . 0.1, 0.2, 0.5, and 1 sec/cm. A control is capable of changing the sweep repetition rate by adjusting the sweep length from 4 to 10 centimeters. This variable length control enables use of Time Base B as a repetition-rate generator over the range of 0.1 cps to 40 kc.

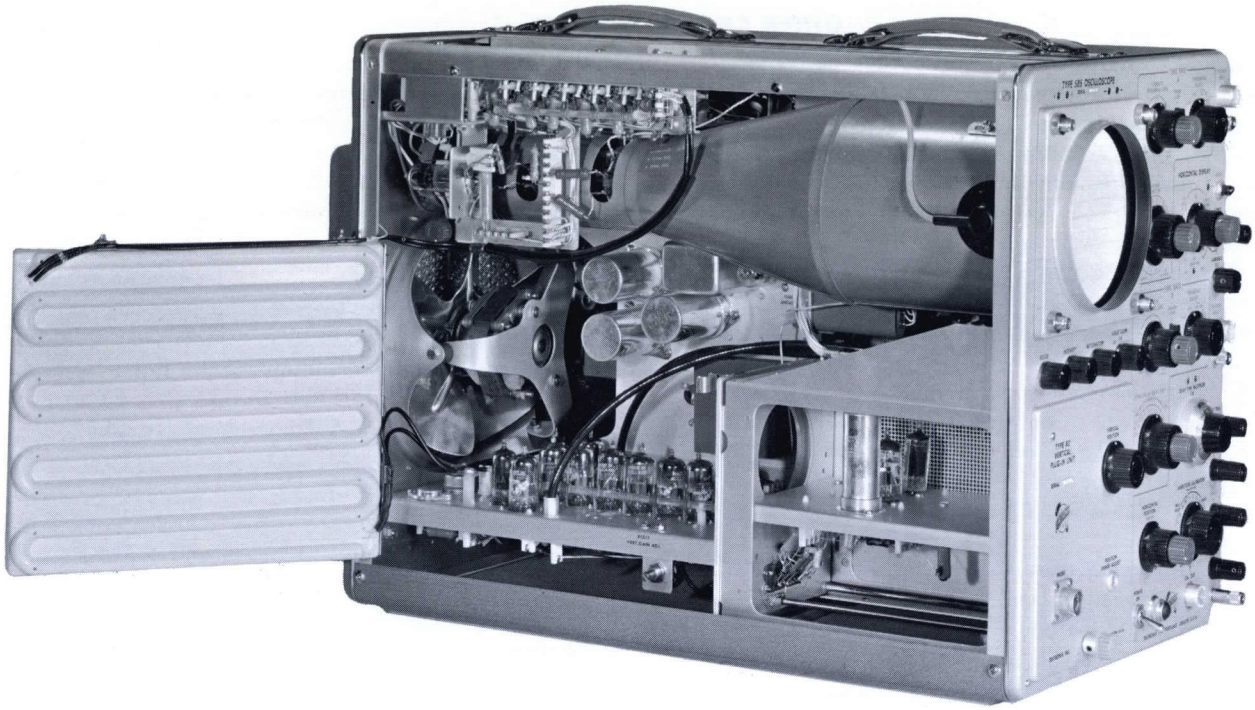
The 5-X MAGNIFIER used with Time Base B extends the fastest sweep speed to 0.4 μsec/cm. It operates on all ranges.

Horizontal-Input Amplifier—The dc-coupled external connection to the sweep-output amplifier is through a front-panel connector. Passband is dc to approximately 240 kc. Combination of a step attenuator and variable attenuator makes the horizontal deflection factor continuously variable from 0.2 v/cm to over 15 v/cm. Input impedance is 1 megohm paralleled by approximately 47 pf.

DC-Coupled Unblanking—The unblanking wavefrom is dc-coupled to the grid of the crt, assuring uniform bias for all sweep speeds and repetition rates at any setting of the intensity control.

TRIGGERING FACILITIES

Amplitude-Level Selection—Adjustable amplitude-level and stability controls provide for triggering the sweep at a selected amplitude level on the triggering waveform. Trigger source can be internal, external, or the line frequency, either ac-coupled or dc-coupled. Trigger point can occur anywhere on the rising or falling slope of the triggering waveform.



Preset Stability—The STABILITY control is locked at the optimum triggering point and requires no adjustment in the fully counterclockwise, PRESET, position.

Trigger Requirements—For internal triggering, a signal large enough to produce one minor division of vertical delection. For external triggering, a signal of 0.2 v to 20 v.

SWEEP DELAY

Start of the sweep of Time Base A can be delayed for a period of from 1 microsecond to 10 seconds after application of the triggering waveform. This is accomplished through simultaneous use of both time bases. Sweep delay for Time Base A is derived from Time Base B via a pickoff circuit. A delayed trigger is generated at the pickoff point, which can be adjusted to any point on the sawtooth waveform (generated by Time Base B). Thus, when using the delayed sweep feature of the Type 585, Time Base B provides accurate time delay while Time Base A presents normal sweep at the end of the delay period. Duration of the sweep delay is controlled by the TIME/CM OR DELAY TIME switch and the DELAY-TIME MULTIPLIER. The settings of the two controls are multiplied together to obtain the actual delay time.

Accuracy of the 15 calibrated steps from 2 μsec/cm to 0.1 sec/cm is within 1% of the indicated delay. Accuracy of the remaining three calibrated steps of 0.2, 0.5, and 1 sec/cm, is within 3% of the indicated delay. Incremental accuracy of the ten-turn precision DELAY-TIME MULTIPLIER is within 0.2% of the indicated setting.

Triggered Operation—When the triggering controls of TIME BASE A are adjusted so that the delayed trigger from TIME BASE B readies the sweep but does not start it, the next signal to arrive will start the sweep. Thus the delayed sweep is actually started by the signal under observation. This allows a steady display even with time jitter or time modulation present in the signal.

Conventional Operation—When the triggering controls of TIME BASE A are adjusted to permit the delayed trigger to start the sweep, the delayed sweep starts precisely at the pick-off point. The start is delayed the amount of time indicated by the settings of the TIME/CM OR DELAY TIME switch and the DELAY-TIME MULTIPLIER. Time modulation or time jitter on the signal will be magnified in proportion to the amount of sweep expansion. However, jitter introduced by the delay and pickoff circuitry is less than one part in 20,000, making extremely large magnification practical.

Trace Brightening—When the signal is displayed on TIME BASE B with the HORIZONTAL DISPLAY switch in the "B" INTENSIFIED BY "A" position, the unblanking pulse of TIME BASE A is added to that of TIME BASE B. Therefore, the period of operation of TIME BASE A appears as a brightened portion on the display. This trace brightening indicates both the point-in-time relationship between the delayed sweep and the original display, and the degree of magnification that will be achieved when the display is transferred to TIME BASE A.

OTHER CHARACTERISTICS

Amplitude Calibrator—A square-wave calibration voltage is available through a front-panel coaxial connector. Eighteen direct-reading fixed steps—0.2, 0.5, 1, 2, 5, 10, 20 and 50 millivolts. . .0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50 and 100 volts peak-to-peak are provided by a single-knob control. Accuracy of the square-wave peak-to-peak amplitude is within 3% of the indicated calibration voltage. Square-wave frequency is approximately 1 kc.

Cathode-Ray Tube—The Tektronix, flat-faced, 5-inch, precision cathode-ray tube, Type 581P___, is a metallized, lumped-constant traveling-wave tube with helical post-accelerating anode. It provides a linear 4-cm x 10-cm viewing area. Accelerating potential is 10 kv. The phosphor normally supplied with the instrument is a P2, but a P1, P7 or P11 will be furnished instead if requested.

Regulated Power Supply—Electronically-regulated dc supply insures stable operation over line variations between 105 and 125 volts or 210 and 250 volts, 50 to 60 cycles. Regulated dc is supplied to heaters in the plug-in preamplifier and the probe by a transistorized regulator circuit.

Thermal Protection—For protection, a thermal cut-out switch interrupts the power if chassis temperature becomes excessive, and holds it off until a safe operating temperature is reached.

Access to Interior—Three-piece cabinet design provides easy access to the interior of the instrument. Each cabinet side is held in place by two quick-opening fasteners, and can be removed in a matter of seconds.

Illuminated Graticule—Edge lighting of the graticule is adjusted by the SCALE ILLUM. control. Display area of the graticule is marked in four vertical and ten horizontal one-centimeter major divisions. Centerlines are further marked in five minor divisions per major division.

Output Waveforms—Two output waveforms are available from front-panel connectors via cathode followers. Approximate amplitude of the peak-to-peak voltages are 150 volts from the SAWTOOTH connector and 20 volts from the +GATE connector (of same duration as the sweep).

Two other output waveforms are available from front-panel connectors. Approximate amplitude of the delayed trigger pulse (occurring at the end of the delay period) is 5 volts, and of the positive gate (+GATE B, of the same duration as sweep B) is 20 volts.

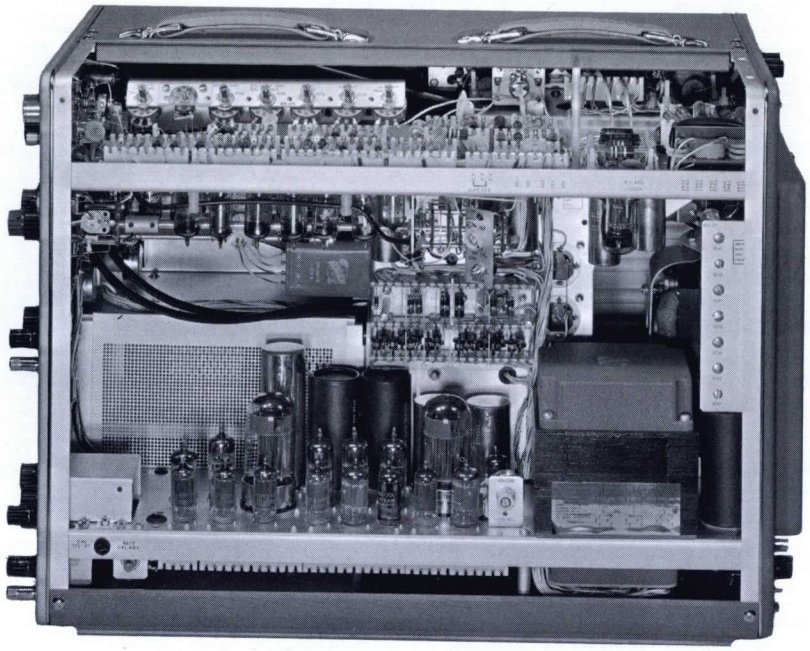
Indicator Lamps—Four beam-position indicator lamps marked with arrows are located above the crt screen. If the beam is positioned horizontally or vertically away from the center of the graticule, either on or off the screen, the appropriate beam-position indicator lamp will light.

Separate indicator lamps also light to designate magnified displays and uncalibrated settings of the sweep-rate controls.

ELECTRON TUBES AND SEMICONDUCTORS

* denotes "or equivalent"

Vertical Amplifier		
Vertical-input amplifiers	7	6DJ8
Beam-position-indicator amplifiers		6DJ8
Drive amplifiers	5	6DJ8
Output amplifier		AX193
Trigger amplifiers	2	6CY5
Trigger CF		6DJ8
Time-Base Generator		
Trigger amplifier	2	6EW6
Trigger shaper	2	6DJ8
Sweep-gating multivibrator and CF		6DJ8
Sweep-gating multivibrator		6DJ8
Unblanking and Holdoff CF		6DJ8
Clipping diode		T12G*
Sawtooth and Gate CF		6DJ8
Lockout multivibrator		6AU6
Holdoff CF and Lockout multivibrator		6DJ8
Delayed-trigger amplifier		6AU6
Clamping diodes	2	T12G*
Disconnect diodes		6AL5
Miller runup		6CL6
Runup CF		6DJ8
Time-Base B Generator		
Trigger amplifier		6DJ8
Trigger shaper		6DJ8
Stability CF and Holdoff CF		6DJ8
Sweep-gating multivibrator and CF		6DJ8
Sweep-gating multivibrator		6AU6
Unblanking CF and Gate CF		6DJ8
Disconnect diodes		12AL5
Miller runup		12AU6
Runup CF and Holdoff CF		6DJ8
Horizontal Amplifiers		
Input and Driver CF		6DJ8
Sweep amplifiers and CF	2	6DJ8
Current booster		6CL6
External-input amplifier		6DJ8
Delay System		
Delay trigger		6DJ8
Delay pickoff	2	6AU6
Delay-trigger CF and Current control		6DJ8
Power Supplies		
High-voltage regulator amplifier		12AU7
High-voltage oscillator		6AU5
High-voltage rectifiers	5	5642
Comparators	2	12AX7
Voltage reference		5651
Regulator amplifiers	5	6AU6
Series regulators	4	12B4



Series regulators	2	6080
Heater regulator		2N277*
Heater regulator		2N301*
Heater regulator		2N212*
Heater clamping		T12G*
Rectifiers	16	1N1566

Miscellaneous

Calibrator	6AU6
Calibrator multivibrator and CF	12AU7
Alternate-trace-sync amplifier and Trace blanking	6DJ8
Cathode-ray tube	T581P2

MECHANICAL SPECIFICATIONS

Ventilation—Filtered forced-air ventilation maintains safe operating temperature. A minimum of two inches unobstructed clearance around the instrument is recommended for adequate ventilation.

Construction—Aluminum-alloy chassis and three-piece cabinet.

Finish—Photo-etched anodized front panel, blue vinyl finish cabinet.

Dimensions—16¾" high by 13" wide by 24" deep.

TYPE 581

Weight—Net is 68 pounds;
Shipping is 88 pounds approx.

Power Requirements—Operates from 105 to 125 volts or 210 to 250 volts, 50 to 60 cycles. 640 watts maximum.

Price, without plug-in unit or probe **$1375**

TYPE 585

Weight—Net is 74 pounds;
Shipping is 91 pounds approx.

Power Requirements—Operates from 105 to 125 volts or 210 to 250 volts, 50 to 60 cycles. 725 watts maximum.

Price, without plug-in unit or probe **$1675**

Note: A plug-in unit and a probe are required to operate the Type 581 or Type 585 oscilloscope.

Included Accessories

2 — Binding post adapters (013-004)
1 — Test lead (012-031)
1 — Green filter (378-514)
1 — 3-conductor power cord (161-010)
1 — Instruction manual

Recommended Accessories

The Type 81 Plug-In Adapter—equips the oscilloscope to accept any Tektronix "A" to "Z" Plug-In Unit.

Price **$125**

Probe Adapter—probe to Type N connector
ORDER PART NO. 013-016 ..... $4.00

Probe Adapter—probe to Type UHF connector
ORDER PART NO. 013-017 ..... $4.00

Probe Adapter—probe to Type BNC connector
ORDER PART NO. 013-018 ..... $5.00

Rack Mount Adapter

A cradle mount to adapt the Type 581 or Type 585 Oscilloscopes for rack mounting is available. It consists of a cradle to support the instrument in any standard 19" relay rack and a mask to fit around the regular instrument panel. Tektronix blue wrinkle finish. Rack height requirements 17½".

ORDER PART NO. 040-182 ..... $45.00

Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).

TYPE 80 PLUG-IN UNIT AND TYPE P80 PROBE

SPECIFICATIONS

The Type 80 Plug-In Unit and Type P80 Probe are designed specifically for operation with Tektronix Type 580-Series Oscilloscopes. Used with a Type 581 or Type 585, the following specifications apply:

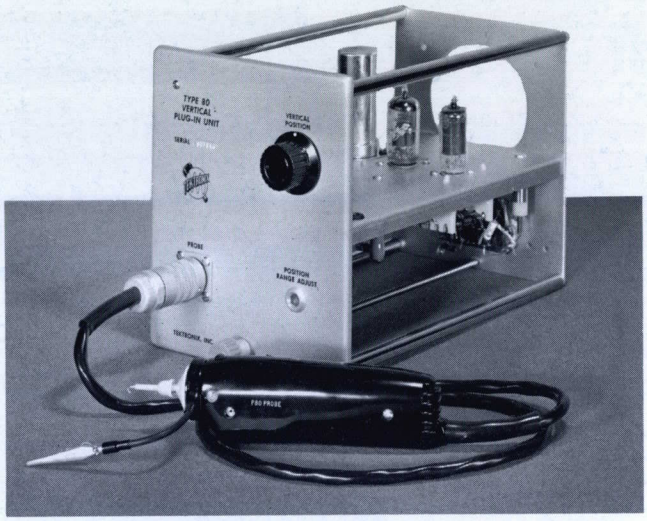
Input Impedance ..... 10 pf, 100 kilohms
Risetime ..... 3.5 nanoseconds
Passband ..... dc to approximately 100 mc
Vertical Deflection Factor ..... 0.1 v/cm.

GENERAL DESCRIPTION

Designed especially for use with the Type 80 Plug-In Unit, the cathode-anode follower Type P80 Probe provides the means for coupling the Type 580-Series Oscilloscopes to the signal source. The oscilloscope, the plug-in unit, and the probe are adjusted for optimum performance as a unit, at the factory. It is recommended that all three be purchased at the same time.

The probe can be connected to the signal source using one of three tips supplied. Or, if desired, special adapters are available which allow direct connection of the probe to Type N, UHF, and BNC connectors. For fast-rising pulses one of these adapters should be used. The probe tips and the probe ground lead form a resonant circuit which produces ringing when excited by fast rising pulses.

Five attenuator heads are supplied with the Type P80 probe. These heads produce vertical deflection factors of 0.2, 0.5, 1, 2, and 5 volts per centimeter. In addition, the heads increase the input resistance of the probe and decrease the input capacitance. The decreased capacitance and increased resistance lessen the possibility that the probe will ring.



MECHANICAL SPECIFICATIONS

Type 80 Plug-In Unit

Construction—Aluminum-alloy chassis.
Finish—Photo-etched panel.
Weight: Net—2½ pounds
Shipping—9 pounds approx.

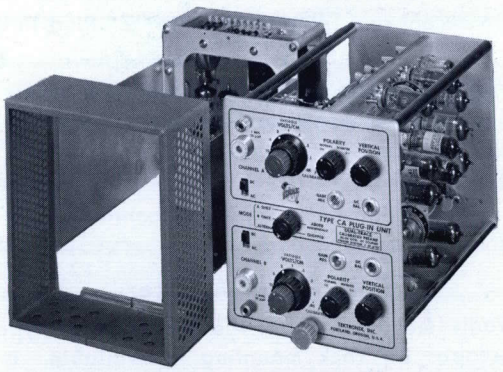
Price **$50**

Type P80 Probe

Construction—impact styrene covering shielded components, 42" standard cable with 7-pin connector.
Dimension—5" long (without tip) x 1¼" x 1¾".
Weight: Net—1¼ pounds
Shipping—8 pounds approx.

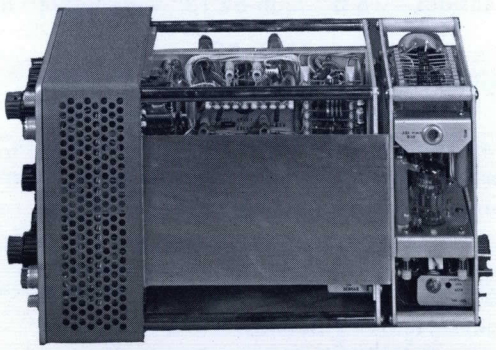
Price **$100**
Includes: 5—probe attenuator heads; 2-X, 5-X, 10-X, 20-X, 50-X.

TYPE 81 PLUG-IN ADAPTER



GENERAL DESCRIPTION

Handy Adapter fits into the Preamplifier compartment, accepts any Tektronix "A" to "Z" Plug-In Unit and retains the passband and basic sensitivity of the Unit.



MECHANICAL SPECIFICATIONS

Construction—Aluminum-alloy chassis, blue vinyl finish exterior housing.
Dimensions—6½" high, 5½" wide, 12½" deep.
Weight: Net—2½ pounds
Shipping—9 pounds approx.

Price **$125**

PLUG-IN UNITS

FOR TEKTRONIX OSCILLOSCOPES

TYPE A D-2
TYPE B D-2
TYPE C-A D-4
TYPE D D-6
TYPE E D-6
TYPE G D-8
TYPE H D-8
TYPE K D-10
TYPE L D-10
TYPE N D-12
TYPE P D-12
TYPE Q D-14
TYPE R D-16
TYPE S D-18
TYPE T D-20
TYPE Z D-20
TYPE 127 ..... D-22

6/60

TYPE A WIDE-BAND

GENERAL DESCRIPTION

The Type A Plug-In Preamplifier meets the requirements of most wide-band applications. Wide passband, excellent transient response, dc-coupling, and calibrated sensitivity are qualities most users require in an oscilloscope vertical amplifier. The Type A gives all of these qualities to Tektronix Type 530, 540 and 550 Series Oscilloscopes.

OTHER CHARACTERISTICS

Calibrated Sensitivity—The vertical attenuator is calibrated in VOLTS/CM of deflection. Nine calibrated steps are provided: 0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10, and 20 v/cm. In addition, a vernier (uncalibrated) control provides for continuously-variable adjustment from 0.05 v/cm to 50 v/cm.

Calibration Accuracy—An adjustment is provided for setting the gain of the unit. When this adjustment is accurately set with the VOLTS/CM switch in the 0.05 v/cm position, the vertical deflection factor for any other position of the switch will be within 3% of the panel reading for that position.

MAIN FEATURES

Deflection Factor

Calibrated—0.05 v/cm to 20 v/cm.
Continuously Variable—0.05 v/cm to 50 v/cm.

Frequency Response and Risetime

Frequency specifications are at 3 db down

With Types 531A, 533, 535A —
dc to 14 mc, 25 nsec

With Type 536 —
dc to 10 mc, 35 nsec.

With Type 532 —
dc to 5 mc, 70 nsec.

With Types 541A, 543, 545A, 555, 581, 585—
dc to 20 mc, 18 nsec.

With Type 551 —
dc to 18 mc, 20 nsec.

TYPE B WIDE-BAND

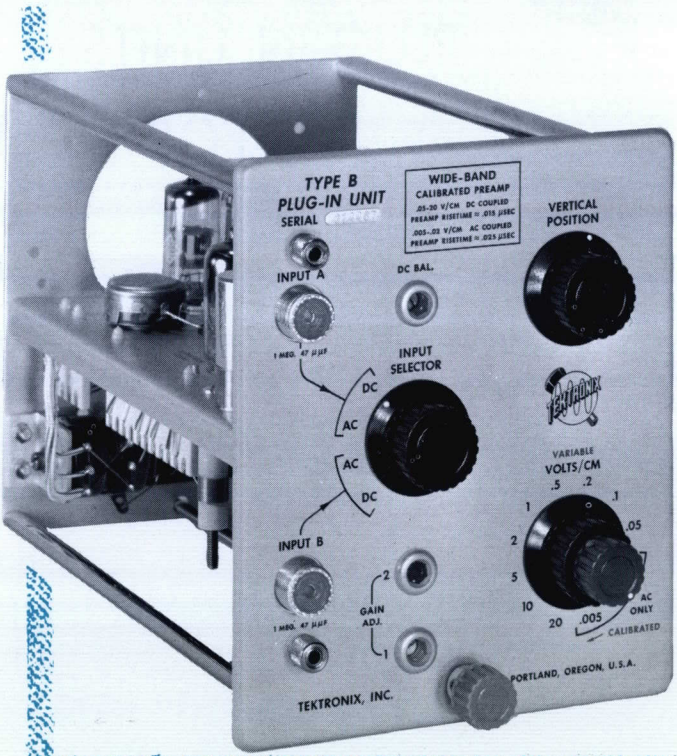
GENERAL DESCRIPTION

The Type B Plug-In Unit is essentially the Type A with a preamplifier stage added. Three additional calibrated deflection factors, 0.005, 0.01, and 0.02 v/cm are available at slightly reduced frequency response and increased risetime. In all other specifications the Type B is identical to the Type A.

OTHER CHARACTERISTICS

Calibrated Sensitivity—The vertical attenuator is calibrated in VOLTS/CM of deflection. Twelve calibrated steps are provided: 0.005, 0.01, 0.02, 0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10 and 20 v/cm. In addition, a vernier (uncalibrated) control provides for continuously-variable adjustment from 0.005 v/cm to 50 v/cm.

Calibration Accuracy—Two adjustments are provided for setting the gain of the unit. When these adjustments are accurately set with the VOLTS/CM switch in the 0.005 v/cm and 0.05 v/cm positions, the vertical deflection factor for any other position of the switch will be within 3% of the panel reading for that position.



DC PREAMPLIFIER

Two Signal Inputs—Two signal input connectors with more than 60-db isolation are controlled by a four-position switch. The INPUT SELECTOR provides for ac-coupling or dc-coupling through either input. A blocking capacitor is inserted in the AC positions, limiting the low-frequency response to 3 db down at 2 cycles.

Input Impedance—47 pf paralleled by 1 megohm.

ELECTRON-TUBE COMPLEMENT

Input CF		12AU6
Amplifiers	2	12AU6
Output CF		12AT7

MECHANICAL SPECIFICATIONS

Construction—Aluminum-alloy chassis.
Finish—Photo-etched panel.
Weight: Net 3½ pounds
Shipping—10 pounds approx.

Price **$90**

For low-capacitance accessory probes, please see the Catalog Accessory Section.

Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).

HIGH-GAIN PREAMPLIFIER

MAIN FEATURES

Deflection Factor

AC-Coupled Only—0.005 v/cm to 0.05 v/cm.
AC or DC-Coupled—0.05 v/cm to 50 v/cm.
Calibrated—0.005 v/cm to 20 v/cm.
Continuously Variable—0.005 v/cm to 50 v/cm.

Frequency Response and Risetime (0.05 to 20 v/cm)

Same as described for Type A.

Frequency Response and Risetime (0.005 to 0.05 v/cm)

Frequency specifications are at 3 db down

With Types 531A, 533, 535A —
2 cycles to 10 mc, 35 nsec.
With Type 536 —
2 cycles to 9 mc, 40 nsec.
With Type 532 —
2 cycles to 5 mc, 70 nsec.
With Types 541A, 543, 545A, 555, 581, 585—
2 cycles to 12 mc, 30 nsec.
With Type 551 —
2 cycles to 12 mc, 30 nsec.

Signal Inputs—Two signal input connectors with more than 60-db isolation are controlled by a four-position switch. The INPUT SELECTOR provides for ac-coupling or dc-coupling through either input. A coupling capacitor is inserted in the AC positions, limiting the low-frequency response to 3 db down at 2 cycles.

Input Impedance—47 pf paralleled by 1 megohm.

ELECTRON TUBES AND SEMICONDUCTORS

* denotes "or equivalent"

Preamplifier		5654
Input CF		12AU6
Cathode follower		6DJ8
Amplifiers	2	12AU6
Output CF		12AT7
Rectifier		T12G*

MECHANICAL SPECIFICATIONS

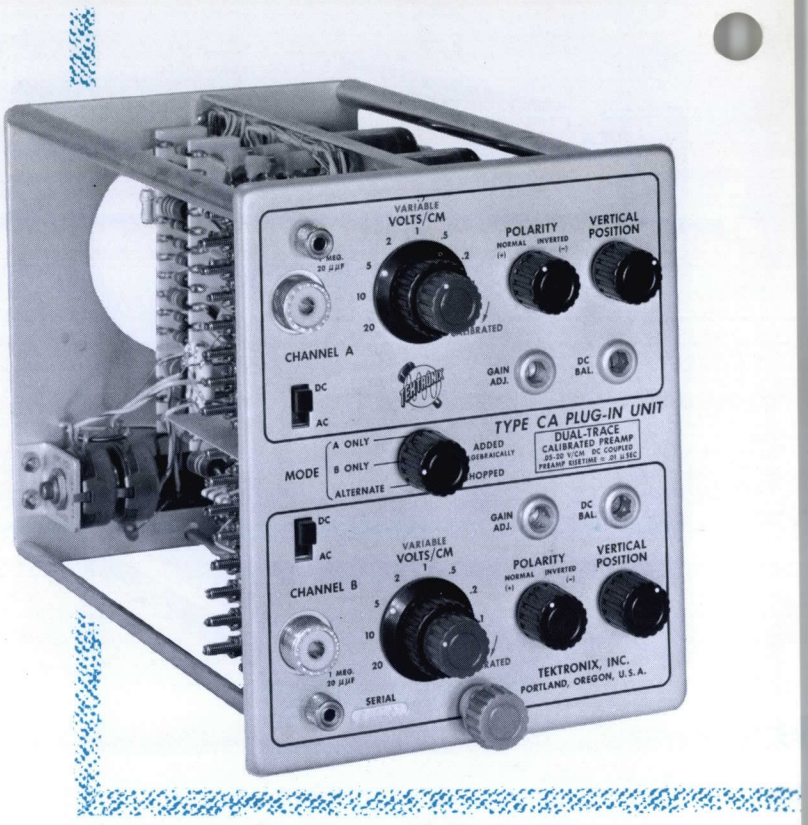
Construction—Aluminum-alloy chassis.
Finish—Photo-etched anodized panel.
Weight: Net—5 pounds
Shipping—11 pounds approx.

Price **$135**

For low-capacitance accessory probes, please see the Catalog Accessory Section.

Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).

TYPE C-A DUAL-TRACE



GENERAL DESCRIPTION

The Tektronix Type C-A Unit contains two identical input channels. Either channel can be operated separately. The two channels can be electronically switched, either at a free-running rate of about 100 kc, or triggered by the oscilloscope sweep. In addition both channels can be combined at the output, adding or subtracting according to the settings of the polarity switches.

When operated A—B or B—A, common-mode rejection is at least 20 to 1 over the entire passband for signals up to 1-v amplitude. Rejection can be improved, especially at low frequencies, by adjusting the vernier attenuator controls and/or the GAIN ADJ. controls. Separate attenuator controls for each channel permit rejection of a common-mode signal of a different amplitude.

In alternate-sweep, free-running, and single-channel modes of operation the Type C-A is identical to its predecessor, the Type 53/54C Dual-Trace Preamplifier.

OTHER CHARACTERISTICS

Calibrated Sensitivity—The vertical attenuators are calibrated in VOLTS/CM of deflection. Nine calibrated steps are provided for each channel: 0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10 and 20 v/cm. In addition, vernier (uncalibrated) controls provide for continuously-variable adjustments from 0.05 v/cm to 50 v/cm for each channel.

Vertical Position Controls—Separate positioning controls are provided for each channel.

Calibration Accuracy — Adjustments are provided for setting the gain of each channel. When accurately

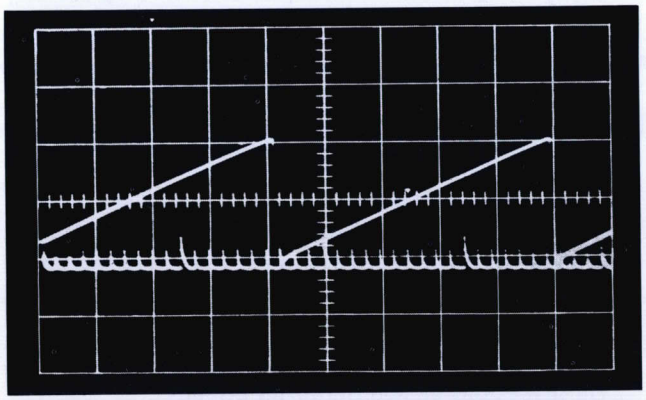


Fig. 1—Type C-A Unit operated in its ALTERNATE mode. Both signals can be independently positioned vertically over the entire viewing area, and either can be reversed in polarity to facilitate measuring or matching. Because the sweeps are identical, and time-delay characteristics of the two amplifier channels are within 2 mμsec, time comparisons can be made with a high degree of accuracy.

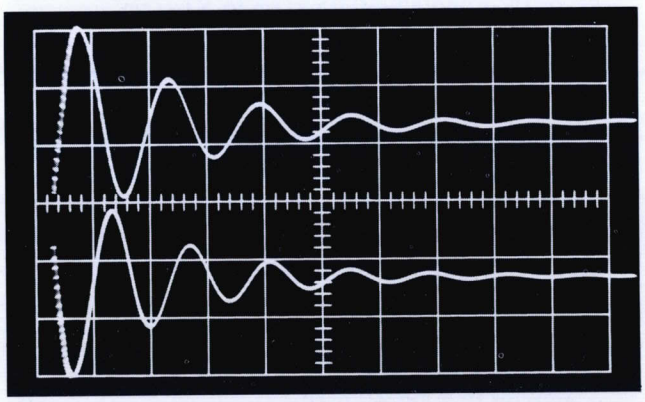


Fig. 2—Single sweep application with Type C-A Unit operated in its CHOPPED mode, simultaneously displaying the response of each of two ringing circuits to the same pulse. Transients of as little as one millisecond duration are well delineated, having about one hundred elements in each trace. For many purposes, shorter transients can be adequately observed.

DC PREAMPLIFIER

MAIN FEATURES

Five Operating Modes

Channel A only.
Channel B only.
Electronic switching at 100 kc (chopped).
Electronic switching on alternate sweeps.
Both channels combined at output (A ± B).

Frequency Response and Risetime

Frequency specifications are at 3 db down

With Types 531A, 533, 535A —
dc to 15 mc, 23 nsec.

With Type 536 —
dc to 10 mc, 35 nsec.

With Type 532—
dc to 5 mc, 70 nsec.

With Types 541A, 543, 545A, 555, 581, 585—
dc to 24 mc, 15 nsec.

With Type 551
dc to 22 mc, 16 nsec.

set, the vertical deflection factor will be within 3% of the panel reading for all switch positions.

Operating Mode Selection—A five-position switch provides for electronic switch operation either triggered or free-running, separate use of either channel, and both channels combined at the output of the unit.

AC-DC Switches—A coupling capacitor is inserted in the AC positions, limiting the low-frequency response to 3 db down at 2 cycles.

Polarity Inversion—Polarity can be inverted on either channel for comparisons of signals 180 degrees out of phase, and A—B or A+B mixing.

Input Impedance—20 pf paralleled by 1 megohm.

ELECTRON-TUBE COMPLEMENT

Input CF	2	6AK5
Amplifiers	4	12AU6
Switching amplifiers	4	6AU6
Output CF		12AT7
Coupling diode		6AL5
Multivibrator		12AT7
Multivibrator waveform shaper		12AT7
Switching CF		12AT7

MECHANICAL SPECIFICATIONS

Construction—Aluminum-alloy chassis.
Finish—Photo-etched anodized panel.
Weight: Net—5½ pounds
Shipping—12 pounds approx.

Price **$250**

Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).

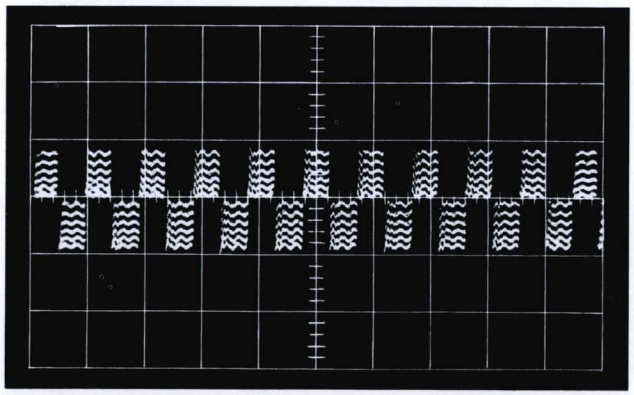


Fig. 3—Single-trace display of signal with hum interference.

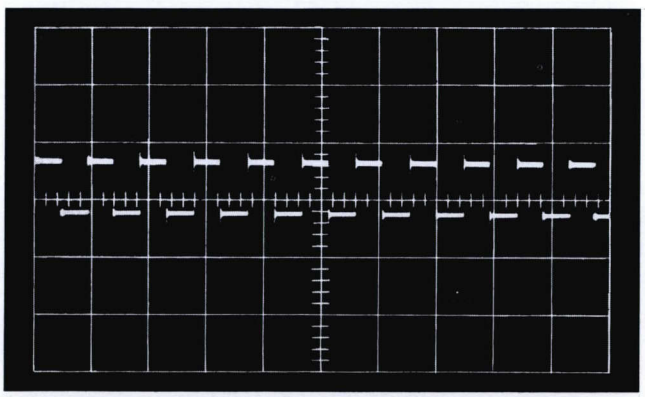


Fig. 4—Same display as Fig. 3, but with interfering signal fed into Channel B. The ADDED ALGEBRAICALLY mode of the Type C-A Unit permits A—B operation for cancellation of unwanted signals. In A—B or B—A operation, common-mode rejection is at least 20 to 1 over the entire passband for signals up to 1-v amplitude.

TYPE D HIGH-GAIN

GENERAL DESCRIPTION

The Type D equips Tektronix Type 530, 540 and 550 Series Oscilloscopes for work requiring dc-coupling at a deflection factor of 1 mv/cm. Differential input with high rejection ratio for in-phase signals permits cancellation of unwanted or interfering signals.

OTHER CHARACTERISTICS

Input Selector—A six-position switch provides for use of either input separately, or both together differentially, either ac-coupled or dc-coupled. In the AC positions a coupling capacitor is inserted, limiting the low-frequency response to 3 db down at 2 cycles.

Differential Input — In the A-minus-B position of the input selector switch, the Type D operates as a differential amplifier whose output is proportional to the difference between signals applied to input A and input B. The differential feature is useful in making voltage measurements between two above-ground points, and for cancelling in-phase signals such as hum pickup in connecting leads. By careful adjustment of the differential-balance control, 10,000-to-1 rejection ratio for in-phase signals up to 20 kc can be achieved at all positions of the MV/CM MULTIPLIER switch.

Deflection Sensitivity Controls — The MILLIVOLTS/CM switch has four calibrated positions: 1, 10, 100, and 1000 mv/cm. A MV/CM MULTIPLIER switch pro-

TYPE E LOW-LEVEL

GENERAL DESCRIPTION

The Type E Plug-in Unit provides Tektronix Type 530, 540 and 550 Series Oscilloscopes with a calibrated vertical deflection factor of 50 microvolts/cm for low-level applications. Maximum combined noise and hum is 5 μv, rms, with input grids grounded at the input connector. Separate high-frequency and low-frequency response controls permit restricting the bandwidth to further increase the signal-to-noise ratio. A rejection ratio of 50,000 to 1 for in-phase signals up to 1 kc can be achieved by careful adjustment of the front-panel differential-balance control. Use of the internal attenuators has a negligible effect on the rejection figure.

OTHER CHARACTERISTICS

Calibrated Sensitivity—The vertical attenuator is calibrated in MILLIVOLTS/CM of deflection. Eight calibrated steps are provided: 0.05, 0.1, 0.2, 0.5, 1, 2, 5 and 10 millivolts/cm. In addition, a vernier (uncalibrated) control provides for continuously-variable adjustment from 50 microvolts/cm to 25 millivolts/cm.

Calibration Accuracy—An adjustment is provided for setting the gain of the unit. When this adjustment is accurately set with the MILLIVOLTS/CM switch in the 5 milli-

MAIN FEATURES

Deflection Factor

Calibrated—50 microvolts/cm to 10 millivolts/cm.

Continuously Variable—50 microvolts/cm to 25 millivolts/cm.

Frequency Response

0.06 cycles to 20 kc at full gain, increasing to 60 kc at 0.5 mv/cm. Frequency specifications are at 3 db down.

Differential Input

50,000-to-1 rejection ratio between in-phase and out-of-phase signals up to 1 kc of $\pm$2 v or less.

Trace Restorer—If the trace should be driven from the screen by a large transient, it can be returned to its normal position immediately by pressing the trace restorer button.

Input Impedance—50 pf paralleled by 10 megohms.

DC DIFFERENTIAL PREAMPLIFIER

MAIN FEATURES

Deflection Factor

Calibrated—1 mv/cm to 50 v/cm.
Continuously Variable—1 mv/cm to 125 v/cm.

Frequency Response

DC to 350 kc at 1 mv/cm sensitivity. . . increasing to DC to 2 mc at 50 mv/cm and lower sensitivity. Frequency specifications are at 3 db down.

Differential Input

10,000-to-1 rejection ratio between in-phase and out-of-phase signals.

Stability — Normal drift is from 2 to 5 mv/hr.

Input Impedance—47 pf paralleled by 1 megohm.

vides for multiplication by 1, 2, 5, 10, 20, and 50. Approximate 3-db point of amplifier high frequency response for each position is also indicated by this switch. The MV/CM MULTIPLIER, by attenuating within the amplifier, reduces drift and increases bandpass in applications that require less than maximum sensitivity. A vernier (uncalibrated) control provides for continuously-variable adjustment from 1 mv/cm to 125 v/cm.

Regulated Heater Voltage — Heaters of all electron tubes in the Type D are operated from the regulated dc voltage supplies in the main oscilloscope unit.

Calibration Accuracy—An adjustment is provided for setting the gain of the unit. When this adjustment is accurately set with the MILLIVOLTS/CM switch in the 1 mv/cm position and the MV/CM MULTIPLIER in the 50 mv/cm position, the vertical deflection factor for any other position of the switches will be within 3% of the panel reading for that position.

MECHANICAL SPECIFICATIONS

Construction—Aluminum-alloy chassis.
Finish—Photo-etched anodized panel.
Weight: Net—5½ pounds
Shipping—12 pounds approx.

Price **$155**

For low-capacitance accessory probes, please see the Catalog Accessory Section.

AC DIFFERENTIAL PREAMPLIFIER

volts/cm position, the vertical deflection factor for any other position of the switch will be within 3% of the panel reading for that position.

Bandwidth Control—A five-position switch provides for approximate high-frequency 3-db points of 60, 10, 1, 0.25, and 0.05 kc. Another five-position switch selects the approximate low-frequency 3-db points of 0.06, 0.2, 0.8, 8 and 80 cycles. Restricting the bandwidth to the requirements of the particular application will provide an increase in the signal-to-noise ratio. Input to grids is dc-coupled to provide good rejection at low frequencies.

MECHANICAL SPECIFICATIONS

Construction—Aluminum-alloy chassis.
Finish—Photo-etched anodized panel.
Weight: Net—5 pounds
Shipping—11 pounds approx.

Price **$175**

Includes: 30" two-conductor shielded cable with input connector.

Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).

TYPE G WIDE-BAND

GENERAL DESCRIPTION

The Type G Plug-In Unit equips Tektronix Type 530, 540 and 550 Series Oscilloscopes for wideband differential-input applications. Common-mode rejection is better than 100 to 1 for the entire passband at full gain, better than 300 to 1 at 60 cycles. Independent step attenuators in each input with 80-db isolation permit mixing signals of wide amplitude difference. Either input can be used separately, INPUT B giving a polarity-inverted display.

OTHER CHARACTERISTICS

Input-Selector—A six-position switch provides for use of either input separately, or both together differentially, either ac-coupled or dc-coupled. In the AC positions a coupling capacitor is inserted, limiting the low-frequency response to 3 db down at 2 cycles.

Calibrated Sensitivity—Each of the two attenuators has 9 calibrated positions: 0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10 and 20 v/cm. A variable attenuator fills in between steps making the adjustment continuously variable from 0.05 v/cm to 50 v/cm. The variable attenuator affects the gain of both inputs at the same time.

Calibration Accuracy—An adjustment is provided for setting the gain of the unit. When this adjustment is ac-

TYPE H WIDE-BAND

GENERAL DESCRIPTION

The Type H is a wide-band preamplifier with dc-coupling over its full sensitivity range. It provides a maximum deflection factor of 5 mv/cm, dc-coupled, in Types 530, 540 and 550 Oscilloscopes, with excellent transient-response characteristics.

OTHER CHARACTERISTICS

Calibrated Sensitivity—The vertical attenuator is calibrated in VOLTS/CM of deflection. Twelve calibrated steps are provided: 0.005, 0.01, 0.02, 0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10 and 20 v/cm. In addition, a vernier (uncalibrated) control provides for continuously-variable adjustment from 0.005 v/cm to 50 v/cm.

Calibration Accuracy—A front-panel adjustment is provided for setting the gain of the unit. When this adjustment is accurately set with the VOLTS/CM switch in the 0.005 v/cm position, the vertical deflection factor for any other position of the switch will be within 3% of the panel reading for that position.

Signal Inputs—Two signal input connectors with more than 60 db isolation are controlled by a four-position switch. The INPUT SELECTOR provides for ac-coupling or dc-coupling through either input. A coup-

MAIN FEATURES

Deflection Factor

AC or DC-Coupled —
Calibrated — 0.005 to 20 v/cm.
Continuously Variable — 0.005 to 50 v/cm.

Frequency Response and Risetime

Frequency specifications are at 3 db down

With Types 531A, 533, 535A —
dc to 11 mc, 31 nsec.

With Type 536 —
dc to 9.5 mc, 37 nsec.

With Type 532 —
dc to 5 mc, 70 nsec.

With Types 541A, 543, 545A, 555, 581, 585—
dc to 15 mc, 23 nsec.

With Type 551 —
dc to 14 mc, 25 nsec.

DC DIFFERENTIAL PREAMPLIFIER

MAIN FEATURES

Common-mode Rejection

100 to 1 at full gain.

Deflection Factor

Calibrated—0.05 v/cm to 20 v/cm.

Continuously Variable—0.05 v/cm to 50 v/cm.

Frequency Response and Risetime

Frequency specifications are at 3 db down

With Types 531A, 533, 535A —
dc to 14 mc, 25 nsec.

With Type 536 —
dc to 10 mc, 35 nsec.

With Type 532 —
dc to 5 mc, 70 nsec.

With Types 541A, 543, 545A, 555, 581, 585—
dc to 20 mc, 18 nsec.

With Type 551 —
dc to 18 mc, 20 nsec.

curately set with the VOLTS/CM switch in the 0.05 v/cm position, the vertical deflection factor for any other position of the switch will be within 3% of the panel reading for that position.

Input Impedance—47 pf paralleled by 1 megohm.

ELECTRON-TUBE COMPLEMENT

Input cathode followers	2	6AK5
Input amplifiers	2	12AU6
Output amplifiers	2	12AU6
Cathode followers		12AT7

MECHANICAL SPECIFICATIONS

Construction—Aluminum-alloy chassis.
Finish—Photo-etched anodized panel.
Weight: Net—5 pounds
Shipping—11 pounds approx.

Price **$185**

For low-capacitance accessory probes, please see the Catalog Accessory Section.

Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).

HIGH-GAIN DC PREAMPLIFIER

ling capacitor is inserted in the AC positions, limiting the low-frequency response to 3 db down at 2 cycles.

Input Impedance—47 pf paralleled by 1 megohm.

ELECTRON-TUBE COMPLEMENT

1st Amplifiers	2	12AU6
Input CF		12AT7
2nd Amplifiers	2	12AU6
Output CF		12AT7

MECHANICAL SPECIFICATIONS

Construction—Aluminum-alloy chassis.
Finish—Photo-etched anodized panel.
Weight: Net—4½ pounds
Shipping—11 pounds approx.

Price **$185**

For low-capacitance accessory probes, please see the Catalog Accessory Section.

Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).

TYPE K FAST-RISE

GENERAL DESCRIPTION

The Type K Fast-Rise Unit provides Types 540 and 550 Series Oscilloscopes with calibrated sensitivity at low input capacitance, taking maximum advantage of the excellent transient response and wide frequency range of the oscilloscope vertical-deflection system. The Type K combined with a fast-rise oscilloscope makes a 12-nanosecond risetime combination, ideal for applications involving fast-rising waveforms. Frequency response is down 3 db ± ½ db at 30 mc, 6 db at approximately 41 mc, 12 db at approximately 55 mc. The combined vertical-amplifier system is dc-coupled, and an AC-DC switch provides for insertion of a capacitor to block the dc component of the input signal, limiting the low-frequency response to 3 db down at 2 cycles. The Type K can be used in all Tektronix Type 530, 540 and 550 Series Oscilloscopes.

OTHER CHARACTERISTICS

Calibrated Sensitivity—The vertical attenuator is calibrated in VOLTS/CM of deflection. Nine calibrated steps are provided: 0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10 and 20 v/cm. In addition, a vernier (uncalibrated) control provides for variable adjustment over a 2-to-1 range on each step.

Calibration Accuracy—An adjustment is provided for setting the gain of the unit. When this adjustment is

MAIN FEATURES

Deflection Factor

Calibrated—0.05 v/cm to 20 v/cm.

Frequency Response and Risetime

Frequency specifications are at 3 db down

With Types 531A, 533, 535A —
dc to 15 mc, 23 nsec.

With Type 536 —
dc to 11 mc, 31 nsec.

With Type 532 —
dc to 5 mc, 70 nsec.

With Tyes 541, 543, 545A, 555, 581, 585—
dc to 30 mc, 12 nsec.

With Type 551 —
dc to 25 mc, 14 nsec.

TYPE L FAST-RISE

GENERAL DESCRIPTION

The Type L Fast-Rise High-Gain Unit is essentially the Type K Plug-In Unit, with an additional amplifier to increase the sensitivity by a factor of 10 for fast-rise applications.

A front-panel switch connects the ac-coupled amplifier into the circuit, increasing the deflection factor to 0.005 v/cm. Slightly reduced frequency response and increased risetime results when the additional amplifier is switched into the circuit. In all other respects, the Type L Unit is identical to the Type K.

OTHER CHARACTERISTICS

Calibrated Deflection Factor—Nine steps are provided: 0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10, and 20 v/cm. When the additional amplifier stage is switched in, the steps are changed to 0.005, 0.01, 0.02, 0.05, 0.1, 0.2, 0.5, 1, and 2 v/cm. In addition, a vernier (uncalibrated) control provides for variable adjustment over a 2-to-1 range on each step.

Calibration Accuracy—Front-panel adjustments are provided for setting the gain of the unit. When these adjustments are accurately set with the VOLTS/CM switch in the 0.05 v/cm position, the vertical deflection factor for any other position of the switch will be within 3% of the panel reading for that switch position.

DC PREAMPLIFIER

accurately set with the VOLTS/CM switch in the 0.05 v/cm position, the vertical deflection factor for any other position of the switch will be within 3% of the panel reading for that position.

Input Impedance—Direct input impedance of the Type K is 1 megohm paralleled by 20 pf. Input impedance with the 10-X attenuator probe, furnished with Tektronix Fast-Rise Oscilloscopes, is 10 megohms paralleled by 8 pf. Other Probes, described in the Accessory Section, provide input capacitances from 12 pf to 2.5 pf, at attenuation ratios from 5 to 1 up to 100 to 1.

ELECTRON-TUBE COMPLEMENT

Input cathode follower		6AK5
Cathode-coupled amplifiers	2	12AU6
Output cathode followers	2	12AT7

MECHANICAL SPECIFICATIONS

Construction—Aluminum-alloy chassis.
Finish—Photo-etched panel.
Weight: Net—4 ½ pounds
Shipping—11 pounds approx.

Price **$135**

For low-capacitance accessory probes, please see the Catalog Accessory Section.

HIGH-GAIN PREAMPLIFIER

MAIN FEATURES

Deflection Factor

AC or DC-Coupled—0.05 v/cm.
9 calibrated steps from 0.05 v/cm to 20 v/cm.
AC-Coupled Only—0.005 v/cm.
10x gain amplifier switched in provides 9 calibrated steps from 0.005 v/cm to 2 v/cm.

Frequency Response and Risetime (0.05 to 40 v/cm)

Same as described for Type K.

Frequency Response and Risetime (0.005 to 4 v/cm)

Frequency specifications are at 3 db down
With Types 531A, 533, 535A —
3 cycles to 15 mc, 23 nsec.
With Type 536 —
3 cycles to 10 mc, 35 nsec.
With Type 532 —
3 cycles to 5 mc, 70 nsec.
With Types 541A, 543, 545A, 555, 581, 585—
3 cycles to 24 mc, 15 nsec.
With Type 551 —
3 cycles to 22 mc, 17 nsec.

Input Impedance—Direct input impedance of the Type L Unit is 1 megohm paralleled by 20 pf. Input impedance with the 10-X attenuator probe, furnished with Tektronix Fast-Rise Oscilloscopes, is 10 megohms paralleled by 8 pf. Other Probes, described in the Accessory Section, provide input capacitances from 12 pf to 2.5 pf, at attenuation ratios from 5 to 1 up to 100 to 1.

ELECTRON-TUBES AND SEMICONDUCTORS

* denotes "or equivalent"

Input cathode follower		6AK5
First amplifier		6AK5
Clamp		T12G*
Second amplifier		6AK5
Cathode follower		6AK5
Cathode-coupled amplifiers	2	12AU6
Output cathode followers	2	12AT7

MECHANICAL SPECIFICATIONS

Construction—Aluminum-alloy chassis.
Finish—Photo-etched panel.
Weight: Net—5 pounds
Shipping—11 pounds approx.

Price **$200**

Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).

TYPE N

GENERAL DESCRIPTION

Designed for use with Tektronix Plug-In Oscilloscopes, the Tektronix Type N Sampling Unit produces a bright display of repetitive high-speed signals. By taking successive samples at a slightly later time at each recurrence of the pulse, the Type N Unit reconstructs the pulse on a relatively long time base. Each sample taken becomes an image-retaining dot on the crt screen.

The Type N Unit provides stable displays with apparent sweep times of 1 nsec/cm (with 10-x magnifier, 100 picoseconds/cm). Delay range of 200 nsec (including display), permits observation of the complete waveform of pulses less than 200-nsec wide. Any portion of the waveform can be observed and measured accurately.

When sampling repetitive high-speed signals the spacing between pulses can vary. If the incoming signals are irregularly spaced, the pulses must be separated by 10 μsec or more. If the incoming signals are regularly spaced, the pulses can occur every 20 nsec.

OTHER CHARACTERISTICS

Sweep Range—a four-position switch, NANOSEC/CM, provides four equivalent sweep times of 1, 2, 5, and 10 nsec/cm (with the magnifier: 100, 200, 500, and 1000 psec/cm).

External Trigger—The Type N Sampling Unit requires an external trigger applied in advance of the signal. Two input connections are provided on the unit for this purpose. The REGENERATED TRIGGER INPUT minimum requirements for an external start-gate trigger include: repetition rate of 50 cps to 100 kc, 50% risetime of four nsec, amplitude of +10 volts, duration of 200 nsec, 40 nsec in advance of the signal. The TRIGGER INPUT minimum requirements for a conventional external trigger include: minimum duration of one nsec, amplitude from +0.5 to 2 volts, 45 nsec in advance of the signal, and repetition rate of 50 cps to approxi-

MAIN FEATURES

Risetime

Approximately 0.6 nsec (corresponding to approximately 600 mc).

Input Impedance

50 ohms.

Sensitivity

10 mv/cm (with 2 mv or less amplitude noise).

Dynamic Range

$\pm$120 mv, minimum linear range before overdriving occurs.

Accidental overload of $\pm$4 volts dc is permissible; higher voltage-pulsed overloads are permissible depending upon duty cycle.

Regulated Supplies

Transistor-regulated +20 v and −20 v dc supplies.

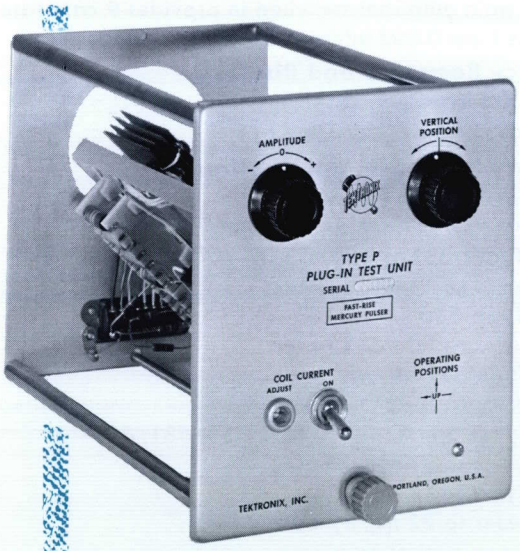
TYPE P

GENERAL DESCRIPTION

The Type P Plug-In Unit fills the need for a test-signal generator of known waveform. It can be used to standardize the main-unit vertical-amplifier transient response of Tektronix Type 540-550 Series Oscilloscopes. In addition, it is suitable for those Type 530 oscilloscopes incorporating a delay line in their vertical deflection system.

The Type P generates a fast-rise step-function test signal of a known waveform. This test signal simulates the output of an ideally compensated Type K Plug-In Unit that is driven with a Tektronix Type 107 Square-Wave Generator.

After standardization, a Type 540-Series Oscilloscope can be used in conjunction with a Type 107 Square-Wave Generator to standardize the transient response of amplifier-type plug-in units. Standardized oscilloscopes and plug-in units can be used interchangeably



PULSE SAMPLING UNIT

mately 50 mc. The recovery time is 10 μsec. Count down occurs above 100 kc. Satisfactory count down can be obtained up to about 50 mc.

Sampling Information—A four-position switch SAMPLES/DISPLAY, determines the number of image-retaining dots appearing on the screen of the cathode-ray tube during one display. The number of dots or samples per display can be 50, 100, 200, or 500. The sampling rate extends from 50 cycles to 100 kilocycles.

MECHANICAL SPECIFICATIONS

Construction—Aluminum-alloy chassis.
Finish—Photo-etched anodized panel.
Weight: Net—9 pounds.
Shipping—13 pounds approx.

Price **$600**

Includes: 1—Unblanking cable and transformer (012-052)
1—External horizontal input cable (012-054)
1—X2 T attenuator 50 Ω (017-003)
1—X5 T attenuator 50 Ω (017-002)
1—X10 T attenuator 50 Ω (017-001)
1—10 nsec 50 Ω coax cable RG58A/U with G.R. connectors (017-501)
1—5 nsec 50 Ω coax cable RG8A/U with G.R. connectors (017-502)
2—1 nsec 50 Ω coax cables RG58A/U with G.R. one end only (017-503)
1—Instruction manual

Optional Equipment

Not supplied as accessories for the Tektronix Pulse Sampling System but available as optional equipment at additional cost are the following:

Master Slave Patch Cord—For dual-beam operation with Tektronix Type 551 and Type 555 Oscilloscopes.
ORDER PART NUMBER 012-055 . . . . . $3.75

Calibrator Adapter—To provide a 50 Ω calibrated signal from oscilloscope calibrator.
ORDER PART NUMBER 017-010 . . . . . $15.00

Timing Standard—For calibrating "N" Sweep Speeds.
ORDER PART NUMBER 013-028 . . . . . $60.00

Tunnel Diode Risetime Tester.
ORDER PART NUMBER 013-029 . . . . . $50.00

FAST-RISE TEST UNIT

MAIN FEATURES

Risetime—When the Type P is used to standardize a Type 540-Series Oscilloscope, risetime of the Type P is approximately 4 nanoseconds (.004 μsec).

Repetition Rate—240 pulses per second.

Polarity—Either positive or negative.

Amplitude—Continuously adjustable from 0 to 3 major graticule divisions.

without readjustment of the high-frequency compensating circuits.

As a result of component aging, particularly tubes, the transient response of an electronic amplifier changes over a period of time. In contrast, the Type P maintains stable waveform characteristics through its precise Tektronix circuit constants. Ordinary measuring equipment will verify circuit values should the output waveform be in doubt.

MECHANICAL SPECIFICATIONS

Construction—Aluminum-alloy chassis.
Finish—Photo-etched panel.
Weight: Net—3 ½ pounds.
Shipping—10 pounds approx.

Price **$90.00**

Price f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).

TYPE Q TRANSDUCER

MAIN FEATURES

Carrier Frequency—25 kilocycles.

Risetime—60 μseconds, (approximately).

Frequency Response—DC to 6 kilocycles.

Strain Sensitivity—Calibrated in ten steps from 10 microstrain (microinches per inch) per major graticule division to 10,000 microstrain per division. Uncalibrated, the sensitivity is variable between steps. The above condition applies to the Type Q Unit when used with a single strain gage having a gage factor of approximately 2. With four active arms and a gage factor of 2, the maximum sensitivity is 2.5 microstrain per division.

Attenuator Accuracy—When set accurately in any one step, the accuracy in any other position is within two percent of the panel reading.

Noise—The peak-to-peak noise is typically equivalent to 1.5 microstrain at maximum calibrated sensitivity. This approximates an rms noise of 0.5 microstrain.

Drift—The amplification system is essentially drift free. The overall system drift is primarily a function of the transducer stability.

GENERAL DESCRIPTION

The Type Q Plug-In Unit permits any Tektronix Type 530, 540, or 550, Series Oscilloscope to be operated with strain gages and other transducers. Designed to measure any mechanical quantity that can be converted to a change in resistance, capacitance, or inductance—through use of a suitable transducing device—this versatile unit provides high gain, low noise, and extremely low drift. Suppressed-carrier amplitude modulation is produced by unbalancing an ac bridge with the strain gages or other transducers. Phase-sensitive demodulation produces the proper deflected-trace direction.

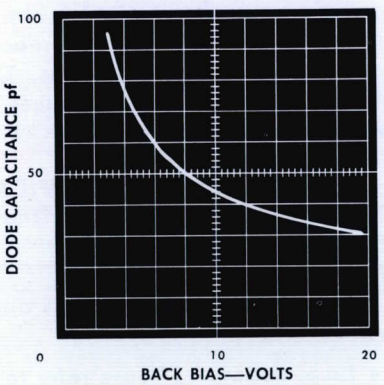
Completely self-contained and requiring no external equipment other than the strain gages or transducers operated with it, the Tektronix Type Q Plug-In Unit bridges the gap between mechanical engineering and electronic instrumentation. Total range of applications is as broad as the mechanical field itself. Applications include stress analysis, vibration studies, and fatigue tests. Typical quantities that can be measured with the unit are force, displacefent, acceleration, and strain.

OTHER CHARACTERISTICS

Equivalent DC Sensitivity—The Type Q Unit is an impedance sensing preamplifier rather than a voltage sensing device. A comparable dc amplification system would require approximately 10 microvolts per division sensitivity for the same amount of power applied to the input bridge.

Resistance Bridge Balance—Range of control allows sufficient compensation for most standard transducers and strain gages.

Gage Resistance Range—With cable lengths to 100 feet, the useful range of gage resistance extends from approximately 50 ohms to 2000 ohms. For optimum performance, the recommended range is between 120 ohms and 500 ohms.



Dynamic plot of the depletion-layer capacitance of a back-biased diode.

Transducer Cable—In most applications, either 3-wire or 4-wire shielded microphone cable gives the best results. Long-lead applications utilizing more than 20 feet of cable require two or four bridge arms at the transducer end of the cable.

Calibration—A push-button switch connects a calibrator resistor across the strain gage electrically to simulate an external mechanical strain. The calibration resistor supplied with the Type Q Unit simulates a—400 μstrain unbalance of the bridge, suitable for most strain gage applications. As with the 120-ohm internal bridge resistor, the 150-k calibration resistor is mounted on a handy plug-in receptacle.

To aid in calibration, a nomograph is included in the instruction manual. This nomograph relates calibration of the supplied resistor to gage factors and strain gage resistances.

No special gage dial is necessary for the unit.

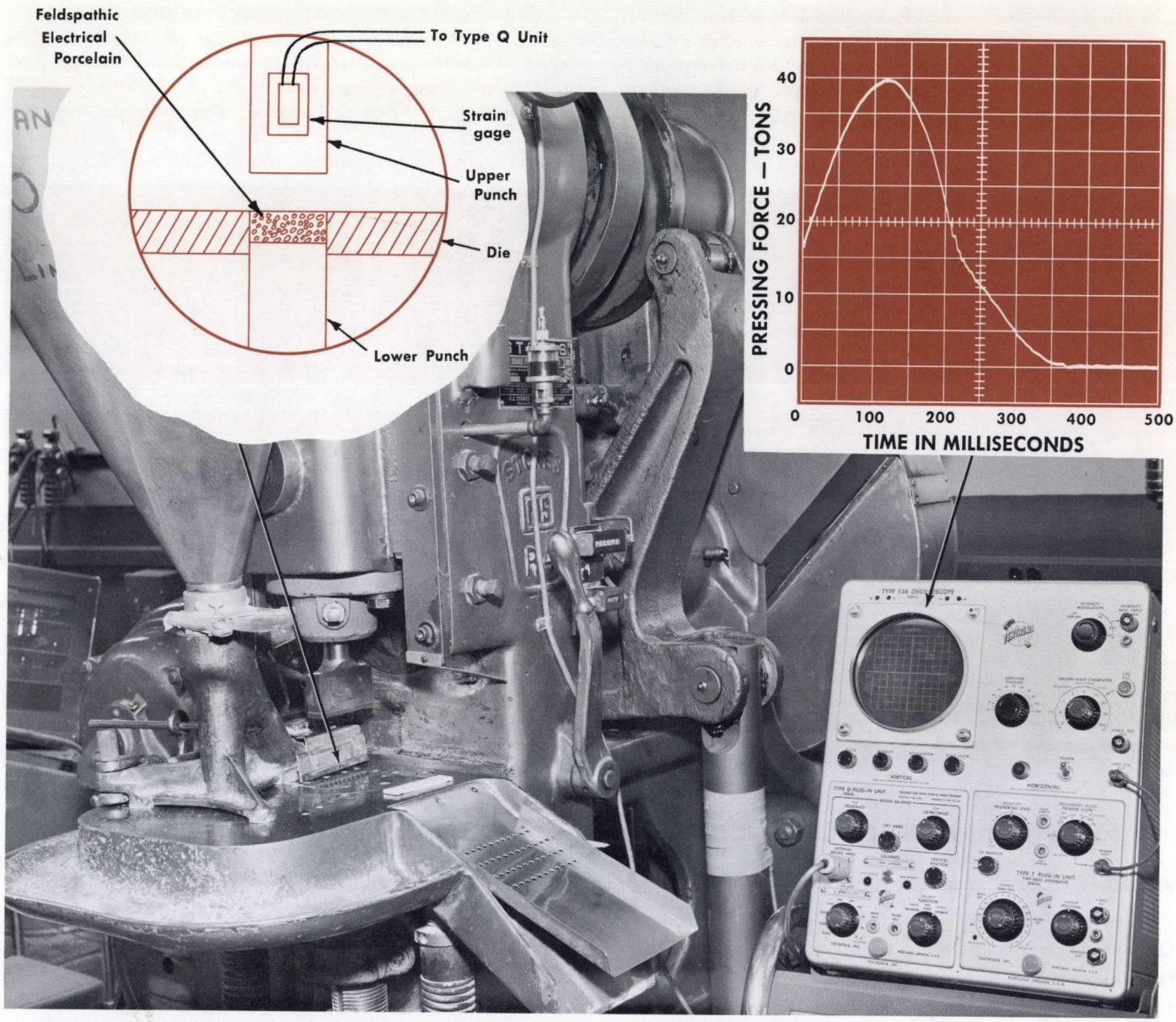
To include the gage factor in the calibration, merely increase or decrease the amplifier gain proportionally.

Capacitance Bridge Balance—Range of control allows sufficient compensation for an unbalance of 250 pf across any external resistive arm of the input bridge.

Polarity Inversion—For convenience in reading the display, the two-position switch allows the demonstration to appear normal or inverted.

TEKTRONIX TYPE Q PLUG-IN UNIT

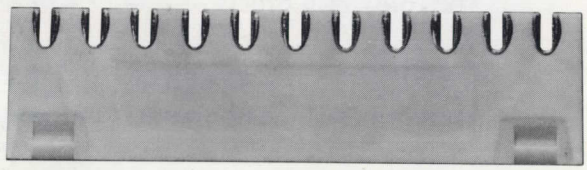
Strain-Gage Application



Ceramic strips currently being used in Tektronix Oscilloscopes and auxiliary instruments are formed by compressing feldspathic electrical porcelain in a die cavity. The strips are then fired in high-temperature kilns and glazed. Silvered notch areas are fired on over the glaze and pre-tinned for easy soldering with just a touch of a small iron.

During the firing operation in the kiln, the green strip shrinks approximately eight percent. Allowable tolerance on length is only one-third of one percent. Using the Tektronix Type 536 Oscilloscope and the Type Q Plug-In Unit, the monitor checks the pressing force on each strip as it is being formed. This assures uniform strips which will not fracture under stress, shock, or vibration. The Type Q Unit can be used with any Tektronix Plug-In Oscilloscope for applications similar to this.

Tektronix ceramic terminal strips are manufactured in seven sizes. The above picture illustrates one of many quality-control processes used to check the 11 notch, 2 yoke ceramic strip. Identical quality-control procedures are used during production of the other strips.



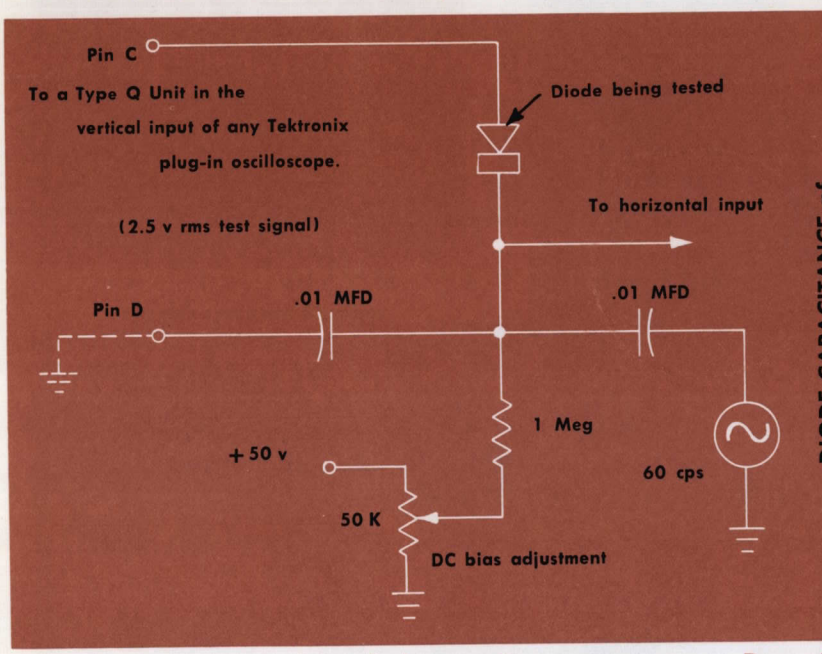
Actual size of Tektronix 11 notch Ceramic Strip.

TEKTRONIX TYPE Q PLUG-IN UNIT

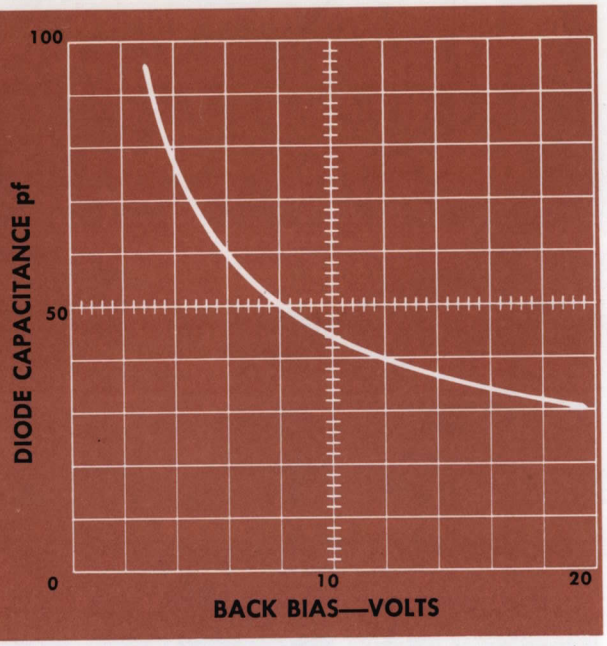
Diode-Capacitance-Measurement Application

The depletion-layer capacitance of a back-biased p-n junction is of interest in the semiconductor field from two standpoints. In high-frequency diodes and transistor collector junctions, a knowledge of the capacitance is needed to predict the high-frequency performance. In other applications, the diode capacitance is used because it is voltage variable. This property allows the diode to be used as a modulator, as a control element in automatic frequency control systems, and as a remote tuning control.

The circuitry shown allows one to plot the capacitance curve rapidly and accurately. A set-up of this type is particularly useful in production testing and matching. Measurement accuracy is slightly affected by the Type Q Unit test signal. The magnitude of the test signal delivered by the Type Q Unit can be reduced with a small amount of additional circuitry.



External circuitry required for diode capacitance measurements.



Dynamic plot of the depletion-layer capacitance of a back-biased diode.

ELECTRON TUBES & SEMICONDUCTORS

Amplifiers	3	12AX7
Oscillator		6AU6
Oscillator Power Amplifier		6CG7
Oscillator Regulator		12AX7
Oscillator Regulator Diode		T12G
Output Cathode Follower		12AU7
Demodulator Cathode Follower		12AU7
Demodulator Diodes	8	T12G

MECHANICAL SPECIFICATIONS

Construction—Aluminum-alloy chassis
Finish—Photo-etched panel
Weight—5 pounds
Price ..... **$300.**

Includes:

1 120 Ω internal bridge resistor assembly
1 150-k calibration resistor assembly
1 4-wire shielded connecting cable
1 Instruction manual

Price f.o.b. factory

Tektronix, Inc.

P. O. Box 831 • Portland 7, Oregon
Phone CYpress 2-2611 • TWX-PD 311 • Cable: TEKTRONIX

TEKTRONIX FIELD OFFICES: Albertson, L. I. N.Y. • Albuquerque, N. M. • Annandale, Va. • Atlanta, Ga. • Buffalo, N.Y. • Cleveland, Ohio • Dallas, Tex. • Dayton, Ohio • Denver, Colo. • Endwell, N.Y. • Greensboro, N. C. • Houston, Tex. • Lathrup Village, Mich. • Lexington, Mass. • East Los Angeles, Calif. • West Los Angeles, Calif. • Minneapolis, Minn. • Mission, Kan. • Orlando, Fla. • Palo Alto, Calif. • Park Ridge, Ill. • Philadelphia, Pa. • San Diego, Calif. • St. Petersburg, Fla. • Scottsdale, Ariz. • Stamford, Conn. • Syracuse, N.Y. • Towson, Md. • Union, N. J. • Willowdale, Ont., Canada.

TEKTRONIX ENGINEERING REPRESENTATIVES: Hawthorne Electronics; Portland, Oregon, Seattle, Washington.

Tektronix is represented in 20 overseas countries by qualified engineering organizations.

A-1091 Printed in USA 1/60

AND STRAIN GAGE UNIT

Phase Adjustment—To increase versatility of the unit, the control permits either resistive or reactive transducer applications to be displayed.

External Bridge—The number of external resistive arms required for strain gage and transducer applications varies from one to four. The versatile Type Q Unit can be used for any of these applications. The input circuit for the Type Q Unit is an ac bridge. The number of external arms required for strain gage and transducer applications varies from one to four. These external transducers become one or more of the input bridge arms. Excitation voltage for the bridge is obtained from a 25-kc oscillator in the Q unit. Total bridge voltage is approximately 5 v rms, regulated.

A five-position switch allows selection of the number of external arms from zero to four. The zero position of the switch permits a quick check of the instrument under normal operation without an external transducer. In addition, the zero position completes the resistive bridge for capacitive transducer applications.

The one-arm position of the switch is used for the simplest type of strain gage application. In this position, an internal bridge resistor is needed to match the value of the single external bridge arm. Standard value of this resistor supplied with the Type Q Unit is 120 ohms. The two-arm and four-arm positions of the switch are used for transducer applications necessitating temperature stability.

Capacitance Measurement—The Type Q Unit can be calibrated for direct reading in capacitance from 1 pf per division to a maximum value of 1000 pf without using a correction curve. Using a correction curve, the range can be extended to 10,000 pf per division. These specifications apply when using the internal 120-ohm bridge circuit. With a 1000-ohm external circuit, the lower limit can be extended to 0.2 pf per division.

Please note that the standard capacitor and test jig are not supplied with the unit.

Capacitance Transducers—Using a capacitance transducer in conjuction with a four-arm resistive bridge results in the following maximum useful sensitivities:

120-ohm bridge (available internally) . . . 1 pf/div
1000-ohm bridge . . . . . 0.2 pf/div

Useful sensitivities are slightly lower when using long cables.

Inductive Transducers—Although the Type Q Unit will function in conjuction with inductive transducers, differential transformers designed for use at 60 cps are only partially satisfactory when used at 25 kc. Special internal provision for balancing inductive transducers is not included in the unit.

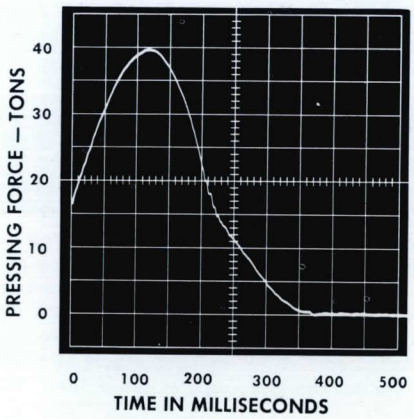
MECHANICAL SPECIFICATIONS

Construction—Aluminum-alloy chassis
Finish—Photo-etched panel
Weight: Net—5 pounds
Shipping—12 pounds approx.

Price . . . . . **$300.**

Includes: 1—120 Ω internal bridge resistor assembly (013-025)
1—150-k calibration resistor assembly (013-026)
1—4-wire 15' shielded connecting cable (012-040)
1—Instruction manual

Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).



Pressing force can be accurately controlled by using the Type Q Unit.

MAIN FEATURES

GENERAL DESCRIPTION

The Type R Transistor Risetime Unit can be used in all Tektronix Type 530, 540 and 550 Series Oscilloscopes when operated on 50 to 60 cycle line frequency. It supplies a fast-rising pulse and the required supply and bias voltages for measurement of transistor rise, fall, delay, and storage times.

Risetime of the pulse supplied by the Type R is less than 5 nanoseconds, therefore measurement limitations will depend mainly on the risetime of the oscilloscope used. Overall risetimes with the oscilloscopes are as follows:

Types 541A, 543, 545A, 555, 581, 585—12 nsec
Type 551—14 nsec
Types 531A, 533, 535A—23 nsec
Type 536—35 nsec
Type 532—70 nsec (The Type 532 and Type 536 have an additional limitation in the lack of signal delay in the main vertical amplifier).

OTHER CHARACTERISTICS

Collector Supply—Positive and negative voltage, 1 v to 15 v continuously adjustable is available from a tran-

Collector Supply

1 to 15 v continuously variable, positive or negative.

Current Capability—400 ma.

Mercury-Switch Pulse Generator

Risetime—less than 5 nsec.

Amplitude—0.02 to 10 v across 50 ohms, positive or negative.

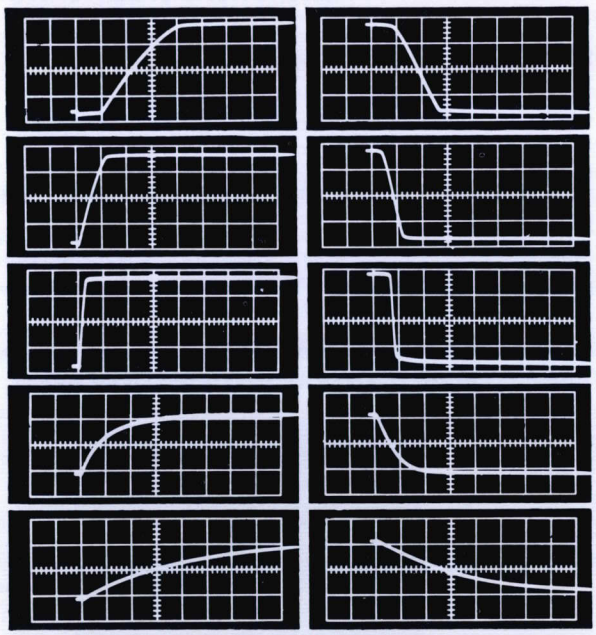
Bias Supply

−0.5 v to +0.5 v and −5 v to +5 v, continuously variable.

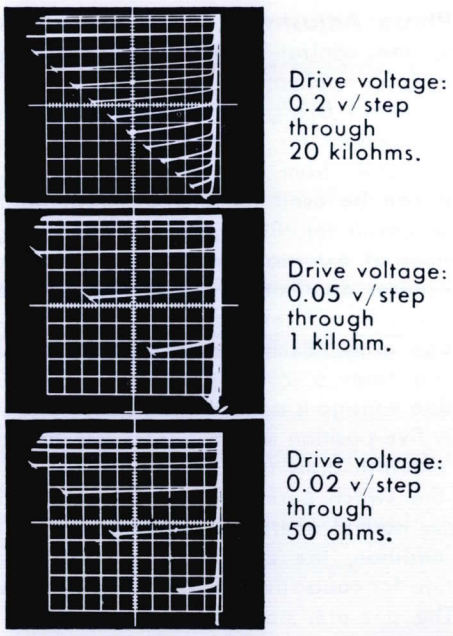
Current Capability—±100 ma.

Calibrated Vertical Deflection

0.5, 1, 2, 5, 10, 20, 50, and 100 ma/cm collector current.

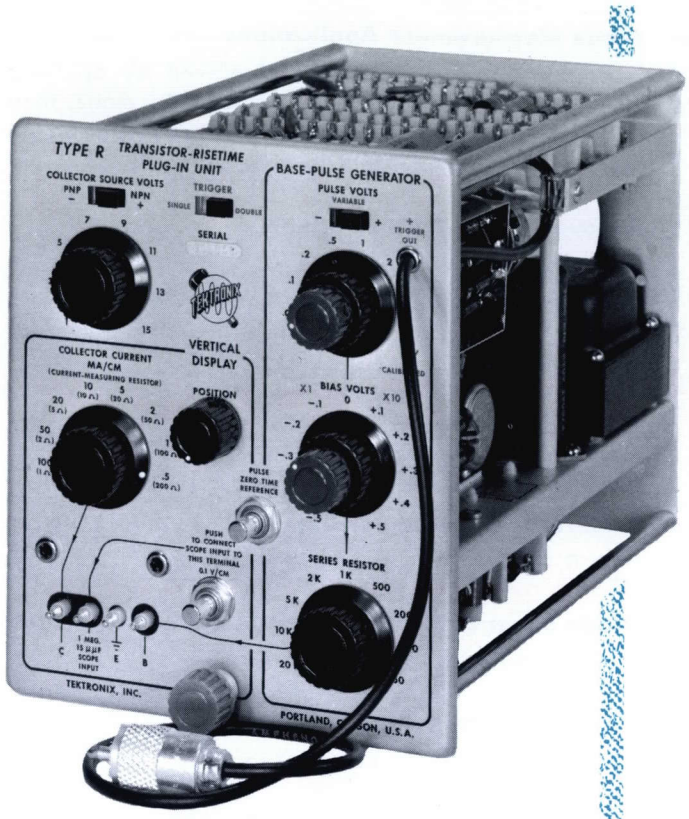


High-frequency characteristics of a transistor under five different conditions of drive. In each pair, the photograph at left shows delay time and rise time, the start of the driving pulse coinciding with the 2-cm graticule line. The second photograph of each pair shows storage time and fall time, the end of the pulse coinciding with the 2-cm line. The Type R Unit plugged into a Tektronix Type 543 Oscilloscope—3.5-v collector supply, 500-ohm collector load, 2-ma/div vertical calibration, 0.5-μsec/div sweep rate. Driving conditions at left of each pair.



Low-frequency characteristics of the same transistor under driving conditions paralleling those of the first three pairs at left. Family of curves photographed on a Tektronix Type 575 Transistor-Curve Tracer—0.5-v/div horizontal calibration, 1-ma/div vertical calibration, 500-ohm load line. Driving conditions at right of each photograph.

TRANSISTOR-RISETIME UNIT



sistor-regulated supply. Vertical display is calibrated in ma/cm of collector current, 0.5, 1, 2, 5, 10, 20, 50, and 100 ma/cm. Connectors are provided for inserting an external resistor in series with the collector.

Pulse Generator—A transistor-regulated 10 v dc power supply is chopped by a mercury switch, providing a 120-c/sec test pulse with a risetime of less than 0.005 μsec. The pulse is applied to the transistor under test through a π attenuator with an output impedance of 50 ohms. Sixteen amplitude steps are provided: +0.05, +0.1, +0.2, +0.5, +1, +2, +5, +10v and −0.05, −0.1, −0.2, −0.5, −1, −2, −5, −10v. A vernier (uncalibrated) control fills in between steps.

Bias Supply—Bias voltage is available for base or emitter in two ranges, −0.5 v through zero to +0.5 v and −5 v through zero to +5 v. Bias supply is transistor regulated.

Base Series Resistors—The base driving resistance can be selected from nine values—50, 100, 200, 500 ohms, 1, 2, 5, 10, and 20 kilohms.

Reference Displays—Zero time reference can be displayed by means of a pushbutton. Another pushbutton permits observation of the voltage on the transistor collector or base, through use of external connections. Amplifier sensitivity for these displays is 0.1 v/cm.

Triggering—A positive constant-amplitude trigger for the oscilloscope sweep is furnished through a short coaxial cable permanently attached to the Type R Unit.

The oscilloscope sweep can be triggered on the rise of the test pulse only, or on both the rise and fall for displaying delay, rise, storage, and fall times simultaneously.

ELECTRON TUBES & SEMICONDUCTORS

* denotes "or equivalent"

Amplifiers	2	12AU6
Amplifiers		12AT7
Trigger output amplifier	2	12AU6
Trigger output amplifier		12AT7
Regulator amplifier		2N121*
Regulator amplifiers	3	2N544*
Regulator amplifiers	2	2N270*
Rectifiers	9	1N1566*
Series regulators	4	2N301*

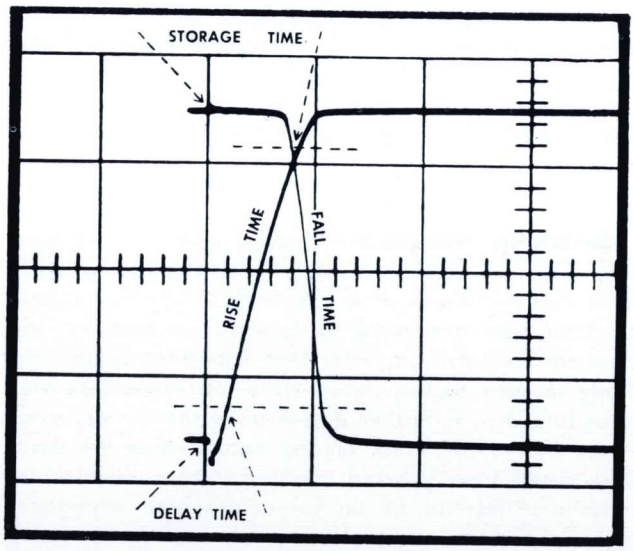
MECHANICAL SPECIFICATIONS

Construction—Aluminum-alloy chassis.
Finish—Photo-etched panel.
Weight: Net—8 pounds
Shipping—14 pounds approx.

Price **$300**

Includes: 1—Grounded emitter small transistor socket (386-852)
1—Grounded base small transistor socket (386-853)
10—Contact clips (344-023)

Price f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).



The Type R Unit can trigger the Oscilloscope sweep either on the start of the test pulse only, or on both the start and finish to display delay, rise, storage, and fall times simultaneously.

MAIN FEATURES

Diode Measurement Applications

Recovery characteristics are displayed by applying calibrated forward-current through the diode, then abruptly turning off this current and establishing a calibrated, constant, reverse current.

Recovery-Time Measurement

Accurate—to 30 nsec.

Comparative—to 15 nsec.

Predicted—limited only by the forward-reverse current ratio.

Calibrated Forward Currents

1, 2, 5, 10, and 20 milliamps.

Calibrated Reverse Currents

0, 0.1, 0.2, 0.5, 1, and 2 milliamps.

Diode Shunt Capacitance

9 picofarads at 0.5 v/cm.

Amplifier Sensitivity

0.05 v/cm and 0.5 v/cm, calibrated.

GENERAL DESCRIPTION

The Type S Unit enables you to display semiconductor-diode switching characteristics on your Tektronix Plug-In Oscilloscope. With Tektronix Type 540-Series, Type 550-Series, and Type 580-Series* Oscilloscopes you can find:

Carrier Recombination—Effective lifetimes to 2 nanoseconds.

Stored Charge—To 10 picocoulombs.

Capacitance—Junction capacitance to 2 picofarads.

Resistance—Bare (bulk) resistance to about ¼ ohms.

The Type S Unit describes the diode in terms of its parameters, while most other currently employed methods describe the diode in terms of its performance in a particular circuit—not necessarily the one in which it will be used. With the Type S method you can predict the behavior of many diodes in many circuits, as well as compare diodes for performance in a particular circuit.

Since the Type S method is a means for plotting voltage across an element while passing constant current through that element, it can also be used to observe the junction characteristics of transistors and to measure the resistance, capacitance, and inductance of other circuit components.

Note: Risetime of the Type S Unit depends on the capabilities of the oscilloscope with which it is used, therefore the ability to analyze fast diodes with Tektronix Type 530-Series Oscilloscopes will be affected by the lower risetimes of these instruments.

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

Switching Transient—A large switching transient occurs in the voltage waveform appearing across a semiconductor diode when the diode is abruptly switched from non-conduction to forward conduction. This transient indicates an initial high impedance across the diode as well as the steady-state low impedance well after turn on. A further deviation in the device action (from that of an ideal diode) occurs when the diode is switched from forward conduction to a reverse-bias condition. Instead of an immediate high impedance across the diode, a momentary low impedance condition exists. These switching characteristics are readily apparent with the Type S Plug-In Unit installed in a Tektronix fast-rise oscilloscope, and the contributing factors can be separated and analyzed.

Base (or Bulk) Resistance—The curves in Figures 3 & 4 show a sudden decrease in diode terminal voltage when forward current is switched off. This decrease occurs with disappearance of the voltage drop across the diode due to ohmic base resistance. The value of this base resistance can be determined, since the voltage drop across it for a given forward current can be measured. As shown in Figures 3 &4, this base resistance decreases as forward current increases.

Stored Charge at the Junction—After the initial terminal-voltage drop, the voltage remaining is due to minirity carriers stored in the junction. These stored carriers must be removed before the diode can assume its steady-state reverse characteristics. When this stored charge is cleared, the reverse diode voltage increases rapidly, as long as reverse current flows, at a rate determined only by the reverse current and the capacitance at the terminals.

Recombination of Current Carriers—As shown in Figures 1 & 2, the time required to clear the stored charge at reverse current of 2 ma is half the time it takes at 1 ma. Simply multiplying reverse current by the time it flows before removal of the charge yields the amount of stored charge. However, as reverse current decreases, the time required to rmove the charge does not increase proportionally. Some other agent—namely, recombination of current carriers—removes part of the charge.

DIODE RECOVERY UNIT

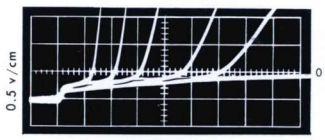
REFERENCE position is provided to establish a true zero voltage reference trace.

MECHANICAL SPECIFICATIONS

Construction—Aluminum-alloy chassis.
Finish—Photo-etched anodized panel.
Weight: Net—4 pounds
Shipping—10 pounds approx.

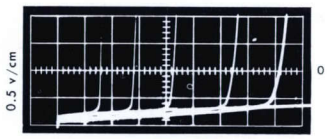
Price **$250.00**

Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).



0.1 μsec/cm

Fig. 1—Diode A

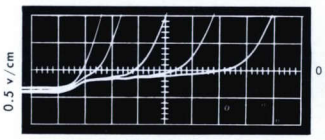


2 μsec/cm

Fig. 2—Diode B

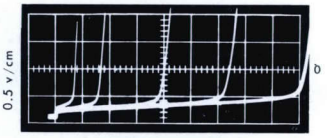
I forward—10 ma. I reverse—2, 1, 0.5, 0.2, 0.1, 0 ma.

Observation of the recovery curves of Figures 1 & 2 shows both reverse current and recombination accounting for removal of the stored charge. It is thus possible to determine not only the stored charge for any of the five forward currents available, but also the rate of recombination. With this information, it is possible to predict diode action to fast transients in any circuit.



0.02 μsec/cm

Fig. 3—Diode A

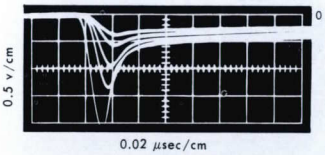


0.5 μsec/cm

Fig. 4—Diode B

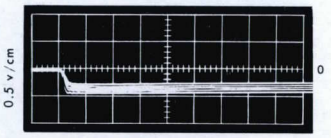
I forward—1, 2, 5, 10, 20 ma. I reverse—2 ma.

Observation of the recovery curves of Figures 3 & 4 shows that the amount of stored charge is proportional to forward current while the recovery time is so short that negligible recombination occurs. Under this condition, after the stored charge is cleared the reverse bias increase is limited only by the diode capacitance (and the shunt capacitance of the instrument). This rate of increase is easily measured at a particular reverse voltage, and thus, the diode capacitance at that voltage can also be determined.



0.02 μsec/cm

Fig. 5—Diode A



0.02 μsec/cm

Fig. 6—Diode C

Turn-on — magnified. I forward — 1, 2, 5, 10, 20 ma.

Observation of the turn-on characteristics of Figures 5 & 6 shows that the voltage drop across a diode suddenly switched on is not always initially as low as the steady-state drop. It is important to remember that the leading edge of any fast transient passed by a diode may be modified by this phenomenon.

NOTE: The above waveform photos are multiple exposures.

OTHER CHARACTERISTICS

Fast-Rise Mercury Switch—Inherent risetime of the mercury switch in the unit is 3 nsec. The switching transient is applied to a fast vacuum tube circuit which shapes the waveform for use as the actual switching signal. Repetition rate is approximately 300 pps for turn-on measurements and approximately 600 pps for recovery measurements.

External Triggering Signals—The Type S Unit supplies an external triggering signal to the associated oscilloscope through its attached coaxial cable. Polarity of the external triggering signal is held constant at an amplitude of approximately 1 volt. This allows the TRIGGER SLOPE Switch on the oscilloscope to remain in the —EXT. position.

Eleven Calibrated Currents—Two switches, FORWARD CURRENT and DIODE MODE, provide eleven calibrated currents: the forward currents range from 1 to 20 milliamps, and the reverse currents range from approximately zero to 2 milliamps.

Vertical Deflection Factors—Two calibrated SENSITIVITY switch positions are provided on the unit: 0.5 v/cm and 0.05 v/cm. In the 0.5 v/cm position, the total diode shunt capacitance is approximately 9 pf. In the 0.05 v/cm position, the total diode shunt capacitance is approximately 16 pf. In addition, a ZERO

TYPE T

GENERAL DESCRIPTION

The Type T Time-Base Generator Plug-In Unit is intended to provide sawtooth sweep voltages to drive the horizontal-deflection system in the Type 536 Cathode-Ray Oscilloscope. This plug-in unit can also be used in the vertical-deflection system of any of the Tektronix Type 530, 540 and 550 Series Oscilloscopes. The Type T unit provides the Type 536 with a wide range of sweep rates for use in the usual oscilloscope applications. Trigger shaping and dc-coupled unblanking circuits are included in the Type T Unit.

HORIZONTAL-DEFLECTION SYSTEM

Calibrated Sweep Rates—The Type T Unit has 22 calibrated sweep rates: 0.2, 0.5, 1, 2, 5, 10, 20, 50 μsec/div—0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50 millisec/div—0.1, 0.2, 0.5, 1, and 2 sec/div. A single 22-position switch is used. In addition, a vernier (uncalibrated) control provides continuously variable sweep rates from 0.2 μsec/div to 6 sec/div. Calibration accuracy of the fixed sweep rates will typically be within 1% of full scale, and in all cases will be within 3%.

Sweep Magnifier—When the 5-x magnifier is switched in, the center two-division portion of the normal sweep is expanded to the left and right of center to fill ten divisions. The POSITION control has sufficient range to display any one-fifth of the magnified sweep. Magnifier increases the calibrated sweep rate to 0.04 μsec/div. Accuracy is within 5% of the displayed portion of the magnified sweep.

MAIN FEATURES

Wide Sweep Range

Twenty-two calibrated sweep rates from 0.2 μsec/div to 2 sec/div.

5-x magnifier, accurate on all ranges.

Versatile Triggering

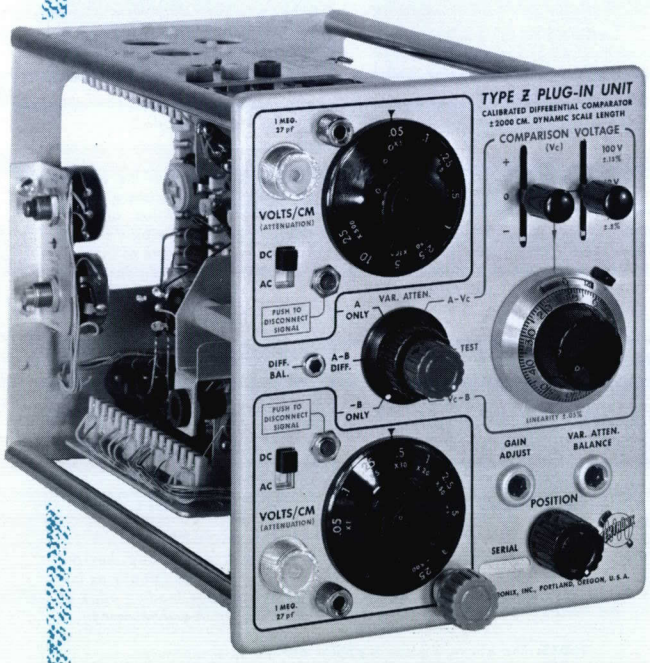
Line, external, ac or dc-coupled, automatic triggering, high-frequency sync.

DC-Coupled Unblanking—When the unit is plugged into the Type 536 Oscilloscope horizontal amplifier, the unblanking waveform is dc-coupled to the control grid of the crt. Uniform bias is assured for all sweep and repetition rates.

Output Waveforms—A 20-v positive-gate waveform of the same time duration as the sweep, and a 150-v positive-going sawtooth waveform are available at front-panel connectors.

Triggering Facilities—Versatile triggering circuitry provides for complete manual control, preset stability control, and fully automatic triggering.

TYPE Z



GENERAL DESCRIPTION

The Type Z Plug-in Unit is designed to extend the accuracy of oscilloscope voltage measurements. Highly adaptable, the unit can be used in three modes of operation: (1) as a conventional preamplifier, (2) as a differential-input preamplifier, or (3) as a calibrated differential comparator. Sensitivity is 50 mv/cm. Dynamic range is ±100 volts. The effective scale length is ±2000 cm—hence, the resolution is a maximum of 0.005%. The high accuracy of the dc comparison voltage assures precise voltage measurements.

With the Type Z in a Tektronix plug-in oscilloscope, calibrated ±dc comparison voltages can be added differentially to the input waveform via the slide-back technique. Input waveform can have an instantaneous rate of rise to 1 volt in 7 nsec, and an instantaneous rate of fall to 1 volt in 5 nsec. A 100-volt waveform can be displayed incrementally with high resolution (of 0.05 v/cm).

The dynamic range of the unit permits common-mode signals up to 100 volts to be applied to the amplifier without attenuation. The common-mode rejection ratio

TIME-BASE GENERATOR UNIT

Amplitude-Level Selection—Adjustable amplitude-level and stability controls provide for triggering the sweep at a selected amplitude level on the triggering waveform. Trigger source can be external, line frequency, or the signal under observation by external connection to the oscilloscope VERT. SIG. OUT terminal, either ac or dc-coupled. The triggering point can be on either the rising or falling slope of the waveform.

Preset Stability—Same as above, except the stability control is preset to the optimum triggering point and requires no readjustment.

Automatic Triggering — Automatic level-seeking trigger circuit provides dependable triggering for most applications with no trigger-control adjustments. Range of automatic operation is between 60 cycles and 2 megacycles, approximately. In the absence of an input signal the sweep is automatically triggered at about a 50-cycle rate, providing a reference trace on the screen.

High-Frequency Sync—Assures a steady display of sine-wave signals up to approximately 15 megacycles. Requires a signal large enough to cause about 2 cm of deflection, or an external signal of about 2 v.

Trigger Requirements—A signal of 0.2 v to 50 v is required.

MECHANICAL SPECIFICATIONS

Construction—Aluminum-alloy chassis.
Finish—Photo-etched panel.
Weight: Net—5½ pounds
Shipping—11 pounds approx.

Price **$235**

Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).

DIFFERENTIAL COMPARATOR UNIT

of 40,000 to 1 allows measurement of differential signals less than 50 millivolts. Larger signals can be attenuated if they do not exceed the dynamic range of the unit.

MEASUREMENT APPLICATIONS

AC and DC VTVM—

Measure ac signals with the same accuracy as dc signals—typically 0.2% within the bandwidth capabilities of the unit.

DC-Coupling

Eliminate "floating oscilloscope" operation.

Observe small ac signals in the presence of large dc components—for example, low-frequency signals on plate amplifiers or power-supply fluctuations to 0 cps.

Measure both dc and signal levels.

Semiconductor Characteristics—

Measure Zener diode ac admittances and Zener voltage together.

Measure transistor output impedance h_{oe} or h_{ob}.

High Amplitude Hum Rejection—

Reject up to 200 volts peak-to-peak common-mode hum.

Pulse-Height Analysis—

Reject any pulse below a preset dc level.

Fast-Recovery Amplifier—

Monitor wide dynamic range signals.

Observe small signals present, during, or following a large pulse—for example, ultrasonic delay line testing or amplifier overload testing.

Modulation Monitor—

Measure residual amplitude modulation on a carrier, hum noise, etc., or incidental amplitude modulation on an FM or PM signal.

Component Matching—

Use differentially as a null detector in bridge setups, with high resolution of the null.

Time-Base or Staircase Comparisons—

Compare incremental linearity of ramps and staircases with high precision.

TYPE Z, TYPE 127

AS A CONVENTIONAL PREAMPLIFIER

Sensitivity—

0.05 volts/cm to 25 volts/cm in 9 calibrated steps.

Attenuation—

Constant input impedance turret attenuators.

9 turret positions provide attenuation of X1, X2, X5, X10, X20, X50, X100, X200, and X500.

Frequency-compensating adjustment provided on the front panel.

Variable Gain—

The 2.5 to 1 ratio control extends sensitivity to over 60 volts/cm.

Risetime—

24 nsec for signals that do not overscan the screen.

Passband (at 3 db down)—

with Types 531 and 535—dc to 9 mc;

with Type 532—dc to 5 mc;

with Types 531A, 533, and 535A—dc to 10 mc;

with Types 540 Series, 555, and 580 Series (with Type 81 Plug-In Adapter)—dc to 13 mc.

Input Impedance—

1 megohm paralleled by approximately 24 pf.

Signal Disconnect Control—

Pushbutton switch allows momentary removal of the signal to establish a zero level.

AS A DIFFERENTIAL INPUT PREAMPLIFIER

(at full sensitivity—5 mv/cm)

Common-mode Signal Level—

$\pm$100 volts.

Common-mode Rejection—

40,000 to 1, minimum (common-mode gain/differential input gain).

200 volts peak-to-peak or $\pm$100 volts common-mode signal produces a maximum of 1 mm of vertical deflection, equal to 5 mv of differential input signal.

Rate of Change—

The input signals must not exceed +1 volt in 7 nsec (to avoid grid current), or —1 volt in 5 nsec.

AS A CALIBRATED DIFFERENTIAL COMPARATOR

Comparison Voltages—

Three voltage ranges are provided: from zero to $\pm$1 volt, from zero to $\pm$10 volts, and from zero to $\pm$100 volts.

TYPE 127 POWER SUPPLY

GENERAL DESCRIPTION

The Tektronix Type 127 supplies proper operating power to one or any combination of two Tektronix Type A to Z Plug-In Preamplifiers. Tektronix Plug-In Preamplifiers, powered by the Type 127, can be used to further increase the signal-handling versatility of Tektronix oscilloscopes employing Type A to Z Plug-In Preamplifiers. Double-differential dual-trace display can be obtained by employing 2 Type D, E, or G Differential Plug-In Preamplifier Units in the Type 127 in conjunction with an oscilloscope using a Type C-A Dual Trace Plug-In Unit. The Type 127 also facilitates the use of Tektronix Plug-In Preamplifiers in other applications.

CHARACTERISTICS

Balanced Output—The outputs of Plug-In Units powered by the Type 127 are fed through dc-coupled differential amplifier stages and cathode followers to provide a push-pull signal at the output terminals. Risetime of the unit is 18 nsec, permitting maximum utilization of the response of Tektronix Type 530-Series Oscilloscopes. Output swing is linear $\pm$3% over a range of $\pm$0.3 volt. Output dc operating levels are adjustable to ground potential.

Gain—The Type 127 has a gain of one, push-pull. With single-ended output, gain is one-half.

Output Terminals—Each channel has four output terminals, two on the front panel and two at the rear. Terminated 170-ohm output cables are furnished.

Multiple-Trace Application—A Type C-A Dual-Trace Unit in an oscilloscope can be fed by two other Plug-In Units powered by the Type 127 to produce a dual-trace display. A four-trace display results when the Type C-A Unit in an oscilloscope is fed by two Type C-A Units powered by the Type 127. Synchronizing pulses for alternate-sweep operation can be introduced through connectors at the rear of the Type 127. An eight-trace display is possible when two Type C-A Units in the Types 551 or 555 Dual-Beam Oscilloscopes are

Internal Regulator—

Maintains voltage essentially independent of the actual power-supply voltages furnished by the oscilloscope or the Type 127 Preamplifier Power Supply.

Comparison Voltage Accuracy—

Within 0.25% on the ±1-volt scale.
Within 0.20% on the ±10-volt scale.
Within 0.15% on the ±100-volt scale.

DC Drift—

Maximum of ±0.1% in 100-hour drift test of comparison voltages.

Precision Potentiometer—

Zero-based linearity of ±0.05%.

Resolution and Accuracy—

0.005% at 100 volts equals 5 mv/mm to 100 volts.

Transient Response—

Rate of rise: The input cathode follower can handle a signal with a rate of rise of less than +1 volt in 7 nanoseconds without the flow of grid current. Grid-current flow will generally distort the waveform.

Rate of fall: The amplifier will be cut off whenever the instantaneous rate of fall of the input signal exceeds —1 volt in 5 nanoseconds. The amplifier will then "run down" linearly at this rate until it "catches up" with the input signal, and then will resume conduction.

Large fast signals can be attenuated to reduce the switching time.

Attenuator Accuracy—

Input attenuators are the constant-input-impedance, frequency-compensated type.
Resistor tolerance is nominally 1%.

MECHANICAL SPECIFICATIONS

Construction—Aluminum-alloy chassis.
Finish—Photo-etched panel.
Weight: Net—6 pounds.
Shipping—12 pounds, approx.

Price **$525**

Price f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).

FOR PLUG-IN UNITS

fed by four Type C-A Units powered by two Type 127 Power Supplies.

Electronic Regulation—All dc supply voltages to the Plug-In Units are electronically regulated to compensate for line voltage and load variations between 105 and 125 v or 210 and 250 v and for current-demand differences among the Plug-In Preamplifiers. A current-sensitive relay switches in a compensating power load when only one preamplifier is plugged into the Type 127.

Amplitude Calibrator—A square-wave calibration voltage is available through a front-panel coaxial connector. Eighteen fixed voltages— 0.2, 0.5, 1, 2, 5, 10, 20, 50, 100 millivolts, 0.2, 0.5, 1, 2, 5, 10, 20, 50, and 100 volts peak-to-peak are provided. Accuracy is within 3%. Square-wave frequency is approximately 1 kc.

ELECTRON-TUBE COMPLEMENT

Output amplifiers	4	6CB6
Output cathode followers	4	12AT7
Calibrator		6AU6
Calibrator		6BQ7
Switching amplifiers	2	6U8
Comparators	2	12AX7
Regulator amplifiers	4	6AU6
Series regulators	2	12B4
Series regulators	3	6080
Voltage reference		5651

MECHANICAL SPECIFICATIONS

Ventilation—Filtered forced-air ventilation maintains safe operating temperatures.

Construction — Aluminum-alloy chassis. Slide-out mounting to rack.

Finish—Photo-etched anodized panel.

Dimensions—8 ¾" high, 19" wide, 20" rack depth, 21 ½" overall depth.

Weight: Net—51 pounds
Shipping—72 pounds approx.

Power Requirements—105 to 125 v or 210 to 250 v, 50 to 60 cycles, 450 watts maximum.

Type 127, without plug-in units **$525**

Includes: 4—170Ω Coaxial cables, 5' long. (012-034)
4—170Ω termining resistors (011-016)
1—3-conductor power cord (161-008)
1—Instruction manual

Recommended Additional Accessories

Supporting Cradles—for rear slide support when the instrument is to be mounted in a backless rack. Two cradles with necessary mounting hardware.

ORDER PART NO. 426-063 . . . . . $7.50

Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).

Output characteristics of the Type 127 in combination with Tektronix Plug-In Units, measured with the Type 127 output terminated in 170 ohms.

Plug-In Unit	Maximum Voltage Gain (push-pull output)	Frequency Response	Risetime
A	2	dc to 15 mc	23 nsec
B	2	dc to 15 mc	23 nsec
	20	5 cps to 11 mc	30 nsec
C-A	2	dc to 17 mc	20 nsec
D	100	dc to 350 kc at a gain of 100, increasing to 2 mc at a gain of 2	
E	2000	.06 cps to 20 kc at full gain, increasing to 60 kc a gain of 200	
G	2	dc to 15 mc	23 nsec
H	20	dc to 12 mc	29 nsec
K	2	dc to 19 mc	18 nsec
L	2	dc to 19 mc	18 nsec
	20	3 cps to 17 mc	20 nsec

PULSE-SAMPLING SYSTEM

INTRODUCTION E-2

TYPE N E-4

TYPE 110 . . . . . E-6

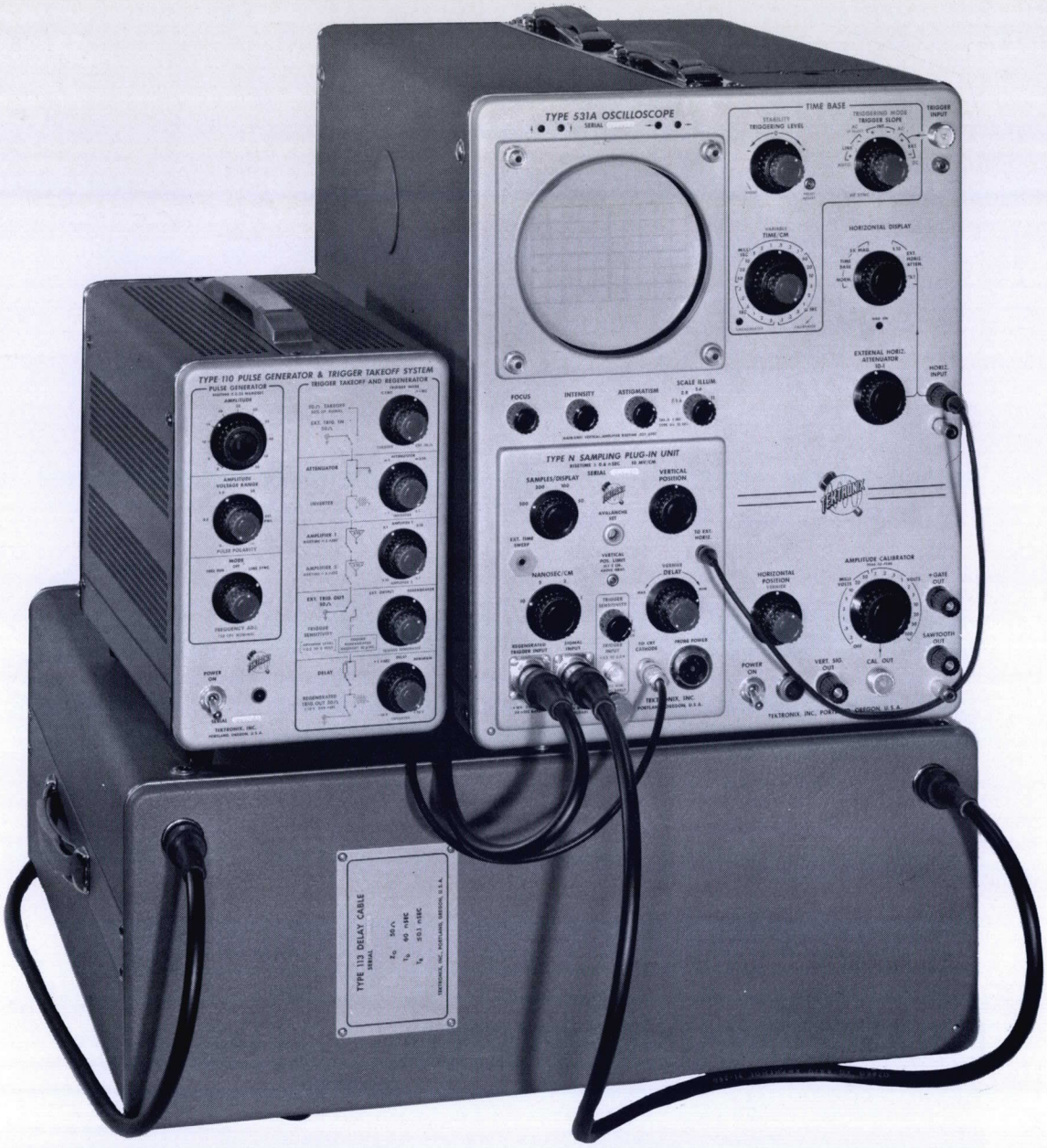
TYPE 111 . . . . . E-8

TYPE 113 . . . . . E-9

APPLICATIONS E-10

5/60

PULSE-SAMPLING SYSTEM



The Tektronix Pulse Sampling System displays recurrent signals with risetime of about 0.6 nsec (corresponding to bandwidth of about 600 mc) and with apparent sweep times of about 1 nsec/cm (with 10-x magnifier, 100 psec/cm). Features include a pulse generator with a repetition rate of 720 pulses/sec nominally and risetime less than 0.25 nsec, trigger takeoff, signal delay, sychronism control, and high basic repetition rate (to 100 kc).

Besides a Tektronix plug-in oscilloscope, the sampling system can consist of a Type 110 Pulse Generator and Trigger Takeoff System, a Type 113 Delay Cable, and a Type N Sampling Plug-In Unit, or a Type 111 Pretrigger Pulse Generator and a Type N Unit, or just a Type N. UNIQUE ASPECT OF THE SYSTEM IS THAT THE USER PURCHASES ONLY THOSE UNITS NEEDED FOR HIS PARTICULAR APPLICATION.

The Type 110 is unnecesssary if a suitable trigger is supplied.

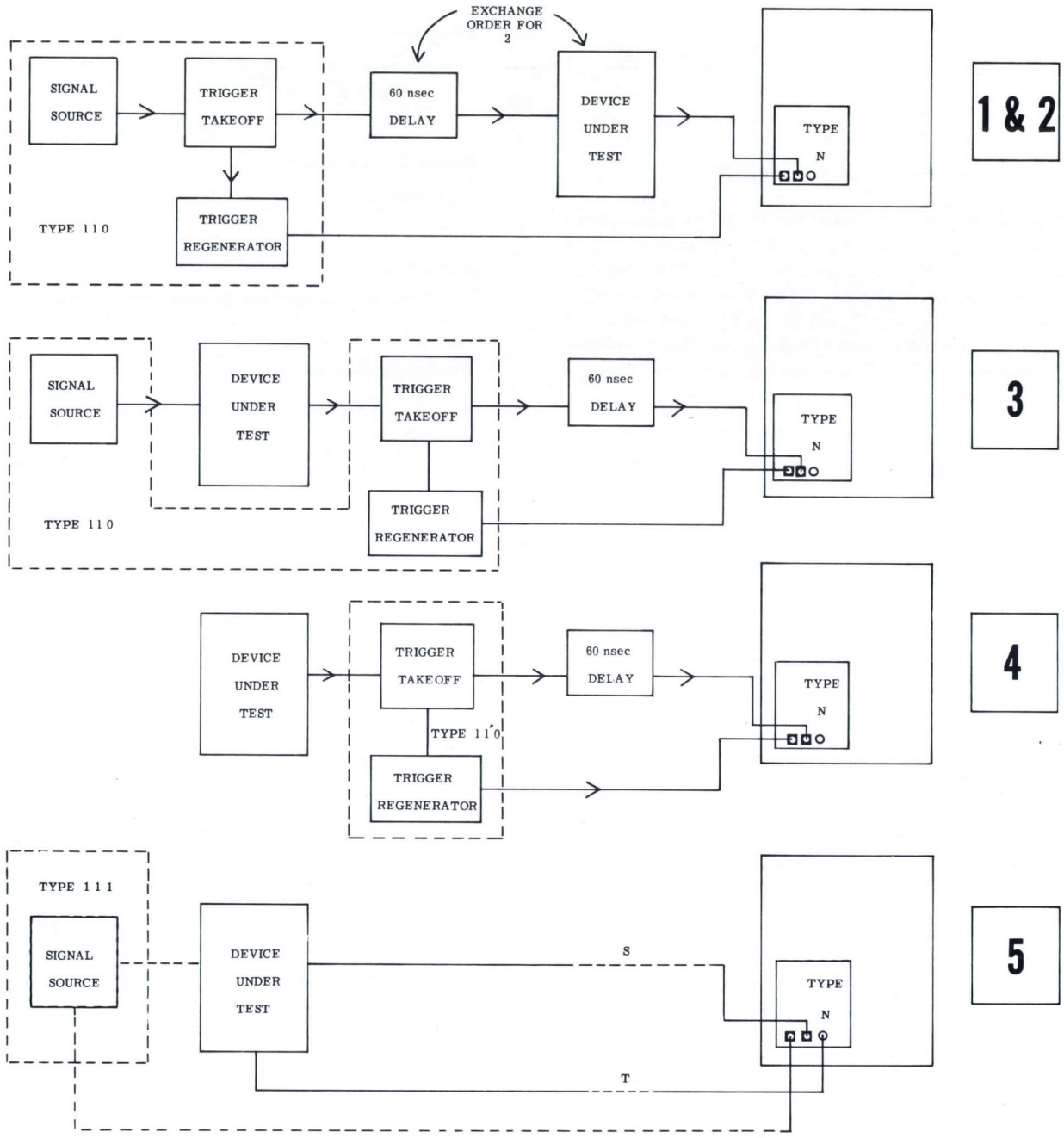
The Type 113 is unnecessary if a proper pretrigger is available.

The Type 111 can replace the Type 110 and Type 113 in certain applications.

Only the Type N is needed—in addition to the oscilloscope—if the signal has a 45 to 200 nsec pretrigger or a repetition rate of 10 to 50 mc.

This highly adaptable, low-cost system converts a general-purpose Tektronix plug-in oscilloscope into a highly specialized instrument without sacrificing any of the original characteristics. The oscilloscope thus fits not only specialized pulse-sampling applications, but also general-purpose laboratory applications.

TYPICAL TEST SYSTEMS



Systems 1 and 2 are useful for observing and measuring not only the output of a device but also the time delay. If the device is linear, it is unimportant where the delay (cable) occurs. If the device is nonlinear, it may be advantageous to place the cable ahead of the device under test, especially if the delay cable risetime is significant, as when using RG8A/U instead of the Type 113.

System 3 is useful for observing and measuring signals with output level much greater than input level and for applications not concerned with time delay.

System 4 is useful for observing and measuring devices such as free-running oscillators which are not triggered and do not have a trigger output. For these applications, the signals need not have a uniform repetition rate under 100 kc, but must have an increasingly uniform rate up to a maximum of 100 mc for proper count down.

System 5 is useful for observing and measuring a device which can furnish a trigger of ½ to 2 volts, with the effective delay between the signal (S) and trigger pulses (T) at the Type N Sampling Plug-In Unit of approximately 45 nsec. The trigger can be made to arrive at least 45 nsec early by choosing the relative lengths of cable in the "S" and "T" paths. The effect of a delay of 45 nsec or more can also be obtained in two other ways: (1) by a signal of 10 mc to 50 mc repetition rate where one triggers on one pulse but observes the following pulse, and (2) by a device such as the Type 111 Pretrigger Pulse Generator, which furnishes a trigger in advance of the signal.

MAIN FEATURES

GENERAL DESCRIPTION

Designed for use with Tektronix Plug-In Oscilloscopes, the Tektronix Type N Sampling Unit produces a bright display of repetitive high-speed signals. By taking successive samples at a slightly later time at each recurrence of the pulse, the Type N Unit reconstructs the pulse on a relatively long time base. Each sample taken becomes an image-retaining dot on the crt screen.

The Type N Unit provides stable displays with apparent sweep times of 1 nsec/cm (with 10-x magnifier, 100 picoseconds/cm). Delay range of 200 nsec (including display), permits observation of the complete waveform of pulses less than 200-nsec wide. Any portion of the waveform can be observed and measured accurately.

When sampling repetitive high-speed signals the spacing between pulses can vary. If the incoming signals are irregularly spaced, the pulses must be separated by 10 μsec or more. If the incoming signals are regularly spaced, the pulses can occur every 20 nsec.

Risetime

Approximately 0.6 nsec (corresponding to approximately 600 mc).

Input Impedance

50 ohms.

Sensitivity

10 mv/cm (with 2 mv or less amplitude noise).

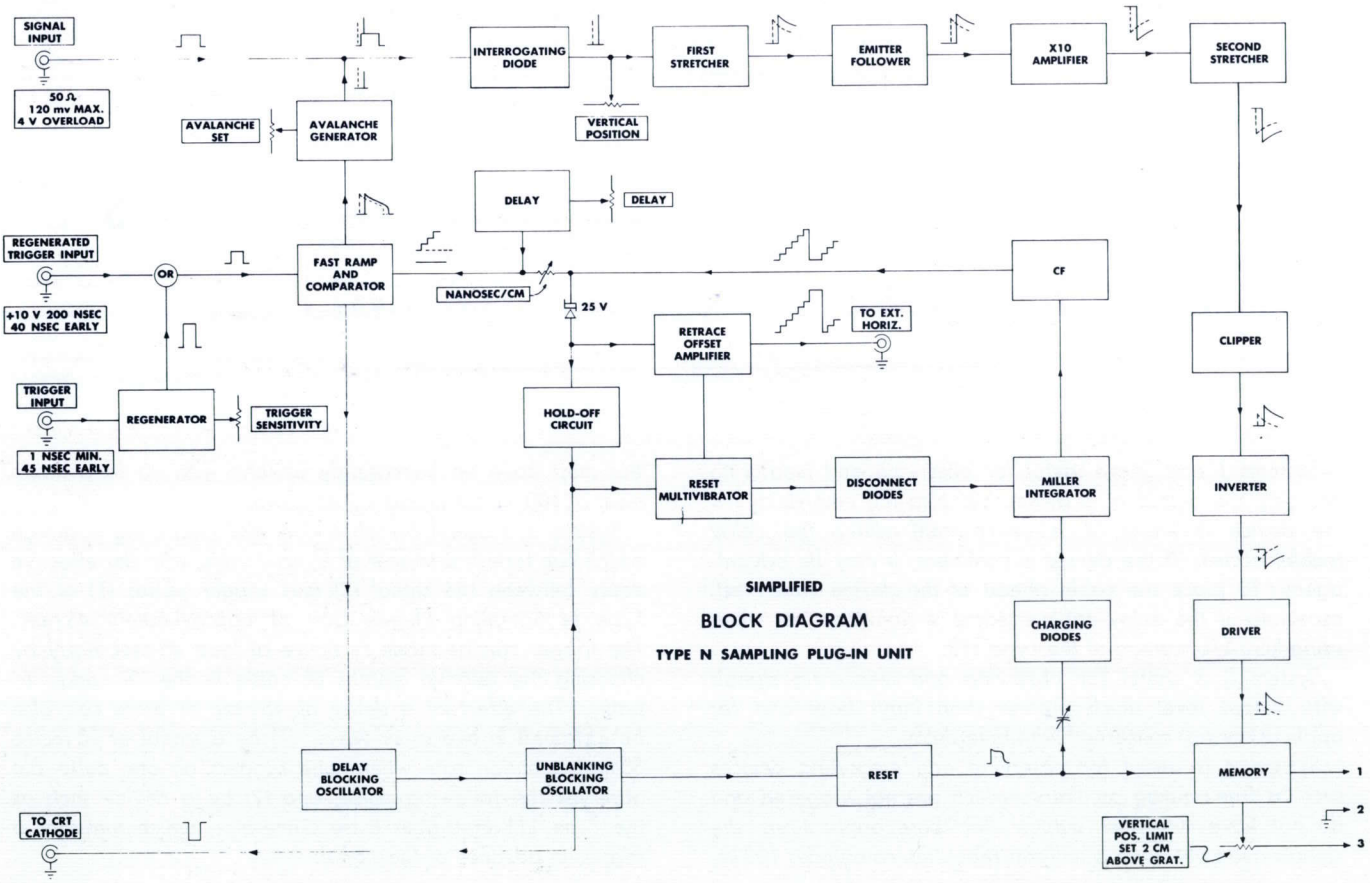
Dynamic Range

$\pm$120 mv, minimum linear range before overdriving occurs.

Accidental overload of $\pm$4 volts dc is permissible; higher voltage-pulsed overloads are permissible depending upon duty cycle.

Regulated Supplies

Transistor-regulated +20 v and −20 v dc supplies.



SAMPLING PLUG-IN UNIT

OTHER CHARACTERISTICS

Sweep Range—a four-position switch, NANOSEC/CM, provides four equivalent sweep times of 1, 2, 5, and 10 nsec/cm (with the magnifier: 100, 200, 500, and 1000 psec/cm).

External Trigger—The Type N Sampling Unit requires an external trigger applied in advance of the signal. Two input connections are provided on the unit for this purpose. The REGENERATED TRIGGER INPUT minimum requirements for an external start-gate trigger include: repetition rate of 50 cps to 100 kc, 50% rise-time of four nsec, amplitude of +10 volts, duration of 200 nsec, 40 nsec in advance of the signal. The TRIGGER INPUT minimum requirements for a conventional external trigger include: minimum duration of one nsec, amplitude from +0.5 to 2 volts, 45 nsec in advance of the signal, and repetition rate of 50 cps to approximately 50 mc. The recovery time is 10 μsec. Count down occurs above 100 kc. Satisfactory count down can be obtained up to about 50 mc.

Sampling Information—A four-position switch SAMPLES/DISPLAY, determines the number of image-retaining dots appearing on the screen of the cathode-ray tube during one display. The number of dots or samples per display can be 50, 100, 200, or 500. The sampling rate extends from 50 cycles to 100 kilocycles.

MECHANICAL SPECIFICATIONS

Construction—Aluminum-alloy chassis.
Finish—Photo-etched anodized panel.
Weight: Net—9 pounds.
Shipping—13 pounds approx.

Price **$600**

Includes: 1—Unblanking cable and transformer (012-052)
1—External horizontal input cable (012-054)
1—X2 T attenuator 50 Ω (017-003)
1—X5 T attenuator 50 Ω (017-002)
1—X10 T attenuator 50 Ω (017-001)
1—10 nsec 50 Ω coax cable RG58A/U with G.R. connectors (017-501)
1—5 nsec 50 Ω coax cable RG8A/U with G.R. connectors (017-502)
2—1 nsec 50 Ω coax cables RG58A/U with G.R. one end only (017-503)
1—Instruction manual

Optional Equipment

Not supplied as accessories for the Tektronix Pulse Sampling System but available as optional equipment at additional cost are the following:

Master Slave Patch Cord—For dual-beam operation with Tektronix Type 551 and Type 555 Oscilloscopes.
ORDER PART NUMBER 012-055 ..... $3.75

Calibrator Adapter—To provide a 50 Ω calibrated signal from oscilloscope calibrator.
ORDER PART NUMBER 017-010 ..... $15.00

Timing Standard—For calibrating "N" Sweep Speeds.
ORDER PART NUMBER 013-028 ..... $60.00

Tunnel Diode Risetime Tester.
ORDER PART NUMBER 013-029 ..... $50.00

Transistor Switching Time Tester.
ORDER PART NUMBER 013-030 ..... *

Transformer Matched "T"—For dividing regenerated trigger.
ORDER PART NUMBER 017-012 ..... *

Variable Attenuator—3 to 1, 50 Ω.
ORDER PART NUMBER 017-029 ..... *

Cathode-Follower Probe—~~100~~ k and approximately 4 pf input, overall attenuation ratio approximately 10 to 1.
ORDER PART NUMBER 010-053 ..... *

50 Ω Step Attenuator—Provides 2-x, 5-x, and 10-x attenuation by switching instead of patching.
ORDER PART NUMBER 017-011 ..... *

Diode Switching-Time Tester.
ORDER PART NUMBER 013-031 ..... *

X-Y Plotter Adapter.
ORDER PART NUMBER 013-032 ..... *

*Prices not available at time of this printing. Please check with your Tektronix Field Engineer or Field Office for prices and shipping schedules.

Price f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).

TYPE 110 PULSE GENERATOR

MAIN FEATURES

PULSE GENERATOR

Pulse risetime—less than 0.25 nsec.

Pulse length—approximately 0.5 nsec, minimum, 40 nsec maximum at full repetition rate, 300 nsec at half repetition rate (one charge line disabled).

Output impedance—50 ohms.

Repetition rate—720 pulses/sec, nominally.

TRIGGER TAKEOFF SYSTEM

Input impedance—50 ohms.

Output signal to trigger system—amplitude approximately 20% of input signal.

Input signals through system—20 mv to 50 volts (transmission losses and reflections less than 2½ %).

Direct external trigger input—4 mv to 10 volt signal.

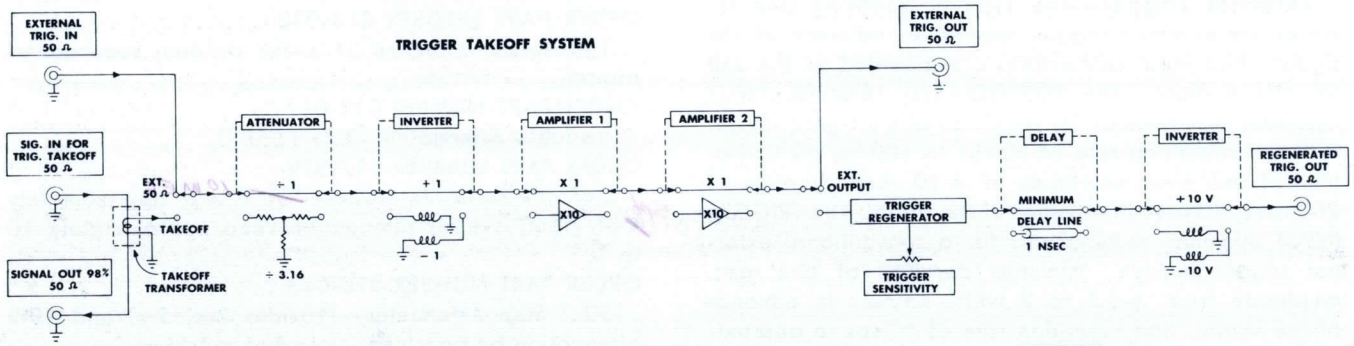
Regenerated trigger out signal—±10 v, 4 nsec 50% risetime, 225 nsec duration.

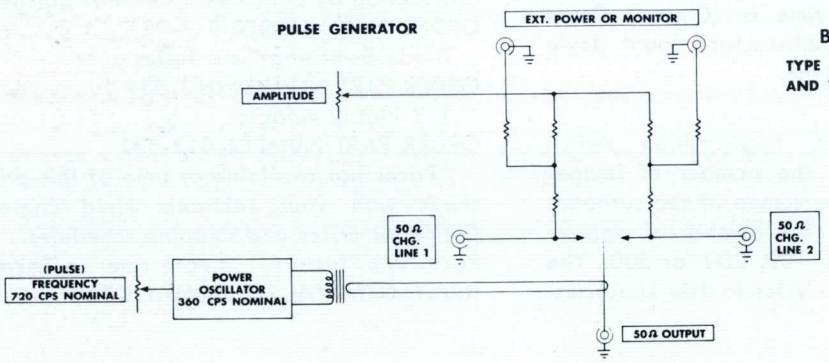
GENERAL DESCRIPTION

Designed for high-speed pulse applications, the Tektronix Type 110 Pulse Generator and Trigger Takeoff System is capable of generating pulses of less than one-fourth nsec risetime by means of a high-repetition-rate mercury relay. Repetition rate is nominally 720 pulses/sec. Output impedance is 50 ohms. The system is capable of generating alternate pulses of different lengths, amplitudes, or polarity.

The independent Trigger Takeoff System utilizes two amplifiers combined with an attenuator. This assures stable triggering over a wide range of signal amplitudes. A flexible switching system permits polarity change and trigger signal amplification, necessary to drive the trigger regenerator. The trigger regenerator output of nominally 10 volts for 225 nsec is adequate for triggering oscilloscopes with relatively slow trigger responses and for starting the Type N Sampling Unit (when the source cannot supply the necessary trigger). Maximum random repetition rate is about 100 kc, but the system counts down from a considerably higher uniform rate (approximately 100 mc). Trigger-response impulse speed is about 1 nsec without amplifiers and 3 nsec with amplifiers switched in. Normal triggering occurs on signals down to 50 mv.

With its calibrated output, the Type 110 Pulse Generator and Trigger Takeoff System facilitates measurement of amplifier linearity, and trigger sensitivity to amplitude or pulse-width changes. The system is useful not only for sampling applications (with many pulses needed to produce one display), but also for conventional applications with oscilloscopes having inadequate triggering characteristics.





SIMPLIFIED
BLOCK DIAGRAM
TYPE 110 PULSE GENERATOR AND TRIGGER TAKEOFF SYSTEM

AND TRIGGER TAKEOFF

OTHER CHARACTERISTICS

Charge Lines—One or two charge lines can be used to provide equal or unequal pulses alternately as desired. Equal charge lines produce 720 pulses/sec repetition rate free running or line synchronized. Unequal charge lines produce alternate pulses of different widths. External charge voltage permits alternate pulses of different amplitudes and polarity.

Trigger Takeoff—The signal is patched into a 50-ohm "loop through" arrangement. Approximately 98% of the input voltage appears at the output after passing through the takeoff (a 2% reflection appears at the input). This is due to an equivalent 2 ohms being inserted in series with the outer conductor of a 50-ohm coaxial transmission line. The equivalent 2 ohms is transformed to 50 ohms for use in the trigger system. Since approximately 4% of the signal energy was available to the trigger channel, approximately 20% of the signal voltage appears as a trigger signal.

Regenerated Trigger—A regenerated trigger signal of ±10 volts amplitude and 225 nsec duration is available from the output of the REGENERATOR OUT connector. Timing delay is nominally 20 nsec, with an additional nsec available from a front-panel switch.

The recovery time is 10 μsec, with count down from approximately 100 mc at a uniform repetition rate. Below 100 kc, a random repetition rate is permissible.

MECHANICAL SPECIFICATIONS

Construction—Three-piece compact unit constructed of light-weight, shock-resistant aluminum alloy. Side panels and bottom panel are easily removable. Transistors and other components are readily accessible.

Finish—Photo-etched anodized front panel with colored control knobs, blue vinyl-finish cabinet.

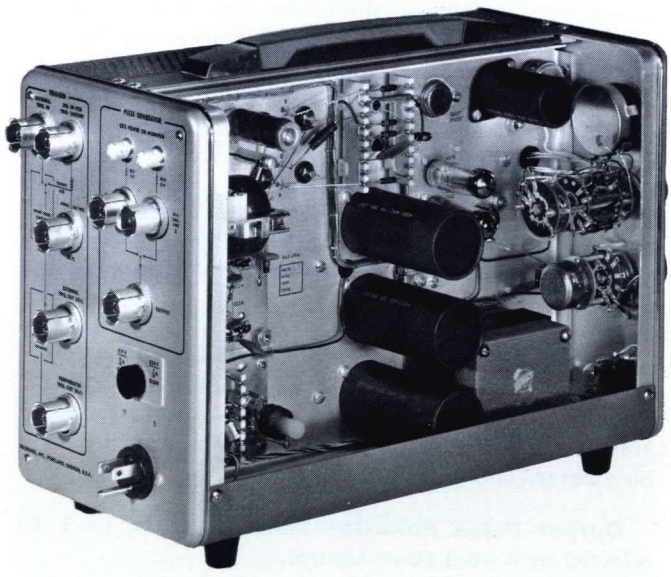
Dimensions—Only 10⅝" high by 6⅞" wide by 16⅛" deep.

Weight: Net—18 pounds.
Shipping—22 pounds approx.

Power Requirements—Operates from 105 to 125 v or 210 to 250 v, 50 to 60 cycles, 48 watts at 117 v.

Price **$650**

Includes: 1—2 nsec 50 Ω coax cable RG58A/U with G.R. connectors (017-505)
1—5 nsec 50 Ω coax cable RG8A/U with G.R. connectors (017-502)
1—20 nsec 50 Ω coax cable RG8A/U with G.R. connectors (017-504)
1—3-Conductor power cord (161-010)
1—Instruction manual



Price f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).

TYPE 111 PRETRIGGER PULSE GENERATOR

GENERAL DESCRIPTION

The Type 111 is a high-repetition rate, fast-rise pulse generator. It is primarily intended for use with the Tektronix Type N Sampling Plug-In Unit; however, its characteristics make it ideally suited for use with conventional oscilloscopes and other equipment as well. The unit provides two pulse outputs: the fast-rising Output Pulses and the Pretrigger Pulses. The Pretrigger Pulses occur from 30 to 250 nanoseconds ahead of each Output Pulse. These Pretrigger Pulses can be used as a Regenerated Trigger Signal for the Type N Unit or as a triggering signal for a conventional oscilloscope. The amount of delay between the Pretrigger Pulse and the Output Pulses is variable by means of a front panel control. This eliminates the need in most applications for low loss delay cables.

Output Pulse Risetime—Equal to or less than 0.5 nsec when the OUTPUT POLARITY Switch is in the (+) position. When the switch is in the (—) position, the risetime is slightly longer.

Output Pulse Duration—Minimum, approximately 2 nsec with no external charge line. Maximum, 100 nsec at low repetition rates decreasing to 20 nsec at 100 kc repetition rate. Maximums are obtained with an external charge line.

Output Pulse Polarity—Either (+) or (—) as selected by a front panel control.

Output Pulse Repetition Rate—Four repetition rate ranges and a vernier control provide a continuous range of adjustment from approximately 10 pps to approximately 100 kc. Overlap between ranges is about 5%.

Output Pulse Aberrations—When the output is properly terminated, overshoot and other aberrations are less than 5% of the peak amplitude of the Output Pulses (as observed on a 600 mc oscilloscope).

Pulse Amplitude—More than ±5 volts. The output voltage is fixed by the particular avalanche transistor used. External attenuators are necessary to vary the output amplitude. Suitable for this purpose are the Type N accessories—the optional variable attenuator and the supplied fixed attenuators.

Pretrigger Pulse Characteristics—Amplitude is about 10 volts, duration is about 250 nsec, and half-amplitude risetime is about 4 nsec.

Pulse Delay—The Output Pulse is delayed from 30 to 250 nsec after generation of the Pretrigger Pulse. The delay is continuously variable by means of a front panel control. Time jitter between the Pretrigger and the Output Pulse is less than 100 picoseconds.

Output Impedance—50 ohms.

External Trigger Signal Requirements—Positive 5 volts with rise rate of 3 volts/μsec, and repetition rate from dc to about 100 kc.

Power Requirements—Operates from 105 to 125 volts or 210 to 250 volts, 50 to 60 cycles, 35 watts at 117 v.

MECHANICAL SPECIFICATIONS

Construction—Three-piece compact unit constructed of light-weight, shock-resistant aluminum alloy. Side panels and bottom panel are easily removable. Transistors and other components are readily accessible.

Finish—Photo-etched anodized front panel with colored control knobs, textured-aluminum cabinet with blue-vinyl finish.

Dimensions—10⅜" high by 6⅝" wide by 11¼" deep.

Weight: Net—8 pounds.
Shipping—13 pounds approx.

Price **$365**

Includes: 1—9 nsec (72 inches) coax cable, RG58A/U with G.R. connector (017-506)
1—X10 attenuator, 50 ohms (017-001)
1—3-Conductor power cord (161-010)
1—Instruction manual

Price f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).

TYPE 113 DELAY CABLE

GENERAL DESCRIPTION

In general, the Tektronix Type 113 Delay Cable is used in those sampling applications in which the Type 110 Trigger Takeoff derives the trigger from a signal—so the trigger can arrive ahead of the signal at the Type N Sampling Plug-In Unit.

The Type 113 Delay Cable may also be used in those applications in which the signal source supplies a suitable trigger—for direct operation of the Type N without need of the Type 110.

Adequate Time Delay—60 nsec inserted in the system where required (with the Type 110 and N system, about 10 nsec can be seen ahead of a fast leading edge).

High Quality Cable—Approximately 1.5 db loss per 100 feet at 1000 mc. Risetime is approximately 0.1 nsec.

MECHANICAL SPECIFICATIONS

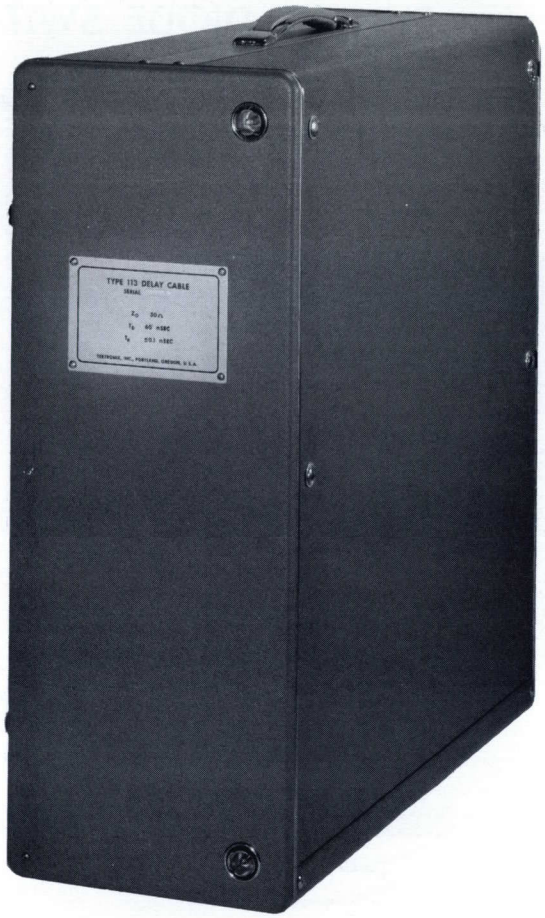
Construction—Three-piece cabinet constructed of light-weight aluminum-alloy houses the coaxial cable compactly coiled between the two G.R. connectors. Side panels and bottom panel are easily removable. Rubber feet installed in one side, the bottom, and the back, facilitate use of the Tektronix Type 113 Delay Cable in any of three positions.

Finish—Photo-etched anodized name plate, blue vinyl-finish cabinet.

Dimensions—23" high by 9½" wide by 23" deep.

Weight: Net—43 pounds.
Shipping—59 pounds approx.

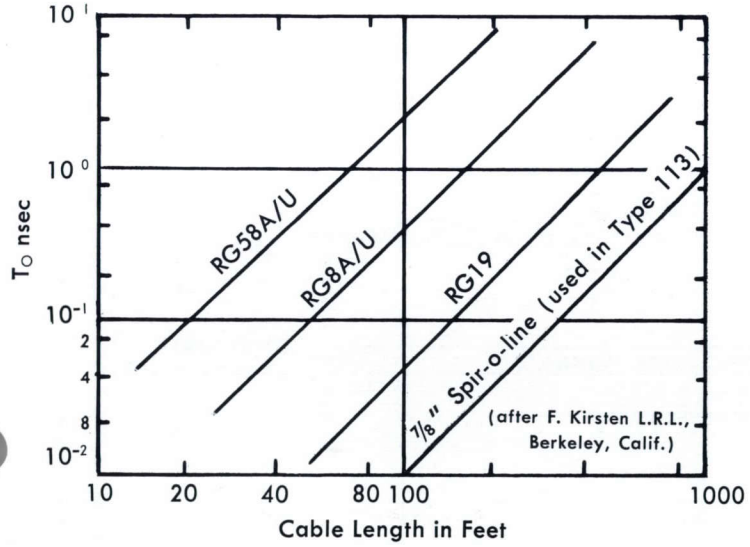
Price **$200**



Price f.o.b. factory. (Please refer to **Terms and Shipment *GENERAL INFORMATION*** page).

TRANSMISSION LINES

Transmission lines used for nanosecond pulses are commonly of the TEM (transverse electric and magnetic fields) mode type. The Type 113 uses this mode, because response is desired to zero frequency with minimum dispersion. In the nanosecond region, skin effect losses cause most of the pulse distortion in well-constructed cables. This results in a nongaussian response. Risetimes of cascaded cables do not follow the usual rms addition method of combining risetimes, as in gaussian amplifiers.

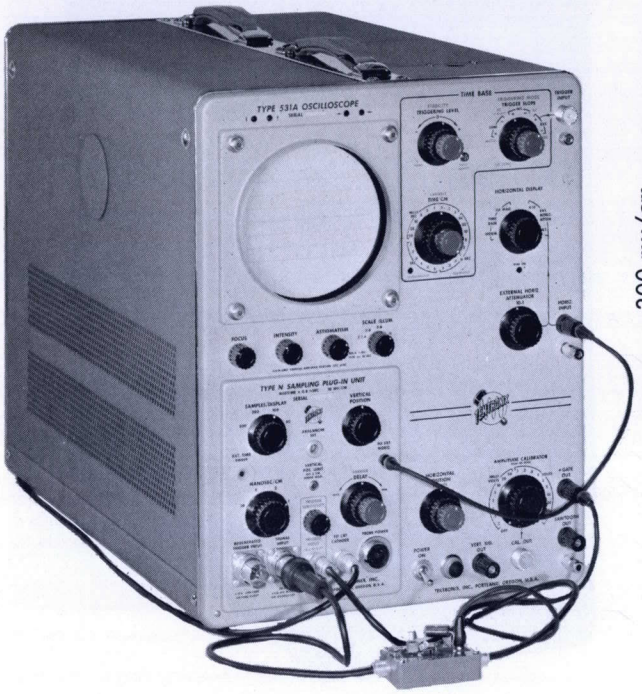


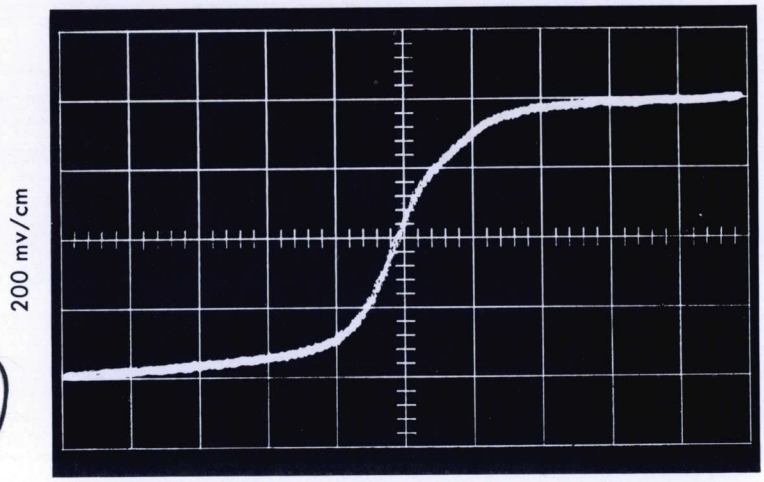
Transmission line distortion of a step function shows up in a distinctive way. The output rises fairly rapidly initially, and then slows considerably, compared to an RC charge. An RC step response requires 2.2 time constants to change from 10% to 90% of the input step. A transmission line requires 60 times the 0-to-50% risetime period to accomplish this (10% to 90%) transition.

The graph illustrates time of rise from 0-to-50% of the input for various common coaxial cables. Note that the risetime deteriorates as the square of the length. Thus, it is very important to keep cable lengths (or delays) to a minimum. The Type 113 uses about 50 feet of 7/8" diameter cable, resulting in a 10% to 90% risetime of about 0.1 nanosecond.

TUNNEL DIODE SWITCHING TIME MEASUREMENT

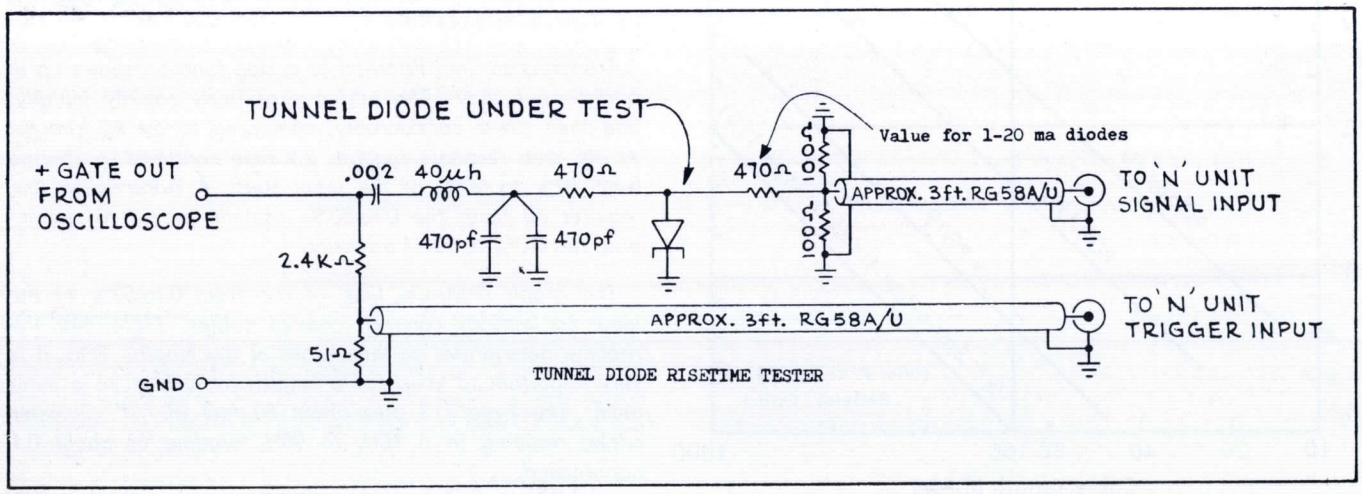
with Tektronix Type N Unit





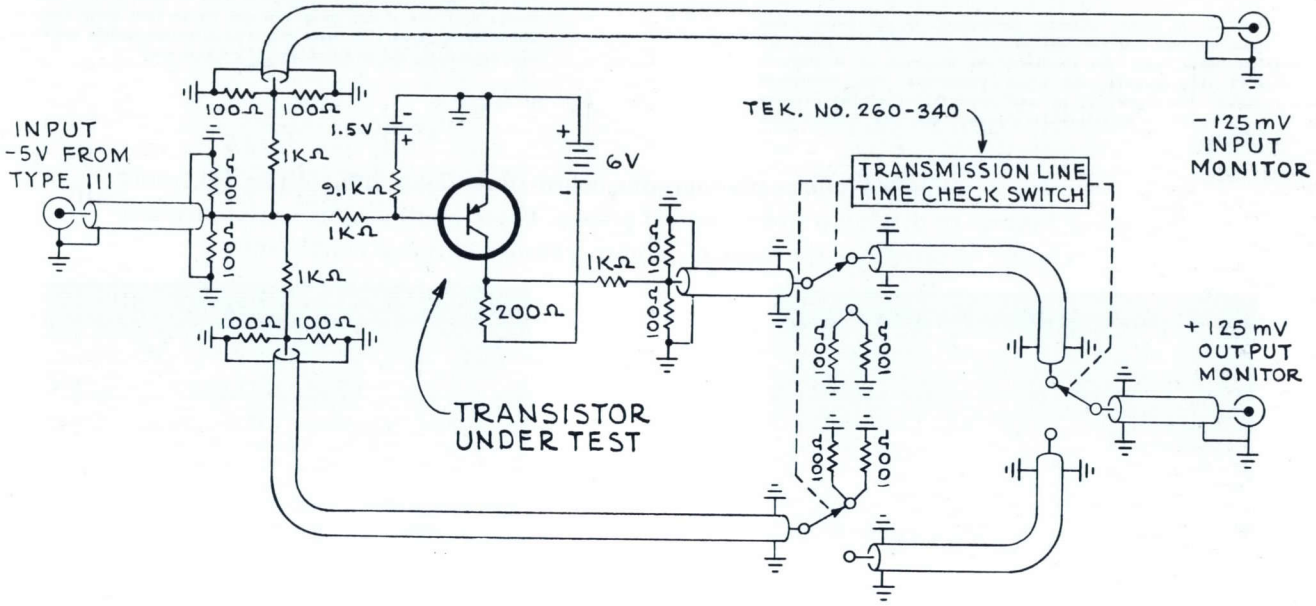
Typical waveform of a gallium arsenide tunnel diode in TEKTRONIX TUNNEL-DIODE RISETIME TESTER. (Part Number 013-029) $50.00

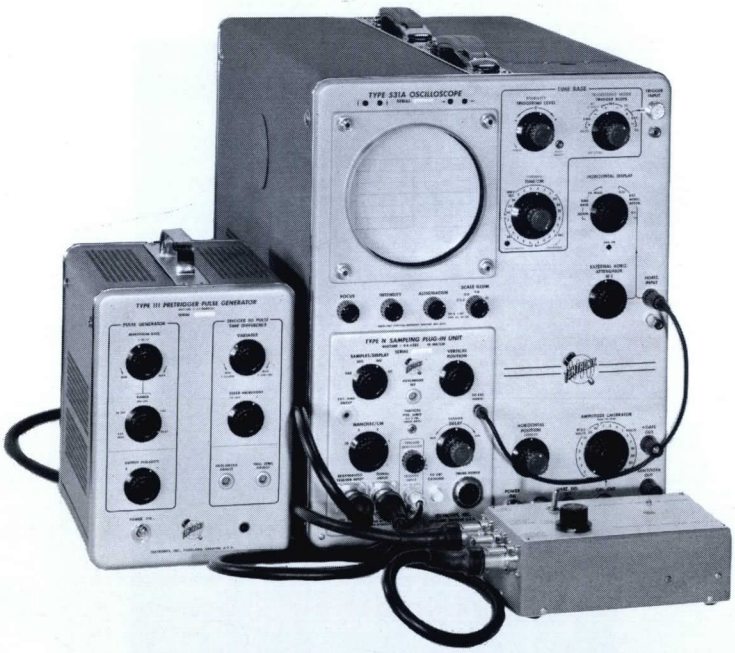
A convenient low-cost method of testing tunnel (Esaki) diodes with nanosecond switching speeds is shown. A Tektronix Plug-In Oscilloscope provides both the current ramp source for the tunnel diode and the pretrigger for the Type N Unit. The Type N Unit is set up in the usual way—however, the oscilloscope main sweep generator is allowed to free run at 1 μsec/cm. The +GATE OUT not only triggers the N Unit but also provides a delayed current ramp with a low rate of change—which allows the tunnel diode to switch at essentially its own rate. This setup does not require a Type 110, Type 111, or Type 113.



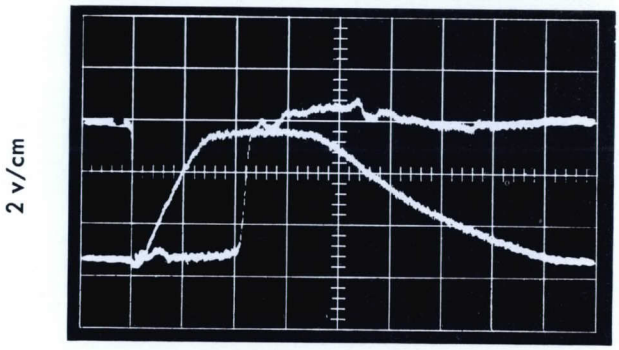
APPLICATIONS

TRANSISTOR SWITCHING TIME MEASUREMENT
with Tektronix Type N Unit and Type 111





A convenient method of testing fast-switching transistors is shown. Input signal is —5 volts, output is about +5 volts, and circuit forced beta is six. The Type 111 supplies a 10 to 100 kc repetition rate input pulse source. Use of the relatively inexpensive Type 111 eliminates need for a delay line. Use of the Transmission Line Time-Check Switch allows time comparisons (of input and output waveforms) without expensive dual-trace or dual-beam arrangements. This test circuit can be used with a Type 105 Square-Wave Generator and a Type L Plug-In Unit for slower transistors (35 nsec or slower), or it can be used with a Type 580-Series Oscilloscope and a Type 111 for medium-speed transistors (10 nsec or slower).



Double exposure of input (—5 v pulse) and output (+4½ volts) of Tektronix Transistor Switching Time Tester (by operating the Transmission Line Time-Check Switch).

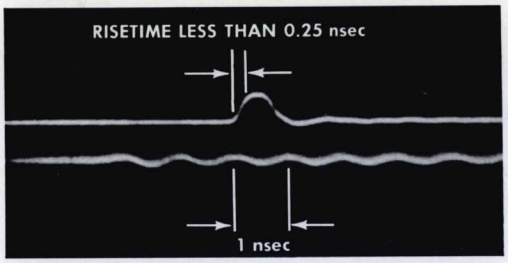


Fig. 1-1. A double exposure photograph of the output pulse from the Type 110 (no external charge line) and a 1 gigacycle/sec timing train. The waveforms are displayed on a Tektronix 0.12 nsec risetime research-type oscilloscope. This photograph shows the risetime to be well under 0.25 nsec. The minimum pulse width is approximately 0.5 nsec. Note the freedom from overshoot.

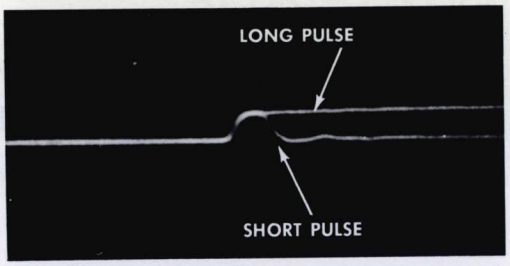
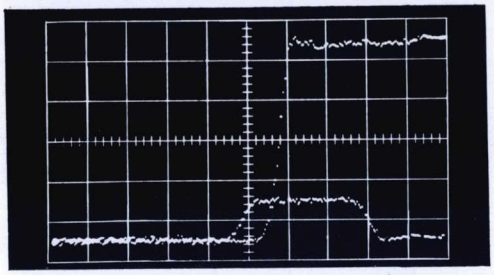


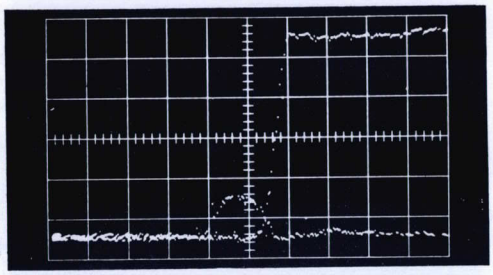
Fig. 1-2. The alternate pulse feature is used to show a short (no charge line) and a long pulse (20 nsec charge line) being generated by the Type 110. Note that there is no appreciable waveform discontinuity due to the addition of a charge line.

The waveform photographs below show the ability of the Tektronix Sampling System to display a wide range of pulses. These photographs were purposely chosen to illustrate the system's abilities under marginal conditions.



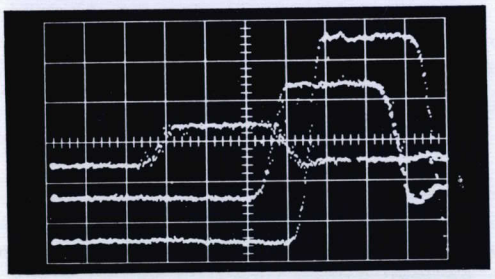
1

The alternate pulse feature of the Type 110 pulse generator is being used to generate a large, long pulse, and a short, small pulse. The trigger take-off system's sensitivity is set for maximum. The signal level is 100 mv/cm, and the sweep speed is 1 nsec/cm. There is clearly less than 1 nsec time difference in triggering on the 100 mv, 3 nsec and the 500 mv long step signals.



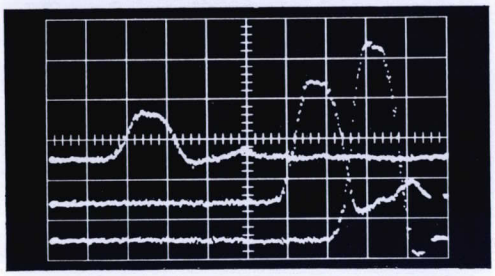
2

This picture shows the same conditions as in Fig. 1, except the small pulse is now only 1 nsec wide. The time shift relative to the large step is just over 1 nsec.



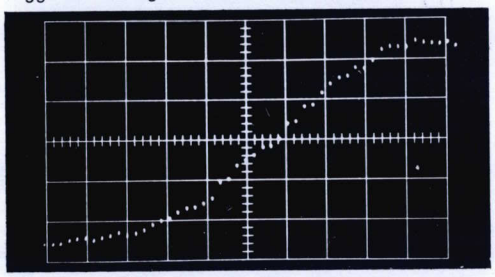
3

The system is operating at maximum sensitivity, 20 mv/cm. A triple exposure, positioned vertically to align the 50% points, allows easy measurement of the time slip. Under these extreme conditions, the smallest pulse has an energy of about 24 millipicojoules. The trigger take-off system then removes approximately 1 millipicojoule for application to the switched system of amplifiers and the trigger regenerator.



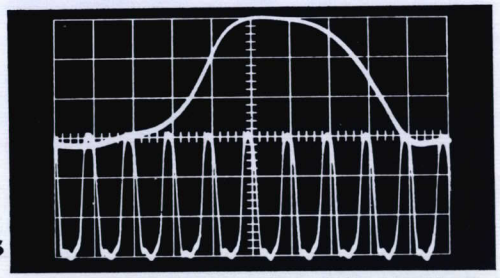
4

The amplifiers in the trigger channel (used in the previous 3 pictures) are switched out. The sensitivity is 2 v/cm. The smallest of the 1 nsec wide pulses furnishes approximately 0.4 v to the trigger regenerator, through the trigger take-off system. This picture is of interest since this is the narrow-pulse response which is obtainable with both the 110 and N Units, when externally triggered with signals between 0.4 and 2 v.



5

The leading edge of the large pulse of Figure 3 is displayed with the 1 nsec/cm sweep speed magnified ten times. This gives an equivalent sweep speed of 100 picoseconds/cm. The risetime of the complete system—110 pulse generator, 110 trigger take-off, 113 delay cable and the N unit—is well under 0.6 nsec.



6

Double exposure shows a 60-mv, 100-mc continuous pulse train at equivalent sweep times of 1 nsec/cm and 10 nsec/cm. The Type 110 derives a trigger from the signal, permitting the Tektronix Sampling System to operate without external triggers, counting down from 100-mc to the 100-kc sampling rate of the N Unit.

HIGH-SPEED OSCILLOSCOPES

TYPE 517A F-2

TYPE 507 . . . . . F-6

5/60

MAIN FEATURES

Excellent Transient Response
7-nanosecond risetime.

Sweep Range
10 nsec/cm to 20 μsec/cm.

Single Sweep Operation
Lockout-Reset Circuitry for one shot recording

Vertical Deflection Factor
0.05 v/cm.

24-kv Accelerating Potential
Writing Rate—1100 cm/μsec.
Recorded on 35 mm TRI-X film at f1.9 with 4.2 to 1 reduction, developed 26 minutes in D-19 at 68°F. Trace density 0.1 above film fog.

Sweep-Displacement Error
Less than 2% of 8 cm.

Signal-Displacement Error
Less than 2% of 2 cm.

Full 4-cm x 8-cm Deflection

Highly Mobile
Indicator unit and power supply mounted on Scope-Mobile.

GENERAL DESCRIPTION

The Tektronix Type 517A Cathode-Ray Oscilloscope is a wide-band high-voltage instrument for the observation and photographic recording of very-fast-rising waveforms having low duty cycle. With its risetime of 7 nanosecond, 24-kv accelerating potential, and high-speed sweeps, the Type 517A is especially well suited to single-sweep applications involving transients of very short duration. Use of the new Tektronix metallized cathode-ray tube, T517P, increases the maximum vertical deflection to a full 4 cm and improves the linearity of the horizontal sweep. Basic vertical deflection factor of the Type 517A is 0.05 volts/cm.

The indicator and power-supply units are mounted on a Type 500 Scope-Mobile, making the Type 517A a convenient, mobile unit. If desired, the indicator and power-supply units can be easily removed from the Scope-Mobile for bench use.

VERTICAL DEFLECTION SYSTEM

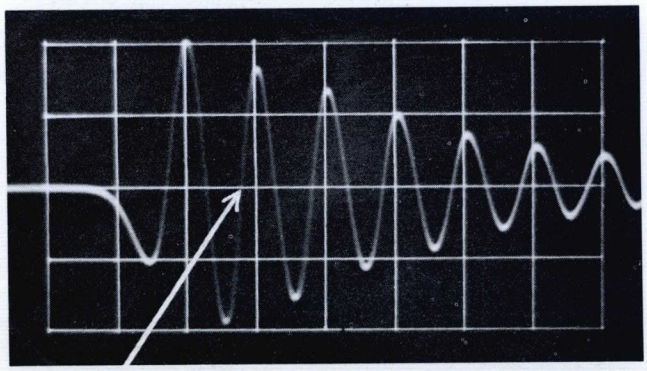
Distributed Amplifier—A 5-stage distributed amplifier is used to derive a transient-response risetime of 7 nanoseconds.

Sensitivity—Basic deflection factor is 0.05 v/cm with 24-kv accelerating potential. A front-panel variable-attenuator control is provided to adjust the sensitivity.

Input—The input of the vertical amplifier is connected through a coaxial connector directly to the 170-ohm first-stage grid line.

Cathode-Follower Probe—To provide higher input impedances, a cathode-follower probe and three capacitive attenuator heads are supplied with the Type 517A. The input impedance of the probe alone consists of 12 megohms paralleled by approximately 5 pf. Each attenuator head will present a different input capacitance, decreasing with higher attenuation ratios. Each attenuator head is adjustable over a ten-to-one range by means of a screwdriver adjustment in the nose of the head, making the following deflection factors and attenuator ranges available:

	Deflection Factor of Type 517A at 24-KV Accelerating Potential	Total Attenuation at CRT
Scope Input	0.05 to 0.1 v/cm	1:1 to 2:1
Probe Body Alone	0.1 to 0.2 v/cm	2:1 to 4:1
Probe with Attenuator I	0.2 to 4 v/cm	4:1 to 80:1
Probe with Attenuator II	2 to 40 v/cm	40:1 to 800:1
Probe with Attenuator III	20 to 400 v/cm	400:1 to 8000:1



Arrow indicates 1100 cm/μsec writing-rate point on 100-mc damped oscillation, displayed on single 10 nsec/cm sweep of Type 517A Oscilloscope with T517P11 crt. Recorded on 35-mm TRI-X film at f1.9 with 4.2 to 1 reduction, developed 26 minutes in D-19 at 68°F.

Step Attenuator—A separate 170-ohm step attenuator is furnished with the Type 517A. The attenuator uses 2% precision resistors, and covers the range of 1 to 64 db in 1-db steps. It is rated at 0.25 w. Also furnished is a 170-ohm coaxial cable, 42" long.

Auxiliary Power—A front-panel socket is provided to supply power for a cathode-follower probe or an auxiliary amplifier stage connected close to the circuit under observation. 6.3 v dc at 1 amp and 120 v regulated dc at 10 ma are available.

HIGH-SPEED OSCILLOSCOPE

Signal Delay—Approximately 65 nsec of delay cable is incorporated in the vertical amplifier. This delay, along with an inherent 55 nsec delay in the amplifier, permits the sweep to start before the signal reaches the vertical deflection plates.

Direct Input CRT—An aperture in the side of the cabinet permits direct connection to the crt deflection plates for observation of extremely-fast transients.

HORIZONTAL DEFLECTION SYSTEM

Calibrated Sweep Rates—The basic sweep waveform is generated by a boot-strap circuit with an inverter stage for balanced deflection. Eleven fixed, calibrated sweep rates accurate within 2% . . . 10, 20, 50, 100, 200, 500 nsec/cm, 1, 2, 5, 10, 20 μsec/cm are available at 24 kv accelerating potential; and 5, 10, 25, 50, 100, 250 nsec/cm, 0.5, 1, 2.5, 5, 10 μsec per cm at 12 kv.

Single-Sweep Operation—Lockout-reset circuitry provides for one shot recording. After a single sweep is triggered, the sweep circuit is automatically locked out until manually reset. When reset, the sweep will fire on the next trigger received, then automatically lock out until the operator presses the reset button.

Trigger Selection—A front-panel switch selects a trigger from an observed signal of either polarity, an external trigger source of either polarity, or the internal trigger generator.

Trigger Requirements—The Type 517A uses a distributed amplifier in the trigger circuitry to handle fast-rise trigger signals. An internal trigger giving a 2-mm deflection will trigger the Type 517A. External trigger requirements are 0.3 to 15 v.

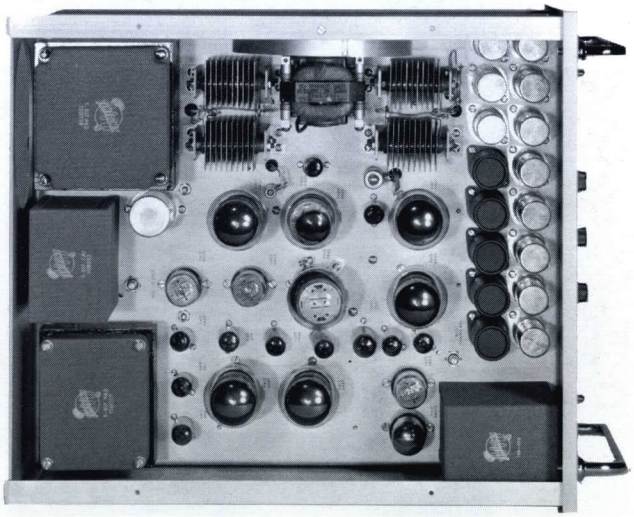
Trigger-Rate Generator — Internal trigger-rate generator is continuously variable from 15 to 15,000 cycles in three ranges with accuracy within 5% of full scale. Two cathode-follower outputs are available . . . 20 v at 50 ohms internal impedance and 60 v at 200 ohms internal impedance. Risetime is approximately 0.15 μsec.

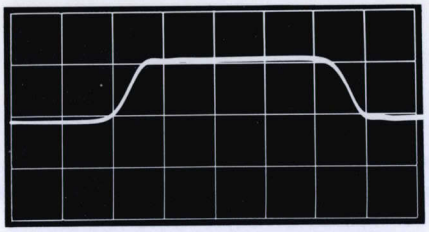
Automatic Duty-Cycle Limiter—The maximum duty cycle of the sweep system is automatically limited to about 30% to avoid exceeding the dissipation limits of some of the sweep circuit components.

POWER SUPPLY

Low Voltage—The low-voltage power supply is separate from the indicator unit, supplying power to it by an inter-connecting cable. All dc supplies are electronically regulated and heaters in the indicator unit are regulated by a saturable-reactor method to insure stable operation over line-voltage and load variations between 105 and 125 v or 210 and 215 v.

High Voltage—Accelerating potentials for the crt are obtained from an oil-filled oscillator-type supply, all voltages electronically regulated to insure stable operation for both load and line changes. A front-panel





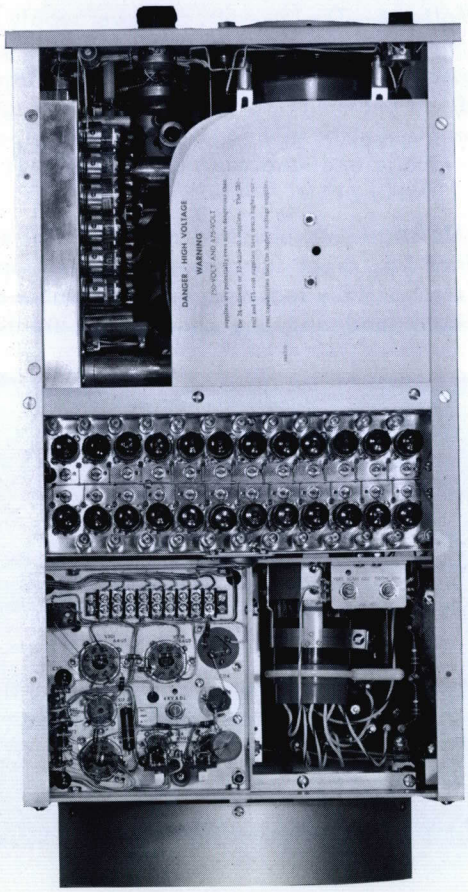
A 45 nsec pulse, initial risetime one nsec, displayed with a sweep time of 10 nsec per centimeter. Note amplifier risetime and freedom from ringing and overshoot.

switch on the indicator unit changes the accelerating voltage from 24 kv to 12 kv by changing the sampling voltage in the regulator circuit.

OTHER CHARACTERISTICS

Amplitude Calibrator—A pulse-type calibrator is used in the Type 517A and is available at the front-panel through a coaxial connector. The output voltage is continuously variable from 0.15 v to 50 v peak full scale in 6 ranges with accuracy within 4% of full scale. Frequency is approximately 25 kc.

Horizontal-Position Vernier—In addition to the normal horizontal-position control, a vernier control calibrated in millimeters provides accurate measurements over a range of 1 cm (24-kv accelerating potential) for use in measuring risetimes, etc.



Metallized Cathode-Ray Tube—The Type 517A uses a new Tektronix crt, T517P___. The T517P___ is a 5" flat-faced metallized precision tube with helical post-accelerating anode. It provides a full 4-cm x 8-cm viewing area when operated at 24-kv accelerating potential. Position of the high-voltage connector permits bringing the tube face flush with the panel. A P11 phosphor is normally furnished. P1, P2, or P7 can be furnished instead if desired. Some other phosphors are available on special order.

Output Waveforms—In addition to the two trigger-rate generator outputs and calibrator output, a +GATE waveform of approximately 30 volts amplitude is available. Its duration is approximately equal to the sweep being generated. Risetime is 30 nsec, from a cathode-follower source impedance of 200 ohms.

Illuminated Graticule—An edge-lighted graticule is marked in centimeter squares, 4 vertical and 8 horizontal, for convenience in making time and amplitude measurements. Illumination is controlled by a front-panel knob.

Cathode-Ray Tube Alignment—A molded nylon handle on the crt socket facilitates realignment of the cathode-ray tube.

ELECTRON-TUBE COMPLEMENT

First distributed amplifier	6	6AK5
Second distributed amplifier	6	6AK5
Third distributed amplifier	7	6CB6
Phase inverter stage	3	6CB6
Driver amplifier	12	6CB6
Output amplifier	24	6CB6
Internal trigger coupling		6CB6
Trigger phase-splitter		6J6
Trigger amplifier	6	6AK5
Trigger limiter		6AG7
Trigger switch		6AG7
Coupling diode		6X4
Lockout CF and Indicator amplifier		12BH7
Sweep Lockout		2D21
Multivibrator	2	6AG7
Duty-cycle limiter		6AN8
Sweep clamp	2	6AG7
Bootstrap cathode followers	2	12BH7
Decoupling diode		6X4
Positive sweep out CF		12BH7
Sweep inverter		6AG7
Voltage regulator CF		12AU7
Negative sweep clamp		6AL5
Sweep out dc restorer		6AL5
Unblanking amplifiers	2	6AG7
Voltage regulator CF		6AS5

Unblanking cathode follower		6J6
+Gate out cathode follower		6J6
Cal multivibrator		12AU7
Clipper		6J6
Cal voltage adjust CF		6J6
Cal out CF		6J6
Trigger rate phantastron generator		6BH6
Trigger coupling and recharging CF		12AU7
Plate catcher		12AU7
Blocking oscillator		12AU7
Output cathode followers	2	12AU7
Astigmatism and probe voltage CF		12AU7
Low-voltage rectifiers	4	6X4
Rectifier		5R4GY
Voltage reference		5651
Comparator		12AX7
Regulator amplifiers	5	6AU6
Series regulators	2	6AU5
Series regulators	6	6AS7
Heater voltage control diode		2AS-15
Heater-regulator amplifier		6AU5
High-voltage rectifiers	5	1X2
High-voltage oscillator		6AU5
Regulator amplifier		12AU7
Series regulator	2	6AU5
High-voltage time delay		6C4
High-voltage rectifier filament oscillator		6AQ5
Astigmatism and probe power CF		12AU7
Cathode-ray tube		T517P11

MECHANICAL SPECIFICATIONS

Ventilation—Filtered, forced-air ventilation assures safe operating temperature. A minimum of 2" of unobstructed clearance around the instruments is recommended for adequate ventilation.

Construction—Aluminum-alloy chassis and cabinets.

Finish—Photo-etched anodized panel, blue wrinkle finished cabinets.

Dimensions—Indicator unit: 18⅜" high, 13" wide, 27" deep. Power supply unit: 9⅝" high, 13" wide, 19¾" deep.

Weight: Indicator, Net—76 pounds
Shipping—94 pounds appr.
Power Supply, Net—69 pounds
Shipping—81 pounds appr.
Scope-mobile, Net—35 pounds
Shipping—50 pounds appr.

Power Requirements—105-125 v or 210-250 v, 50-60 cycles, 1250 watts.

Type 517A **$3500**

Includes: 1—Type 500A Scope-Mobile
1—Power supply unit
1—P170CF cathode-follower probe (010-101)
1—B170A step attenuator (011-017)
1—P170 coaxial cable (012-006)
1—H510 viewing hood (016-001)
1—B510 bezel (014-001)
1—3-conductor power cord (161-010)
1—Inter-unit power cable (012-032)
1—Instruction manual

Optional Phosphors

P11 phosphor normally furnished.
P1, P2, P7 optional.....No extra charge

Prices f.o.b. factory. (Please refer to **Terms and Shipment, GENERAL INFORMATION** page.)

MAIN FEATURES

Deflection Factor—Approximately 50 v/cm to 500 v/cm

Calibrated Vertical Positioning

24-kv Accelerating Potential

Risetime—Approximately 10 nsec

Sweep Range—20 nsec/cm to 50 μsec/cm

6-cm by 10-cm Deflection

GENERAL DESCRIPTION

The Tektronix Type 507 is a specialized oscilloscope, designed primarily for high-voltage surge testing as applied to power transformers, high-voltage insulators, lightning arresters, and their associated design and acceptance tests. Both Indicator Unit and Power Supply are mounted on a Type 500A Scope-Mobile for convenience and mobility.

VERTICAL-DEFLECTION SYSTEM

Risetime—A passive damping network inserted in the deflection leads to the crt is adjusted for optimum transient response (without overshoot or ringing) of 10 nsec.

Deflection Factor—The Tektronix Type T507P11 crt deflection factor is approximately 50 v/cm.

Step Attenuator—The input signal is connected to a series voltage-divider chain of ten equal resistors (normally 7.2 ohms each) mounted on a tap switch. The ratio of signal applied to the deflection plates can be selected by the tap switch from 10% to 100% in 10% steps. The 72-ohm input impedance presented by the divider chain properly terminates Amphenol Type 21-125 coaxial cable. Step attenuator impedances designed to properly terminate other cable impedances as low as 50 ohms can be provided on request. Contact your Tektronix Field Engineer or Representative for information.

The vertical-input system will withstand crest voltages of 3 kv of the standard 1.5 x 40 μsec surge-testing waveform. Voltage-breakdown and heat-dissipation limitations must be considered before impressing signals greater than 3 kv and/or longer than 40 μsec.

Vertical Input —A standard UHF signal-input connector is located on the rear of the instrument.

Signal Delay—Two standard UHF connectors are provided on the rear of the Type 507 for insertion of an external length of delay cable into the vertical-input signal circuit. Choice of the appropriate length and type of cable is at the discretion of the user. No delay cable is furnished with the Type 507.

NOTE: Ground Voltage Transients—Due to the physical configurations and electrical parameters of the apparatus used in surge testing, large voltage transients are often induced into the grounding system. Since the oscilloscope signal-cable shield must be connected to some point in this ground system for potential and current measurements, the ground-voltage transients will be impressed upon the oscilloscope chassis.

Two undesirable consequences may arise from the ground transients: First, the oscilloscope power-transformer insulation may be overstressed, causing breakdown. Second, a current flow will be set up through the chassis capacity to earth, power source, and any ground conductor that is connected to the instrument. Such circulating currents in the oscilloscope chassis may disturb the proper operation of the instrument. Ordinarily the sweep and crt-unblanking circuits will be most noticeably affected. Other circuits can be disturbed also.

Especial attention has been given to the layout and grounding of the circuitry in the Type 507 to ensure minimum sensitivity to extraneous disturbances. The excellent performance in a variety of surge testing laboratories indicates that a high degree of success has been reached in the Type 507 toward accommodating ground disturbances.

As in all practical instruments, however, there must be a limit to the ground voltages which the Type 507 can withstand. Our tests indicate a limit of 2000 crest volts to ground for transformer breakdown.

Once the ground-voltage limit is approached in a particular surge-testing apparatus the engineer will wish

SURGE-TESTING OSCILLOSCOPE

to employ means exterior to the Type 507 to reduce the impressed voltages. Several well known techniques are in use for isolating the oscilloscope from circulating ground currents. These range from motor generator sets for power line isolation to multiple shielded enclosures large enough to surround the oscilloscope, operator, and 60-cps power generator.

Tektronix fully realizes that instrument performance can be accurately evaluated only under the conditions of actual use. As a specialized instrument the Type 507 represents an important investment. We suggest that the prospective buyer contact his Tektronix Field Engineer or Engineering Representative and arrange for a demonstration. His address is listed in this catalog.

Polarity Switch—A three-position switch reverses the deflection-plate polarity. The center position is used to apply markers for photographing time references.

Positioning Switch—The Type 507 has a seven-step vertical-position switch with 50 v steps of −150 v, −100 v, −50 v, 0, +50 v, +100 v, and +150 v. A two-position switch selects either 50 v steps or continuously variable adjustment.

External Voltmeter Connectors—Terminals are provided for a high-impedance (5000 Ω/volt) dc voltmeter, permitting vertical calibration when using the variable positioning.

HORIZONTAL DEFLECTION SYSTEM

Calibrated Linear Sweep Rates—The sweep waveform is generated by a boot-strap circuit and an inverter stage for balanced deflection. Eleven fixed, calibrated sweep rates . . . 20, 50, 100, 200, 500, nanoseconds/cm, 1, 2, 5, 10, 20, and 50 μsec/cm are available.

Trigger Selection—A five-position front-panel switch selects a trigger, external or internal of either positive or negative polarity. The marker position is used when time markers are desired.

Trigger Amplitude—A signal of 100 v to 3 kv amplitude is required for both internal triggering and triggering with an external signal.

Sweep Mode—When the switch is in the single-sweep position, pressing the RESET button arms the sweep circuit. The sweep then can be triggered internally, by MANUAL TRIGGER, or by an external trigger.

POWER SUPPLY

Low Voltage—The low-voltage power supply is separate from the indicator unit, supplying power to it by an interconnecting cable. All dc supplies are electronically regulated to ensure stable operation over line-voltage and load variations between 105 and 125 v or 210 and 250 v.

High Voltage—Accelerating potentials for the crt are obtained from an oil-filled oscillator-type supply, all voltages electronically regulated to ensure stable operation for both load and line changes.

OTHER CHARACTERISTICS

Cathode-Ray Tube—The Type 507 uses the new Tektronix T507P___ crt. A P11 phosphor is normally furnished. P1, P2, and P7 are available as optional phosphors. Some other phosphors are available upon request.

Accelerating Potential—With its 24 kv accelerating potential and high-speed sweeps, the Type 507 is well suited to single-sweep applications involving transients of very short duration.

Time Markers—Markers are available as a function of the MICROSECONDS/CM switch for convenient calibration of the sweep. The 0.05-μsec time mark is available at sweep speeds from 0.02 μsec/cm to 0.2 μsec/cm, 0.5 μsec from 0.5 μsec/cm to 2 μsec/cm, 5 μsec from 5 μsec/cm to 20 μsec/cm, and 10 μsec at 50 μsec/cm. These are useful as references when photographing pulses.

TYPE 507

Trip Pulse For Manual Triggering—This is intended for use in triggering a trip-pulse generator. A pulse of approximately 700 v amplitude and 5 μsec width is available at the output connector. Pulse amplitude and width may be affected somewhat by the length of the cable used.

Connectors—Standard UHF connectors for Signal In, Signal Out To Delay Line, Signal In From Delay Line, Trip Pulse Out, and External Trigger In are located at the rear of the instrument. 6.3 v ac at 1 amp is available through a front-panel pin jack.

Illuminated Graticule—An edge-lighted graticule is marked in centimeter squares, 6 vertical and 10 horizontal, for convenience in making time and amplitude measurements. This graticule is removable. Illumination is controlled by a front-panel knob.

MECHANICAL SPECIFICATIONS

Ventilation—Filtered, forced-air ventilation assures safe operating temperature. A minimum of 2" of unobstructed clearance around the instrument is recommended for adequate ventilation.

Construction—Aluminum-alloy chassis and cabinets.

Finish—Photo-etched anodized panel, blue wrinkle-finished cabinets.

Dimensions—Indicator unit: 16¾" high, 13" wide, 23⅝" deep. Power supply unit: 10½" high, 13" wide, 17½" deep.

Weight: Indicator, Net—53 pounds
Shipping—68 pounds appr.
Power Supply, Net—41 pounds
Shipping—51 pounds appr.
Scope-mobile, Net—35 pounds
Shipping—50 pounds appr.

Power Requirements—105-125 v or 210-250 v, 50-60 cycles, 600 watts.

TYPE 507 ..... **$3000.**

Includes: 1—Type 500A Scope-Mobile
1—Power supply unit
1—Common buss ground connector (013-011)
1—3-conductor power cord (161-010)
1—Bezel (014-001)
1—Green Filter (378-503)
1—Inter-unit power cable (012-012)
1—Instruction manual

Optional Phosphors

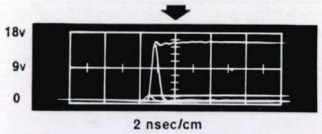
P11 phosphor normally furnished.
P1, P2, P7 optional ..... No extra charge

Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page.)

for clear display of:

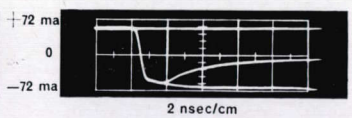
Single-Shot Nuclear Events/Transistor Switching/Fast Diode Turn-on/Radio-Frequency Waveforms/Tunnel-Diode Switching

Small pulses—with minimum slewing



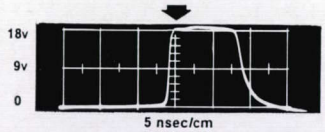
Outstanding trigger capability is illustrated by this multiple-exposure photograph which demonstrates the Type 519 triggered internally by various wave shapes—including one small amplitude signal having 0.5-nsec duration.

Fast-diode recovery time



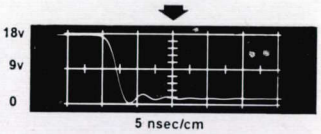
Switching and storage times in fast diodes can be measured easily by the Type 519. In this multiple-exposure, diode-recovery-time waveform, the upper trace is +50 ma reference, the middle trace shows the diode turn-off, and the lower trace shows the diode shorted.

Avalanche-transistor characteristics



A Type 2N636 transistor in avalanche generates the pulse shown. This output pulse is available from the Rate Generator on the Type 519 at 50 ohms impedance—with the repetition rate variable from 3 cycles to 30 kilocycles.

High-speed circuit analysis



The Type 519 Oscilloscope is an invaluable tool for testing active or passive wideband circuits. In this wideband amplifier waveform, little or no correction is necessary for the inherent risetime of the oscilloscope.

NEW KMC OSCILLOSCOPE TEKTRONIX TYPE 519

. . . for recording high-speed one-shot occurrences

NOW, you can see and record non-repetitive, high-speed phenomena with a standard oscilloscope—one that does not depend upon sampling techniques. On its distributed-deflection CRT, you can observe bright displays with 100-line-per-centimeter definition. You can photograph fractional-nanosecond signals with ease on its full 2 x 6 centimeter display area.

You will find the Type 519 engineered for convenience . . .

Internally—all circuit components of the complete unit fit compactly, yet are readily accessible for easy maintenance. A fixed signal-delay line plus variable sweep-delay control maintains the wide display passband and eliminates any need for adjusting delay-cable lengths.

Externally—the Type 519 features a minimum of controls and connectors for an instrument in this range. A carefully-coordinated front-panel layout facilitates your test setups and procedures and aids greatly in saving engineering time and effort.

You need no auxiliary equipment for many high-speed applications. In fact, for normal operation, you make two connections only: (1) you plug-in the power cord, (2) you couple-in the signal source.

With such operational ease—combined with its inherent Tektronix reliability—the Type 519 is an ideal laboratory oscilloscope for your high-speed measurements up to the KMC region and slightly beyond—especially those applications demanding a photographic record of one-shot occurrences.

CHARACTERISTICS

Passband—from dc, 3 db point typically above 1 KMC. **Instrument Risetime**—less than 0.35 nanosecond (including trigger takeoff, delay line, CRT, and termination). **Synchronization**—200 mv peak-to-peak, 1 MC to 1 KMC. **Accelerating Potential**—24 kilovolts. **Sensitivity**—10 volts/centimeter, maximum, into 125 ohms. **Time Base**—linear 6-centimeter sweeps from 2 nanoseconds/centimeter to 1 microsecond/centimeter in 9 steps. **Sweep Delay**—through 35 nanoseconds. **Triggering**—jitter-free: **External**—3-microwatt (20-millivolt) pulse of 1-nanosecond duration. **Internal**—2-tracewidth pulse of 1-nanosecond duration. Signal waveform undisturbed by trigger takeoff. **Power and High-Voltage Supplies**—electronically regulated. **Calibration-Step Generator. Avalanche-Transistor Rate Generator.**

Type 519 KMC Oscilloscope (f.o.b. factory) **$3800**

Please call your Tektronix Field Engineer for complete specifications and a demonstration of the Type 519 in your own applications.

Tektronix, Inc.

P. O. Box 500 • Beaverton, Oregon

Phone Mitchell 4-0161 • TWX—BEAV 311 • Cable: TEKTRONIX

TEKTRONIX FIELD OFFICES: Albuquerque, N. Mex. • Atlanta, Ga. • Baltimore (Towson) Md. • Boston (Lexington) Mass. • Buffalo, N.Y. • Chicago (Park Ridge) Ill. • Cleveland, Ohio • Dallas, Texas • Dayton, Ohio Denver, Colo. • Detroit (Lathrup Village) Mich. • Endicott (Endwell) N.Y. • Greensboro, N.C. • Houston, Texas • Indianapolis, Ind. • Kansas City (Mission) Kan. • Los Angeles, Calif. Area (East Los Angeles, Encino • West Los Angeles) • Minneapolis, Minn. • Montreal, Quebec, Canada • New York City Area (Albertson, L.I., N.Y. • Stamford, Conn. • Union, N.J.) • Orlando, Fla. • Philadelphia, Pa. • Phoenix (Scottsdale) Ariz. Poughkeepsie, N.Y. • San Diego, Calif. • San Francisco (Palo Alto) Calif. • St. Petersburg, Fla. • Syracuse, N.Y. • Toronto (Willowdale) Ont., Canada • Washington, D.C. (Annandale, Va.).

TEKTRONIX ENGINEERING REPRESENTATIVES: Hawthorne Electronics, Portland, Oregon • Seattle, Washington. Tektronix is represented in twenty overseas countries by qualified engineering organizations.

In Europe please write Tektronix Inc., Victoria Ave., St. Sampsons, Guernsey C.I., for the address of the Tektronix Representative in your country.

Scheduled: April 12, 1961, *Electronic Design;*
April, 1961, *Industrial Research, Review of Scientific Instruments.*

3-INCH PORTABLE OSCILLOSCOPES

TYPE 310A G-2

TYPE 316 . . . . . G-6

TYPE 317 . . . . . G-10

TYPE 321 . . . . . G-14

MAIN FEATURES

Designed for Easy Handling
Small—10" x 6¾" x 17".
Weighs only 23½ pounds.

Transient Response
Risetime—90 nsec.

Frequency Response
DC to 4 mc—0.1 v/div to 125 v/div.
2 cycles to 3.5 mc—0.01 v/div to 0.1 v/div.

Sweep Range
0.1 μsec/div to 0.6 sec/div.
18 calibrated sweep rates.

Versatile Triggering
Internal, external, line . . . ac-coupled or dc-coupled, and automatic triggering.

GENERAL DESCRIPTION

The Tektronix Type 310A Oscilloscope is a 3" Portable with new mechanical features. Use of advanced construction techniques has produced a more rugged instrument with greater shock-resistant characteristics. The same desirable degree of compactness of its predecessor the Type 310 has been retained. Longer life and greater reliability have been attained through the use of silicon rectifiers and dual-triodes of an advanced design.

The Type 310A Oscilloscope is an instrument you can take with you—easily, comfortably. Small size and low weight combined with operation on 50 to 800-cycle line frequency make this an ideal instrument for maintenance and calibration of specialized measuring and recording instruments at their point of use. Accurate calibration and excellent linearity assure faithful displays and precise time and amplitude measurements either in the laboratory or in the field. Functional panel design and versatile control systems contribute to operator convenience.

VERTICAL-DEFLECTION SYSTEM

DC-Coupled Vertical Amplifier—Main amplifier passband is dc to 4 mc. Vertical deflection is calibrated in steps of 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50 v/div. Low-frequency response is limited to 2 cycles when the AC-DC switch is in the AC position. An ac-coupled preamplifier switched in by the VOLTS/DIV control provides three additional calibrated steps of 0.01, 0.02, and 0.05 v/div, at a frequency response of 2 cycles to 3.5 mc. In addition, a 2.5-to-1 vernier (uncalibrated) control provides for continuously-variable adjustment from 0.01 v/div to 125 v/div. A jewel light on the front panel indicates when the control is in the variable (uncalibrated) position. Vertical amplifier is factory-adjusted for optimum transient response. Risetime is less than 90 nsec. Input impedance is 1 megohm paralleled by approximately 40 pf.

Calibration Accuracy—Internal adjustments are provided for setting the gain of the vertical amplifier. When these adjustments are accurately set with the VOLTS/DIV switch in the 0.1 and 0.01 v/div positions, the vertical deflection factor for any other position of the switch will be within 3% of the panel reading for that switch position.

Probe—A low-capacitance probe (10-x atten.) is supplied with the instrument. Input capacitance with the probe is approximately 13 pf paralleled by 10 megohms.

HORIZONTAL-DEFLECTION SYSTEM

Wide Sweep Range—The Type 310A has 18 calibrated sweep rates: 0.5, 1, 2, 5, 10, 20, 50, 100, 200, 500 μsec/div, ... 1, 2, 5, 10, 20, 50 millisec/div, 0.1, 0.2 sec/div. In addition, a vernier (uncalibrated) control provides sweep rates continuously adjustable from 0.5 μsec/div to 0.6 sec/div. A jewel light in the front panel indicates when the control is in the variable (uncalibrated) position. Calibration accuracy of the 18 fixed sweeps is within 3%.

Sweep Magnifier—Sweep magnification is obtained by increasing the gain of the sweep-output amplifier by a factor of 5. The center 2-division portion of the normal trace is expanded to 10 divisions. The HORIZONTAL POSITION control has sufficient range to display any one-fifth of the magnified sweep. The 5-x magnifier applied to the 0.5-μsec/div sweep extends the calibrated range to 0.1 μsec/div. Accuracy is within 3% of the displayed portion of the magnified sweep on all ranges except the 0.5 μsec/div range, where accuracy is within 5%.

DC-to-4 MC OSCILLOSCOPE

DC-Coupled Unblanking—The unblanking waveform is dc-coupled to the control grid of the cathode-ray tube. This assures uniform bias for all sweep speeds and repetition rates.

Triggering Facilities—Versatile triggering circuitry provides for complete manual control, preset stability control, and fully-automatic triggering.

Amplitude-Level Selection—Adjustable amplitude-level and stability controls provide for triggering the sweep at a selected amplitude level on the triggering waveform. Trigger source can be internal, external, or the line frequency, either ac-coupled or dc-coupled. The triggering point can be on either the rising or falling slope of the triggering waveform.

Preset Stability—Same as above, except the stability control is preset to the optimum triggering point and requires no readjustment.

Automatic Triggering—Automatic level-seeking trigger circuit provides dependable triggering for most applications. One simple setting assures positive sweep-triggering by signals of widely differing amplitudes, shapes, and repetition rates. No trigger controls need be touched until a different type of operation is desired. Range of automatic operation is between 60 cycles and 2 mc, approximately. In the absence of an input signal the sweep is automatically triggered at about a 50-cycle rate, providing a reference trace on the screen.

Trigger Requirements—Internal triggering—a signal large enough to produce a one-half division deflection. External—a signal of 0.2 v to ±20 v.

Horizontal Input—A back-panel terminal permits use of an external signal to drive the horizontal amplifier. Deflection factor is 1.5 v/div.

OTHER CHARACTERISTICS

Voltage Calibrator—A square-wave voltage is available through a front-panel binding post. Eleven fixed voltages—0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50, and 100 volts peak-to-peak—are provided. Accuracy is within 3%. Square-wave frequency is about 1 kc.

Accelerating Potential—1.85 kv accelerating potential, electronically regulated, is applied to the flat-faced 3WP__ cathode-ray tube. A P2 phosphor is normally supplied, but P1, P7 or P11 can be furnished instead if desired. Some other phosphors are available on special order.

Regulated Power Supply—Electronically-regulated dc supplies insure stable operation over line-voltage and load variations between 105 and 125 v or 210 and 250 v, 50 to 800 cycles.

Illuminated Graticule—The edge-lighted graticule has 8 vertical and 10 horizontal ¼-inch divisions. Illumination is controlled by a front-panel knob. An appropriate filter is provided to increase contrast when viewing in a brightly-lighted room.

Hinged Chassis—The Type 310A opens up to permit easy accessibility to all tubes and components.

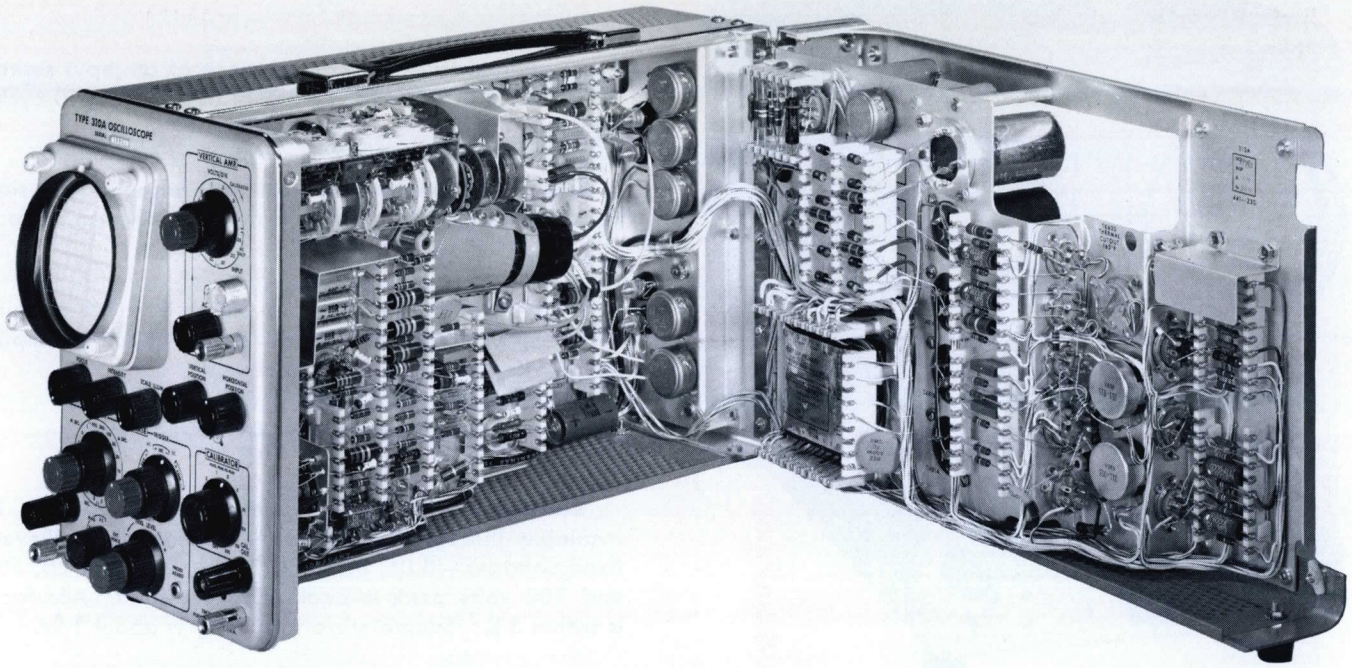
ELECTRON TUBES AND SEMICONDUCTORS

* denotes "or equivalent"

Vertical

Preamplifier		6AU6
Preamplifier cathode protector		T12G*
Preamplifier CF		6BH6
Input amplifiers	2	6AU6
Driver CF's		6DJ8
Output amplifiers	2	6CL6
Trigger-pickoff CF		6BH6

TYPE 310A



Horizontal	
Trigger-input amplifier	6DJ8
Trigger multivibrator	6DJ8
Sweep-gating multivibrator and CF	6DJ8
Sweep-gating multivibrator	6AU6
Disconnect diodes	6AL5
Miller-runup sweep generator and CF	6AN8
Holdoff CF's	12AT7
Horizontal-input CF and external-horizontal input CF	6DJ8
Horizontal-output amplifiers	6DJ8

Power Supplies		
Voltage reference		5651
Voltage rectifiers	12	1N1566*
Regulator amplifiers	3	6BH6
Series regulators	3	12B4
High-voltage oscillator		6AQ5
High-voltage rectifiers	2	5642
Error-signal amplifiers		12AU7
Miscellaneous		
Calibrator multivibrator and CF		12AU7
Calibrator multivibrator		6AU6
Cathode-ray tube		3WP2

MECHANICAL SPECIFICATIONS

Construction—Self-contained, cabinet and chassis made of aluminum alloy. New mechanical techniques improve accessibility to components and tubes.

Finish—Photo-etched anodized front panel, blue wrinkle-finished cabinet.

Dimensions—10" high, 6¾" wide, 17" long.

Weight: Net—23½ pounds
Shipping—30 pounds appr.

Power Requirements—105 to 125 volts, 175 watts.

The Type 310A will operate over the range of 50 to 800 cps, but at 800 cps about 4% greater line voltage is required. Unless otherwise specified, the instrument will be shipped wired for operation within the line-voltage range of 105 to 125 volts. The Type 310A can be ordered wired for operation on several nominal line voltages as follows:

Nominal Line Voltage	Operating Range
(Figures taken at 60 cps)	
110	99 to 117 volts
117	105 to 125 volts
124	111 to 132 volts
220	198 to 235 volts
234	210 to 250 volts
248	223 to 265 volts

A metal decal on the transformer gives complete instructions for changing the operating range.

Type 310A **$625**

Includes: 1—10-x attenuator probe
1—Binding-post adapter (013-004)
1—Green filter (378-509)
1—3-conductor power cord (161-013)
1—Instruction manual

Optional Phosphors

P2 crt phosphor normally furnished.
P1, P7, P11 optional.....No extra charge

Recommended Additional Accessories

Fan Base—Provides filtered forced-air ventilation to reduce operating temperature when the Type 310A is being used continuously over long periods, or in a hot or limited-ventilation area. The fan base tilts the oscilloscope to a convenient viewing angle. For use on 105-125 v, 50 to 60 cycles only.

Order Part # 016-012 ..... **$35.00**

Fan Base—For use on 210-250 v, 50 to 60 cycles only.

Order Part # 016-013 ..... **$35.00**

Prices f.o.b. factory. (Please refer to **Terms and Shipment**, ***GENERAL INFORMATION*** page.)

MAIN FEATURES

Passband
DC to 10 mc at 0.1 v/div to 125 v/div.
2 c to 10 mc at 0.01 v/div to 0.1 v/div.

Transient Response
Risetime—35 nsec.

Sweep Range
22 calibrated sweep rates from 0.2 μsec/div to 2 sec/div, continuously variable from 0.2 μsec/div to 6 sec/div. Accurate 5-x magnifier increases calibrated rate to 40 nsec.

Triggering
Amplitude-level selection with preset or manual stability control, and fully-automatic triggering.

Portability
Size— 8½" wide, 12" high, 19½" overall depth.
Weight—34 pounds.

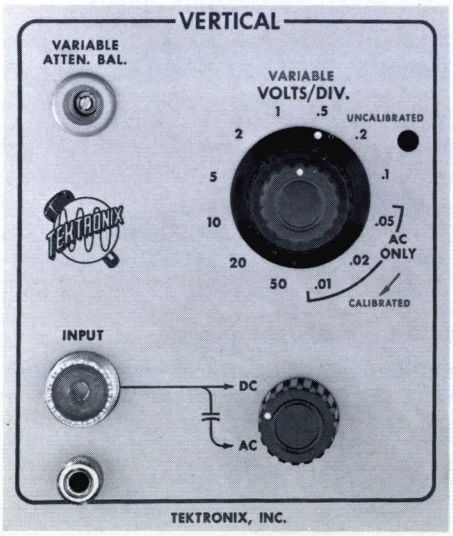
GENERAL DESCRIPTION

The Tektronix Type 316 Oscilloscope replaces the popular Type 315D, providing greatly improved performance and dependability with approximately the same degree of compactness. A new cabinet design with easily-removable sides improves accessibility, and an improved mechanical arrangement minimizes the effects of shock and vibration on accurate operation.

From the users viewpoint, the Type 316 is a convenient laboratory tool that is just right in performance, size and weight for calibration and trouble-shooting use at remote locations. It requires only a small amount of bench space and is very easy to operate. All 22 calibrated sweep rates are selected with one knob, which also indicates the new calibrated sweep rate when the magnifier is in use. Preset stability for all triggering modes eliminates trigger-control adjustment in most applications, but manual stability control is retained and can be switched in when desired. Warning lights indicate when vertical and horizontal deflection controls are not in their calibrated positions. Convenient ground terminals are located beneath each coaxial connector. Panel controls and terminals are arranged for efficient operation.

VERTICAL-DEFLECTION SYSTEM

DC-Coupled Vertical Amplifier—Main amplifier passband is dc to 10 mc, risetime is 35 nsec. Vertical deflection is calibrated in steps of 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50 v/div. Low-frequency response is 3 db down at 2 cycles when the AC-DC switch is in the AC position.



An ac-coupled preamplifier switched in by the VOLTS/DIV control provides three additional calibrated steps of 0.01, 0.02 and 0.05 v/div at a frequency response of 2 cycles to 10 mc, risetime 35 nsec. In addition, a 2½-to-1 vernier (uncalibrated) control provides for continuously-variable adjustment from 0.01 v/div to 125 v/div. A front-panel neon light indicates when the control is in the variable (uncalibrated) position.

Calibration Accuracy—Internal adjustments are provided for setting the gain of the vertical amplifier. When these adjustments are accurately set with the VOLTS/DIV switch in the 0.1 v/div and 0.01 v/div positions, the vertical deflection factor for any other position of the switch will be within 3% of the panel reading for that position.

Delay Network—A signal delay of 0.25 μsec is introduced by the balanced delay network. Permits observation of the leading edge of the waveform that triggers the sweep.

Input Impedance—1 megohm paralleled by approximately 40 pf.

Probe—The vertical sensitivity of the Type 316 is reduced by a factor of ten by use of the 10-x attenuator probe supplied with the instrument. The Probe presents an input impedance of 10 megohms paralleled by approximately 13 pf.

DC-to-10 MC OSCILLOSCOPE

HORIZONTAL-DEFLECTION SYSTEM

Wide Sweep Range—A single knob is used to select any of 22 calibrated sweep rates: 0.2, 0.5, 1, 2, 5, 10, 20, 50 μsec/div, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50 msec/div, 0.1, 0.2, 0.5, 1, and 2 sec/div. In addition, a vernier (uncalibrated) control provides for continuous adjustment from 0.2 μsec/div to 6 sec/div. A front-panel neon light indicates when the control is in the variable (uncalibrated) position. Calibration accuracy of the 22 fixed sweep rates is within 3%.

Sweep Magnifier—When the 5-x magnifier is switched in, calibrated sweep rates are read from the outer ring of numbers circling the TIME/DIV knob. The magnifier expands the normal sweep to fifty divisions, and the HORIZONTAL positioning control has sufficient range to display any ten divisions of the magnified sweep. Calibration accuracy is within 5% of the displayed portion of the magnified sweep.

DC-Coupled Unblanking—The unblanking waveform is dc-coupled to the grid of the crt, assuring uniform grid bias for all sweep and repetition rates.

Triggering Facilities—Versatile triggering circuitry provides for complete manual control, preset stability control, and fully-automatic triggering.

Amplitude-Level Selection—Adjustable amplitude-level and stability controls provide for triggering the sweep at a selected amplitude level on the triggering waveform. Trigger source can be internal, external, or the line frequency, either ac-coupled or dc-coupled. The triggering point can be on either the rising or falling slope of the triggering waveform.

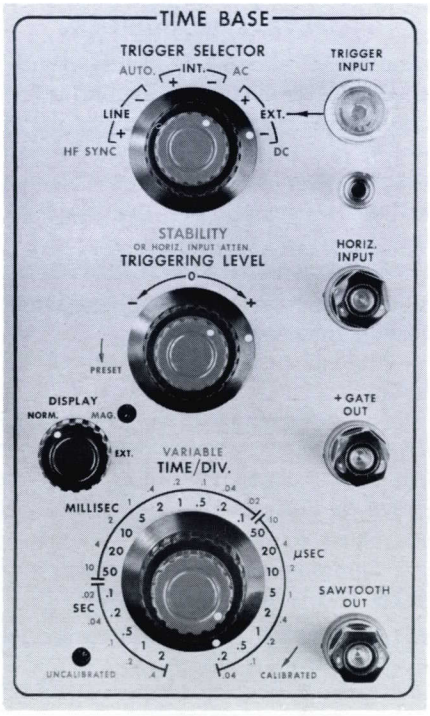
Preset Stability—Same as above, except the stability control is preset to the optimum triggering point and requires no readjustment.

Automatic Triggering—Automatic level-seeking trigger circuit provides dependable triggering for most applications. One simple setting assures positive sweep-triggering by signals of widely differing amplitudes, shapes, and repetition rates. No trigger controls need be touched until a different type of operation is desired. Range of automatic operation is between 60 cycles and 2 megacycles, approximately. In the absence of an input signal the sweep is automatically triggered at about a 50-cycle rate, providing a reference trace on the screen.

High-Frequency Sync—Assures a steady display of sine-wave signals up to approximately 20 megacycles. Requires a signal large enough to cause about 2 cm of deflection, or an external signal of about 2 v.

Trigger Requirements—Internal—a signal large enough to cause a one-fifth division deflection. External—a signal of 0.2 v to 20 v.

Horizontal Input Amplifier—DC-Coupled external connection to the sweep amplifier is through a front-panel



connector. Deflection factor is approximately 1.4 v/div. Frequency response is dc to 500 kc.

OTHER CHARACTERISTICS

Calibrator—A square-wave calibrating voltage is available through a front-panel coaxial connector. Eleven fixed peak-to-peak voltages are provided: 0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50 and 100 volts. Accuracy is within 3%. Square-wave frequency is approximately 1 kc.

Cathode-Ray Tube—A new Tektronix flat-faced 3" cathode-ray tube is used in the Type 316. Accelerating potential is 1.85 kv. A P2 phosphor is normally supplied. P1, P7, P11 can be furnished instead if desired. Some other phosphors are available on special order.

Output Waveforms—A 20 v (approx.) positive-gate waveform of the same duration as the sweep, and a 150 v (approx.) positive-going sweep sawtooth waveform are available at front-panel connectors.

Regulated Power Supplies—Electronic regulation compensates for line-voltage and load variations between 105 and 125 v, or 210 and 250 v.

Illuminated Graticule—The edge-lighted graticule is divided into 8 vertical and 10 horizontal ¼" divisions. Illumination is controlled by a front-panel knob.

ELECTRON TUBES AND SEMICONDUCTORS

* denotes "or equivalent"

Vertical		
Preamplifier		6CB6
Preamplifier CF and voltage setting CF		6DJ8
Preamp Cathode Protector		T12G*
Input CF	2	6AU6
Input amplifiers	2	6AU6
Amplifier CF		6DJ8
Output amplifiers	2	6CL6
Trigger-pick-off CF		6AU6
Horizontal		
Trigger amplifier		6DJ8
Trigger multivibrator		6DJ8
Sweep-gating multivibrator and CF		6DJ8
Sweep-gating multivibrator and unblanking CF		6AN8
Gate out CF and sweep out CF		6DJ8
Disconnect diodes		6AL5
Miller-runup sweep generator and CF		6AN8
Holdoff CF		6DJ8
Horizontal input CF and driver CF		6DJ8
Horizontal-output amplifiers and CF	2	6DJ8
Power Supplies		
High voltage oscillator		6AQ5
High voltage regulator		12AU7
High voltage rectifiers	2	5642
Voltage reference		5651
Voltage rectifiers	14	1N1566*
Regulator amplifiers	2	6AU6
Difference amplifier and voltage-setting CF		6AN8
Series regulator		6080

RM16 RACK-MOUNTING MODEL

GENERAL DESCRIPTION

The Type RM16 is a mechanically rearranged Type 316 Oscilloscope. It mounts in a standard 19-inch rack on slide-out tracks. It can be pulled forward, tilted, and locked in any of seven positions for servicing. Requires only 7 inches of rack height. Electrical characteristics of the instrument are the same as described for the Type 316 Oscilloscope.

MECHANICAL SPECIFICATIONS

Ventilation—Filtered, forced-air ventilation maintains safe operating temperature.

Finish—Photo-etched anodized panel, etched aluminum cabinet.

Construction—Aluminum-alloy chassis and cabinet. Slide-out mounting.

Dimensions—7" high, 19" wide, 17⅝" rack depth. See page B-8 for complete mounting dimensions.

Weight: Net—45 pounds

Shipping—65 pounds appr.

Type RM16 (50 to 60 cycle supply) **$825**

Type RM16MOD101 (50 to 400 cycle supply) **$860**

Includes: 1—Probe (10-x atten.)
1—Binding post adapter (013-004)

1—Green filter (378-509)
1—3-conductor power cord (161-010)
1—Set, mounting hardware
1—Pair, guide rails (351-017)
1—Instruction manual

Recommended Additional Accessories

Supporting Cradles—for rear slide support when the instrument is to be mounted in a backless rack. Two cradles with the necessary hardware.

ORDER PART NO. 426-064 ..... $6.50

Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page.)

Series regulator	12B4
Miscellaneous	
Calibrator multivibrator and CF	12AU7
Calibrator multivibrator	6AU6
Cathode-ray tube	T316P2

MECHANICAL SPECIFICATIONS

Ventilation—Filtered forced-air ventilation maintains safe operating temperature. A minimum of 2" of unobstructed clearance around the instrument is recommended for adequate ventilation.

Construction—Aluminum-alloy chassis and cabinet.

Finish—Photo-etched anodized panel, blue wrinkle-finished cabinet.

Dimensions—8½" wide, 12" high, 19½" overall depth.

Weight: Net—34 pounds
Shipping—42 pounds appr.

Power Requirements—105 to 125 v or 210 to 250 v, 50 to 60 cycles, 260 watts. Type 316MOD101 operates on 50 to 400 cycle supply; uses dc fan motor.

Unless otherwise specified, the instrument will be shipped wired for operation within the line-voltage range of 105 to 125 volts. The Type 316 can be ordered wired for operation on several nominal line voltages as follows:

Nominal Line Voltage (Figures taken at 60 cps)	Operating Range
110	99 to 117 volts
117	105 to 125 volts
124	111 to 132 volts
220	198 to 235 volts
234	210 to 250 volts
248	223 to 265 volts

A metal decal on the transformer gives complete instructions for changing the operating range.

Price, Type 316 (50 to 60 cycles) **$750**

Price, Type 316MOD101 (50 to 400 cycles) **$785**

Includes: 1—10-x attenuator probe
1—Binding-post adapter (013-004)
1—Green filter (378-509)
1—3-conductor power cord (161-010)
1—Instruction manual

Optional Phosphors

P2 crt phosphor normally furnished.

P1, P7, P11 optional .....No extra charge.

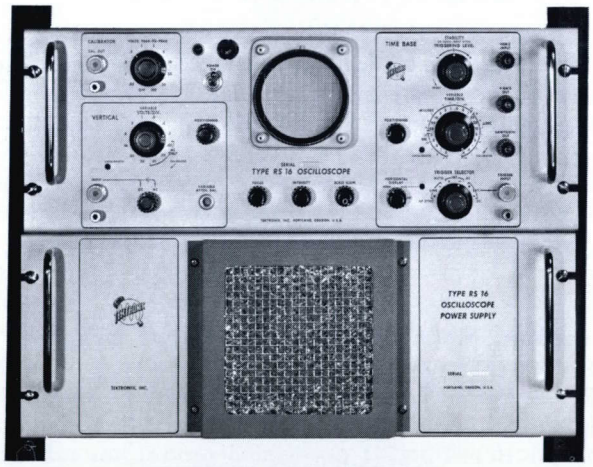
Recommended Additional Accessories

Fan Motor Kit—For converting Type 316 for use on 50 to 400 cycle line frequency (Type 316MOD101). Contains brackets, rectifier, and fan motor.

ORDER PART NO. 040-141 ..... $40.00

Prices f.o.b. factory. (Please refer to **Terms and Shipment**, ***GENERAL INFORMATION*** page.)

RS16 RACK-MOUNTING MODEL



GENERAL DESCRIPTION

The Type RS16 is a two unit model of the Type RM16. It is designed for use in racks with limited depth and requires only 11⅜" of rack depth. The power-supply unit has a built-in fan for forced-air ventilation. The indicator unit requires a minimum of 50 cfm of cooling air from a separate source to prevent overheating when operated continuously. Both units bolt directly to the rack; do not have slide-out mounting. A 60" inter-unit power cable is furnished. Electrical characteristics of the Type RS16 are the same as described for the Type 316 Oscilloscope.

MECHANICAL SPECIFICATIONS

Construction—Aluminum chassis and cabinets.

Finish—Photo-etched anodized panels, etched aluminum cabinets.

Dimensions—Indicator unit 7" high, 19" wide, 11⅜" deep; Power Supply—7" high, 19" wide, 5½" deep.

Weight—Indicator unit, Net—20 pounds
Shipping—36 pounds appr.
Power Supply unit, Net—18 pounds
Shipping—30 pounds appr.

Type RS16 ..... **$875**

Includes: 1—Probe (10-x atten.)
1—Binding-post adapter (013-004)
1—Green filter (378-509)
1—3-conductor power cord (161-010)
1—Set, mounting hardware
1—Instruction manual

Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page.)

MAIN FEATURES

GENERAL DESCRIPTION

The Type 317 is an excellent oscilloscope for the daylight conditions often encountered in the field and at production test stations. Its brilliant trace, provided by 9-kv accelerating potential on a Tektronix 3-inch cathode-ray tube, is easily readable in bright areas . . . even at low sweep-repetition rates. And its dc-to-10 mc vertical response and wide sweep range easily take care of most of today's complex field and test station applications. Of course, these fine characteristics make it an excellent laboratory oscilloscope, too.

VERTICAL-DEFLECTION SYSTEM

DC-Coupled Vertical Amplifier — Main amplifier passband is dc to 10 mc, risetime is 35 nsec. Vertical deflection is calibrated in steps of 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50 v/div. Low-frequency response is 3 db down at 2 cycles when the AC-DC switch is in the AC position. An ac-coupled preamplifier switched in by the VOLTS/DIV control provides three additional calibrated steps of 0.01, 0.02 and 0.05 v/div at a frequency response of 2 cycles to 10 mc, risetime 35 nsec. In addition, a 2½-to-1 vernier (uncalibrated) control provides for continuous adjustment from 0.01 v/div to 125 v/div.

Calibration Accuracy — Internal adjustments are provided for setting the gain of the vertical amplifier. When these adjustments are accurately set with the VOLTS/DIV switch in the 0.1 v/div and 0.01 v/div positions, the vertical deflection factor for any other position of the switch will be within 3% of the panel reading for that position.

Delay Network—A signal delay of 0.25 μsec is introduced by the balanced delay network. Permits observation of the leading edge of the waveform that triggers the sweep.

Input Impedance—1 megohm paralleled by approximately 40 pf.

Probe—The vertical sensitivity of the Type 317 is reduced by a factor of ten by use of the 10-x attenuator probe supplied with the instrument. The probe presents an input impedance of 10 megohms paralleled by approximately 13 pf.

DC-COUPLED VERTICAL AMPLIFIER

Passband—dc to 10 mc at 0.1 to 125 v/div.
Passband—2 cycles to 10 mc at 0.01 to 0.1 v/div.
Risetime—35 nsec.

WIDE SWEEP RANGE

22 Direct-reading calibrated rates from 0.2 μsec/div to 2 sec/div.
5-x Magnifier increases the calibrated sweep rate to 40 nsec/div.
Continuously variable sweep rates from 40 nsec/div to 6 sec/div.

9-KV ACCELERATING POTENTIAL

Bright trace, even at low sweep-repetition rates.

HIGH RELIABILITY

New frame-grid dual triodes insure excellent stability and reliability.

EASY TRIGGERING

Automatic triggering eliminates readjustment in most applications.
Preset or manual stability control for complete triggering versatility.

HORIZONTAL-DEFLECTION SYSTEM

Wide Sweep Range—A single knob is used to select any of 22 calibrated sweep rates: 0.2, 0.5, 1, 2, 5, 10, 20, 50 μsec/div, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50 msec/div, 0.1, 0.2, 0.5, 1, and 2 sec/div. In addition, a vernier (uncalibrated) control provides for continuous adjustment from 0.2 μsec/div to 6 sec/div. Calibration accuracy of the 22 fixed sweep rates is within 3%.

Sweep Magnifier—When the 5-x magnifier is switched in, calibrated sweep rates are read from the outer ring of numbers circling the TIME/DIV knob. The magnifier expands the normal sweep to fifty divisions, and the HORIZONTAL positioning control has sufficient range to display any ten divisions of the magnified sweep. Calibration accuracy is within 5% of the displayed portion of the magnified sweep.

DC-Coupled Unblanking—The unblanking waveform is dc-coupled to the grid of the crt, assuring uniform grid bias for all sweep and repetition rates.

DC-to-10 MC—9-KV OSCILLOSCOPE

Triggering Facilities—Versatile triggering circuitry provides for complete manual control, preset stability control, and fully-automatic triggering.

Amplitude-Level Selection—Adjustable amplitude-level and stability controls provide for triggering the sweep at a selected amplitude level on the triggering waveform. Trigger source can be internal, external, or the line frequency, either ac-coupled or dc-coupled. The triggering point can be on either the rising or falling slope of the triggering waveform.

Preset Stability—Same as above, except the stability control is preset to the optimum triggering point and requires no readjustment.

Automatic Triggering — Automatic level-seeking trigger circuit provides dependable triggering for most applications. One simple setting assures positive sweep-triggering by signals of widely differing amplitudes, shapes, and repetition rates. No trigger controls need be touched until a different type of operation is desired. Range of automatic operation is between 60 cycles and 2 megacycles, approximately. In the absence of an input signal the sweep is automatically triggered at about a 50-cycle rate, providing a reference trace on the screen.

High-Frequency Sync—Assures a steady display of sine-wave signals up to approximately 20 megacycles. Requires a signal large enough to cause about 2 cm of deflection, or an external signal of about 2 v.

Trigger Requirements—Internal—a signal large enough to cause a one-fifth division deflection. External—a signal of 0.2 v to 20 v.

Horizontal Input Amplifier—DC-Coupled external connection to the sweep amplifier is through a front-panel connector. Deflection factor is approximately 1.4 v/div. Frequency response is dc to 500 kc.

OTHER CHARACTERISTICS

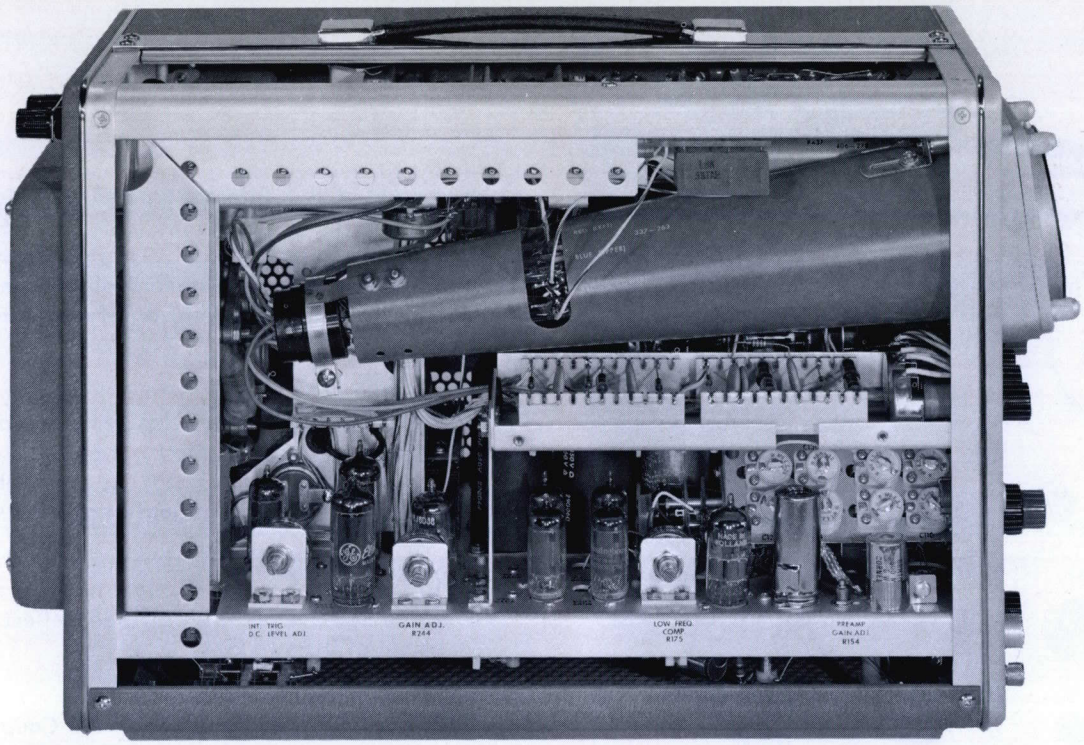
Calibrator—A square-wave calibrating voltage is available through a front-panel coaxial connector. Eleven fixed peak-to-peak voltages are provided: 0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50 and 100 volts. Accuracy is within 3%. Square-wave frequency is about 1 kc.

Cathode-Ray Tube—A new Tektronix flat-faced 3" cathode-ray tube with helical post-accelerating anode is used in the Type 317. Accelerating potential is 9 kv. A P2 phosphor is normaly supplied. P1, P7, and P11 are available as optional phosphors. Some other phosphors are available on special order.

Output Waveforms—A 20 v (approx.) positive-gate waveform of the same duration as the sweep, and a 150 v (approx.) positive-going sweep sawtooth waveform are available at front-panel connectors.

Regulated Power Supplies—Electronic regulation compensates for line-voltage and load variations between 105 and 125 v, or 210 and 250 v.

Illuminated Graticule—The edge-lighted graticule is divided into 8 vertical and 10 horizontal ¼"divisions. Illumination is controlled by a front-panel knob.



Warning Indicators for Uncalibrated Settings—Separate front-panel neon lights indicate when the vertical-attenuator and sweep-rate controls are not in their calibrated positions.

ELECTRON TUBES AND SEMICONDUCTORS

* denotes "or equivalent"

Vertical

Vertical preamplifier		6CB6
Voltage-setting CF and preamplifier		6DJ8
Preamplifier cathode protector		T12G*
Input amplifiers	2	6AU6
Input CF	2	6AU6
Driver CF.		6DJ8
Output amplifiers	2	6CL6

Horizontal

Trigger pickoff CF		6AU6
Trigger-input amplifier		6DJ8
Trigger multivibrator		6DJ8
Sweep-gating multivibrator and CF		6DJ8
Sweep-gating multivibrator and unblanking CF		6DJ8
Gate-out CF and sawtooth-out CF.		6DJ8
Miller runup and CF		6AN8
Disconnect diodes		6AL5
Holdoff CF and driver		6DJ8
Input CF and horizontal driver		6DJ8
Horizontal-output amplifier and CF	2	6DJ8

Power Supplies

Rectifiers	14	1N1566*
Voltage reference		5651
Regulator amplifiers	2	6AU6
Difference amplifier and voltage-setting CF		6AN8
Series regulator		6080
Series regulator		12B4
Error-signal amplifiers		12AU7
High-voltage oscillator		6CZ5
High-voltage rectifiers	5	5642

Miscellaneous

Calibrator multivibrator and CF		12AU7
Calibrator multivibrator		6AU6
Cathode-ray tube		T317P2

MECHANICAL SPECIFICATIONS

Ventilation—Filtered forced-air ventilation maintains safe operating temperature. A minimum of 2" of unobstructed clearance around the instrument is recommended for adequate ventilation.

Construction—Aluminum-alloy chassis and cabinet.

Dimensions—8½" wide, 12" high, 19½" overall depth.

Weight: Net—34 pounds
Shipping—42 pounds appr.

Finish—Photo-etched anodized panel, blue wrinkle-finished cabinet.

Power Requirements—105 to 125 v or 210 to 250 v, 50 to 60 cycles, 260 watts. Type 317MOD101 operates on 50 to 400 cycle supply; uses dc fan motor.

Unless otherwise specified, the instrument will be shipped wired for operation within the line-voltage range of 105 to 125 volts. The Type 317 can be ordered wired for operation on several nominal line voltages as follows:

Nominal Line Voltage (Figures taken at 60 cps)	Operating Range
110	99 to 117 volts
117	105 to 125 volts
124	111 to 132 volts
220	198 to 235 volts
234	210 to 250 volts
248	223 to 265 volts

A metal decal on the transformer gives complete instructions for changing the operating range.

Price, Type 317 (50 to 60 cycles) **$800**

Price, Type 317MOD101 (50 to 400 cycles) **$835**

Includes: 1—Attenuator probe (10-x)
1—Binding-post adapter (013-004)
1—Green filter (378-509)
1—3-conductor power cord (161-010)
1—Instruction manual

Optional Phosphors

P2 crt phosphor normally furnished.
P1, P7, P11 optional . . . . . .No extra charge.

Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page.)

RM17 RACK-MOUNTING MODEL

GENERAL DESCRIPTION

The Type RM17 is a mechanically rearranged Type 317 Oscilloscope for mounting in a standard 19" rack. The instrument mounts to the rack on slide-out tracks. It can be pulled forward, tilted, and locked in any of seven positions for servicing convenience. Electrical characteristics of the instrument are the same as described for the Type 317 Oscilloscope.

MECHANICAL SPECIFICATIONS

Ventilation—Filtered, forced-air ventilation maintains safe operating temperature.

Construction—Aluminum-alloy chassis, and cabinet. Slide-out mounting.

Finish—Photo-etched anodized panel, blue wrinkle-finished cabinet.

Dimensions—7" high, 19" wide, 17⅝" rack depth. Please see page B-8 for complete mounting dimensions.

Weight: Net—40 pounds
Shipping—66 pounds appr.

Type RM17 (50 to 60 cycles) **$875**
Type RM17MOD101 (50 to 400 cycles) **$910**

Includes: 1—Probe (10-x atten.)
1—Binding-post adapter (013-004)
1—Green filter (378-509)
1—3-conductor power cord (161-010)
1—Pair, guide rails (351-017)
1—Set, mounting hardware
1—Instruction manual

Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page.)

MAIN FEATURES

Designed for Field Work
Operates on AC, DC or self-contained batteries.
Weight: only 13½ pounds without batteries, less than 17 pounds with batteries.
Size: 8¾" high by 5¾" wide by 16" deep.

Transient Response
Risetime—0.07 μsec.

Frequency Response
DC to 5 mc

Vertical Deflection Factor
11 calibrated steps:
0.01 v/div to 20 v/div.
Continuously variable between steps, and to approximately 50 v/div uncalibrated.

Sweep Range
19 calibrated sweep rates:
0.5 μsec/div to 0.5 sec/div.
5-x Magnifier extends range to 0.1 μsec/div.
Sweep time adjustable between steps, and to approximately 2 sec/div uncalibrated.

Versatile Triggering
Type: automatic or amplitude-level selection.
Mode: ac-coupled or dc-coupled.
Slope: plus, from rising slope of trigger, minus, from falling slope of trigger.
Source: internal, from the vertical signal, external, from the triggering signal.

GENERAL DESCRIPTION

The new Tektronix Type 321 Oscilloscope is a high-performance, completely portable instrument. It will operate anywhere on its own internally contained batteries, on the dc power systems of airplanes, boats, autos, and trucks, or on any standard ac power system. It is small and light and provides a sharp, bright display on its 3-inch cathode-ray tube.

Use of advanced construction techniques and improved components, such as ceramic terminal strips, has produced a compact instrument with excellent shock-resistant characteristics. Small size and low weight make the Type 321 Oscilloscope truly portable. It operates from ten high-current size D flashlight cells, or ten rechargeable size D cells, or 11.5 to 35 volts dc, or 105 to 125 volts or 210 to 250 volts rms, 50 to 800 cycles, single-phase, ac.

Operating temperature range from preliminary tests indicates optimum performance and reliability on the self-contained batteries from 30° to 120° F and at altitudes to 20,000 feet. Accurate calibration and precise linearity assure exact time and amplitude measurements either in the field or in the laboratory. Suitable for applications involving the most modern, complex electronic circuitry, the versatile Type 321 Oscilloscope is dependable, rugged, easy-to-operate.

VERTICAL-DEFLECTION SYSTEM

DC-Coupled Vertical Amplifier—Main vertical passband is dc to 5 mc. Risetime is 0.07 μsec. Vertical deflection is calibrated in steps of 0.01, 0.02, 0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10, and 20 v/div. A vernier control provides for continuously variable adjustment from 0.01 v/div to 50 v/div uncalibrated. In addition, the fully-clockwise position of the VOLTS/DIV switch marked CAL 4 DIV, allows observation of an internally-coupled 40-mv peak-to-peak square-wave signal.

Calibration Accuracy—Internal adjustments are provided for setting the gain of the vertical amplifier. When these adjustments are accurately set (with the VOLTS/DIV switch in the fully clockwise position) for four major divisions of signal, the vertical deflection factor for any other switch position will be within 4%.

Input Impedance—1 megohm paralleled by approximately 30 pf.

Probe—The 10-x attenuator probe supplied with the instrument presents an input impedance of 10 megohms paralleled by approximately 9 pf, and reduces the vertical sensitivity by a factor of ten.

HORIZONTAL-DEFLECTION SYSTEM

Sweep Range—Sweep time is calibrated in steps of 0.5, 1, 2, 5, 10, 20, and 50 μsec/div. . . 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, and 50 msec/div. . . 0.1, 0.2, and 0.5 sec/div. A vernier control provides for continuously variable adjustment from 0.5 μsec/div to approximately 2 sec/div uncalibrated. Accuracy of the nineteen fixed sweep rates is within 4%.

Sweep Magnifier—When the VARIABLE knob on the VOLTS/DIV switch is pulled out, the center two-division portion of the displayed waveform is expanded to ten divisions. The HORIZONTAL POSITION control has sufficient range to cover any one-fifth of the magnified sweep. The 5X MAG applied to the 0.5 μsec/div sweep extends the calibrated range to 0.1 μsec/div. Accuracy is within 4% of the displayed portion of the magnified sweep.

Deflection Blanking—The unblanking waveform is coupled to a separate deflection system in the electron gun of the cathode-ray tube. The system consists of two pairs of cross-connected deflection plates which intercept the beam current, blanking the crt screen during the retrace portion of the sweep. This unique system assures uniform beam current for all sweep speeds and repetition rates. In addition, external blanking can be accomplished

TRANSISTORIZED PORTABLE OSCILLOSCOPE

by using the crt grid terminal on the back of the oscilloscope.

Triggering Facilities—Versatile circuitry provides for complete manual control or fully-automatic triggering.

Amplitude-Level Selection—Adjustable amplitude-level and stability controls provide for triggering the sweep at a selected amplitude level on the triggering waveform. Trigger source can be internal or external, ac-coupled or dc-coupled. Trigger point can occur anywhere on the rising slope or falling slope of the triggering waveform.

Automatic Triggering—Automatic level-seeking trigger circuit provides dependable triggering for most applications. One setting assures positive sweep-triggering by signals of widely differing amplitudes, shapes, and repetition rates. No trigger controls need be adjusted until another type of operation is desired. Range of automatic operation is between 60 cycles and 2 megacycles, approximately. The sweep is triggered automatically at about a fifty-cycle rate in the absence of an input signal to provide a convenient reference trace on the screen.

Trigger Requirements—For internal triggering, a signal large enough to produce one minor division of vertical deflection is required. For external triggering, a signal of 0.5 to 50 volts is necessary.

Horizontal Input—DC-coupled external connection to the sweep amplifier is through a front-panel connector. Bandpass is dc to 1 mc. The horizontal deflection factor is approximately 1.5 volts/div with the 5X MAG on. Input impedance is 100 kilohms paralleled by approximately 20 pf.

OTHER CHARACTERISTICS

Amplitude Calibrator—A 500-mv peak-to-peak square-wave voltage is available through a front-panel connector. In addition, an internally coupled 40-mv peak-to-peak square-wave voltage is available in the fully clockwise position (CAL 4 DIV) of the VOLTS/DIV switch. Accuracy is within 4%. Frequency of the square wave is approximately 2 kc.

Intensity Modulation—The cathode-ray tube display can be intensity modulated by an external signal connected to the crt grid terminal on the back panel of the oscilloscope. A negative signal of approximately 30 volts peak is required to cut off the beam from maximum brightness. Less voltage is required with lower intensity settings.

Cathode-Ray Tube—A new Tektronix flat-faced, 3-inch post accelerator cathode-ray tube, Type 321P__, provides a bright trace and utilizes low heater power. Accelerating potential is 4 kv. Deflection blanking of the beam is used. The phosphor normally supplied with the instrument is a P2, but a P1, P7, or P11 will be furnished instead if requested.

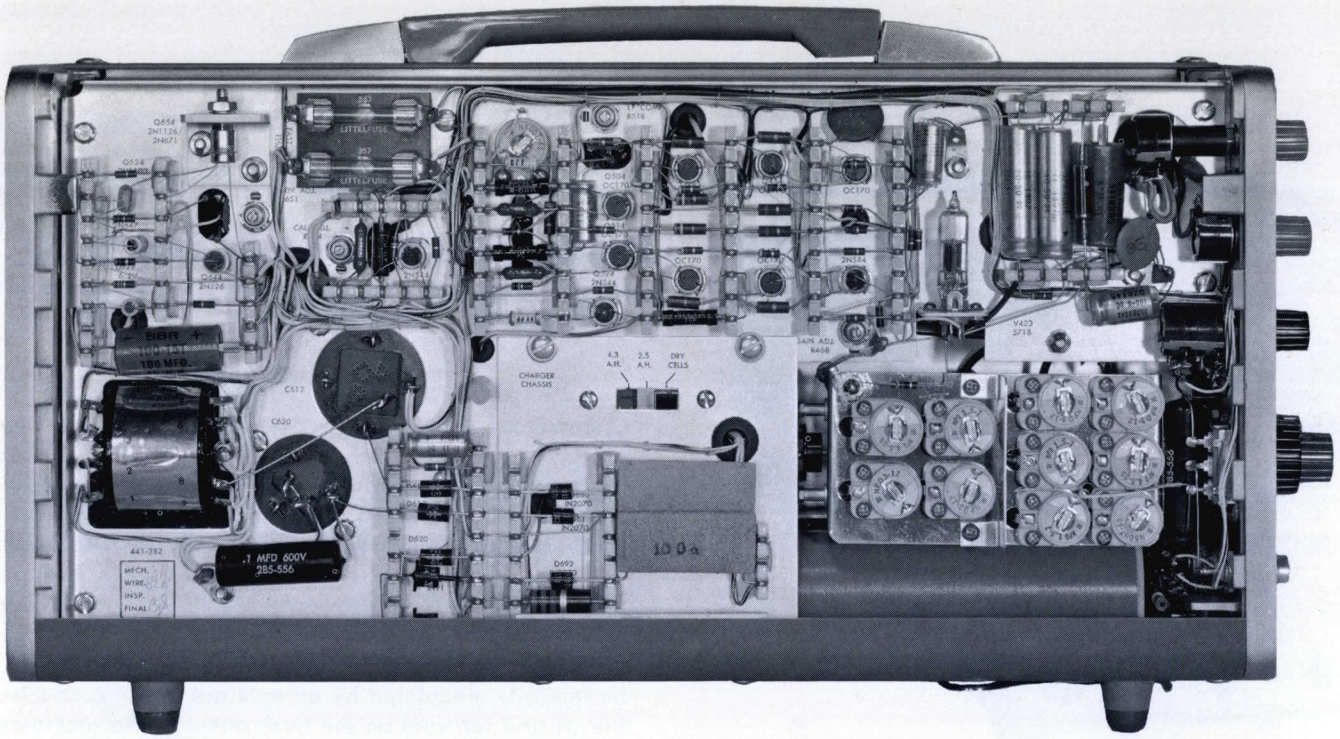
Regulated Power Supply—Electronically-regulated dc supply insures stable operation over line variations between 11.5 to 35 volts dc, or 105 to 125 volts or 210 to 250 volts rms, 50 to 800 cycles.

Illuminated Graticule—Edge lighting of the graticule is adjusted by the SCALE ILLUM. control when operating from an ac line, only. Display area of the graticule is marked in six vertical and ten horizontal one-fourth inch major divisions. Centerlines are marked in five minor divisions per major division.

BATTERY CHARGER

The battery charger will not operate on dc. It will operate only as long as the ac power cord is connected to an ac line. When the power switch is turned ON, a trickle charge of approximately 25 ma maintains the batteries at their existing state of charge. When the power switch is turned OFF, a higher charging rate is applied to the batteries. The batteries will go on "charge" at the rate of approximately 0.4 ampere until they attain full charge.

TYPE 321



Normally, the batteries will require approximately twelve hours to become fully charged at this rate. After the batteries have reached full charge, the charger will automatically switch from the higher charging rate to the lower maintaining rate.

MECHANICAL SPECIFICATIONS

Construction—Self-contained, compact unit constructed of light-weight, shock-resistant cast aluminum front and rear panels. Side panels, and bottom panel—containing the internally attached battery case—are easily removable. Transistors and components are readily accessible.

Finish—Photo-etched anodized front panel, blue vinyl-finish cabinet.

Dimensions—Only 8¾" high by 5¾" wide by 16" deep.

Weight: Net—13½ pounds without batteries
17 pounds with batteries
Shipping—24 pounds without batteries
28 pounds with batteries

Power Requirements—Operates from ten size D flashlight cells or ten size D rechargeable cells (approximately 5 hours using 4.3 ampere-hour cells, rated at more than 750 complete charge and discharge cycles). Also operates from 11.5 to 35 volts dc, or 105 to 125 volts or 210 to 250 volts, rms single-phase ac. For protection, a thermal cutout switch interrupts the power if chassis temperature exceeds 120° F and holds it off until a safe operating temperature is reached.

Type 321 (without batteries) $785

includes:

1 10-times Attenuation Probe
1 3-wire Adapter (103-013)
1 3-wire DC Power Cord (161-016)
1 3-wire AC Power Cord (161-015)
1 Green Filter (378-521)
1 Operator's Manual
1 Parts List and Schematic Diagrams Booklet

Set of ten rechargeable 4.3 ampere-hour batteries (when available) $66.00

Set of ten rechargeable 2.5 ampere-hour batteries, currently available $36.50

OPTIONAL PHOSPHORS

A P2 phosphor is normally supplied with the Type 321 Oscilloscope, but a P1, P7, or P11 phosphor will be furnished instead, if requested.

Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page.)

GENERAL PURPOSE OSCILLOSCOPES

TYPE 502 ..... H-2
TYPE 503 ..... H-6
TYPE RM503 ..... H-9
TYPE 504 ..... H-10
TYPE RM504 ..... H-13
TYPE 515A H-14
TYPE RM15 ..... H-17
TYPE 516 ..... H-18

MAIN FEATURES

Sensitivity—200 μv/cm, dc-coupled, both beams.

Differential Input—at all sensitivities.

Calibrated Sweeps—1 μsec/cm to 5 sec/cm.

Sweep Magnification—2, 5, 10 and 20 times.

X-Y Curve Tracing with Two Beams (horizontal-deflection voltage common to both beams, maximum horizontal sensitivity 0.1 v/cm).

Single-Beam X-Y Curve Tracing — at 200 μv/cm, both axes.

Regulated Heater Supplies—input stages of both vertical amplifiers have transistor-regulated parallel heater supplies.

GENERAL DESCRIPTION

The Tektronix Type 502 combines a number of extremely useful features in one compact oscilloscope. In addition to conventional applications, it offers dual-beam displays on linear time bases with the high sensitivity desired in many industrial and scientific applications, dual-beam X-Y displays at medium sensitivities, and single-beam X-Y displays at high sensitivities.

APPLICATIONS

Here are just a few of the many possible uses for this versatile new oscilloscope:

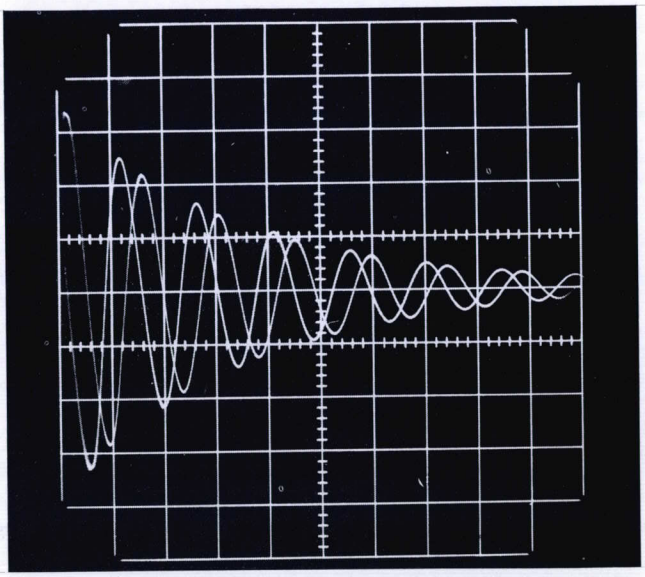
1. Compare and measure the waveforms at two points in a circuit simultaneously.
2. Compare and measure the outputs of two transducers on the same time base.
3. Display X-Y curves with one or both beams in a variety of applications.
4. Plot one transducer output against another—pressure against volume or temperature for instance.
5. Compare and measure stimulus and reaction, or the outputs of two probes, on the same time base.
6. Use the differential-input feature for cancellation of common-mode signals, and to eliminate the need for a common terminal, in both single and dual displays.
7. Measure phase angles and frequency differences.

VERTICAL-DEFLECTION SYSTEMS

High-Gain DC-Coupled Amplifiers—Both vertical amplifiers have the same characteristics. Passbands are dc to 100 kc at 200 μv/cm, increasing to dc to 200 kc at 1 mv/cm, to dc to 400 kc at 50 mv/cm, and dc to 1 mc at 0.2 v/cm. Vertical response at the lower sensitivities varies according to switch position as follows: 0.5 v/cm—dc to 300 kc; 1 v/cm—dc to 500 kc; 2 v/cm—dc to 1 mc; 5 v/cm—dc to 300 kc; 10 v/cm—dc to 500 kc; 20 v/cm—dc to 1 mc.

Sensitivity—Vertical deflection is calibrated in sixteen steps: 200, 500 μv/cm, 1, 2, 5, 10, 20, 50, 100 mv/cm, 0.2, 0.5, 1, 2, 5, 10 and 20 v/cm. When the upper-beam amplifier is switched to the horizontal-deflection plates, its gain is automatically increased to make the horizontal and vertical sensitivities equal.

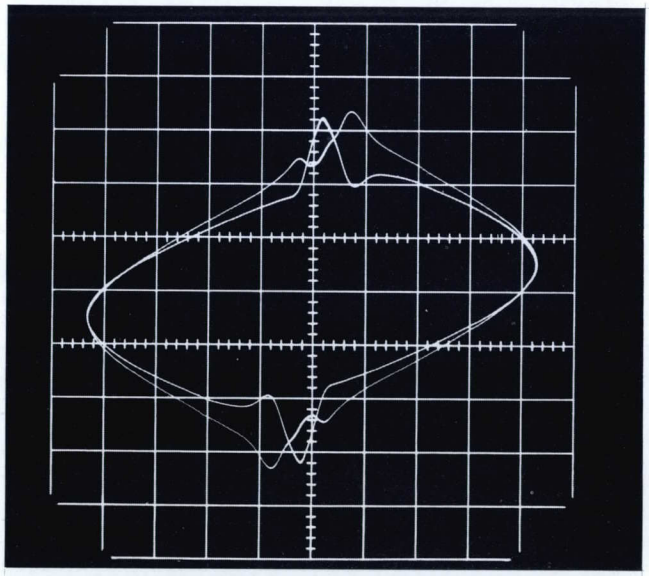
Phase Characteristics—When both vertical amplifiers are set at the same sensitivity, the typical phase shift between amplifiers will be within 5 degrees at the specified 3-db point. At one-tenth of the quoted 3-db point for each sensitivity setting, the typical phase shift between amplifiers is less than one degree.



DUAL DISPLAY ON LINEAR TIME BASE
Comparison of waveforms at two points in a ringing circuit. This kind of display is useful in many types of investigation.

DUAL-BEAM OSCILLOSCOPE

Calibration Accuracy — Internal adjustments are provided for setting the gain of both amplifiers. When accurately set, sensitivities at all positions will be within 3% of the panel readings.



DUAL-BEAM X-Y CURVE TRACING
Typical production-test application: display of EI loops of two transformers manufactured under identical conditions.

Input Selection—A six-position switch for each amplifier provides for differential input and single-ended input either normal through the A input or inverted through the B input. An inverted display on one beam is sometimes desirable in comparison measurements. Inputs are dc or ac-coupled with low frequency response limited to 2 cycles when the inputs are ac-coupled.

Differential Input—Rejection ratios for differential inputs are approximately 1000 to 1 from 200 μv/cm to 1 mv/cm, diminishing to 100 to 1 at 0.2 v/cm and 50 to 1 at 5 vcm. These ratios were measured using a 1-kc square wave.

Input Impedances—47 pf paralleled by 1 megohm, both channels.

Probes—Two Tektronix probes are supplied with the Type 502. With these 10-x attenuator probes the input impedance becomes 14 pf paralleled by 10 megohms.

HORIZONTAL-DEFLECTION SYSTEM

For single-beam applications where equal horizontal and vertical-deflection characteristics are desirable, the upper-beam amplifier can be switched to the crt horizontal-deflection plates. This type of operation has the advantages of 200 μv/cm sensitivity and differential input for both horizontal and vertical deflection. A panel light indicates when the upper-beam amplifier is connected to the horizontal-deflection plates.

Calibrated Sweeps—A single direct-reading control is used to select any of 21 calibrated sweep rates: 1, 2, 5, 10, 20, 50 μsec/cm, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50 msec/cm, 0.1, 0.2, 0.5, 1, 2 and 5 sec/cm. Calibration accuracy is within 3%.

Sweep Magnifier—Four degrees of sweep magnification are provided: 2, 5, 10 and 20 times. Any 10 cm of the magnified sweep can be displayed. Calibration of the magnified sweep will be accurate at all rates within the maximum calibrated rate of 1 μsec/cm. Calibration accuracy is within 3% of the displayed portion of the magnified sweep. A warning light indicates when the maximum calibrated rate is being exceeded.

External Input to Horizontal Amplifier—An external signal can be used for horizontal deflection in applications such as curve tracing with both beams. Five calibrated sensitivity steps are provided: 0.1, 0.2, 0.5, 1 and 2 v/cm.

Automatic Triggering—The automatic triggering mode eliminates triggering readjustments and is suitable

for most applications. Amplitude-level selection with preset stability is also available. The sweep can be operated free-running when desired.

Trigger Selection—The triggering signal can be selected from either amplifier internally or from an external source, and can be either ac-coupled or dc-coupled. The sweep can also be triggered internally at the power-line frequency. A switch provides for triggering on either the rising or falling slope of the triggering signal.

Trigger Requirements—Internal triggering—a signal large enough to produce a 2-mm deflection. External triggering—a signal of 0.2 v to 10 v.

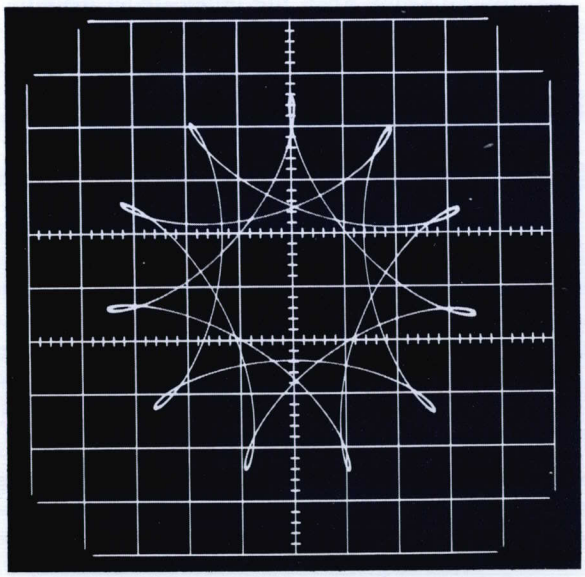
OTHER CHARACTERISTICS

Amplitude Calibrator—A square-wave calibration voltage is available through a front-panel connector. Six fixed voltage steps are provided: 1, 10, 100 mv, 1, 10 and 100 v peak-to-peak. Accuracy is within 3%. Square-wave frequency is about 1 kc.

Cathode-Ray Tube — A new Tektronix two-gun cathode-ray tube with two pairs of vertical and one pair of horizontal-deflection plates is used in the Type 502. Accelerating potential is 3 kv. Display area for each beam is 8 cm by 10 cm. Both beams overlap in the center 6-cm vertical area. A P2 phosphor is normally supplied, however, P1, P7, and P11 are available instead if desired, and some other phosphors are available on special order.

Regulated Power Supplies—Electronic regulation compensates for line-voltage and load variations between 105 and 125 or 210 and 250 v. In addition, the parallel heater supplies to the input stages of both vertical amplifiers are transistor regulated.

Illuminated Graticule—The edge-lighted graticule is marked in 10 vertical and 10 horizontal one-centimeter divisions with two-millimeter markings on the baselines. Illumination is controlled by a front-panel knob.



SINGLE-BEAM X-Y CURVE TRACING
Frequency-comparison application: differential input of both X and Y amplifiers facilitates display of roulette patterns.

ELECTRON TUBES AND SEMICONDUCTORS

* denotes "or equivalent"

Vertical

Input amplifiers	4	6AU6
Drivers	4	6AU6
Driver CF's and output amplifiers	4	12AT7
Trigger pickoff CF	2	6AU6

Horizontal

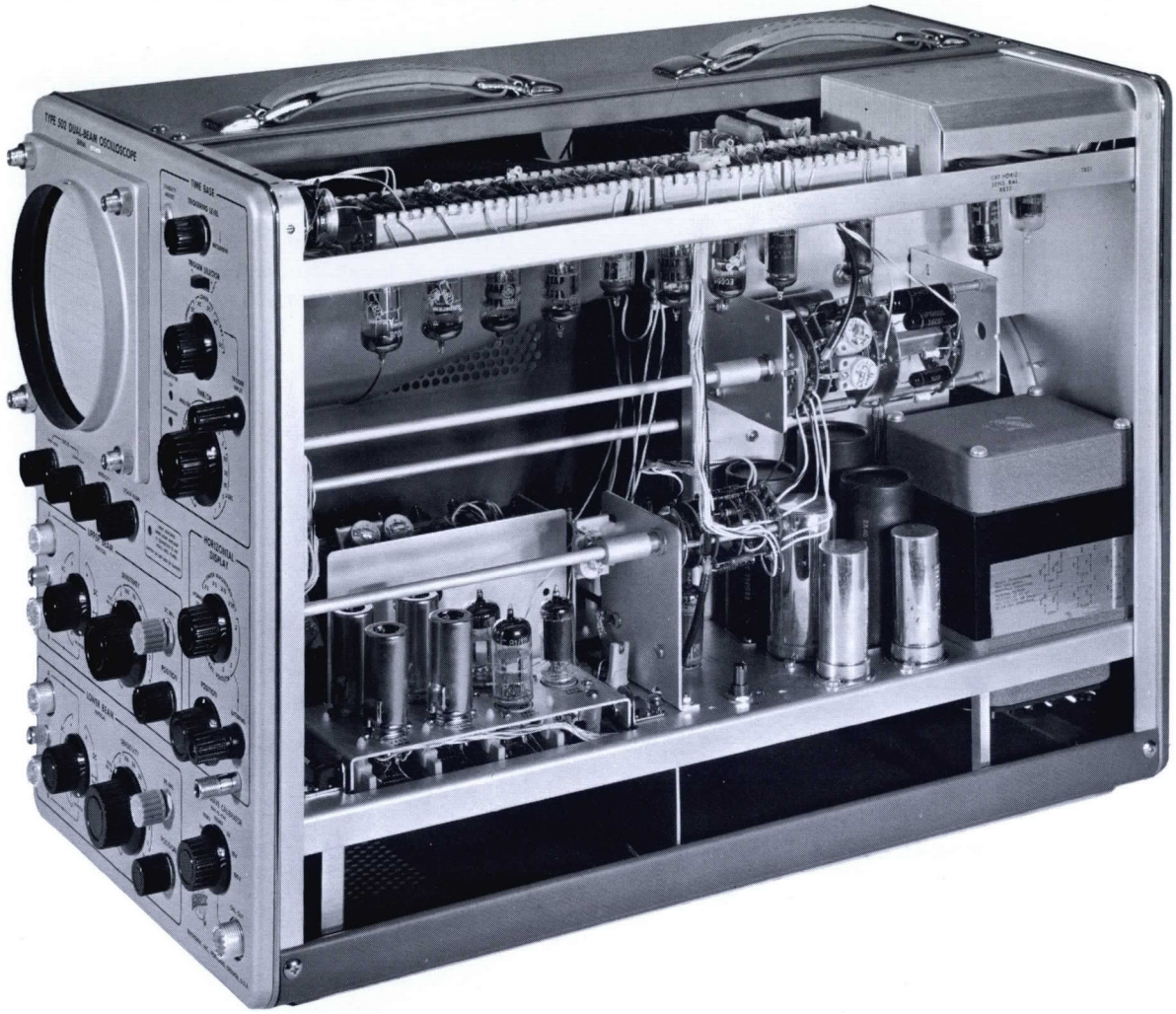
Trigger input amplifier		6DJ8
Trigger multivibrator		6DJ8
Sweep-gating multivibrator and CF		6AN8
Sweep-gating multivibrator and holdoff CF		6AN8
Disconnect diodes		6AL5
Miller-runup sweep generator and CF		6AN8
Holdoff and sweep-input CF's		6DJ8
Horizontal-input amplifiers	2	6AU6
Horizontal-output amplifier		6DJ8

Power Supplies

Rectifier		6BW4
Rectifier	2	5AR4
Voltage reference		5651
Series regulators	4	12B4
Comparators	3	6AN8
Heater regulators	2	2N214*
Heater series regulator		2N307*
High-voltage oscillator		6DT5
High-voltage rectifiers	3	5642
Error-signal amplifiers		12AU7

Miscellaneous

Calibrator multivibrator		6AN8
Calibrator multivibrator		6AU6
Cathode-ray tube		T5021P2



MECHANICAL SPECIFICATIONS

Ventilation—Filtered forced-air ventilation maintains safe operating temperature. A minimum of 2" of unobstructed clearance around the instrument is recommended for adequate ventilation.

Construction—Aluminum-alloy chassis and three-piece cabinet.

Finish—Photo-etched anodized panel, blue wrinkle-finished cabinet.

Dimensions—23½" long, 11¼" wide, 15" high.

Weight: Net—56 pounds
Shipping—71 pounds approx.

Power Requirements—105-125 v or 210-250 v, 50-60 cycles, 280 watts.

Type 502 ..... **$825**

Includes: 2—10-x attenuator probes.
2—Binding post adapters (013-004)
1—Green filter (378-503)
1—3-conductor power cord (161-010)
1—Instruction manual

Optional Phosphors

P2 crt phosphor normally furnished.
P1, P7, P11 optional .....no extra cost.

Rack Mount Adapter

A cradle mount to adapt the Type 502 Oscilloscope for rack mounting is available. It consists of a cradle to support the instrument in any standard 19" relay rack and a mask to fit around the regular instrument panel. Tektronix blue wrinkle finish. Rack height requirements 17½".
ORDER PART NO. 040-194 ..... $45.00

Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).

TYPE 503 DC to 450KC

MAIN FEATURES

Identical Vertical and Horizontal Amplifiers

Passband—dc to 450 kc.
Vertical Sensitivity—1 mv/cm to 20 v/cm in 14 calibrated steps. 1 mv/cm to 50 v/cm continuously variable (uncalibrated).
Differential input at all sensitivities.
Constant input impedance (1 megohm-47 pf) at all sensitivities—standard 10-x attenuator probe can be used.

Sweep Range

1 μsec/cm to 5 sec/cm.
21 calibrated sweep rates.
Sweep time continuously variable (uncalibrated) from 1 μsec/cm to approximately 12 sec/cm.

Sweep Magnification

2, 5, 10, 20, and 50 times.

Amplitude Calibrator

500 mv and 5 mv peak-to-peak square-wave voltages available at front panel.

Regulated Heater Supply

For vertical and horizontal input stages.

GENERAL DESCRIPTION

The Type 503 Oscilloscope incorporates, for the first time, Tektronix standards of precision and reliability in an instrument in the dc-to-450 kc range. Identical vertical and horizontal amplifiers supply an accurate means of plotting curves using the X-Y method of operation. In addition, both amplifiers offer single-ended inputs for conventional operation or differential inputs for cancellation of common-mode signals.

Basic sensitivity is 1 mv/cm. Sweep rates to 1 μsec/cm combined with the 10-x magnification factor provide dependable sweep rates to 0.1 μsec/cm. Other features include: functional panel layout, electronically-regulated power supplies, and flexible triggering facilities. High standards of quality and construction combined with advanced design technique make it possible to use a minimum number of tubes for the maximum degree of precision and reliability.

HORIZONTAL AND VERTICAL DEFLECTION SYSTEMS

DC-Coupled Amplifiers—Passband is dc to 450 kc (at 3 db down) for both amplifiers. Deflection is calibrated in steps of 1, 2, 5, 10, 20 and 50 mv/cm . . . 0.1, 0.2, 0.5, 1, 2, 5, 10, and 20 volts/cm. A vernier control permits continuous adjustment between the 14 steps, and to about 50 volts/cm uncalibrated.

Calibration Accuracy—Internal adjustments set the gain of each amplifier. When these adjustments are set accurately, the calibration will be within 3% of the indicated switch position.

Relative Phase Shift—Using + INPUT connectors and with both amplifiers at equal sensitivity settings, phase difference between the amplifiers will be no more than one degree up to 100 kc and no more than two degrees up to 450 kc. At unequal sensitivity settings the phase shift will be no more than six degrees up to 50 kc. For any selected frequency within the passband of the instrument and at any sensitivity setting, the phase difference can be adjusted to 0°

Input Impedance—1 megohm paralleled by about 47 pf.

SWEEP GENERATOR

Sweep Range—Sweep time is calibrated in steps of 1, 2, 5, 10, 20, and 50 μsec/cm . . . 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, and 50 msec/cm . . . 0.1, 0.2, 0.5, 1, 2, and 5, sec/cm. Calibration accuracy is within 3% of the indicated switch position. A vernier control permits continuous adjustment between the 21 steps, and to over 12 sec/cm, uncalibrated.

Sweep Magnifier—The SWEEP MAGNIFIER control selects five steps of magnification; 2, 5, 10, 20, and 50 times. When the magnifier is switched in, the center portion of the normal sweep is expanded equally to left and right to fill ten centimeters. Size of the portion expanded is determined by the step of magnification selected. The HORIZONTAL POSITION control has sufficient range to display any ten centimeters of the magnified sweep. When the magnified sweep does not exceed the maximum calibrated rate of 0.1 μsec/cm, accuracy is within 5% of the displayed portion.

Deflection Blanking—The unblanking waveform is coupled to a separate deflection system in the electron gun of the cathode-ray tube. The system consists in part of two pairs of cross-connected deflection plates which intercept the beam current, blanking the crt screen except during sweep time. This unique system uses simplified circuitry and at the same time provides improved reliability. It assures uniform beam current for all sweep and repetition rates. In addition, external beam modulation can be accomplished by using the crt grid-input terminal on the back of the oscilloscope.

X-Y, OSCILLOSCOPE

TRIGGERING FACILITIES

Automatic Triggering—Fully counter-clockwise position of the LEVEL control eliminates triggering readjustments, provides dependable triggering for most applications. One setting assures positive sweep triggering by signals of different amplitudes, shapes, and repetition rates. In the absence of an input signal, automatic triggering of the sweep occurs at about a fifty-cycle rate and provides a convenient reference trace on the crt screen.

Trigger Requirements—Triggering internally requires a signal large enough to produce one-half centimeter of vertical deflection. Triggering externally requires a signal of at least one-half volt.

Amplitude-level Selection—Adjustable amplitude-level and slope controls allow sweep triggering at any selected point on the triggering waveform. Trigger source can be internal, external, or from the line frequency, either ac or dc-coupled.

OTHER CHARACTERISTICS

Amplitude Calibrator—Two square-wave calibration voltages are available through front-panel connectors. Peak-to-peak amplitude of these two voltages is 500 millivolts and 5 millivolts. Accuracy is within 3%. Frequency of the square wave is between 300 and 500 cycles.

Intensity Modulation—The crt grid terminal on the back panel of the oscilloscope permits beam-intensity modulation.

Cathode-Ray Tube—A new Tektronix 5" flat-faced precision cathode-ray tube, T503P___, is used in the Type 503. Accelerating potential is 3 kv. A high-contrast trace easily readable under high ambient light conditions has been achieved with an improved P2 phosphor. This new phosphor also has distinct advantages for oscilloscope photography. The new P2 phosphor is normally supplied with the Type 503, but a P1, P7, or P11 will be supplied instead if requested.

Alignment of Cathode-Ray Tube—Should adjustment of the cathode-ray tube alignment become necessary, an easily accessible knob, located on the rear support bracket of the crt, provides smooth positive control of the crt alignment.

Graticule—Usable viewing area is marked in eight vertical and ten horizontal one-centimeter divisions. Centerlines are further marked in five minor divisions per centimeter. Convenient control from the SCALE ILLUM. knob provides adjustable edge-lighting for the graticule.

Regulated Power Supplies—Electronically-regulated dc supplies insure stable operation over line fluctuations between 105 and 125 volts or 210 and 250 volts. Line frequency is 50 to 800 cycles. The low-line voltage requirement increases about 10% at 400 cycles and about 15% at 800 cycles. The input stage filaments of the vertical and horizontal amplifiers are supplied with regulated dc.

ELECTRON TUBES AND SEMICONDUCTORS

* Denotes "or Equivalent"

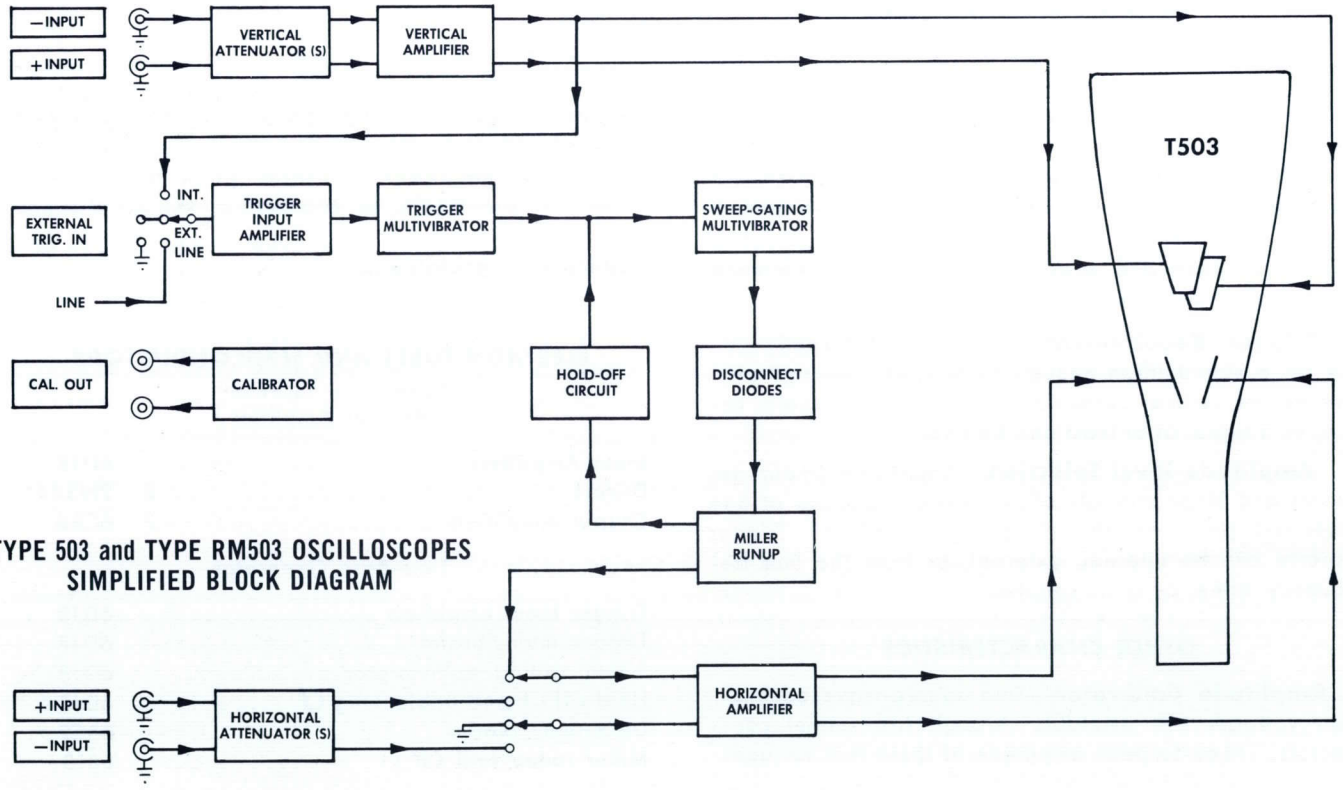
Vertical Amplifier

Input Amplifiers		6DJ8
Drivers	2	2N544*
Output Amplifiers	2	6CB6

Time-Base Generator

Trigger input amplifiers	6DJ8
Trigger multivibrator	6DJ8
Sweep gating multivibrator	6DJ8
Hold-off CF and unblanking CF	6DJ8
Disconnect diodes	6BC7
Miller runup and CF	6BL8

TYPE 503



TYPE 503 and TYPE RM503 OSCILLOSCOPES
SIMPLIFIED BLOCK DIAGRAM

Horizontal Amplifier		
Input amplifiers		6DJ8
Drivers	2	2N544*
Output amplifiers	2	6CB6
Power Supplies		
Low-voltage rectifiers	3	1N2070*
Low-voltage rectifiers	3	1N2071*
High-voltage rectifier		5642
Voltage reference		5651
Comparator amplifier		6BL8
Oscillator		6DQ6A
Miscellaneous		
Cathode-ray tube		T503P2

MECHANICAL SPECIFICATIONS

Construction—Aluminum-alloy chassis and cabinet. Side panels easily removable and components readily accessible.

Finish—Photo-etched anodized front panel, blue vinyl-finish cabinet.

Dimensions—13½" high, 9¾" wide, 21½" deep.

Weight: Net 31 pounds.
Shipping—43 pounds approx.

Power Requirements—105 to 125 v or 210 to 250 v, 50 to 800 cycles, 107 watts at 117 v.

Type 503 Oscilloscope ..... **$625.**

Includes: 2—Binding post adapters (013-004)
1—Green Filter (378-522)
1—Instruction manual

RM503 RACK-MOUNTING MODEL

GENERAL DESCRIPTION

The Type RM503 is a mechanically rearranged Type 503 Oscilloscope. It bolts directly to a standard 19" rack. Does not have slide-out mounting. Requires only 7" of rack height.

Front-panel controls and connectors are conveniently located for ease of accessibility and simplicity of operation. Electrical characteristics of the RM503 are the same as described for the Type 503 Oscilloscope.

MECHANICAL SPECIFICATIONS

Contruction—Aluminum-alloy chassis.

Finish—Photo-etched, anodized front panel, etched aluminum chassis.

Dimensions—7" high, 19" wide, 16½" deep.

Weight: Net—27 pounds.
Shipping—49 pounds approx.

Type RM503 ..... **$640**

Includes: 1—Set mounting hardware
2—Binding post adapters (013-004)
1—Green filter (378-522)
1—Instruction manual

Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).

MAIN FEATURES

Passband—DC to 450 kc (at 3 db down).

Vertical Sensitivity—5 mv/cm to 20 v/cm in 12 calibrated steps. 5 mv/cm to 50 v/cm continuously variable (uncalibrated).

Single-ended input.

Constant input impedance—(1 megohm—47 pf) at all sensitivities, standard 10-x probe can be used.

Sweep Range

1 μsec/cm to 0.5 sec/cm.
18 calibrated sweep rates.
Sweep time adjustable between steps, and to approximately 1.2 sec/cm uncalibrated.

Amplitude Calibrator

500 mv and 25 mv peak-to-peak square-wave voltages available at front panel.

Regulated Heater Supply

Regulated dc supplied to the input stage filaments.

GENERAL DESCRIPTION

Tektronix standards of precision and reliability are introduced to the low frequency scope field in the Type 504 Oscilloscope. For applications within its dc to 450 kc capabilities, the Type 504 is an accurate dependable instrument at a modest cost. It is equally well adapted for laboratory or classroom. The Type 504's reduced size requires less bench space and suggests its use for many field applications and production-line-testing jobs. Many features not normally found in low-frequency oscilloscopes are included in the Type 504. Some of these are: flexible triggering facilities, 5 mv/cm vertical sensitivity, constant input impedance at all sensitivities, bandpass of dc to 450 kc, deflection blanking, and simple layout with parts easily accessible.

VERTICAL-DEFLECTION SYSTEM

DC-Coupled Amplifier—Passband is dc to 450 kc (at 3 db down). Deflection is calibrated in steps of 5, 10, 20, and 50 mv/cm . . . 0.1, 0.2, 0.5, 1, 2, 5, 10, and 20 volts/cm. A vernier control (uncalibrated) permits continuous adjustment between the 12 steps, and to about 50 volts/cm.

Calibration Accuracy—Internal adjustments set the gain of the vertical amplifier. When these adjustments are set accurately, the calibration will be within 3% of the indicated switch position.

Input Impedance—1 megohm paralleled by about 47 pf.

HORIZONTAL-DEFLECTION SYSTEM

Sweep Range—Sweep time is calibrated in steps of 1, 2, 5, 10, 20, and 50 μsec/cm . . . 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, and 50 msec/cm . . . 0.1, 0.2, 0.5, sec/cm. Calibration accuracy is within 3% of the indicated switch position. A 2.5:1 vernier control permits continuous adjustment between the 18 steps, and to over 1.2 sec/cm, uncalibrated.

Deflection Blanking—The unblanking waveform is coupled to a separate deflection system in the electron gun of the cathode-ray tube. The system consists in part of two pairs of cross-connected deflection plates which intercept the beam current, blanking the crt screen except during sweep time. This unique system uses simplified circuitry and at the same time provides improved reliability. It assures uniform beam current for all sweep and repetition rates. In addition, external beam modulation can be accomplished by using the crt grid-input terminal on the back of the oscilloscope.

TRIGGERING FACILITIES

Amplitude-level Selection—Adjustable amplitude-level and slope controls allow sweep triggering at any selected point on the triggering waveform. Trigger source can be internal, external, or from the line frequency, either ac-coupled or dc-coupled.

Automatic Triggering—Fully counter-clockwise position of the LEVEL control eliminates triggering readjustments, provides dependable triggering for most applications. One setting assures positive sweep-triggering

DC to 450 KC OSCILLOSCOPE

by signals of different amplitudes, shapes, and repetition rates. In the absence of an input signal, automatic triggering of the sweep occurs at about a fifty-cycle rate and provides a convenient reference trace on the crt screen.

Trigger Requirements—Triggering internally requires a signal large enough to produce one-half centimeter of vertical deflection. Triggering externally requires a signal of at least one-half volt.

OTHER CHARACTERISTICS

Amplitude Calibrator—Two square-wave calibration voltages are available through front-panel connectors. Peak-to-peak amplitude of these two voltages is 500 millivolts and 25 millivolts. Accuracy is within 3%. Frequency of the square wave is between 300 and 500 cycles.

Intensity Modulation—The crt grid terminal on the back panel of the oscilloscope permits beam-intensity modulation.

Cathode-Ray Tube—A new Tektronix 5" flat-faced precision cathode-ray tube, T503P__, is used in the Type 504. Accelerating potential is 3 kv. A high-contrast trace easily readable under high ambient light conditions has been achieved with an improved P2 Phosphor. This new phosphor also has distinct advantages for oscilloscope photography. The new P2 phosphor is normally supplied with the Type 504, but a P1, P7, or P11 will be supplied instead if requested.

Alignment of Cathode-Ray Tube—Should adjustment of the cathode-ray tube alignment become necessary, an easily accessible knob, located on the rear support bracket of the crt, provides smooth positive control of the crt alignment.

Graticule—Usable viewing area is marked in eight vertical and ten horizontal one-centimeter divisions. Centerlines are further marked in five minor divisions per centimeter. Convenient control from the SCALE ILLUM. knob provides adjustable edge-lighting for the graticule.

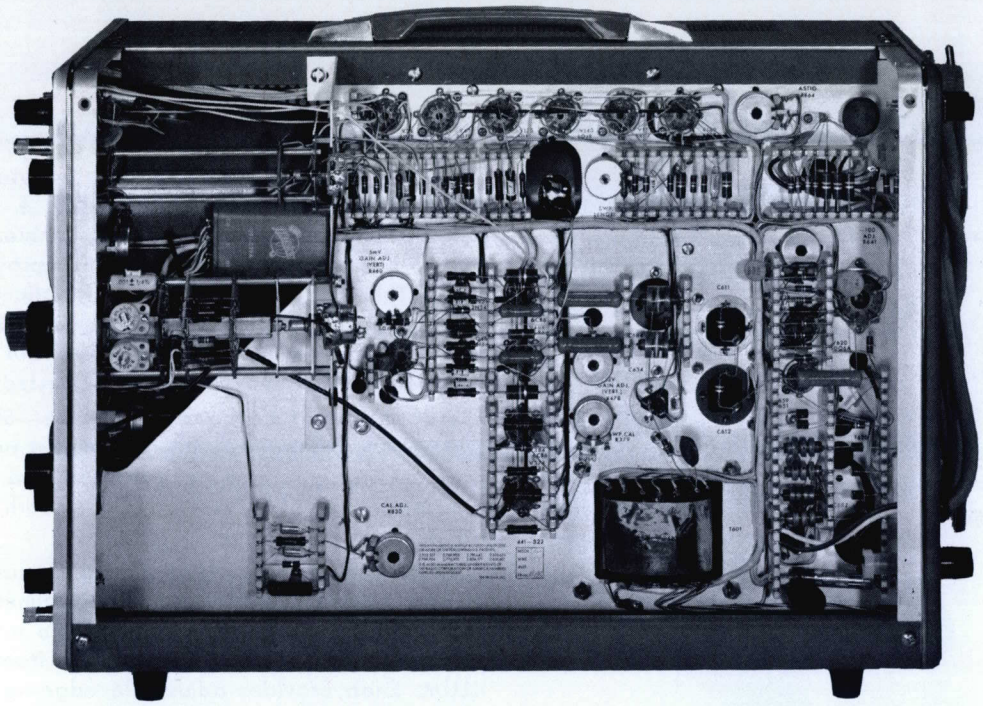
Regulated Power Supplies—Electronically-regulated dc supplies insure stable operation over line fluctuations between 105 and 125 volts or 210 and 250 volts. Line frequency is 50 to 800 cycles. The low-line voltage requirement increases about 10% at 400 cycles and about 15% at 800 cycles. The input stage filaments are supplied with regulated dc.

ELECTRON TUBES AND SEMICONDUCTORS

*Denotes "or Equivalent"

Vertical Amplifier		
Input Amplifier		6DJ8
Drivers	2	2N544*
Output amplifiers	2	6CB6
Time-Base Generator		
Trigger input amplifier		6DJ8
Trigger multivibrator		6DJ8
Sweep gating multivibrator		6DJ8
Hold-off CF and unblanking CF		6DJ8
Disconnect diodes		6BC7
Miller runup and CF		6BL8
Horizontal Amplifier		
Output amplifiers	2	6CB6
Power Supplies		
Low-voltage rectifiers	3	1N2071*
Low-voltage rectifiers	3	1N2070*
High-voltage rectifier		5642
Voltage reference		5651
Comparator amplifier		6BL8
Oscillator		6DQ6A
Miscellaneous		
Cathode-ray tube		T503P2

TYPE 504



MECHANICAL SPECIFICATIONS

Construction—Aluminum-alloy chassis and cabinet. Side panels easily removable and components readily accessible.

Finish—Photo-etched anodized front panel, blue vinyl-finished cabinet.

Dimensions—13 ½" high, 9 ¾" wide, 21 ½" deep.

Weight: Net—29 pounds

Shipping—41 pounds approx.

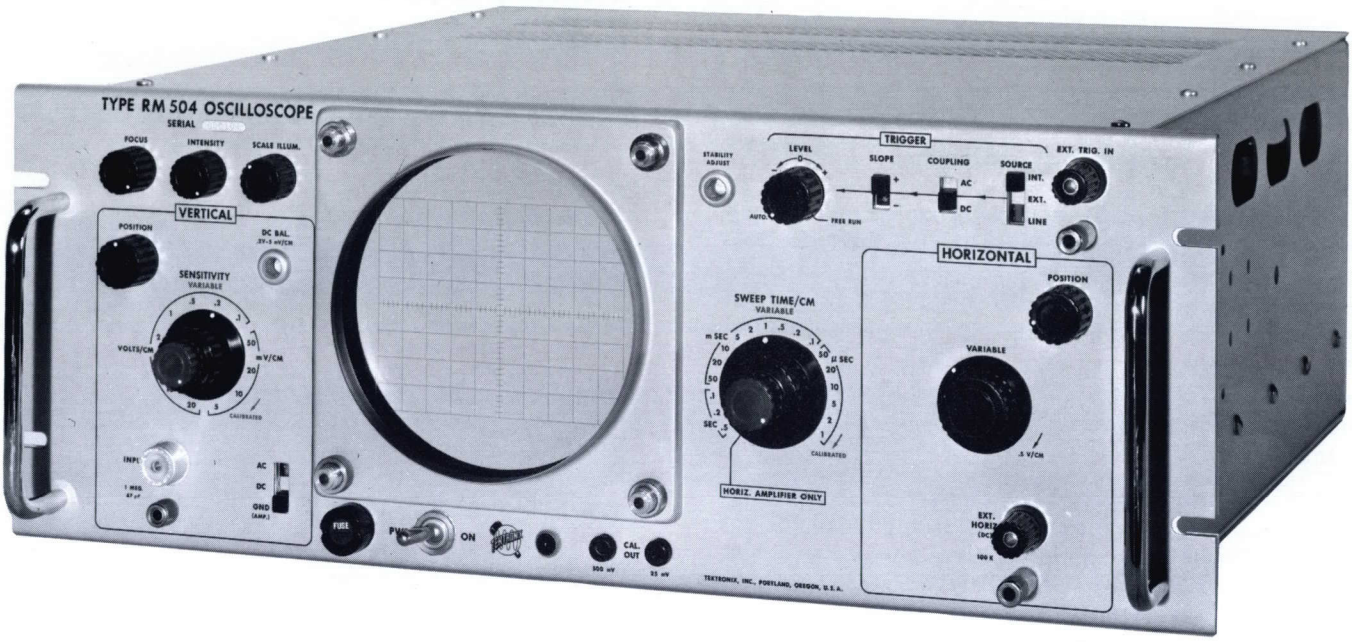
Power-Requirements—105 to 125 v or 210 to250 v, 50 to 800 cycles, 93 watts at 117 v.

Type 504 Oscilloscope ..... **$525.**

Includes: 2—Binding post adapters (013-004)
1—Green filter (378-514)
1—Instruction manual

Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).

RM504 RACK-MOUNTING MODEL



GENERAL DESCRIPTION

The Type RM504 is a mechanically rearranged Type 504 Oscilloscope. It bolts directly to a standard 19" rack. Does not have slide-out mounting. Requires only 7" of rack height.

Front panel controls and connectors are conveniently located for ease of accessibility and simplicity of operation. Electrical characteristics of the RM504 are the same as described for the Type 504 Oscilloscope.

MECHANICAL SPECIFICATIONS

Construction—Aluminum-alloy chassis.

Finish—Photo-etched, anodized front panel, etched aluminum chassis.

Dimensions—7" high, 19" wide, 16½" deep.

Weight: Net—25 pounds
Shipping—47 pounds approx.

Type RM504 ..... **$535.**

Includes: 1—Set mounting hardware
2—Binding post adapters (013-004)
1—Green filter (378-514)
1—Instruction manual

Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).

MAIN FEATURES

Frequency Response—DC to 15 mc.

Transient Response—23 nsec risetime.

Vertical Deflection Factor

9 calibrated steps from 0.05 v/cm to 20 v/cm.
0.05 v/cm to 50 v/cm, continuously variable.

Balanced 0.25 μsec Delay Network

Wide Sweep Range

22 calibrated steps from 0.2 μsec/cm to 2 sec/cm.
0.04 μsec/cm to 6 sec/cm, continuously variable.
5-x magnifier, accurate on all ranges.

Versatile Triggering Circuitry

Amplitude-level selection with preset or manual stability control, and fully-automatic triggering.

GENERAL DESCRIPTION

The Tektronix Type 515A is a dc-coupled general-purpose cathode-ray oscilloscope combining the latest Tektronix oscilloscope circuitry in a compact moderately-priced instrument. Wide sweep range of 0.04 μsec/cm to 6 sec/cm, dc to 15 mc passband, and vertical deflection factor to 0.05 v/cm qualify the Type 515A for general-purpose laboratory work. Reduced size requires less bench space and permits its use for many field applications.

Other outstanding features include dc-coupled unblanking, a new Tektronix flat-faced 5" cathode-ray tube, and versatile triggering circuitry. Accurate calibration of both sweep and vertical amplifier permits reliable quantitative measurements directly from the screen. Functional panel arrangement and versatile control system makes the Type 515A an easy-to-use oscilloscope for the field and laboratory.

VERTICAL-DEFLECTION SYSTEM

DC-Coupled Vertical Amplifier—The Type 515A vertical passband is dc to 15 mc, risetime is 23 nsec. The vertical attenuator is calibrated in VOLTS/CM of deflection. Nine calibrated steps are provided: 0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10, and 20 v/cm. In addition, a vernier (uncalibrated) control provides for continuously-variable adjustment from 0.05 v/cm to 50 v/cm. A front-panel neon light indicates when the control is in the variable (uncalibrated) position.

Calibration Accuracy—An internal adjustment is provided for setting the gain of the vertical amplifier. When this adjustment is accurately set with the VOLTS/CM switch in the 0.05 v/cm position, the vertical deflection factor for any other position of the switch will be within 3% of the panel reading for that position.

Two Signal Inputs—Two coaxial signal input connectors with more than 60-db isolation are controlled by a four-position switch. The INPUT SELECTOR switch selects ac-coupling or dc-coupling. A blocking capacitor is inserted in the AC positions, limiting the low-frequency response to 2 cycles.

Input Impedance—1 megohm paralleled by approximately 36 pf.

Probe—The vertical sensitivity is reduced by a factor of 10 by use of a 10-x attenuator probe supplied with the instrument. The probe presents an input impedance of 10 megohms paralleled by approximately 11.5 pf.

Balanced Delay Network—A signal delay of 0.25 μsec is introduced by the balanced (push-pull) delay network. Permits observation of the leading edge of the waveform that triggers the sweep.

HORIZONTAL-DEFLECTION SYSTEM

Wide Sweep Range—The Type 515A has 22 calibrated sweep rates: 0.2, 0.5, 1, 2, 5, 10, 20, 50 μsec/cm; 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50 millisec/cm; 0.1, 0.2, 0.5, 1, 2 sec/cm. A single 22-position sweep-rate switch is used. In addition, a vernier (uncalibrated) control provides sweep rates continuously adjustable from 0.04 μsec/cm to 6 sec/cm. A front-panel neon light indicates when the control is in the variable (uncalibrated) position. Calibration accuracy of the fixed sweep rates is within 3%.

Sweep Magnifier—When the 5-x magnifier is switched in, the center two-centimeter portion of the normal sweep is expanded to left and right of center to fill ten centimeters. The HORIZONTAL POSITION control has sufficient range to display any one-fifth of the magnified sweep. Magnifier increases the calibrated sweep rate to 0.04 μsec/cm. TIME/CM of the magnified sweep is indicated by a second blue-colored figure at each position of the sweep-rate switch. Accuracy is within 5% of

DC to 15 MC OSCILLOSCOPE

the displayed portion of the magnified sweep. An indicator light reminds the operator when the magnifier is in use.

DC-Coupled Unblanking—The unblanking waveform is dc-coupled to the control grid of the crt assuring uniform grid bias for all sweep and repetition rates.

Triggering Facilities—Versatile triggering circuitry provides for complete manual control, preset stability control, and fully-automatic triggering.

Amplitude-Level Selection—Adjustable amplitude-level and stability controls provide for triggering the sweep at a selected amplitude level on the triggering waveform. Trigger source can be internal, external, or the line frequency, either ac-coupled or dc-coupled. The triggering point can be on either the rising or falling slope of the triggering waveform.

Preset Stability—Same as above, except the stability control is preset to the optimum triggering point and requires no readjustment.

Automatic Triggering—Automatic level-seeking trigger circuit provides dependable triggering for most applications. One simple setting assures positive sweep-triggering by signals of widely differing amplitudes, shapes, and repetition rates. No trigger controls need be touched until a different type of operation is desired. Range of automatic operation is between 60 cycles and 2 megacycles, approximately. In the absence of an input signal the sweep is automatically triggered at about a 50-cycle rate, providing a reference trace on the screen.

High-Frequency Sync—Assures a steady display of sine-wave signals up to approximately 20 megacycles. Requires a signal large enough to cause about 2 cm deflection, or an external signal of about 2 v.

Trigger Requirements—Internal triggering—a signal large enough to cause 2 mm deflection. External triggering—a signal of 0.5 v to 20 v.

Horizontal Input Amplifier—DC-coupled external connection to the sweep amplifier is through a front-panel connector. Deflection factor is 1.4 v/cm. Frequency response is dc to 500 kc at maximum sensitivity.

OTHER CHARACTERISTICS

Amplitude Calibrator—A square-wave calibration voltage is available through a front-panel coaxial connector. Eleven fixed voltages—0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50, and 100 volts peak-to-peak are provided. Accuracy is within 3%. Square-wave frequency is about 1 kc.

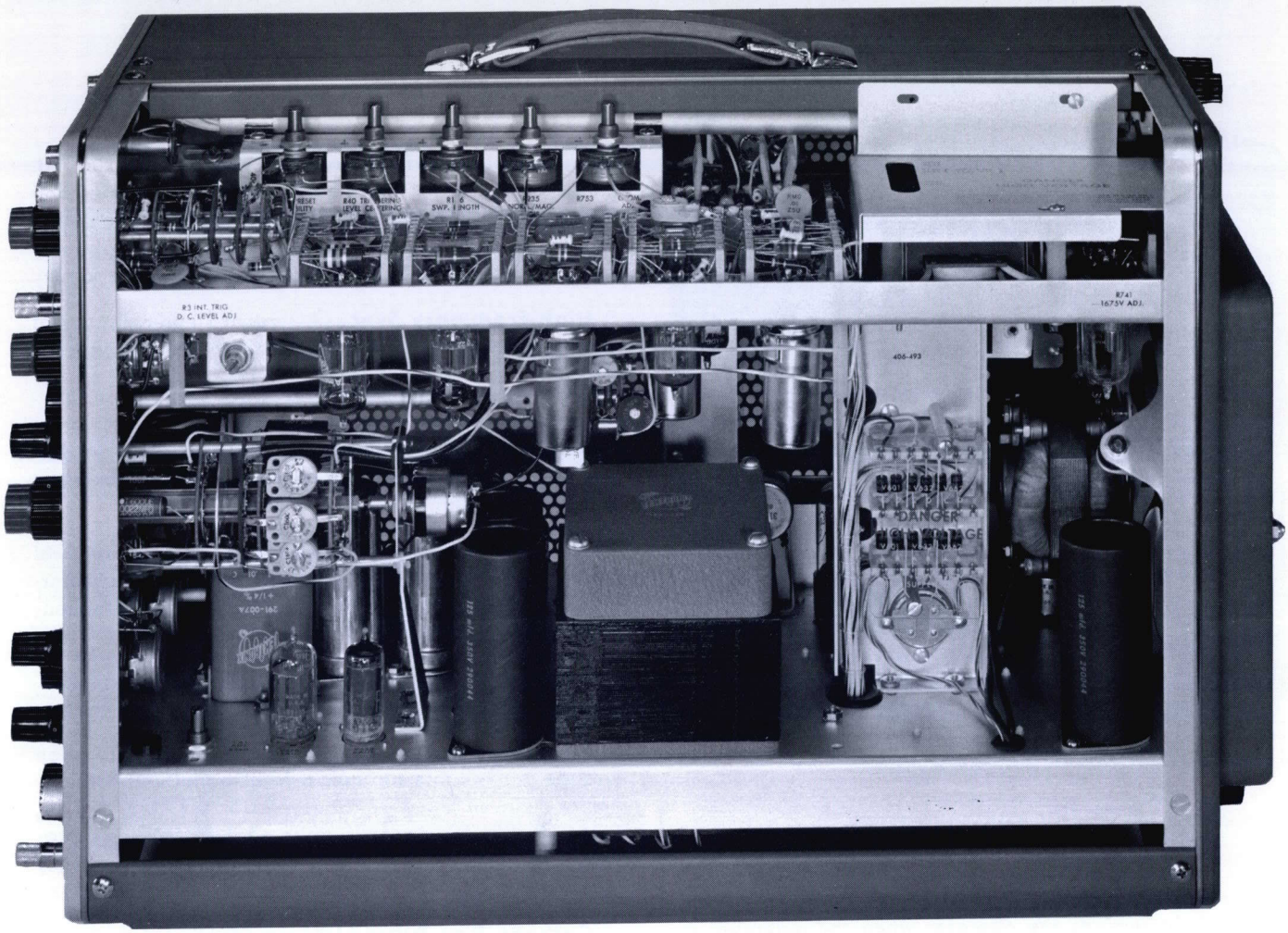
Cathode-Ray Tube—4-kv accelerating potential is applied to a new Tektronix 5" flat-faced precision tube, T55P___, with a helical post-accelerating anode. A P2 phosphor is normally supplied. P1, P7, or P11 can be furnished instead if desired. Some other phosphors are available on special order.

Alignment of Cathode-Ray Tube—Should adjustment of the cathode-ray tube alignment become necessary, an easily accessible knob, located on the rear support bracket of the crt, provides smooth positive control of the crt alignment.

Output Waveforms—A 20-v positive-gate waveform of the same time duration as the sweep, and a 150-v positive-going sweep-sawtooth waveform are available at front-panel connectors.

Regulated Power Supply—Electronic regulation compensates for load differences and line-voltage variations between 105 and 125 v or 210 and 250 v.

Illuminated Graticule—An edge-lighted graticule is marked in 6 vertical and 10 horizontal centimeter-divisions with 2-millimeter baseline divisions. Illumination is controlled by a front-panel knob.



ELECTRON TUBES AND SEMICONDUCTORS

* denotes "or equivalent"

Vertical

Input CF's	2	6AU6
Input amplifiers	2	12BY7
Amplifier CF's		6DJ8
Output amplifiers	2	6CL6
Trigger-pickoff CF's		6DJ8

Horizontal

Trigger-input amplifier		6DJ8
Trigger multivibrator		6DJ8
Holdoff CF's		12AT7
Sweep-gating multivibrator and unblanking CF		6AN8
Sweep-gating multivibrator and CF		6DJ8
Disconnect diodes		6AL5
Miller-runup sweep generator and CF		6AN8
Sawtooth-out CF and + gate-out CF		6DJ8
Horizontal-amplifier input CF and horizontal-driver CF		6DJ8
Horizontal-output amplifier and CF's	2	6DJ8

Power Supplies

Rectifiers	14	1N1566*
Voltage reference		5651
Regulator amplifiers	2	6AU6
Difference amplifiers		6AN8
Series regulator		6080
Series regulator		6AU5
High-voltage oscillator		6AQ5
High-voltage rectifiers	3	5642
Error-signal amplifiers		12AT7

Miscellanous

Calibrator multivibrator		6AU6
Calibrator multivibrator		12AU7
Cathode-ray tube		T55P2

MECHANICAL SPECIFICATIONS

Ventilation—Filtered, forced-air ventilation maintains safe operating temperature. A minimum of 2" of unobstructed clearance around the instrument is recommended for adequate ventilation.

Construction—Cabinet and chassis are made of aluminum alloy.

Finish—Photo-etched anodized panel, blue wrinkle-finished cabinet.

Dimensions—9 ¾" wide, 13 ½" high, 21 ½" deep.

Weight: Net—46 pounds
Shipping—58 pounds approx.

Power Requirements—105 to 125 v or 210 to 250 v, 50-60 cycles 300 watts. Type 515AMOD101 operates on 50 to 400 cycle supply; uses dc fan motor.

Price, Type 515A **$800**

Price, Type 515AMOD101 ..... **$835**

Includes: 1—10-x attenuator probe
2—Binding-post adapters (013-004)
1—Green filter (378-514)
1—3-conductor power cord (161-008)
1—Instruction manual

Optional Phosphors

P2 crt phosphor normally furnished.
P1, P7, P11 optional.....No extra charge

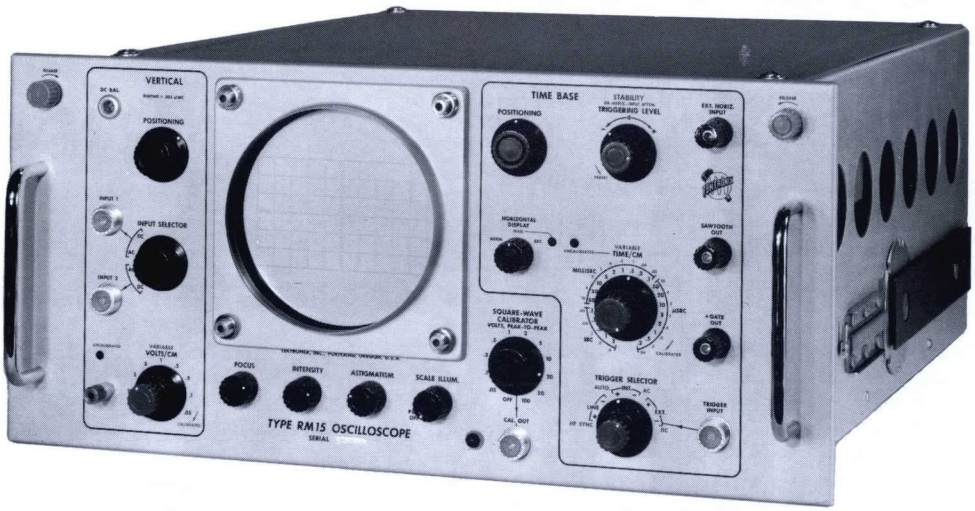
Recommended Additional Accessories

Fan Motor Kit—For converting Type 515A for use on 50 to 400 cycle line frequency (Type 515AMOD101). Contains brackets, rectifier, and fan motor.

ORDER PART NO. 040-140 ..... $40.00

Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).

RM15 RACK-MOUNTING MODEL



GENERAL DESCRIPTION

The Type RM15 is a mechanically rearranged Type 515A Oscilloscope. It mounts in a standard 19-inch rack on slideout tracks. It can be pulled forward, tilted, and locked in any of seven positions for servicing convenience. Electrical characteristics of the instrument are the same as described for the Type 515A Oscilloscope.

MECHANICAL SPECIFICATIONS

Ventilation—Filtered, forced-air ventilation maintains safe operating temperature.

Construction—Cabinet and chassis are made of aluminum alloy.

Finish—Photo-etched anodized panel, etched aluminum cabinet.

Dimension—8 ¾" high, 19" wide, 23" rack depth. See page B-8 for complete mounting dimensions.

Weight: Net 57 pounds
Shipping—75 pounds approx.

Other mechanical specifications are the same as described for the Type 515A Oscilloscope.

Type RM15 (50 to 60 cycle supply **$875**
Type RM15MOD101 (50 to 400 cycle supply) **$910**

Includes: 1—10-x attenuator probe
2—Binding-post adapters (013-004)
1—Green filter (378-514)
1—3-conductor power cord (161-010)
1—Set, mounting hardware
1—Pair, guide rails (351-006)
1—Instruction manual

Recommended Additional Accessories

Supporting Cradles—for rear slide support when the instrument is to be mounted in a backless rack. Two cradles with necessary mounting hardware.
ORDER PART NO. 426-063 ..... $7.50

TYPE 516 DC to 15MC

MAIN FEATURES

Two Identical Input Channels

Passband—dc to 15 mc (at 3 db down)
Risetime—23 nanoseconds.
Vertical Sensitivity—0.05 v/cm to 20 v/cm in 9 calibrated steps. Continuously variable from 0.05 v/cm
Vertical Sensitivity—0.05 v/cm to 20 v/cm in 9 calibrated steps. Continuously variable from 0.05 v/cm to approximately 50 v/cm, uncalibrated.

Four Operating Modes

Channel A only.
Channel B only.
Chopped—electronic switching at about 150 kc.
Alternate—electronic switching on alternate sweeps.

Sweep Range

0.2 μsec/cm to 2 sec/cm.
22 calibrated steps.
Continuously variable from 0.04 μsec/cm to 6 sec/cm, uncalibrated.
5-X magnification.

Trigger System

Automatic or amplitude-level selection (preset or manual).
Rising or falling slope.
Internal, external, or line frequency, either ac or dc-coupled.

GENERAL DESCRIPTION

The Type 516 is a dual-trace oscilloscope using frame-grid tubes for high reliability. It is a compact, semi-portable instrument ideally suited to bench work applications. Vertical deflection factor is 0.05 v/cm for each channel, with four operating modes. Small size and light weight combined with simple operation and reliable performance fit the Type 516 Oscilloscope for many laboratory and field applications.

VERTICAL-DEFLECTION SYSTEM

DC-Coupled Vertical Amplifier—Both channels have identical input characteristics. Passband is dc to 15 mc (at 3 db down). Risetime is 23 nsec. Deflection is calibrated in steps of: 0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10, and 20 v/cm. A vernier control permits continuous adjustment between steps, and to about 50 v/cm, uncalibrated.

Calibration Accuracy—Internal adjustments set the gain of each channel. When these adjustments are set accurately the deflection factor will be within 3% of the indicated switch position.

Positioning Control—Each channel has a separate vertical-position control.

Mode Selection—A switch selects one of four operating modes—each channel separately or both channels electronically switched either at a free running rate of about 150 kc or triggered by the oscilloscope sweep.

AC-DC Switches—A coupling capacitor (in AC positions) limits low-frequency response to 3 db down at 2 cycles.

Polarity Control—Each channel has a separate polarity control (for comparison of signals 180 degrees out of phase).

Input Impedance—1 megohm paralleled by 20 pf.

Signal Delay—A balanced delay network permits observation of the leading edge of the sweep-trigger waveform.

HORIZONTAL-DEFLECTION SYSTEM

Sweep Range—Sweep time is calibrated in steps of 0.2, 0.5, 1, 2, 5, 10, 20, 50-μsec/cm . . . 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50 msec/cm . . . 0.1, 0.2, 0.5, 1, and 2 sec/cm. Calibration accuracy is within 3% of the indicated switch position. A vernier control permits continuous adjustment between the 22 steps, and to over 6 sec/cm, uncalibrated.

Sweep Magnifier—When the 5-x magnifier is switched in, the center two-centimeter portion of the normal sweep is expanded to left and right of center to fill ten centimeters. The HORIZONTAL POSITION control has sufficient range to display any one-fifth of the magnified sweep. Used with the fastest sweep, the magnifier extends the calibrated sweep range to 0.04 μsec/cm. TIME/CM of the magnified sweep is indicated by a second blue-colored figure at each position of the sweep-rate switch. Accuracy is within 5% of the displayed portion of the magnified sweep. A neon lamp lights to indicate when the magnifier is in use.

DC-Coupling Unblanking—The unblanking waveform is dc-coupled to the control grid of the crt. This

DUAL-TRACE OSCILLOSCOPE

assures uniform beam current for all sweep speeds and repetition rates at any setting of the intensity control. An external crt cathode terminal permits beam-intensity modulation.

Horizontal Input—A front-panel connector permits dc-coupled external connection to the sweep amplifier. Horizontal deflection factor is 1.4 v/cm, and bandpass extends from dc to 500 kc at maximum sensitivity.

TRIGGER FACILITIES

Amplitude-Level Selection—Adjustable amplitude-level and stability controls allow sweep triggering at any selected amplitude level on the triggering waveform. Trigger source can be internal, external, or the line frequency, either ac-coupled or dc-coupled. Trigger point can occur anywhere on the rising or falling slope of the triggering waveform.

Preset Stability—The STABILITY control locks at the optimum triggering point and requires no adjustment in the fully counter-clockwise, PRESET position.

Automatic Triggering—Automatic level-seeking trigger circuit eliminates triggering readjustments—provides dependable triggering for most applications. One setting assures positive sweep triggering by signals of widely differing amplitudes, shapes, and repetition rates. Automatic triggering of the sweep occurs at about a fifty-cycle rate in the absence of an input signal, and provides a convenient reference trace on the crt screen.

Trigger Requirements—Triggering internally requires a signal large enough to produce on minor division of vertical deflection. Triggering externally requires a signal of from 0.5 to 25 volts.

High-Frequency Sync—Assures steady display of sine-wave signals to at least 15 megacycles. Requires a signal large enough to cause about 2 cm deflection, or an external signal of about 2 volts.

OTHER CHARACTERISTICS

Amplitude Calibrator—Eleven square-wave calibration voltages are available through front-panel connectors. Peak-to-peak amplitude is in steps of 0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50, and 100 volts. Accuracy is within 3%. Frequency of the square-wave is approximately 1 kc.

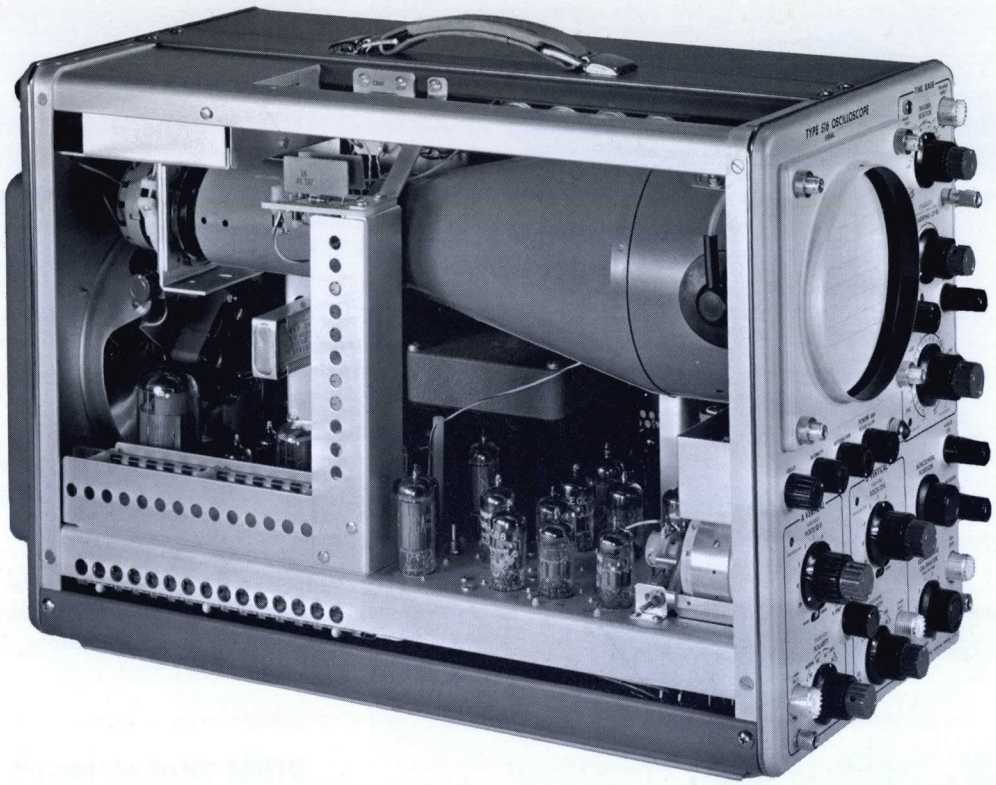
Tektronix Cathode-Ray Tube—A precision flat-faced 5-inch cathode-ray tube, Type T55P___, provides a bright trace. Accelerating potential is a 4 kv. A P2 phosphor is normally supplied, P1, P7, or P11 can be furnished instead if desired.

Alignment of Cathode-Ray Tube—Should adjustment of the cathode-ray tube alignment become necessary, an easily accessible knob, located on the rear support bracket of the crt, provides smooth positive control of the crt alignment.

Dual-Trace Blankng—A blanking voltage is available to eliminate switching transients from the display when the instrument is operated in its chopped mode. The blanking voltage can be supplied to the crt cathode by means of a switch located on the back panel of the instrument.

Graticule—Usable viewing area is marked in six vertical and ten horizontal one-centimeter divisions. Center lines are further marked in five minor divisions per centimeter. Convenient control from the SCALE ILLUM. knob provides adjustable edge-lighting.

TYPE 516



Regulated Power Supplies—Electronically-regulated dc supplies insure stable operation over line fluctuations between 105 and 125 volts or 210 and 250 volts.

Output Waveforms—Two output waveforms are available from front-panel connectors. Approximate amplitude of the peak-to-peak voltages are 150 volts from the SAWTOOTH OUT connector and 20 volts from the +GATE OUT connector.

Warning Indicators for Uncalibrated Settings—Separate front-panel neon lights indicate when the vertical-attenuator and sweep-rate controls are not in their calibrated positions.

MECHANICAL SPECIFICATIONS

Ventilation-Filtered forced-air ventilation maintains safe operating temprature. A minimum of 2" of unobstructed clearance around the instrument is recommended for adequate ventilation.

Construction—Aluminum alloy chassis and cabinet.

Finish—Photo-etched anodized front panel, blue vinyl-finished cabinet.

Dimensions—13½"high, 9¾" wide, 21½" deep.

Weight: Net—40 pounds
Shipping—61 pounds approx.

Power Requirements—105 to 125 volts or 210 to 250 volts, 50 to 60 cycles, 297 watts at 117v. The Type 516MOD101 operates on 50 to 400 cycle supply; uses dc fan motor.

If requested the instrument will be wired for any of the following nominal line voltages.

Nominal Line Voltage (Figures taken at 60 cps)	Operating Range
110	99 to 117 volts
117	105 to 125 volts
124	111 to 132 volts
220	198 to 235 volts
234	210 to 250 volts
248	223 to 265 volts

A metal decal on the transformer gives complete instructions for changing the operating range.

TYPE 516 (50-60 cycles) **$1000**

TYPE 516MOD101 (50-400 cycles) **1035**

Includes: 2—10-x attenuator probes
2—Binding post adapters (013-004)
1—Green filter (378-514)
1—3-Conductor power cord (161-010)
1—Instruction manual

RACK MOUNT ADAPTER

A cradle mount to adapt the Type 516 Oscilloscope for rack mounting is available. It consists of a cradle to support the instrument in any standard 19" relay rack and a mask to fit around the regular instrument panel. Tektronix blue wrinkle finish. Rack height requirements 15½".

ORDER PART NO. 040-193. . . . . .$45.00

Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).

TELEVISION OSCILLOSCOPES

TYPE 524AD J-2

TYPE 525 . . . . . J-6

TYPE 526 . . . . . J-10

5/60

MAIN FEATURES

Frequency Response

Normal—dc to 10 mc from 0.15 v/cm to 50 v/cm.
2 cycles to 10 mc from 15 mv/cm to 50 v/cm.

Flat—within 1% from 60 cycles to 5 mc.

IRE—meets IRE standards for level measurements.

Transient Response—35 nsec risetime.

Sweep Range

Continuously variable, 0.1 μsec/cm to 0.01 sec/cm.

Time Markers

Five markers—0.05 μsec, 0.1 μsec, 1.0 μsec, 200 pips per television line, and 40 pips per television line.

Sweep Delay

Permits detailed observation of any portion of a single television line.

DC-Coupled Unblanking

Variable Duty-Cycle Amplitude Calibrator

GENERAL DESCRIPTION

The Tektronix Type 524AD Oscilloscope is a self-contained instrument with the characteristics desirable for maintenance and adjustment of television transmitter and studio equipment. The Type 524AD will prove itself invaluable in enabling the engineer to observe any portion of the television picture — from complete frames to small portions of individual lines.

Features contributing to the versatility of this oscilloscope include—accurate time markers to facilitate sync-pulse timing, normal response of dc to 10 mc, flat response within 1% from 60 cycles to 5 mc for color-television work, variable-duty-cycle amplitude calibrator, and two steps of sweep magnification, 3x and 10x, for detailed observations.

VERTICAL DEFLECTION SYSTEM

DC-Coupled Vertical Amplifier—The main vertical amplifier has a passband of dc to 10 mc for deflection factors from 0.15 v/cm to 50 v/cm. Low-frequency response is 3 db down at 2 cycles when the AC-DC switch is in the AC position. An ac-coupled preamplifier switched in by the VOLTS/CM control provides additional deflection factors from 0.015 v/cm to 0.15 v/cm. A variable attenuator control fills in between steps and provides continuously variable adjustment from 0.015 v/cm to 50 v/cm. The vertical amplifier is factory adjusted for optimum transient response. Risetime is less than 35 nsec and the input impedance is 1 megohm paralleled by approximately 45 pf.

Frequency Response—A switch on the access panel selects the desired bandwidth of the vertical amplifier. The NORMal position provides a passband of dc to 10 mc. The FLAT position provides a vertical-amplifier response flat within 1% from 60 cycles to 5 mc. About 5% overshoot will occur on extremely sharp waveforms when the switch is in the FLAT position; however, TV signals within the 5 mc passband are not affected. Response of the amplifier meets the IRE standards for level measurements when the access-panel switch is in the IRE position. EXTernal position provides ac-coupled external connections to the vertical-deflection plates, bypassing the main vertical amplifier but retaining the function of the vertical-position control.

Two Signal Inputs—Two coaxial connectors with more than 50-db isolation are controlled by a front-panel switch. Each input can be either ac or dc-coupled to the vertical amplifier.

Probe—The vertical sensitivity is reduced by a factor of 10 by use of a 10x attenuator probe supplied with the instrument. The probe presents an input impedance of 10 megohms paralleled by approximately 15 pf.

Delay Network—A 0.25 μsec signal-delay network is incorporated in the vertical amplifier to permit observation of the waveform that triggers the sweep.

HORIZONTAL DEFLECTION SYSTEM

Calibrated Sweeps—The Type 524AD has a continuously variable, linear, triggered time base covering the range of 0.1 μsec/cm to 0.01 sec/cm in five fixed-range steps. Dual sweep-time multiplier dials cover the range between steps. Calibration accuracy is within 5%.

DC-Coupled Unblanking—The unblanking waveform is dc-coupled to the grid of the cathode-ray tube assuring uniform bias for all sweep speeds and repetition rates.

Sweep Delay—Detailed observation of any portion of the television picture is accomplished by continuous sweep delay from 0 to 25 milliseconds. After the desired delay, the sweep is triggered by one of the line sync pulses. The sweep delay is adjustable with a 3-turn potentiometer through about 1½ fields, and operates at the frame rate of 30 cycles so only consecutive lines of one field are observed at any time. A field-shift button permits switching to the corresponding interlaced lines in the other field.

TELEVISION OSCILLOSCOPE

Sweep Magnifier—Sweep magnification is obtained by increasing the drive to the sweep-output amplifier by a factor of either 3 or 10. The center portion of the normal sweep is expanded equally to left and right of center. The 3-turn horizontal-position control has sufficient range to cover the entire magnified sweep. Accuracy is within 5%.

Trigger Selector—Both normal and delayed sweeps can be triggered by an external signal of either polarity, or internally by either the positive or negative portion of the signal under observation, or by the power-line frequency.

Trigger Requirements—Internal triggering—a signal large enough to produce a one-half centimeter deflection. External—a signal of 0.5 v to 50 v. Composite waveform—a signal large enough to produce a 1.5-centimeter deflection.

OTHER CHARACTERISTICS

Voltage Calibrator—A variable-duty-cycle square-wave calibration voltage is continuously variable from zero to 50 volts in seven ranges. Full-scale calibration is accurate within 3%; variable control is linear within 1% of full scale. Square-wave frequency is approximately 1 kc, but the frequency will vary somewhat as duty cycle is varied to 1% or 99%.

Time-Mark Generator—Time markers are inserted as intensification pips on the crt trace at time intervals of 0.025H, 0.005H, 1.0 μsec, 0.1 μsec, and 0.05 μsec. Since H is 63.5 μsec, 0.025H will give 40 pips per television line and 0.005H will give 200 pips per television line. These markers provide a means of accurately timing the sync pulses of a composite signal. Pips spaced at 40 or 200 per television line are useful for adjusting both color and monochrome equipment.

A phasing control permits markers to be positioned on any desired point of the waveform under observation.

Output Waveforms—Positive and negative-gate waveforms of the same time duration as the sweep, and the sweep sawtooth waveform are available at front-panel connectors.

Line-Indicating Video—When a picture monitor is connected to the coaxial connector at the rear of the cabinet, the picture appearing on the monitor will be brightened during the time of the oscilloscope sweep. This technique is useful when it is desired to know what portion of the picture is being displayed on the oscilloscope.

60-Cycle Sweep—A 60-cycle sweep with variable amplitude and phasing through approximately 150° is provided to facilitate bandwidth measurements with a video sweep generator.

Cathode-Ray Tube—A flat-faced 5ABP__ cathode-ray tube with 4-kv electronically-regulated accelerating potential is used in the Type 524AD. A P-1 phosphor is normally supplied although other phosphors are available upon request.

Alignment of Cathode-Ray Tube—Should it become necessary to touch up the alignment of the cathode-ray tube, a molded nylon handle on the crt socket can be reached in a matter of seconds. Release the two quick-opening fasteners on the left cabinet side, and lower the cabinet side out of the way, or remove it completely.

Regulated Power Supply—All dc supplies are electronically regulated to insure stable operation over line-voltage and load variations between 105 and 125 v or 210 and 250 v, 50 to 60 cycles.

TYPE 524AD

Probe Power Socket—A front-panel socket will provide power for a cathode-follower probe or auxiliary amplifier circuitry. 6.3 v ac at 1 amp and 120 v regulated dc at 15 ma are available at the socket.

Illuminated Graticule—An edge-lighted graticule is marked in centimeters. Illumination is controlled by a front-panel knob. A graticule marked for modulation measurements is also supplied with the instrument.

ELECTRON TUBES AND SEMICONDUCTORS

* denotes "or equivalent"

Preamplifier	2	6U8
Cathode follower		12AT7
Cathode-coupled amplifier	2	6CL6
Cathode follower		6BQ7A
Driver	2	6CL6
Cathode follower, constant-current triode		6BQ7A
Output amplifier	6	6AG7
Voltage regulator		6AS5
Cal multivibrator		12AU7
Cal clipper amplifier and CF		12AT7
Trigger inverter and clamp diode		6BQ7A
Sync amplifier		12BZ7
Sync separator and coupling diode		12BZ7
Phantastron		6BH6
Trigger delay comparator		12BZ7
Trigger amplifier		6AG7
Coupling diode		6AL5
Negative multivibrator		12BY7
Positive multivibrator		12BY7
Gate amplifier and astigmatism CF		12AU7
Unblanking amplifier		12AT7
Clamp tube		6AG7
DC restorer		6AL5
Cathode follower		12AT7
Decoupling diode and CF		12AT7
Feedback amplifier		6U8
Clamp and CF		12AT7
Sweep-output amplifier	2	6AH6
Sweep-output cathode follower		6BQ7A
Voltage rectifier	8	IN1566*
Voltage reference		5651
Regulator amplifier	4	6AU6
Regulator series tube	2	12B4
Rectifiers	3	6X4
Voltage-comparator amplifier		12AX7
Regulator series tube		6AS7
Regulator series tube		6AS5
Time-mark pulse shaper and CF		6BQ7A
Clamp		T12G*
Marker phase multivibrator		6U8
Time-mark oscillator		6AK5
Pulse amplifier		6BQ7A
High-voltage regulator amplifier		12AU7
High-voltage oscillator		6AQ5
High-voltage rectifier	3	5642
Cathode-ray tube		5ABP1

MECHANICAL SPECIFICATIONS

Construction—Aluminum-alloy chassis and three-piece cabinet.

Ventilation—Filtered, forced-air ventilation maintains safe operating temperature. A minimum 2" of unobstructed clearance around the instrument is recommended for adequate ventilation.

Finish—Photo-etched anodized panel, blue wrinkle-finished cabinet.

Dimensions—25" long, 13" wide, 16¾" high.

Weight: Net—61 pounds
Shipping—80 pounds appr.

Power Requirements—105-125 v or 210-250 v, 50-60 cycles, 500 watts.

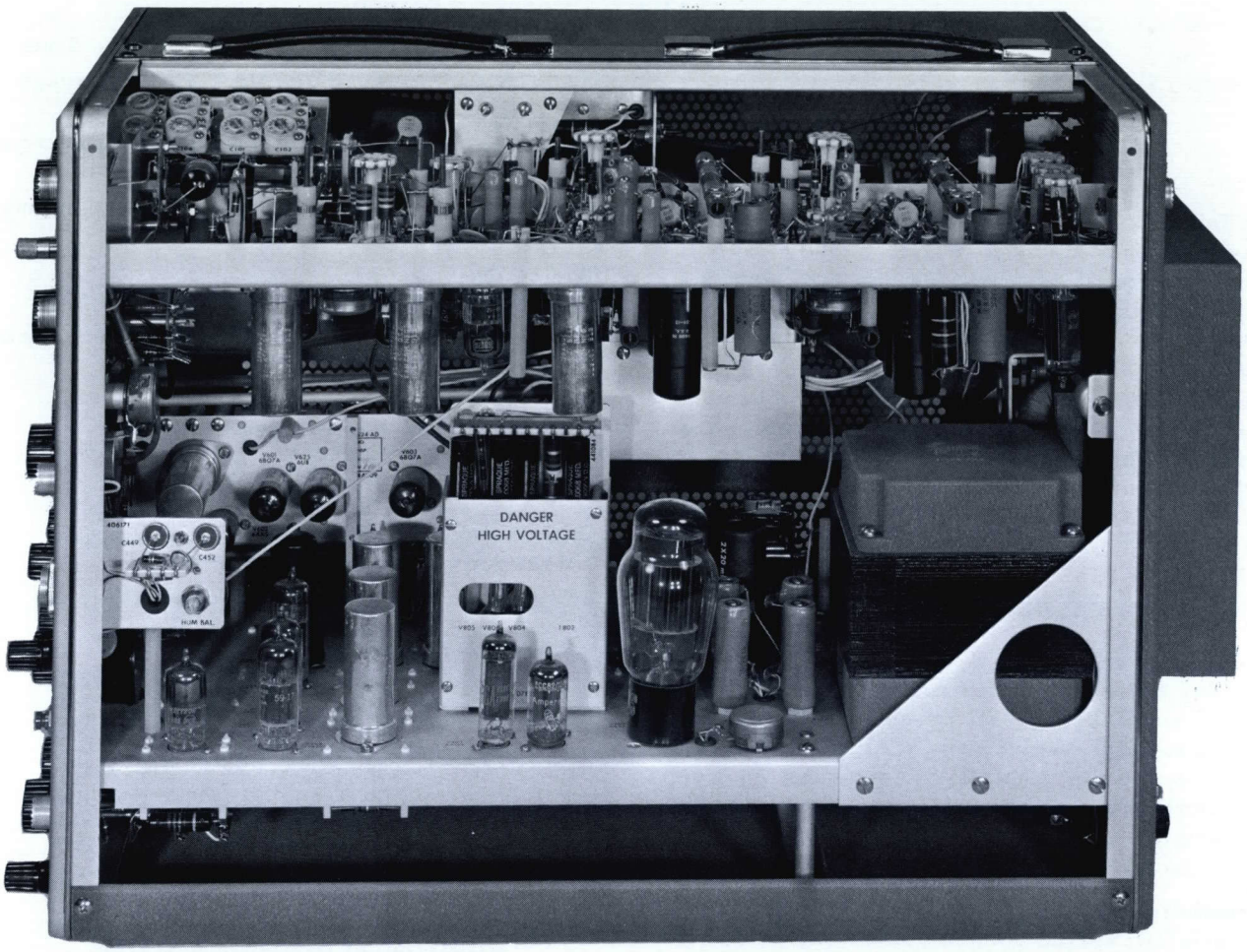
Price **$1250**

Includes: 1—10X attenuator probe
2—Binding-post adapters (013-004)
1—TV RMA style graticule (331-009)
1—Viewing hood (016-001)
1—3-conductor power cord (161-010)
1—Instruction manual

Rack Mount Adapter

A cradle mount to adapt the Type 524AD oscilloscope for rack mounting is available. It consists of a cradle to support the instrument in any standard 19" relay rack and a mask to fit around the regular instrument panel. Tektronix blue wrinkle finish. Rack height requirements 17½".

ORDER PART NO. 040-182 ..... $45.00



Optional Phosphors

P1 crt phosphor normally furnished.
P7, P11 optional ..... No extra charge

Recommended Additional Accessories

Type 500A Scope-Mobile $100.00

P500CF Cathode-Follower Probe has input impedance of 40 megohms paralleled by 4 pf and gain of 0.8 to 0.85. With 10x attenuator head, input impedance is 10 megohms paralleled by 2 pf. Amplitude distortion is less than 3% on unidirectional signals up to 5 v.

ORDER PART NO. 010-015 ..... $64.00

See Accessory Section of this catalog for 75-ohm coaxial cables, attenuators, and terminating resistors.

Prices f.o.b. factory. (Please refer to **Terms and Shipment**, ***GENERAL INFORMATION*** page.)

MAIN FEATURES

Frequency Response

FLAT—within 1% between 60 cycles and 5 mc.

LOW PASS—passes stair steps, eliminating high frequencies.

HIGH PASS—passes high frequencies, eliminating stair steps.

IRE—meets IRE standards for level measurements.

Excellent Linearity

Insures accurate color signal linearity measurements.

Automatically-Synchronized Sweeps

Both field and line rates.

Keyed Clamp-Type DC Restorer

Gain Stability Within 1%

GENERAL DESCRIPTION

The Tektronix Type 525 Television Waveform Monitor displays the composite video waveform with the precision required for all television broadcasting. Exacting demands of the color-television broadcaster for an accurate display of signal linearity, level, and bandwidth are fulfilled with the Type 525.

Special features of the Type 525: Four vertical-amplifier response characteristics, automatically-synchronized sweeps at line or field rate, bridging, or terminating, or differential signal inputs, keyed dc restorer, stable gain characteristics. Simplicity of controls aids in easy monitor operation.

VERTICAL DEFLECTION SYSTEM

Frequency Response—A response selector switch selects any one of four characteristics: IRE, with high-frequency cutoff about 2 mc in accordance with IRE standards for level measurements; FLAT, within 1%, between 60 cycles and 5 mc; LOW PASS, passes the stair steps but eliminates the high frequencies; HIGH PASS, with increase in gain adjustable to 5x, excludes the stair steps but passes the high frequencies for linearity tests.

Sensitivity—The basic deflection factor of the vertical amplifier is 0.015 v/cm. A three-step attenuator, 1x, 2x, 5x, and variable gain control can adjust the waveform to fill the graticule.

Stability—Electronic regulation of all dc power, and use of current stabilization in the amplifier, maintains stability and constant gain. Minimum adjustment of the monitor is required after it is once set. Gain stability is within 1% over a ten-hour period.

Linearity—The vertical amplifier linearity is well above the requirements for highly accurate color-television video signal linearity measurements. Signals can be expanded to the equivalent of 35 cm, with any 7 cm accurately displayed on the screen.

DC Restorer—A clamp circuit, keyed by a pulse derived from the sync-separator circuit, restores the dc level of the display to the tip of the sync pulse at each line-frequency pulse. The restorer can be switched in or out as desired.

Vertical Input Connectors—All input connectors are located at the rear of the instrument. The vertical deflection system has push-pull input to permit two single-ended signals to be applied to the monitor at the same time. They can be independently selected, rapidly compared, or applied differentially to cancel out in-phase unwanted signals, by a front-panel switch. Each input is paralleled with another coaxial connector to permit the monitor to bridge or terminate the video circuit. The 75-ohm terminating resistors are supplied with the instrument.

HORIZONTAL DEFLECTION SYSTEM

Sync Separator—A sync-separator circuit receives the composite video signal either internally from a point on the vertical amplifier, or through an external-trigger connector located at the rear of the instrument. External triggering requires a signal of at least 0.5-v amplitude.

Field and Line Speeds—The sweep will synchronize automatically with either line or field pulses. Sweep frequencies correspond to 7875 cycles for line and 30 cycles for field frequencies. A front-panel switch selects one or the other sweep frequency.

Horizontal Rate, Magnifier—The variable HORIZONTAL RATE control adjusts the sweep-time rate so 2, 3, or 4 lines or fields can be displayed at one time. A three-position switch selects accurate magnification of the sweep by 1x, 5x, or 25x. Magnification expands the portion of the sweep that is centered, equally to right and left of screen center.

OTHER CHARACTERISTICS

Amplitude Calibrator—The calibrator provides pulses with a duty cycle of about 75%, and with amplitudes between .015 volts and 1.5 volts, peak-to-peak, continuously adjustable in four ranges, 0.05, 0.15, 0.5,

TELEVISION WAVEFORM MONITOR

and 1.5 volts. Accuracy is within 2% of full scale on all ranges. The continuously-adjustable interpolating control is linear within 1%.

Cathode-Ray Tube—The T52P__, a Tektronix crt, is used in the Type 525. The T52P__ is a precision 5" flat-faced tube with a helical post-accelerating anode, providing 8 cm of linear vertical deflection. 4-kv accelerating potential provides a bright trace. P1 phosphor is provided, although other phosphors are available upon request.

Regulated Power Supply—DC power supplies are regulated to maintain constant dc voltages for changes in load, and for ac input voltages between 105 and 125 volts, or 210 and 250 volts, 50 to 60 cycles.

Illuminated Graticule—An edge-illuminated graticule is marked in percentage, to +100 and −40. Each centimeter division equals 20%. Illumination is controlled by a front-panel knob.

External Time Markers—A binding post, located at the rear of the instrument, is available for applying external time markers to the crt cathode.

Accessibility—The Type 525 cabinet is designed for standard rack mounting. Chassis is attached to the cabinet with a slide-out mounting that permits it to be tilted vertically, providing easy access to all components.

Internal Adjustments — Internal-adjustment controls, which may require readjustment occasionally, are mounted on the left of the chassis near the front, easily accessible to the operator by sliding the monitor partly out of the case.

ELECTRON TUBES AND SEMICONDUCTORS

* denotes "or equivalent"

Vertical		
Vertical phase splitter amplifier	2	6CB6
Phase splitter CF's		6DJ8
Preamplifier	2	6CL6
Preamplifier output CF's		6DJ8
Vertical amplifier input CF's		6DJ8
Gated clamp diodes	2	6AL5
High-pass amplifiers		6DJ8
High-pass amplifier CF's		6DJ8
Vertical output amplifiers	2	6CL6
Horizontal		
Internal trigger inverter		6U8
External trigger inverter		6U8
Sync separator and clamp diode		6U8
Grid bias clamp		T12G*
Keying-pulse pickoff and shaper		6U8
Keying-pulse limiter		T12G*
Keying-pulse shaper diode and phase splitter		6DJ8
Trigger input CF and clamp diode		6AL5
Clamp diodes		HB-5*
Clamp diode and unblanking CF		6DJ8
Phantastron sweep generator		6DB6
Sweep generator CF and sweep amplifier input CF		6DJ8
Sweep amplifier input CF and voltage regulator amplifier		6DJ8
Sweep amplifiers		6DJ8

TYPICAL COLOR-TV WAVEFORMS AS VIEWED ON THE TYPE 525 TELEVISION WAVEFORM MONITOR

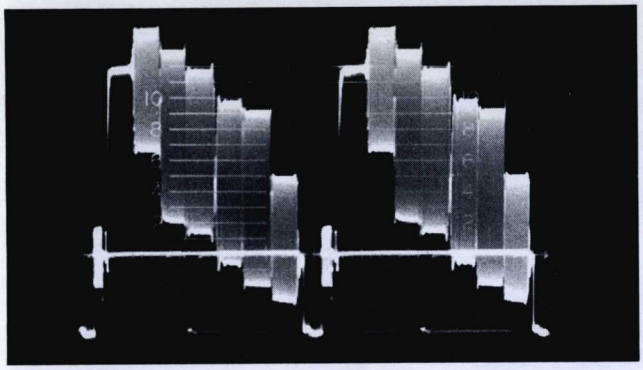


Fig. 1—Color-bar waveform with FLAT vertical response.

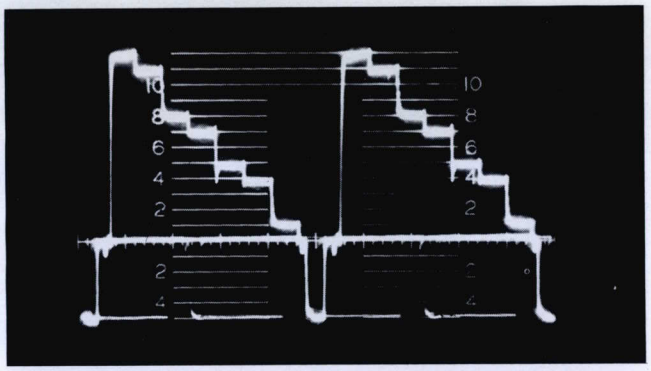


Fig. 2—Same waveform as Fig. 1 with LOW-PASS response.

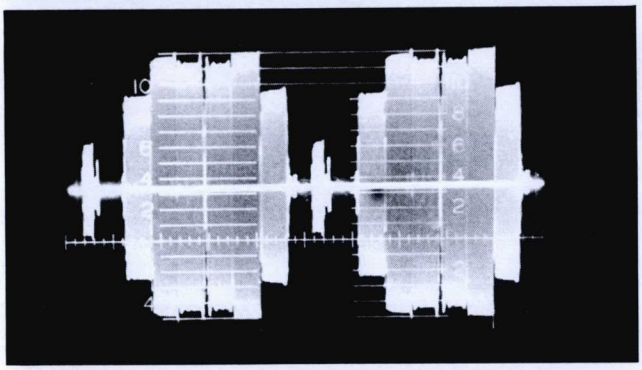


Fig. 3—Fig. 1 waveform with HIGH-PASS response.

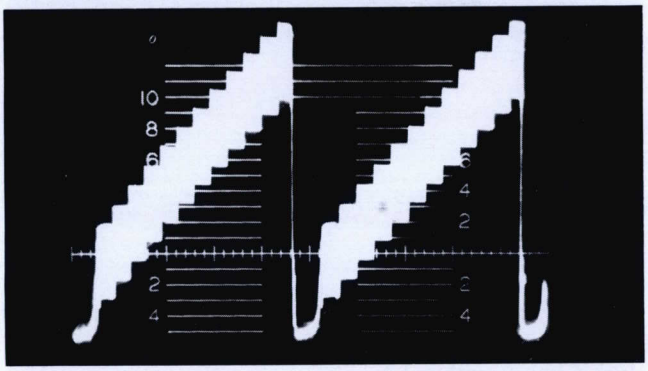


Fig. 4—Staircase with 3.58 mc added—FLAT vertical response.

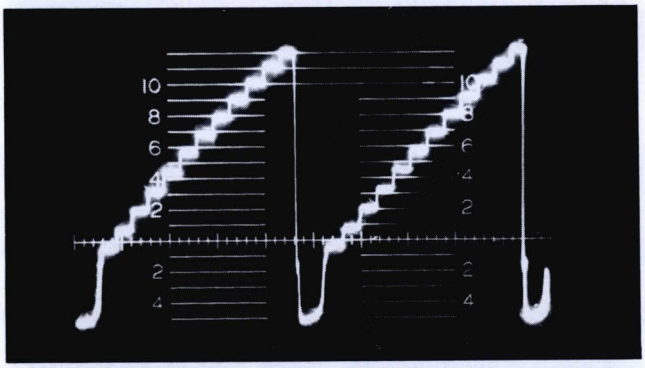


Fig. 5—Same waveform as Fig. 4 with LOW-PASS response.

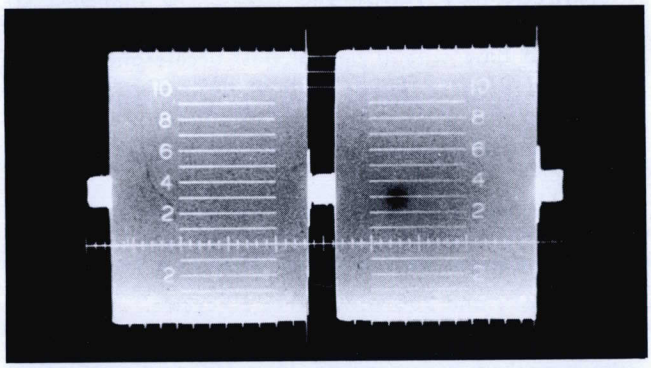


Fig. 6—Fig. 4 waveform with HIGH-PASS response.

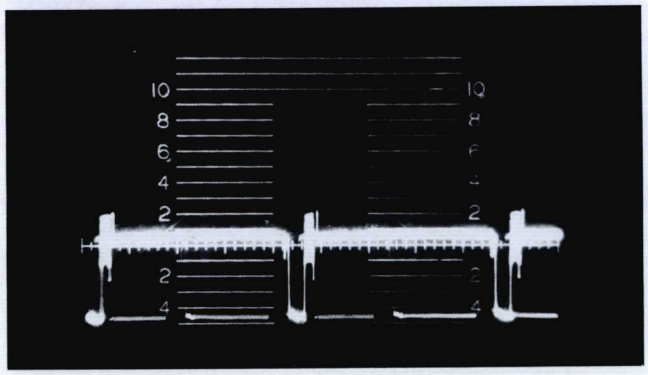


Fig. 7—Horizontal-sync pulse with color burst—FLAT vertical response.

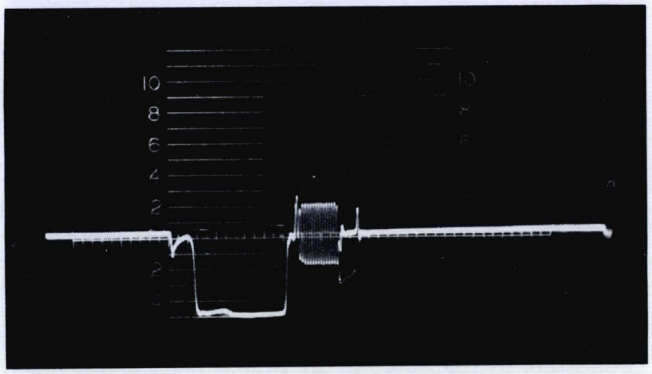


Fig. 8—Same as Fig. 7 with sweep magnified 5 times.

Photos taken through the courtesy of KPTV, Portland, Oregon.

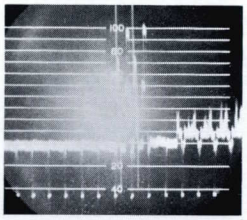


Fig. 9—Two-line test signal displayed at field sweep rate with 25-times sweep magnification. Vertical amplifier is set at FLAT response. (flat from 60 cycles to 5 mc).

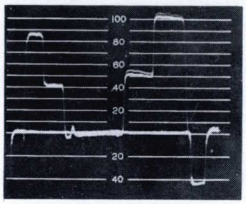


Fig. 11—Same test signal displayed with vertical amplifier switched to LOW PASS response. Sweep duration 70 μsec at half the line rate.

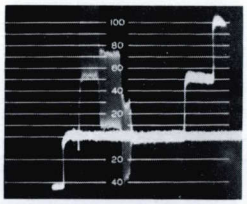


Fig. 10—Same test signal displayed with intensifier turned on. Sweep duration 60 μsec at line rate, vertical amplifier set at FLAT response.

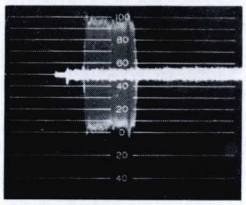


Fig. 12—Cross-modulation check—same test signal displayed with vertical amplifier switched to HIGH PASS response. Shows relative amplifications at the three luminance levels.

Sweep amplifier CF's		6DJ8
Sweep output amplifiers		6DJ8
Power Supplies		
Voltage rectifiers	8	1N1566*
Voltage reference		5651
Comparator		12AT7
Comparator		6U8
Series regulators	2	6080
Series regulator		12B4
High voltage oscillator		6AQ5
High voltage comparator		6U8
High voltage comparator CF		12AT7
Miscellaneous		
Calibrator multivibrator and sync separator CF		6DJ8
Calibrator multivibrator and amplifier		6DJ8
Calibrator clamp and CF		6DJ8
Cathode-ray tube		T52P1

MECHANICAL SPECIFICATIONS

Mounting—Cabinet designed to mount in a relay rack. Chassis slides forward out of the cabinet and tilts up for convenience in servicing.

Shock Mount—High-gain stages of the vertical amplifier are shock mounted to reduce vacuum-tube microphonics.

Ventilation—Safe operating temperature is maintained by filtered, forced-air ventilation.

Construction—Aluminum-alloy cabinet and chassis.

Finish—Photo-etched anodized panel, blue wrinkle-finished cabinet.

Dimensions—8-23/32" high, 19" wide, 20¾" rack depth, 22¼" overall.

Weight: Net—54 pounds
Shipping—73 pounds appr.

Power Requirements—105-125 or 210-250 v, 50-60 cycles, 380 watts.

Type 525 ..... **$1100**

Includes: 1—F510-5 green filter (378-503)
2—75-ohm termination resistors (011-023)
1—3-conductor power cord (161-010)
1—Instruction manual

Optional Phosphors

P1 crt phosphor normally furnished.
P7, P11 optional ..... No extra charge

Special Models

Type 525MOD111—Equipped with intensifier for vertical-blanking-interval test signal. Additional circuitry provides for displaying the two or three lines of the vertical blanking interval that are used to carry transmission test signals. The cathode-ray tube is unblanked only during the test-signal period. Sweep speed is automatically increased to a maximum sweep duration of approximately 60 μsec so that a single line of the test signal can be displayed over the full screen width. Sweep repetition rate is consequently increased to 15.75 kc for maximum brightness. The start of the unblanking period is adjustable between 13 and 21 lines after the beginning of the vertical blanking interval; thus including all lines suitable for carrying test signals.

Type 525MOD111 ..... **$1145**

Prices f.o.b. factory. (Please refer to **Terms and Shipment**, **GENERAL INFORMATION** page.)

MAIN FEATURES

Phase Accuracy—±1.5° by vector presentation, ±1° by null technique.

Phase Resolution—Better than 0.1° at 3.58 mc.

Saturation Measurements—±2% on graticule, closer when comparing two signals.

Interfield Signal Key—Permits easy display of test signals during vertical blanking time.

Linear Time Base—Operates at line rate, synchronized by horizontal sync pulse.

Burst Brightening—Positive identification of burst packet.

Push-Pull Synchronous Demodulators—DC-Coupled to crt.

Self-Checking Circuitry

Subcarrier Regenerator

GENERAL DESCRIPTION

The Tektronix Type 526 Vectorscope greatly reduces the time and effort involved in making extremely-accurate relative phase and amplitude measurements of chrominance information in the N.T.S.C. color signal. Electronically-switched dual signal channels facilitate matching equipment such as encoders, cameras, etc.

The Type 526 presents either a vector display of the demodulated chroma signal, or a display of the demodulated chroma signal on a linear time base. DC-Coupled signal circuits permit monitoring program signals as well as industry test signals such as 75% saturated color bars, interfield test signals, linearity stair step, and the Bell Kelly Set tests for differential phase and amplitude. A built-in subcarrier regenerator facilitates operation remote from the subcarrier source.

VECTOR PRESENTATION

The vector presentation is a graphic display for operational measurements with a color-bar, interfield-test signal, other industry test signals, or with program material. Signal circuits are dc-coupled, preventing changes in chroma signal composition from affecting the positioning of the display.

Through a time sharing arrangement, the signal from an internal 3.59-mc test oscillator can be fed through the signal circuits. This signal will form a circle of controllable amplitude when quadrature-phasing and amplifier-gain-balance controls are properly adjusted, and will match the circle inscribed on the graticule when positioning and test-circle-amplitude controls are properly adjusted. A test circle matched with the graticule circle verifies the accuracy of the vector display. The test circle can also be used to verify the accuracy of the complementary-color relationships. Phase measurements accurate within ±1.5° can be made using the vector display. Accuracy of saturation measurements will be within ±2% on graticule, closer when comparing two signals.

LINEAR-SWEEP PRESENTATION

Phase measurements are simplified by displaying the demodulated chroma signals vertically on a linear horizontal sweep, which is terminated by the horizontal sync pulse and restarts just prior to the burst packet. Using the null technique, differential phase can be measured with an accuracy of ±0.5°. Resolution is 0.1° at 3.58 mc, or 75 psec. A signal magnifier can be used to expand the vertical deflection approximately 5 times.

DUAL DISPLAYS

Two input channels, each with its own gain control, are electronically switched at about a 500-cycle rate permitting the display of two different signals simultaneously for direct comparison.

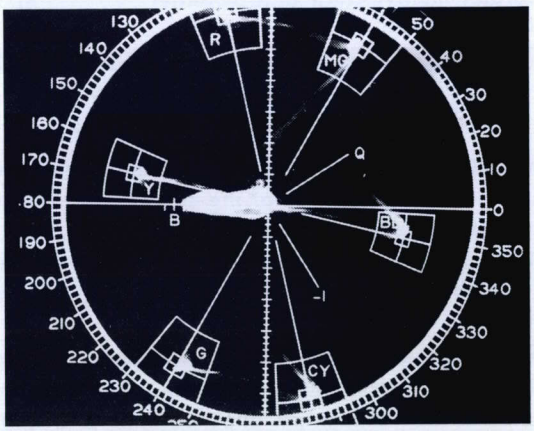


Fig. 1—Vector display of encoder output with 75% saturated color-bar test signal. Test-circle alignment with each other and with scribed graticule circle verifies accuracy of Vectorscope.

COLOR-TELEVISION VECTORSCOPE

When using the vector display, an internally generated reference signal (test circle) can be fed into either channel A or B to calibrate the instrument, or both channel A and channel B signals can be displayed together for comparison measurements. The signal into a portion of the broadcast plant can be compared directly with the signal out to measure any phase and/or amplitude distortion contributed by the equipment. The independent gain controls of each channel of the Vectorscope produce virtually no phase-shift effects, and have a range of over 40 db. Also, the outputs of any

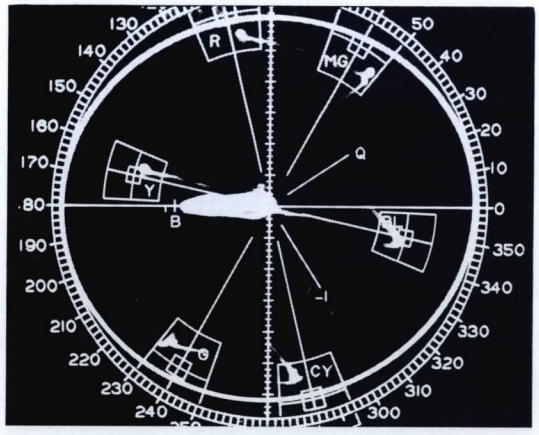


Fig. 2—Same as Fig. 1 except that Vectorscope amplifier-balance control is out of correct adjustment. Test-circle distortion indicates horizontal gain is greater than vertical gain.

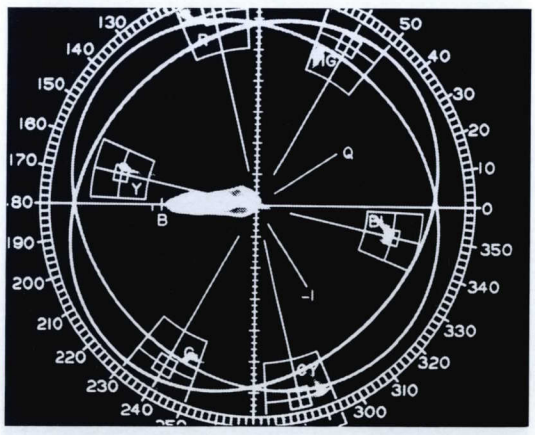


Fig. 3—Same as Fig. 1 except that Vectorscope quadrature control is out of correct adjustment, as indicated by the misalignment of the two test circles. Note red and magenta are displaced in opposite direction to green and cyan.

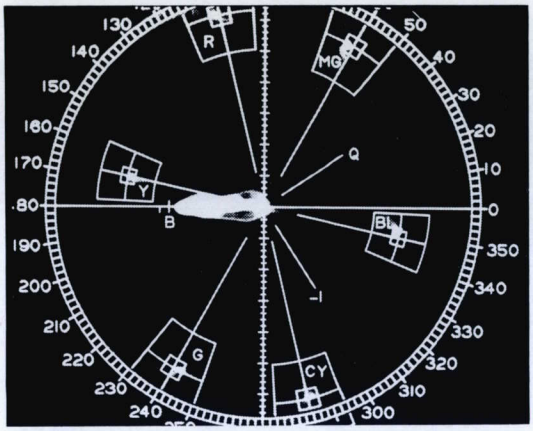


Fig. 4—Output of a well-adjusted encoder displayed on the Vectorscope. The test circle was turned off for this photograph.

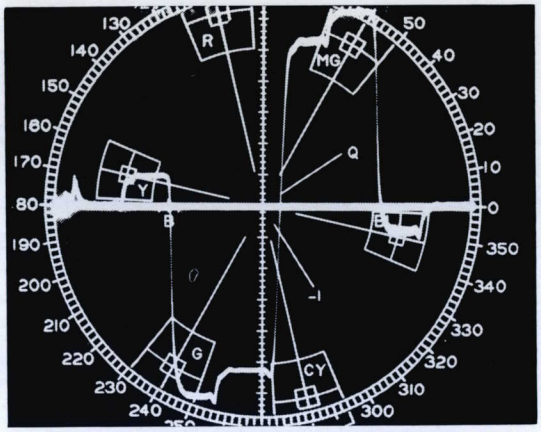


Fig. 5—Demodulated color-bar signal displayed on linear sweep. Burst packet at left end of trace is nulled out, indicating correct phasing of burst at 180°. The signal channel not in use provides a reference trace on the screen at zero signal level.

two portions of the broadcast plant can be directly compared for matching purposes.

Either signal channel can be turned off while the other remains in use, providing a zero reference point in the form of a sharply defined spot in the center of the display. Any drift in the Vectorscope circuits will affect the position of the spot and is therefore easily detected and corrected.

When using the linear-sweep display, turning off one channel while the other remains in use provides a zero reference line against which signals can be nulled. This technique eliminates the possibility of measurement errors due to parallax.

PHASE MEASUREMENT

Phase measurements are made by demodulating the chroma signal with a subcarrier signal which can be shifted in phase relative to burst phase in the signal. High accuracy is obtained with the 20-turn precision calibrated phase shifter. This control is a two-speed illuminated dial with direct readout in degrees and tenths of degrees. It has a range of 0° to 200°, and the 180° point can be verified within the instrument. Random phase shifts in the subcarrier signal due to cable length can be cancelled out with a push-button operated phase-shift network covering 0° to 330° in twelve steps. A fine-phase control (±20°) provides for variable adjustment between steps, and fine phase adjustment when using the burst-controlled oscillator.

INTERFIELD-SIGNAL KEY

When the INTERFIELD SIGNAL KEY Switch is in the ON position, the cathode-ray tube is gated on only

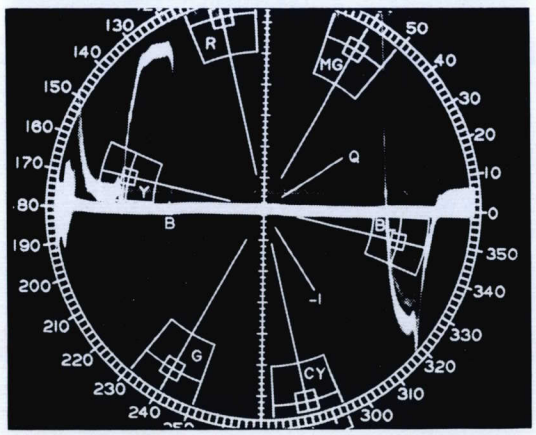


Fig. 6—Same signal as Fig. 5 with Vectorscope vertical magnifier turned on. DC-Coupled system permits detection of subcarrier presence during black and white bars, indicated by departure from zero reference. Need for adjustment of encoder carrier balance is indicated.

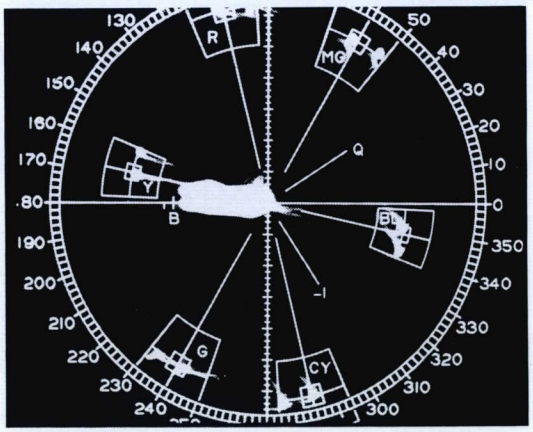


Fig. 7—Dual vector display. Electronic switching of Vectorscope inputs presents signals from two encoders for direct comparison measurements.

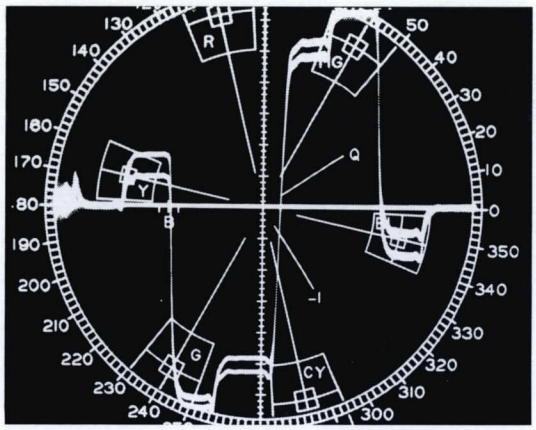


Fig. 8—Line-sweep display of same signals as in Fig. 7. Phase displacement is indicated by difference in amplitude. Note that burst packet from only one encoder is nulled out.

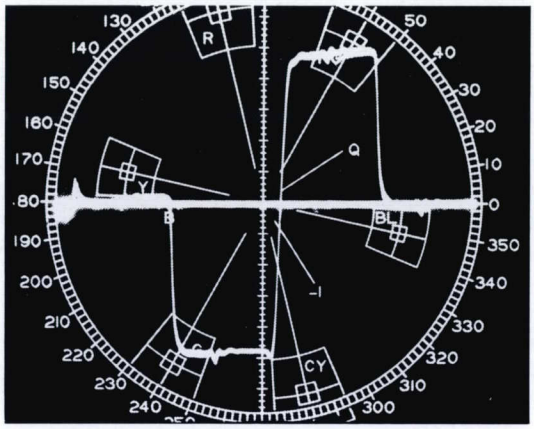


Fig. 9—With blue bar nulled out, its complement, yellow, should also be nulled out. Picture above indicates that either the encoder lacks complementary relationships, or that differential-phase distortion is restored when Y signal is removed, trouble is the latter.

during the 3 or 4 lines occupied by the interfield signal. Video clutter is thus eliminated from the display.

BURST BRIGHTENING

The burst amplifier in the burst-controlled oscillator circuit is keyed on during the first 3 μsec of the linear sweep. During the 3-μsec interval the crt trace is brightened for positive identification of the burst packet. Trace brightening during the burst-sampling interval also facilitates adjustment of burst-amplifier gating.

OTHER CHARACTERISTICS

DC-Coupled Signal Circuits—DC-Coupling from the push-pull synchronous demodulators to the cathode-ray tube prevents changes in chroma signal composition from affecting the positioning of the display, making possible the detection and measurement of color carrier present during blanking time. Carrier-balance corrections can be made even while on the air, because the vector display shows the direction and magnitude of the required adjustments.

Video Inputs—Channel A and channel B inputs are designed for high-impedance loop-through operation and are compensated for 75-ohm line impedance (R= 3.3 megohms, C=10 pf). Input stages are cathode followers. Sufficient gain is provided to allow use of a compensated probe rather than loop-through input.

Composite video, sync negative, 1.0-volt peak-to-peak permits internal synchronization, eliminating the need for a signal at the sync input connector. When using external sync, channels A and B can receive non-composite video or chroma.

Sync Input—1.0-volt sync-negative composite video or negative-going composite sync, 3.5 v to 8 v, can be used. If the interfield-signal keying feature is not re-

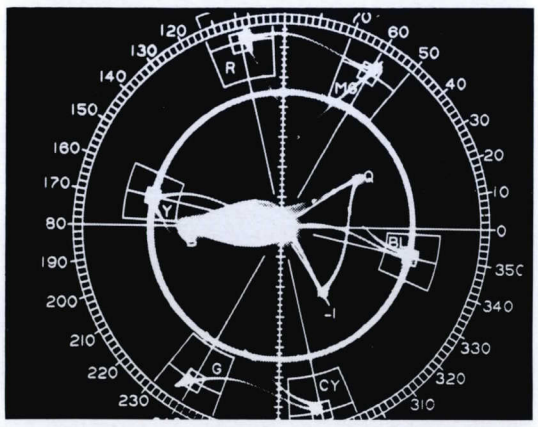


Fig. 10—Test circle adjusted to pass though blue also passes through yellow. If relative amplitudes change as Y signal is switched from off to on, differential-amplitude distortion is present.

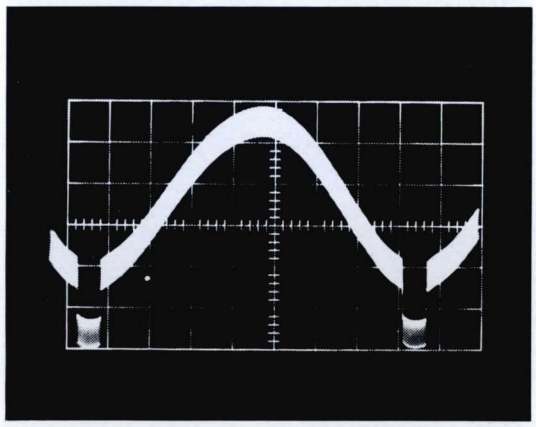


Fig. 11—Oscilloscope display of Bell Kelly Set test signal which is used to measure both differential-phase distortion and differential-amplitude distortion.

quired, horizontal-drive pulses can be used to synchronize the Type 526. Input is high-impedance loop-through type, compensated for 75-ohm line impedance (R=1 megohm, C=25 pf).

External Subcarrier Input—High-impedance compensated loop-through connector for 75-ohm coaxial cable (R=1 megohm, C=20 pf). Input has buffer-amplifier stage and requires a signal level of 2 volts peak-to-peak minimum.

Vertical Signal Output—The demodulated vertical signal is available at a binding post, dc-coupled, for feeding remote indicators.

Trace Intensification Input—A jack (PL-55) is provided for external trace-brightening pulses. Internal blanking circuitry is disconnected when an external signal is being applied. Signal required for trace brightening is an ac-coupled positive-going 20-volt pulse, which can be obtained from the + GATE terminal of any Tektronix Oscilloscope that is being triggered by the vertical-signal output of the Type 526. This type of trace brightening is useful for determining the time limits over which a phase shift is occurring.

Cathode-Ray Tube—A special Tektronix cathode-ray tube, the T526P__, is used in the Type 526. It is a 5" flat-faced monoaccelerator tube with similar vertical and horizontal sensitivities, excellent linearity. Accelerating potential is 4 kv. A P1 phosphor is normally furnished, with P7, and P11 as optional phosphors. Some other phosphors can be furnished on special order.

Regulated Power Supplies—The self-contained low-voltage and crt-high-voltage power supplies are electronically regulated against changes in load and line-voltage fluctuations between 105 and 125 volts or

Accessibility—The Type 526 is designed for standard rack mounting. Chassis attaches to rack with slide-out mounting that permits it to be tilted vertically, providing easy access to all components.

ELECTRON TUBES AND SEMICONDUCTORS

* denotes "or equivalent"

Input Amplifier

Input CF	2	6AU6
Switched amplifier	2	6DB6
Test circle oscillator		2N544*
Burst pickoff amplifier and sync CF		6AU6
Voltage setting diodes	4	T12G*
Switching multivibrator		12AU7
Asymmeteric multivibrator		6DJ8

Sync, Unblanking, and Sweep Generator

Sync amplifier		6AU6
Sync separator		6BA8A
ISK multivibrator clamp and sweep-gating disconnect diodes		6BC7
ISK multivibrator		12AU7
ISK unblanking mixer and CF		6DJ8
Burst-gate generator and CF		6DJ8
Blanking diodes	4	HB5*
Sweep-gating multivibrator and CF		6DJ8
Sweep-gating multivibrator		6BA8A
Miller-runup sweep generator and CF		6AN8

Subcarrier Regenerator and Processing

Burst-gating diodes	4	T12G*
Burst-gating inverter and CF		6DJ8
Burst amplifier		6688
Burst phase detector		6AL5
Burst controlled oscillator		6AU6
External subcarrier isolation amplifier		6AU6
Helidel driver amplifier		6AU6

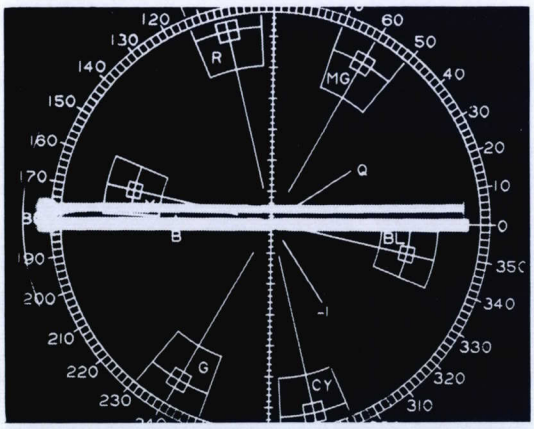


Fig. 12—Line-sweep display of same signal as in Fig. 11 fed directly into Vectorscope, with gain control at maximum and magnifier on. Lower line is reference, upper line is the phase-demodulated 3.58-mc information contained in signal. Lack of differential-phase distortion is evidenced by straight line.

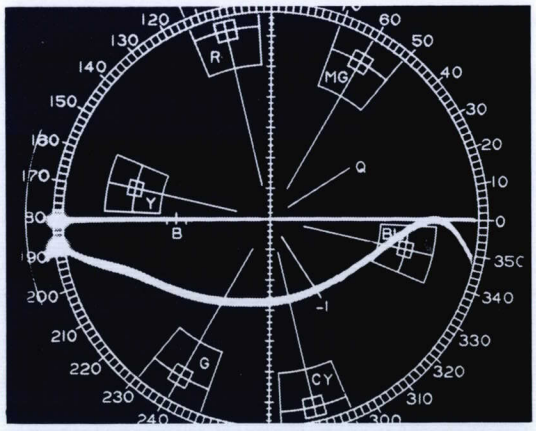
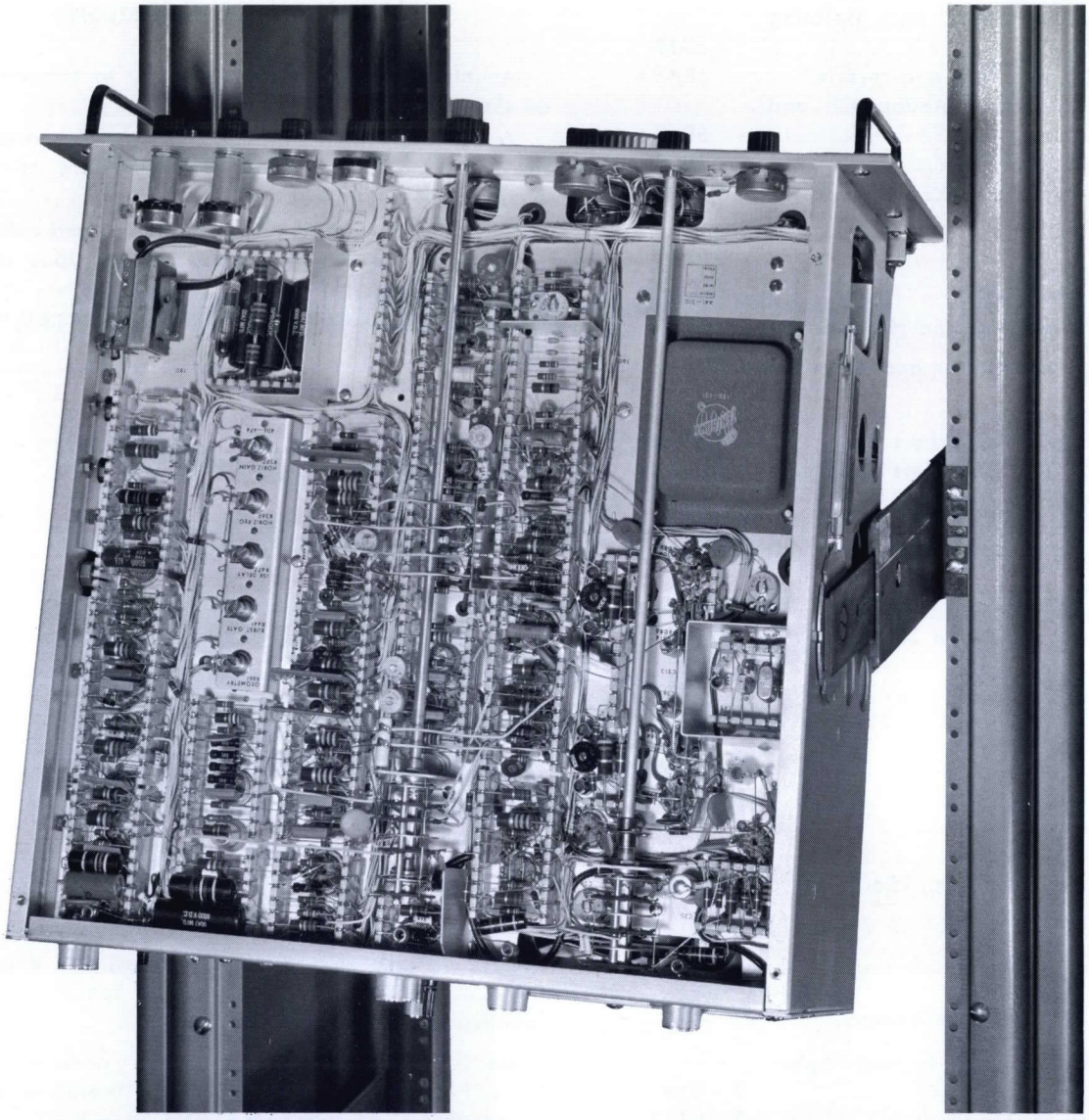


Fig. 13—Same conditions as in Fig. 12 except Bell Kelly Set signal has passed through an amplifier and Vectorscope gain is set at approximately half of maximum with magnifier turned off. Differential-phase distortion contributed by amplifier is measured at 3.1° with the precision phase control of the Type 526.



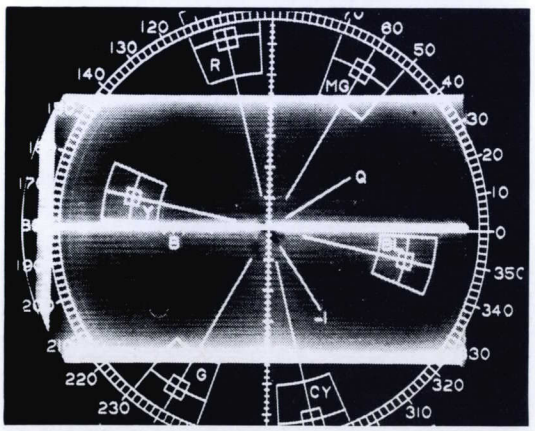


Fig. 14—Vectorscope line-sweep display of Bell Kelly Set signal with asynchronous demodulation (burst-controlled oscillator free running). Gain control is set at approximately half of maximum and magnifier is turned off. Lack of differential-amplitude distortion is evidenced by lack of variation in amplitude.

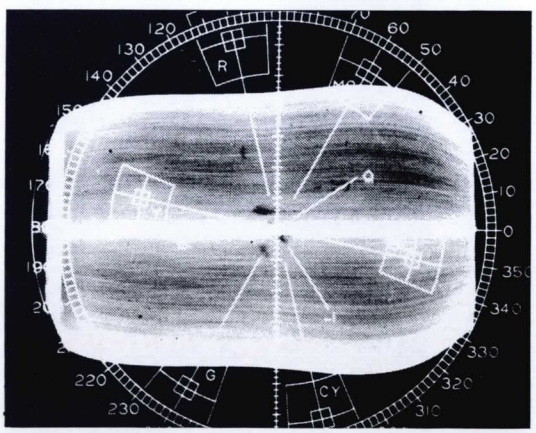


Fig. 15—Same conditions as Fig. 14 except signal has passed through an amplifier. Differential-amplitude distortion contributed by the amplifier is measured at 30% by using maximum amplitude as reference.

TYPE 526

Helidel phase-correcting and isolating amplifier CF's		6DJ8
Subcarrier AGC amplifier and rectifier		6BA8A
Vertical demodulator isolating CF and driver CF		6DJ8
Switcher driver CF		6DJ8
180° switcher		6AR8
Horizontal demodulator isolating and driver CF's		6DJ8

Vertical and Horizontal Demodulator and Amplifier

Vertical demodulators	2	6DB6
Vertical differential amplifiers	2	6AU6
Vertical-out CF and amplifiers	2	6BA8A
Horizontal demodulators	2	6DB6
Horizontal differential amplifiers	2	6AU6
Horizontal-out CF and amplifiers	2	6BA8A

Power Supply

Voltage reference		5651
Voltage rectifiers	12	1N1566*
Series regulators		6DE7
Regulator amplifiers	3	6AU6
Shunt regulators	2	6CW5
Shunt regulators	2	12B4
High-voltage oscillator		6CZ5
High-voltage regulator amplifier		12AU7
High-voltage rectifier		5642
Cathode-ray tube		T526P1

Miscellaneous

Voltage controlled phase-locking capacitors	2	V56*
Voltage-set diode capacitors	3	V56E*

MECHANICAL SPECIFICATIONS

Mounting—Chassis mounts directly to standard rack on slide-out rails.

Ventilation—Self-contained fan provides ample filtered cooling air to keep the instrument at a safe operating temperature.

Construction—Aluminum-alloy chassis and cabinet.

Finish—Photo-etched anodized panel, blue wrinkle-finished cabinet.

Dimensions—8⅝" high, 19" wide, 18½" rack depth.

Weight: Net—45 lbs.
Shipping—71 lbs appr.

Power Requirements—105 to 125 v or 210 to 250 v, 50 to 60 cycles, 340 watts.

Type 526 ..... **$1800**

Includes: 3—75-ohm terminations (011-023)
1—3-conductor power cord (161-010)
1—Pair, guide rails
1—Instruction manual.

Recommended Additional Accessories

Supporting Cradles—for rear slide support when the instrument is to be mounted in a backless rack. Two cradles with necessary mounting hardware.

ORDER PART NO. 426-063 ..... $7.50

EXPORT MODELS

The Type 526MOD158 is engineered for the C.C.I.R. color subcarrier frequency of 4.4296875 mc/sec. The Precision Phase Shift dial reads directly in degrees at the C.C.I.R. frequency. All other specifications are identical to those for the Type 526.

Type 526MOD158 ..... price on request
Prices f.o.b. factory (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page.)

CHARACTERISTIC-CURVE TRACERS

TYPE 570 . . . . . K-2

TYPE 575 . . . . . K-8

5/60

MAIN FEATURES

Displays Family of Curves on CRT Screen

Four to twelve characteristic curves per family.

Plots All Important Characteristics

Plate current against plate or grid voltage.
Screen current against plate or grid voltage.
Grid current against plate or grid voltage.

Positive-Bias Curves

Plots up to 8 positive-bias curves per family.
(up to 12 negative-bias curves)

Calibrated Controls

Accurate current and voltage readings directly from the crt screen.

Wide Display Range

11 current ranges from 0.02 ma/div to 50 ma/div.
9 voltage ranges from 0.1 v/div to 50 v/div.
11 series-load resistors from 300 ohms to 1 megohm.
7 grid-step values from 0.1 v/step to 10 v/step.

GENERAL DESCRIPTION

The Tektronix Type 570 Characteristic-Curve Tracer presents an accurate graphic analysis of electron-tube characteristics under almost any conceivable operating conditions. Circuit design can now be tailored to more closely fit the operating characteristics of available tubes. Tubes can be selected faster and more accurately for circuits requiring other than average electron-tube characteristics. Two-socket arrangement with front-panel switching permits rapid comparisons between two tubes, or two sections of the same tube. You can also make rapid comparisons with preselected curves outlined on a crt mask. Patch-cord connector system with socket-adapter plates gives you complete control of operating-condition setup. Various socket-adapter plates furnished and wide range of heater voltages available fit the requirements of practically all receiving-type electron tubes.

The Type 570 is also an excellent tool for the instructor in electronics, both in the classroom and in the laboratory.

CHARACTERISTIC-CURVE DISPLAYS

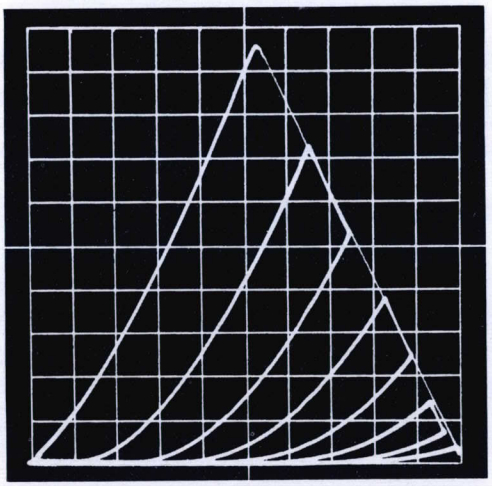


Fig. 1—Plate current plotted against plate voltage for one triode section of a 12AU7. Plate load is 5 k, peak plate-supply voltage is 500 v. Grid voltage is changed 5 v between curves, from —35 v to zero. Vertical sensitivity is 5 ma/div, horizontal sensitivity 50 v/div. Calibrated controls permit accurate current and voltage readings directly from the screen.

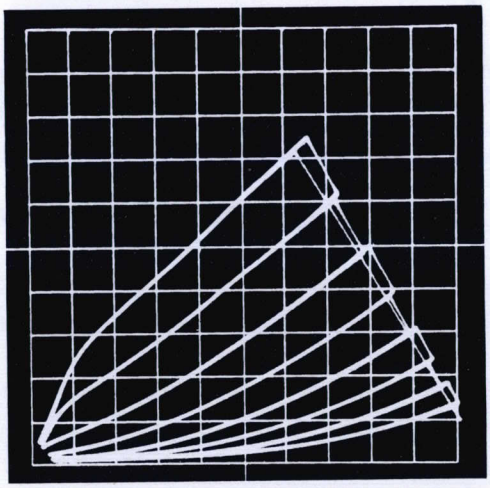


Fig. 2.—Same triode section of 12AU7 with only 20-v peak plate supply and sensitivities increased to 0.2 ma/div vertical and 2 v/div horizontal. Grid voltage is shanged 2 v between curves, from —14 v to zero. This is essentially a 25-times magnification of the lower left portion of Fig. 1, showing the operating characteristics at low plate-supply voltage.

ELECTRON-TUBE-CURVE TRACER

CATHODE-RAY-TUBE DISPLAY

Vertical Axis—Concentric controls provide for selection of plate, screen, or grid current display; and selection of any one of eleven current-per-division values —0.02, 0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, and 50 ma/div. A graticule divides the screen into ten vertical divisions. Calibration accuracy is within 3%, permitting accurate current readings directly from the screen.

Horizontal Axis—Either plate or grid voltage can be displayed on the horizontal axis, and nine voltage-per-division values are available—0.1, 0.2, 0.5, 1, 2, 5, 10, 20, and 50 v/div. Ten horizontal divisions are scribed on the graticule. Calibration accuracy is within 3%, permitting accurate voltage readings directly from the screen.

Positioning—Concentric controls provide for both vertical and horizontal positioning of the display.

CHARACTERISTIC-CURVE DISPLAYS

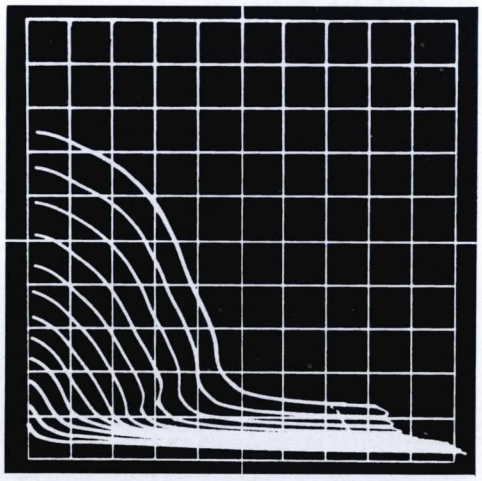


Fig. 3—Screen current plotted against plate voltage with positive grid bias on a 6AQ5. Plate load is 300 ohms, peak plate voltage is 100 v, screen-grid voltage is 100 v, with grid voltage changing 2 v/step from +16 v to below zero. Vertical scale is 10 ma/div, horizontal scale 10 v/div.

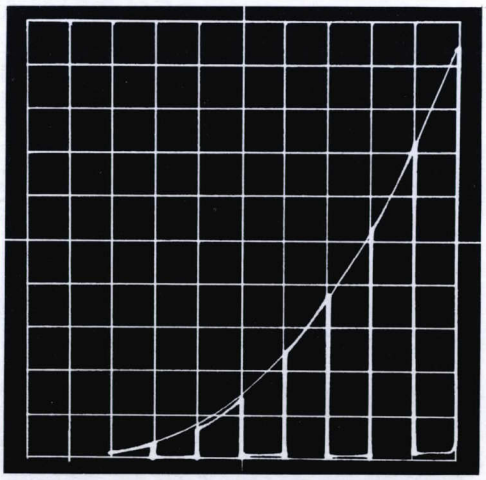
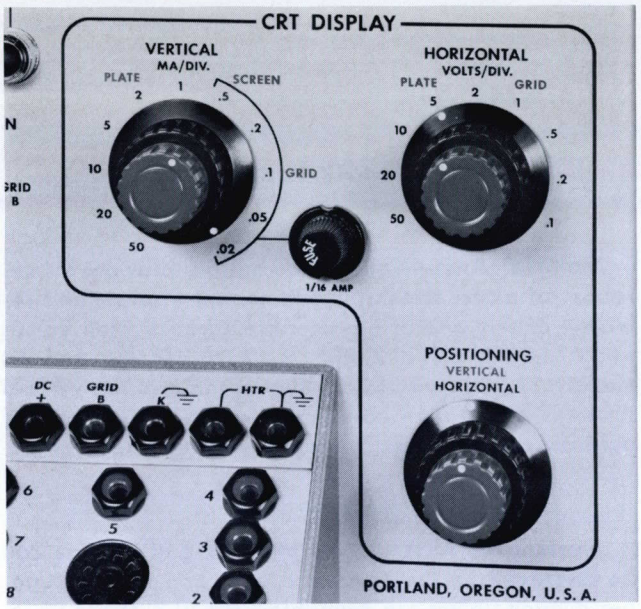


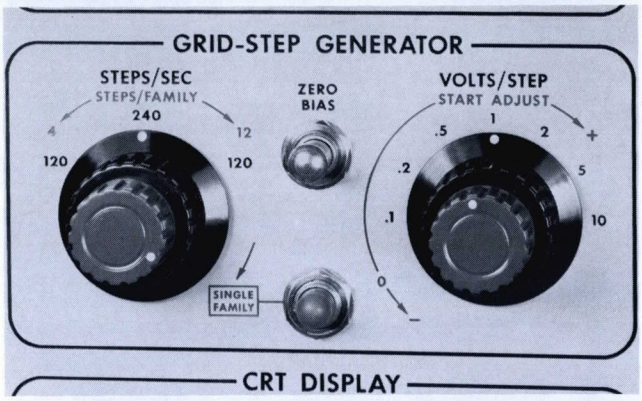
Fig. 4—Typical 12AU7 Eg-Ip curves. Plate load 5 k, peak plate-supply voltage 500 v, grid voltage changing 5 v/step from —35 v to zero, vertical sensitivity 5 ma/div, horizontal sensitivity 5 v/div.



GRID-STEP GENERATOR

Family of Curves—A variable control is provided to adjust the number of curves in the display. As few as four and as many as twelve curves can be selected. A single family can be safely displayed with the tube under heavy overload conditions by means of a position on the STEPS/FAMILY control and a push button. With the STEPS/FAMILY control in the single-family position, pressing the button applies the selected conditions to the tube for only a fraction of second. Use of the SINGLE FAMILY push button permits observation or photography of tube characteristics under unusual conditions without danger of damage to the tube under test.

The STEPS/SEC switch controls the switching-rate of the step generator. A 120 or 240-steps/sec rate can be selected. The extra 120-steps/sec position causes switching to occur at the opposite end of the characteristic curve, for convenience when the area of interest is at



either end of the curves displayed. (When the Type 570 is used with a 50-cycle supply frequency, the step/sec rate will be either 100 or 200.)

Bias voltage applied to the grid of the tube under test is impressed in a series of steps to produce the number of curves desired in the display. The voltage difference between steps is selected by a seven-position switch. Calibrated switch positions are: 0.1, 0.2, 0.5, 1, 2, 5, and 10 volts/step, accurate within 3%. Up to 150 ma peak grid current is available. A variable control is provided to adjust the starting point to a positive voltage, zero, or

CHARACTERISTIC-CURVE DISPLAYS

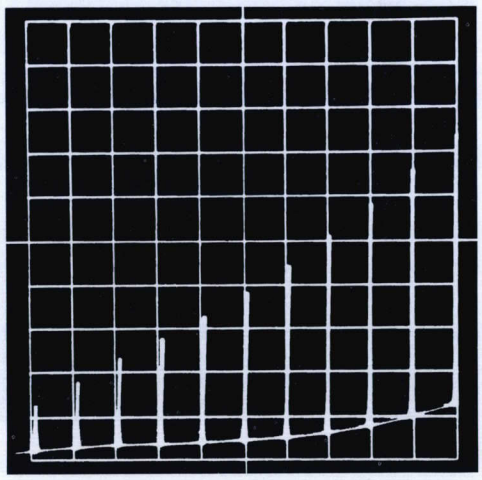


Fig. 5—Another family of curves with positive grid bias. Screen current is plotted against grid voltage. Operating conditions of the 6AQ5 are identical to Fig. 3, except horizontal sensitivity is 2 v/div.

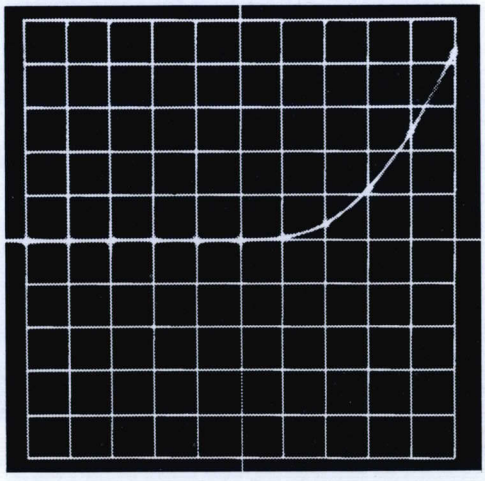
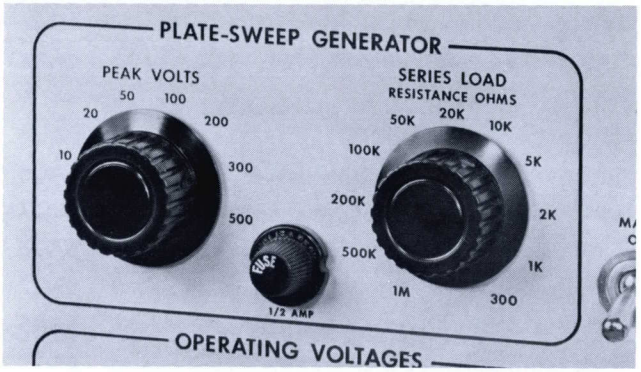


Fig. 6—Typical GERMANIUM DIODE curve. Inherent flexibility of the Type 570 permits accurate evaluation of diode characteristics and detailed examination of any part of the curve. Calibrated scales above are 0.2 v/div horizontal, 0.5 ma/div vertical, with zero points at center of screen.

a negative voltage. Pressing the ZERO BIAS push button causes the display of the zero-bias curve only, to use as a reference in adjusting the starting point. As many as eight positive-bias curves can be included in the display.

PLATE-SWEEP GENERATOR

An eleven-position switch selects the desired series-load resistance for the plate circuit of the tube under test. Series-load values are: 300 ohms, 1 k, 2 k, 5 k, 10 k, 20 k, 50 k, 100 k, 200 k, 500 k, and 1 megohm. Power-handling capacity of all load resistors is sufficient to dissipate the maximum power available in the plate circuit.



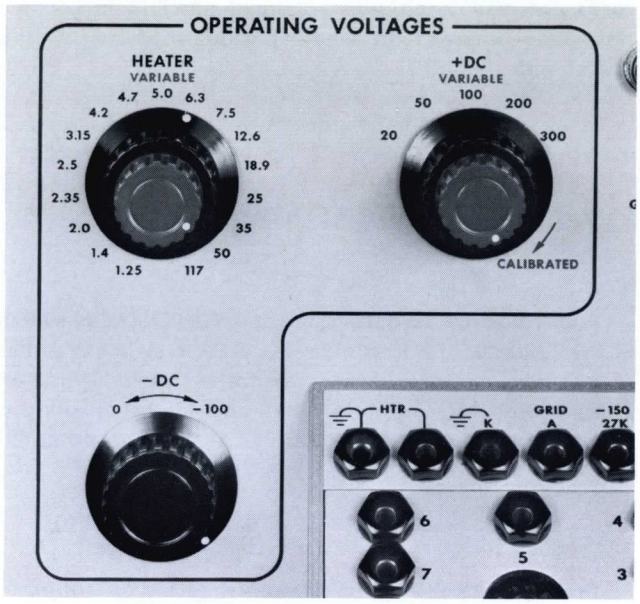
The peak voltage applied to the plate through the series-load resistance is selected by an eight-position switch. Peak voltages are: 5, 10, 20, 50, 100, 200, 300, and 500 volts.

OPERATING VOLTAGES

Heater voltage is available in 17 fixed steps: 1.25, 1.4, 2.0, 2.35, 2.5, 3.15, 4.2, 4.7, 5.0, 6.3, 7.5, 12.6, 18.9, 25, 35, 50, and 117 volts ac. A control permits adjusting the selected heater voltage approximately ±20% for simulating the effects of low or high line voltage. The variable control provides sufficient spread between steps to supply the proper heater voltage for practically all receiving-type vacuum tubes. Maximum power available from the heater transformer is 30 watts.

Positive dc voltage is available in five calibrated steps: 20, 50, 100, 200, and 300 volts, accurate within 3%. The positive voltage is also continuously variable from approximately 10 to 300 v. Up to 50 ma steady current is supplied. An adequate reserve is available for higher peak currents.

Negative dc voltage is available, continuously variable from 0 to —100 v. The negative dc supply is capable of delivering up to 1 watt.

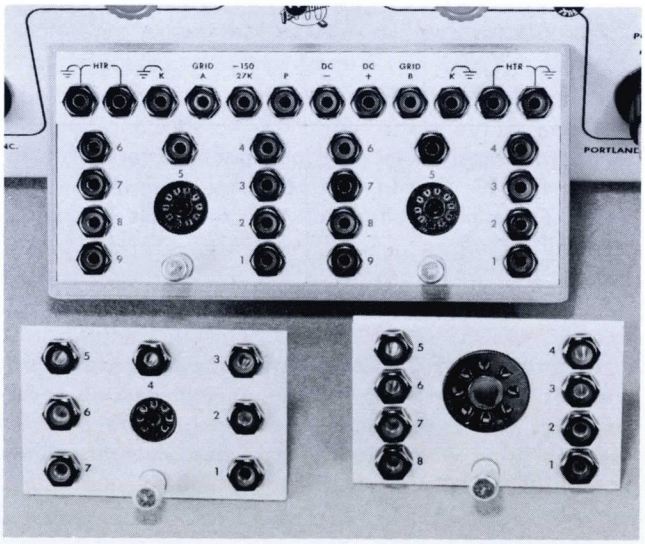


VOLTMETER

The built-in voltmeter indicates the positive and negative operating voltages in seven ranges: 0 to 7, 14, 35, 70, 140, 350, 700 volts. The voltmeter can be switched to show the percent of heater voltage indicated by the heater-voltage selector switch.

ADAPTER PLATES

Eight quick-changing adapter plates are furnished with the Type 570 — 2 with octal sockets, 2 with nine-



pin miniature sockets, 2 with seven-pin miniature sockets, and 2 with pilot holes only. Plate receptacle holds any two adapter plates at the same time. Small banana jacks connect to each socket terminal. Three types of patch

cords are also furnished, making it possible to connect any tube element to any voltage supplied by the instrument.

OTHER FEATURES

Tube-Socket Switching—The TEST POSITION switch in the center of the front panel is used to switch in either of two vacuum tubes during comparison tests. It has an OFF position for changing tubes and for establishing a reference trace on the screen. Control-grid potential drops to —150 v in the off position.

Safety Switch—The extremely flexible operational-setup facility of the Type 570 requires that potentially dangerous voltages be present at the patch panel. All voltages to the patch panel can be removed by a front panel switch for safety and convenience while changing the operation setup. A jewel light indicates when power is present at the patch panel.

Regulated Power Supply—Electronic voltage regulation is used to compensate for line-voltage changes between 105 and 125 volts or 210 and 250 volts, and for variations in loading. All voltages affecting calibrations are fully regulated. Heater, negative-dc, and peak-plate supplies are unregulated.

Cathode-Ray Tube—A Tektronix T52P__ cathode-ray tube is used in the Type 570. Accelerating potential is approximately 4 kv. P1 phosphor is normally supplied. P2, P7, or P11 can be furnished instead if desired. Some other phosphors are available on special order.

Alignment of Cathode-Ray Tube—Should adjustment of the cathode-ray tube alignment become necessary, an easily accessible knob, located on the rear support bracket of the crt, provides smooth positive control of the crt alignment.

Illuminated Graticule—The 10 x 10-division graticule is edge-lighted. Illumination of the graticule is controlled by a front-panel knob.

ELECTRON-TUBE COMPLEMENT

Split-load phase inverters and shaper amplifiers	2	6AN8
Rectifiers	2	6AL5
Cathode follower and step-control CF		12AT7
Clamp and coupling diode		6AL5
Grid-step generator		6AU6
Step-generator cathode followers		12AT7
Step multivibrator		6AN8
Disconnect diodes		6AL5
Step CF and voltage regulator CF		12AX7
Step amplifiers	2	6AU6
Step amplifier		12AT7
Cathode follower		6CL6
Plate power-supply rectifiers	2	6AX4
Rectifier diodes		6AL5
Horizontal-deflection amplifiers	2	6AU6
Horizontal-deflection amplifier CF	2	6AU6
Horizontal-deflection output amplifiers		6BQ7A
Vertical-deflection amplifiers	2	6AU6
Vertical-deflection output amplifiers		6BQ7A
Variable dc-supply rectifier		6AX5
Fixed dc-supply rectifier	4	6X4
Regulator amplifiers	2	6AU6
Voltage reference		5651
Regulator amplifier and series regulator		6AN8
Regulator amplifier		6AN8
Series regulators	2	12B4
Series regulator		6CD6GA
Variable dc-supply CF		12AT7
High-voltage oscillator		6AQ5
Regulator amplifier and CF		12AU7
High-voltage rectifiers	2	5642
Cathode-ray tube		T52P1

MECHANICAL SPECIFICATIONS

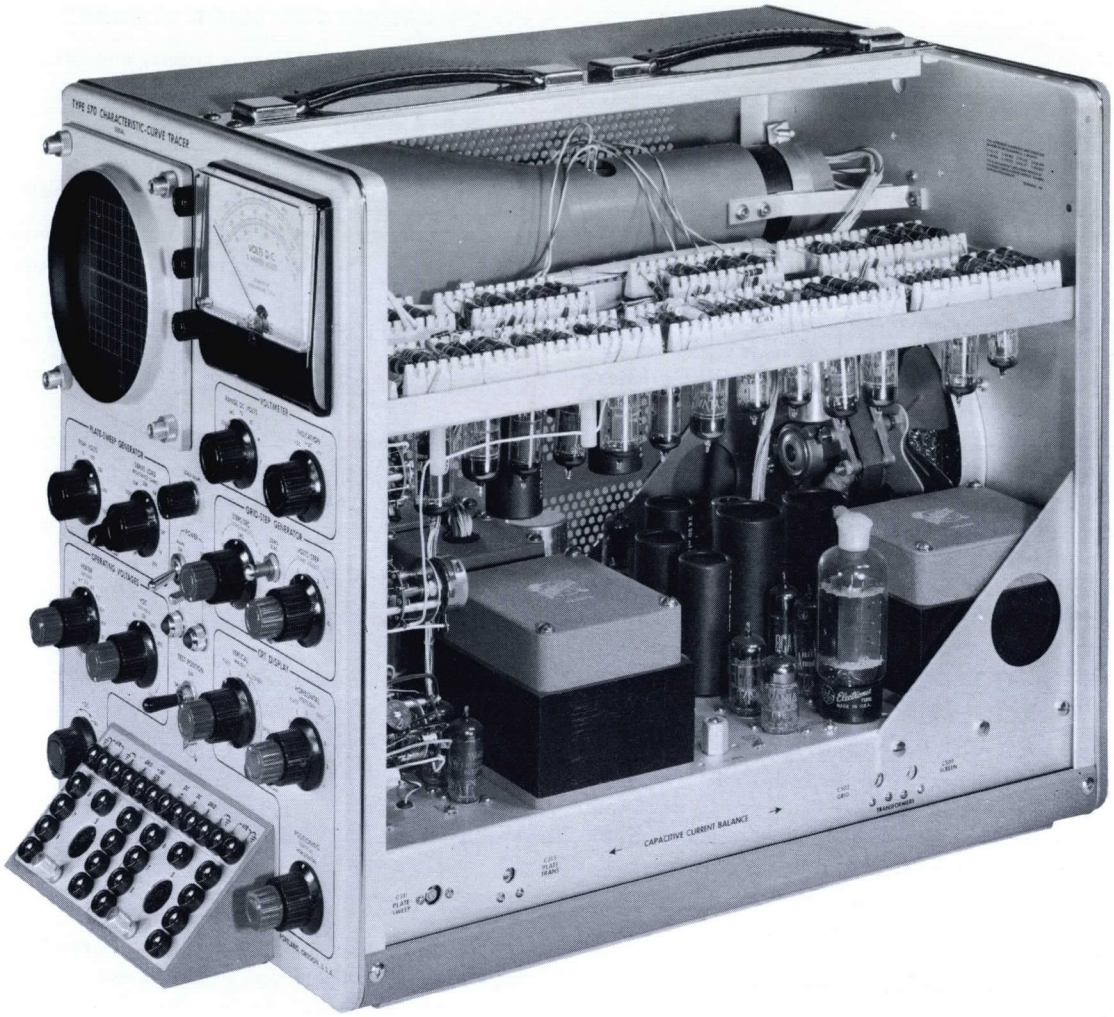
Ventilation—Filtered, forced-air circulation maintains safe operating temperature. A minimum 2" of unobstructed clearance around the instrument is recommended for adequate ventilation.

Construction—Aluminum-alloy chassis and cabinet.

Finish—Photo-etched anodized panel, blue wrinkle-finished cabinet.

Dimensions—16½" high, 13" wide, 24½" deep.

Weight: Net—75 pounds
Shipping—96 pounds appr.



Power Requirements—105-125 or 210-250 v, 50 or 60 cycles, 400 watts maximum, 300 watts standby.

Note: When the Type 570 is used with a 50-cycle supply frequency, the steps/sec rate will be either 100 or 200.

Type 570 ..... **$995**

Includes: 2—7 pin adapter plates (016-004)
2—8 pin adapter plates (016-005)
2—9 pin adapter plates (016-006)
2—Blank adapter plates (016-007)
5—Double patch cords black 6" (012-023)
5—Double patch cords red 6" (012-024)
2—Suppressor cords 100 Ω 6" (012-025)
2—Suppressor cords 300 Ω 6" (012-026)
2—Suppressor cords 1 k 6" (012-027)
5—Single patch cords black 6" (012-028)
5—Single patch cords red 6" (012-029)
5—1/16 amp 3AG Fast-Blo fuses
5—1/2 amp 3AG Fast-Blo fuses
1—6U8 electron tube
1—3-conductor power cord (161-010)
1—Instruction manual

Optional Phosphors

P1 crt phosphor normally furnished.
P2, P7, P11 optional ..... No extra charge

Rack Mount Adapter

A cradle mount to adapt the Type 570 Characteristic-Curve Tracer for rack mounting is available. It consists of a cradle to support the instrument in any standard 19" relay rack and a mask to fit around the regular instrument panel. Tektronix blue wrinkle finish. Rack height requirements 17½".

ORDER PART NO. 040-182 ..... $45.00

Prices f.o.b. factory. (Please refer to **Terms and Shipment**, ***GENERAL INFORMATION*** page.)

MAIN FEATURES

20-AMPERE COLLECTOR DISPLAYS

(10 ampere average supply current).

2.4-AMPERE BASE SUPPLY

Positive or Negative Collector Sweep

Collector supply—0 to 20 v, 10 amperes
—0 to 200 v, 1 ampere.

Positive or Negative Base Stepping

4 to 12 steps/family, repetitive or single family display.

17 current/step positions, 1 μa/step to 200 ma/step.

5 voltage/step positions, with 24 different driving resistances.

Calibrated Display

Vertical Axis—	Horizontal Axis—
Collector current	Base current
Base voltage	Collector voltage
Base current	Base voltage
Base source voltage	Base source voltage

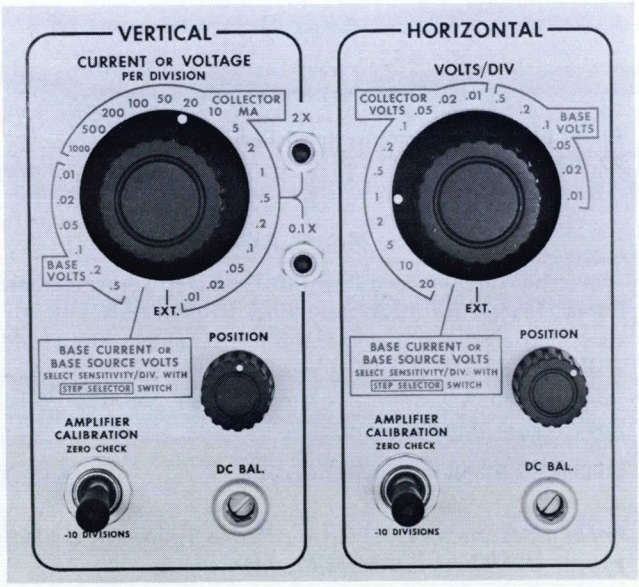
GENERAL DESCRIPTION

The Tektronix Type 575 traces characteristic curves for both PNP and NPN transistors on the face of a cathode-ray tube. Equal steps of current, or equal steps of voltage, are applied to the transistor input. The voltage applied to the collector is swept from zero to a selected value on each input step. Seven different transistor characteristics are accurately plotted for examination and measurement. Vertical deflection is calibrated for collector current, base voltage, base current, and base source voltage. Horizontal deflection is calibrated for collector voltage, base voltage, base current, and base source voltage. The number of steps per family is adjustable from 4 to 12, and the step/sec rate is 120 or 240. A repetitive display or a single family can be presented. Dissipation limiting resistors can be switched into the collector supply circuit. When equal steps of voltage are in use, series resistors can be switched into the step output circuit.

Plug-in transistor receptacles are furnished with the Type 575 for convenience in rapid comparison testing. Two receptacles for transistors with long leads, and two receptacles for transistors with pin connectors plug directly into the binding posts on the test panel.

CATHODE-RAY-TUBE DISPLAY

Vertical Axis—A 24-position switch provides for selection of collector current, base voltage, base current, or base source voltage. Calibrated vertical deflection in current-per-division for collector current is selected from sixteen of the switch positions, 0.01 ma/div to 1000 ma/div. Pushbuttons are provided for multiplying each current step by 2 and dividing by 10, increasing the current range to 0.001 to 2000 ma/div. Calibrated vertical deflection in volts-per-division for base voltage is selected from six other positions of the switch, 0.01 v/div to 0.5 v/div. Another position of the switch provides for vertical deflection by base current or base source voltage. Calibrated vertical deflection for base current and base source voltage is selected with the STEP SELECTOR switch.



Vertical Axis—A 24-position switch provides for selection of collector current, base voltage, base current, or base source voltage. Calibrated vertical deflection in current-per-division for collector current is selected from sixteen of the switch positions, 0.01 ma/div to 1000 ma/div. Pushbuttons are provided for multiplying each current step by 2 and dividing by 10, increasing the current range to 0.001 to 2000 ma/div. Calibrated vertical deflection in volts-per-division for base voltage is selected from six other positions of the switch, 0.01 v/div to 0.5 v/div. Another position of the switch provides for vertical deflection by base current or base source voltage. Calibrated vertical deflection for base current and base source voltage is selected with the STEP SELECTOR switch.

A vertical-position control and an amplifier-zero-check switch are provided.

Horizontal Axis—A 19-position switch provides for selection of base voltage, collector voltage, base current, or base source voltage. Calibrated horizontal deflection in volts-per-division for base voltage is selected from six switch positions, 0.01 v/div to 0.5 v/div. Calibrated deflection for collector voltage is selected from eleven other positions, 0.01 v/div to 20 v/div. Another switch position provides for horizontal deflection by base current or base source voltage. Calibrated horizontal deflection for base current and base source voltage is selected with the STEP SELECTOR switch.

A horizontal-position control and an amplifier-zero-check switch are provided.

TRANSISTOR-CURVE TRACER

BASE STEP GENERATOR

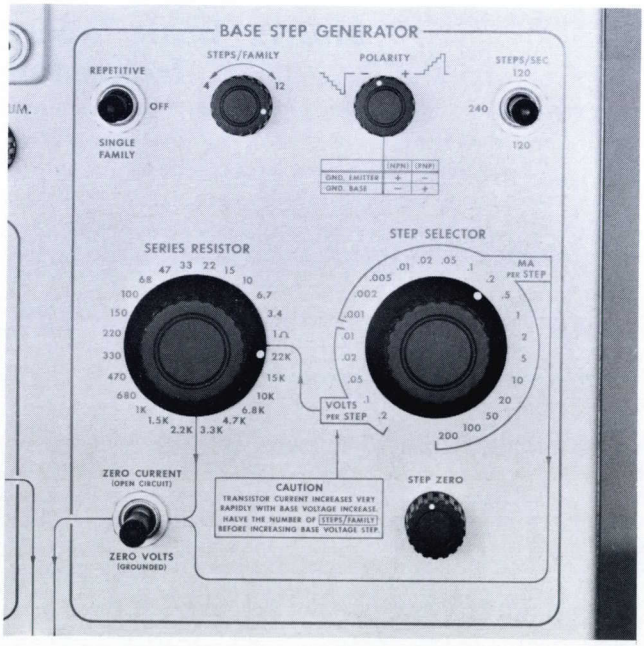
The Type 575 step generator produces input steps of constant current from 0.001 ma/step to 200 ma/step, and input steps of constant voltage from 0.01 v/step to 0.2 v/step with a source impedance of one ohm. A polarity switch provides for stepping the input in either the positive or negative direction. The number ot steps per family is adjustable from 4 to 12, and a repetitive or single-family display can be presented. Either a 120-steps/sec or 240-steps/sec repetition rate can be selected. (When the Type 575 is used with a 50-cycle supply frequency, the step/sec rate will be either 100 or 200.) A switch is provided for grounding the transistor input for a zero voltage reference check, and opening the transistor input for a zero current reference check. The starting point of input current or voltage steps can be adjusted with the STEP ZERO control.

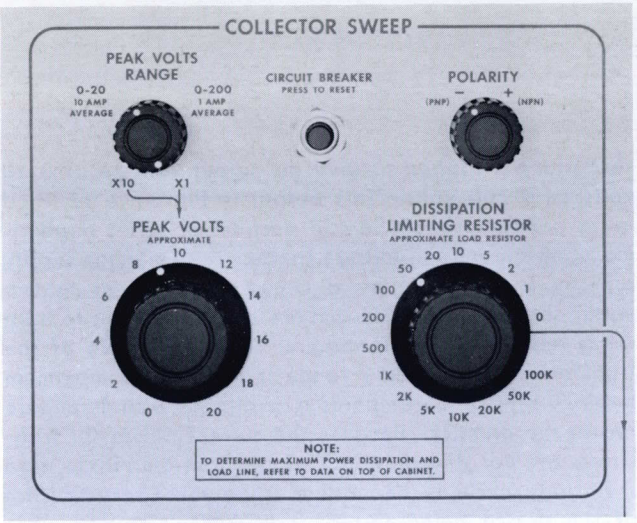
When constant-voltage input steps are in use a resistance is inserted in series with the one-ohm source impedance of the step generator. This driving resistance can be selected from 23 values, 3.3 ohms to 22 kilohms.

COLLECTOR SWEEP

The collector supply of the Type 575 consists of a variable transformer driving a power transformer whose secondary is tapped to give an output voltage of 0-20 volts or 0-200 volts. This output is full-wave rectified using germanium rectifiers in parallel or series depending upon the output-voltage range. The collector-supply primary is protected by a circuit breaker, set to trip within 30 seconds at 1.2 ampere rms current but to hold on a rms current of 1 ampere. The turns ratio of the transformer for the 20-v range is such that a maximum peak current of 15 amperes is available with 1 ampere rms in the primary. Because the current pulses for transistors are not sinusoidal nor of constant amplitude, and their duty cycle is dependent upon the characteristics of the device being tested, it is difficult to say what maximum collector-current curves can be plotted. Generally, a family of collector-current curves can be plotted to 20 amperes or more when the transistors have a beta of 8 or greater. When checking diodes the waveform of the current pulses is such that a curve of about 15 amperes maximum can be drawn.

The voltage applied to the collector is swept to a selected value on each input current or voltage step. A polarity switch provides for sweeping the collector voltage in either the positive or negative direction. Peak collector voltage is continuously adjustable from zero to 20 v, and from zero to 200 v. Maximum average current is 10 amperes on the 0-to-20 v range, 1 ampere on the 0-to-200 v range. Any of fifteen load resistors from 0.35 ohm to 100 kilohms can be inserted for limiting collector dissipation.





OTHER FEATURES

Input Selection—A switch is provided for changing the test conditions from the common-emitter to the common-base configuration.

Comparison Tests—Two transistors can be rapidly compared by switching the test conditions from one to the other.

Regulated Power Supply—Electronic voltage regulation is used to compensate for line-voltage changes between 105 and 125 volts or 210 and 250 v, and for variations in loading. All voltages affecting calibrations are fully regulated.

Cathode-Ray Tube—A Tektronix T52P__ cathode-ray tube is used in the Type 575. Accelerating potential is approximately 4 kv. P1 phosphor is normally supplied. P2, P7, or P11 can be furnished instead if desired. Some other phosphors are available on special order.

Alignment of Cathode-Ray Tube—Should adjustment of the cathode-ray tube alignment become necessary, an easily accessible knob, located on the rear support bracket of the crt, provides smooth positive control of the crt alignment.

Illuminated Graticule—The 10 by 10-division graticule is edge-lighted. Illumination, focus, intensity and astigmatism controls are conveniently located on the front panel.

MECHANICAL SPECIFICATIONS

Ventilation—Filtered, forced-air circulation maintains safe operating temperature. A minimum 2" of unobstructed clearance around the instrument is recommended for adequate ventilation.

Construction—Aluminum-alloy chassis and three-piece cabinet.

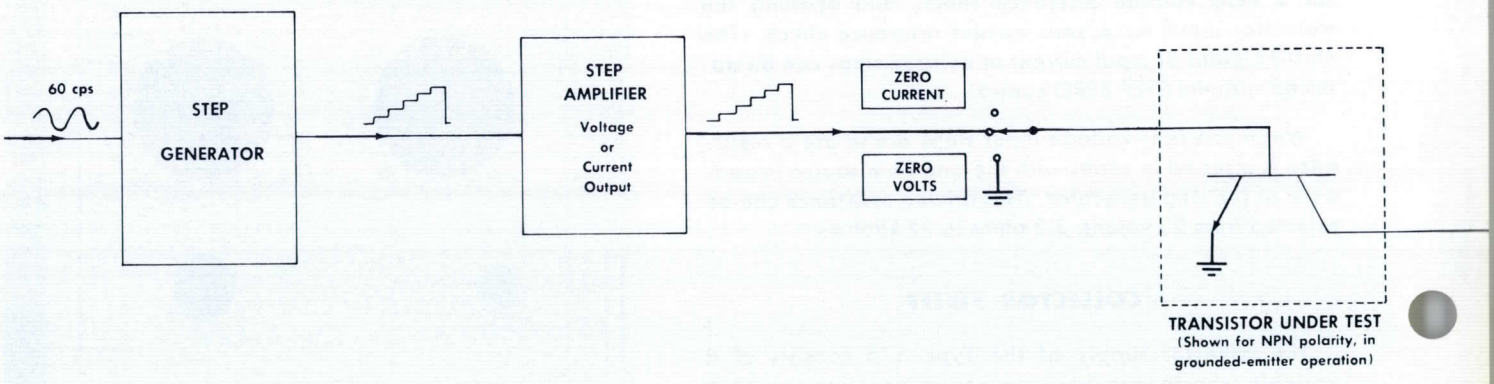
Finish—Photo-etched anodized panel, blue wrinkle-finished cabinet.

Dimensions—24" long, 13" wide, 16¾" high.

Weight: Net—70 pounds
Shipping—84 pounds appr.

Power Requirements—105-125 or 210-250 volts, 50-60 cycles, 410 watts maximum, 220 watts standby.

SIMPLIFIED BLOCK DIAGRAM
Shows basic operation of the Type 575 Transistor-Curve Tracer.



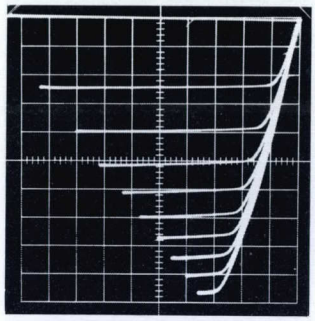


Fig. 1 — PNP Transistor
Collector current vs collector voltage with constant-current base steps. Collector sweep is 0 to 5 v with a 0.25-ohm load, base current is 50 ma/step. Vertical deflection is 1000 ma/div, horizontal deflection 0.5 v/div.

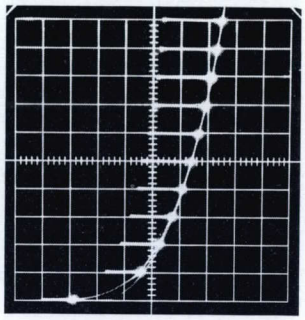


Fig. 2 — NPN Transistor
Base current vs base voltage with constant-current base steps. Collector sweep is 0 to 1 v, base current 0.1 ma/step. Vertical deflection is 0.1 ma/div, horizontal deflection 0.05 v/div. Dots represent equal increments of base current. Dynamic base impedance can be determined from this display.

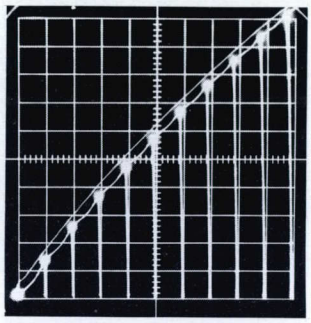


Fig. 3 — NPN Transistor
Collector current vs base current with constant-current base steps. Collector sweep is 0 to 1.5 v, base current 0.1 ma/step. Vertical deflection is 5 ma/div collector current, horizontal deflection 0.1 ma/div base current. Incremental and dc current gain can be determined from this display.

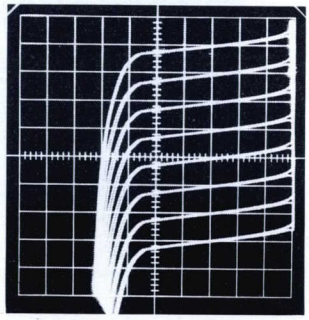


Fig. 4 — PNP Transistor
Collector current vs collector voltage with base grounded and constant-current emitter steps. Collector sweep is 0 to 120 v through a 5 k load resistor, emitter current 1 ma/step. Vertical deflection is 1 ma/div, horizontal deflection 10 v/div.

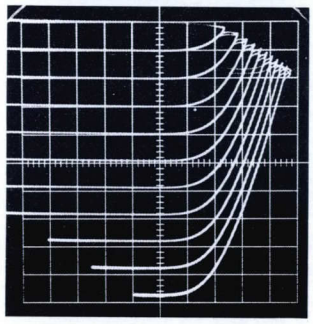
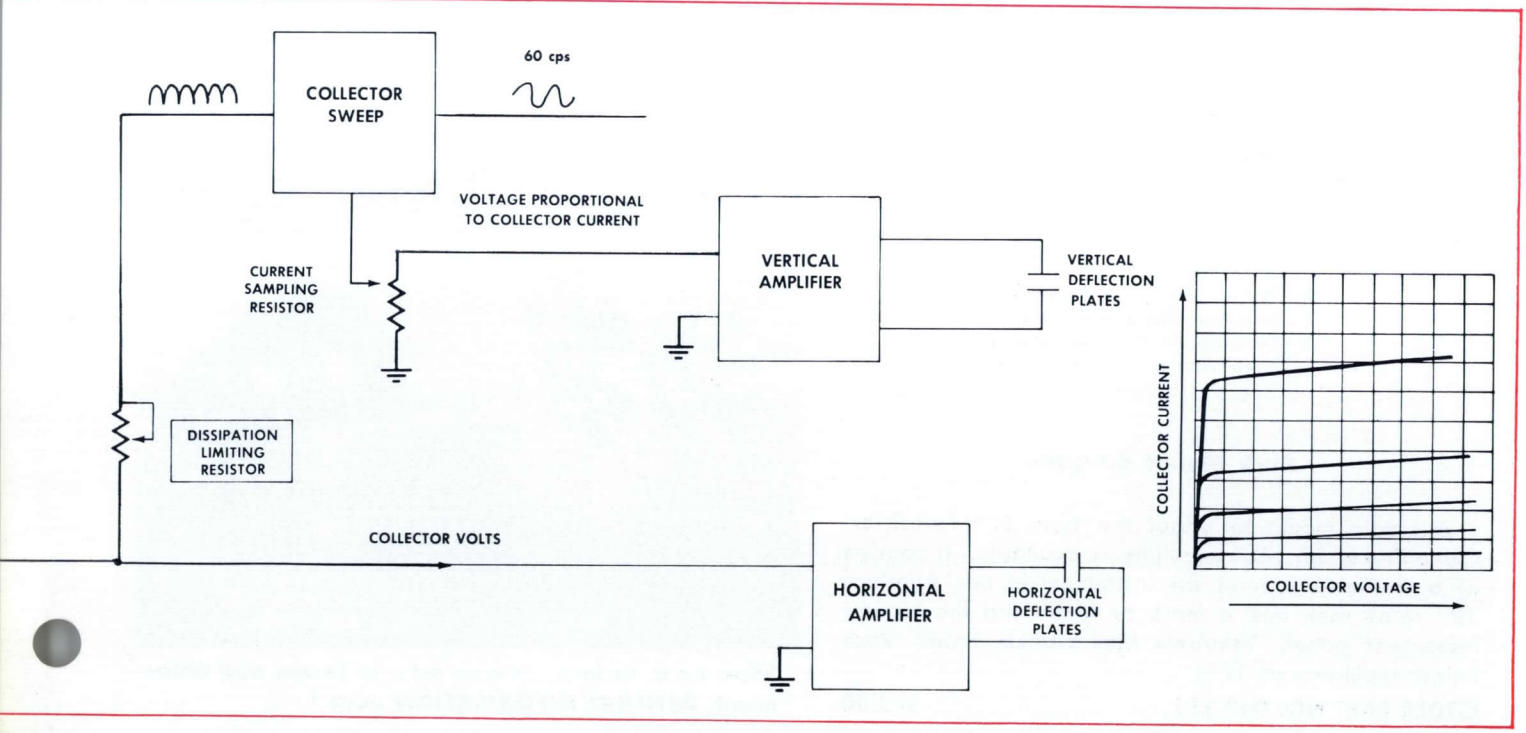


Fig. 5 — PNP Transistor
Collector current vs collector voltage with base grounded and constant-current emitter steps. Collector sweep is 0 to 1.5 v, emitter current 200 ma/step. Vertical deflection is 200 ma/div, horizontal deflection 0.1 v/div.



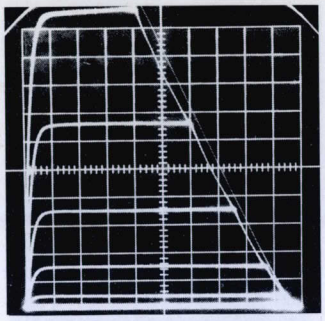


Fig. 6 — NPN Transistor

Collector current vs collector voltage with constant-voltage base steps. Collector sweep is 0 to 2 v, base voltage 0.02 v/step, vertical deflection is 5 ma/div, horizontal deflection 0.2 v/div.

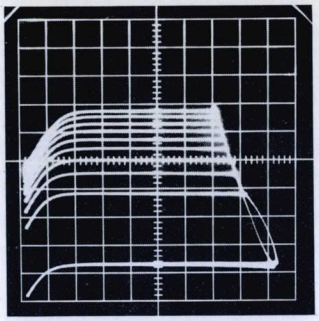


Fig. 7 — NPN Transistor

Base voltage vs collector voltage with constant-current base steps. Collector sweep is 0 to 1 v, base current 0.1 ma/step. Vertical deflection is 0.05 v/div base voltage, horizontal deflection 0.1 v/div collector voltage.

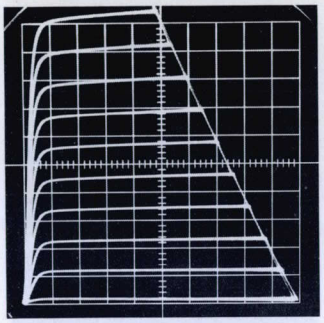


Fig. 8 — NPN Transistor

Collector current vs collector voltage with constant-current base steps. Collector sweep is 0 to 2 v, base current 0.01 ma/step. Vertical deflection is 0.5 ma/div, horizontal deflection 0.2 v/div.

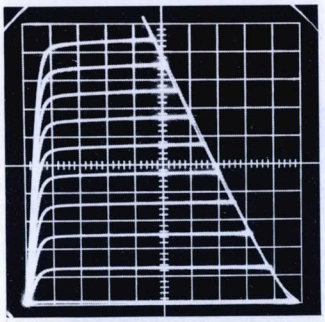


Fig. 9 — NPN Transistor

Same as Fig. 8 except base-current steps are 0.1 ma/step and vertical deflection is 5 ma/div.

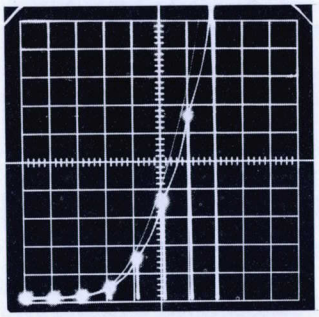


Fig. 10 — NPN Transistor

Collector current vs base voltage with constant-voltage base steps. Collector sweep is 0 to 1.5 v, base voltage 0.05 v/step with a 1-ohm source impedance. Vertical deflection is 0.5 ma/div, horizontal deflection 0.05 v/div.

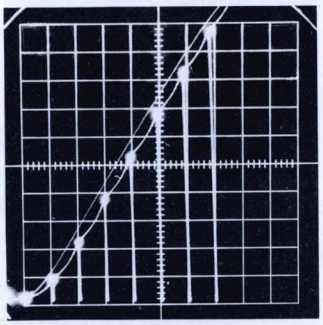


Fig. 11 — NPN Transistor

Same as Fig. 10 except base-voltage steps are 0.1 v/step with a 470-ohm source impedance.

Note: When the Type 575 is used with a 50-cycle supply frequency, the step/sec rate will be either 100 or 200.

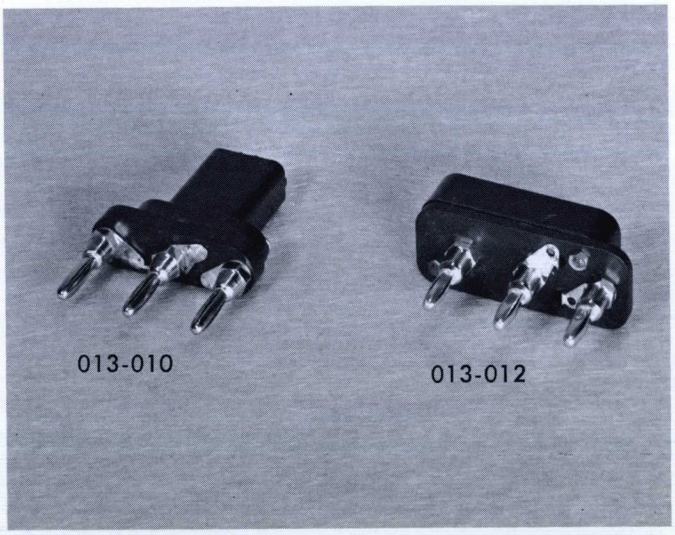
Price **$975**

Includes: 1—Green filter (378-503)
2—2N1381 Transistors (151-039)
2—Long-lead transistor receptacles (013-010)
2—Short-lead transistor receptacles (013-012)
1—3-conductor power cord (161-010)
1—Instruction manual

Rack Mount Adapter

A cradle mount to adapt the Type 575 Transistor-Curve Tracer for rack mounting is available. It consists of a cradle to support the instrument in any standard 19" relay rack and a mask to fit around the regular instrument panel. Tektronix blue wrinkle finish. Rack height requirements 17½".

ORDER PART NO. 040-182 . . . . . $45.00



Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page.)

SQUARE-WAVE AND PULSE GENERATORS

TYPE 105 ..... L-2

TYPE 107 ..... L-4

TYPE 110 ..... L-6

TYPE 111 ..... L-8

6/60

MAIN FEATURES

Risetime

Less than 20 nsec into a terminated 93-ohm cable. As short as 13 nanoseconds under suitable conditions.

Frequency Range

25 cycles to 1 mc, continuously variable.

Frequency Meter

Direct reading, accurate within 3% of full scale.

Maximum Output

15 v, approximately, into 93-ohm cable.
More than 160 ma, peak-to-peak.

GENERAL DESCRIPTION

The Tektronix Type 105 Square-Wave Generator produces square waves with flat horizontal portions, free of overshoot and ringing, over a wide frequency range. Square-wave current greater than 160 ma, peak-to-peak, available at the output terminal, permits a useable voltage swing across very-low impedance loads. Risetime is less than 20 nsec into a terminated 93-ohm cable, and is approximately 13 nanoseconds into a 52-ohm cable terminated at both ends.

Testing wide-band amplifiers with a square-wave generator and an oscilloscope is a fast, efficient method both in the laboratory and in the television station. Such characteristics as transient response, bandwidth, and phase shift are quickly revealed. For examination of the high-frequency response a square wave having a risetime faster than that of the amplifier being tested is required. In addition, the test signal must be free of overshoot and ringing. For examination of the low-frequency response a square wave having flat horizontal portions is required. The Tektronix Type 105 Square-Wave Generator provides a suitable signal for both of these tests, making it possible to quickly and accurately test amplifiers, filters, etc., having passbands from a few cycles to 20 mc.

For an excellent discussion on the connection between bandwidth and frequency response, composition of risetime and other details associated with square wave testing, see Vol. 18, Radiation Laboratory Series, "Vacuum Tube Amplifiers" (McGraw-Hill).

CHARACTERISTICS

Frequency Range—The frequency range is 25 cycles to 1 mc, continuously variable, in nine ranges—100, 250 cycles, 1, 2.5, 10, 25, 100, 250 kc, and 1 mc. Frequency is read directly on a meter accurate within 3% of full scale.

Risetime—Less than 20 nsec into a terminated 93-ohm cable; approximately 18 nanoseconds when the 93-ohm cable is terminated at both ends; approximately 13 nanoseconds into a 52-ohm cable terminated at both ends. For higher output voltages larger output impedances can be used, with a corresponding increase in risetime.

Output Amplitude—The output voltage is adjustable from 10 to 100 v across the internal 600-ohm load. The maximum square-wave current available at the output is greater than 160 ma (peak-to-peak). With a 75-ohm terminated output coaxial cable, the maximum voltage available is approximately 12 volts; with a 93-ohm cable, approximately 15 v.

Sync Terminals—Provision is made to furnish an output synchronizing signal whose amplitude is independent of the square-wave output-control setting. A sync-input terminal permits the square wave to be synchronized with a frequency standard.

Regulated Power Supply—Electronically-regulated dc supplies insure stable operation over line variations of 105-125 v, 210-250 v.

ELECTRON-TUBE COMPLEMENT

Multivibrator	2	6CB6

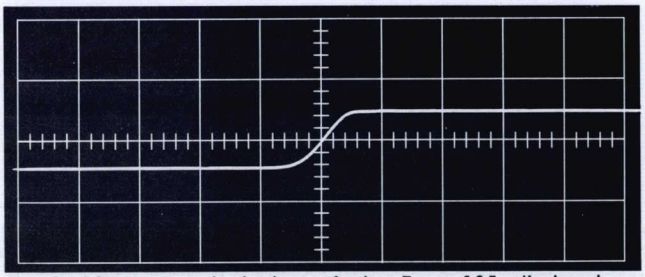
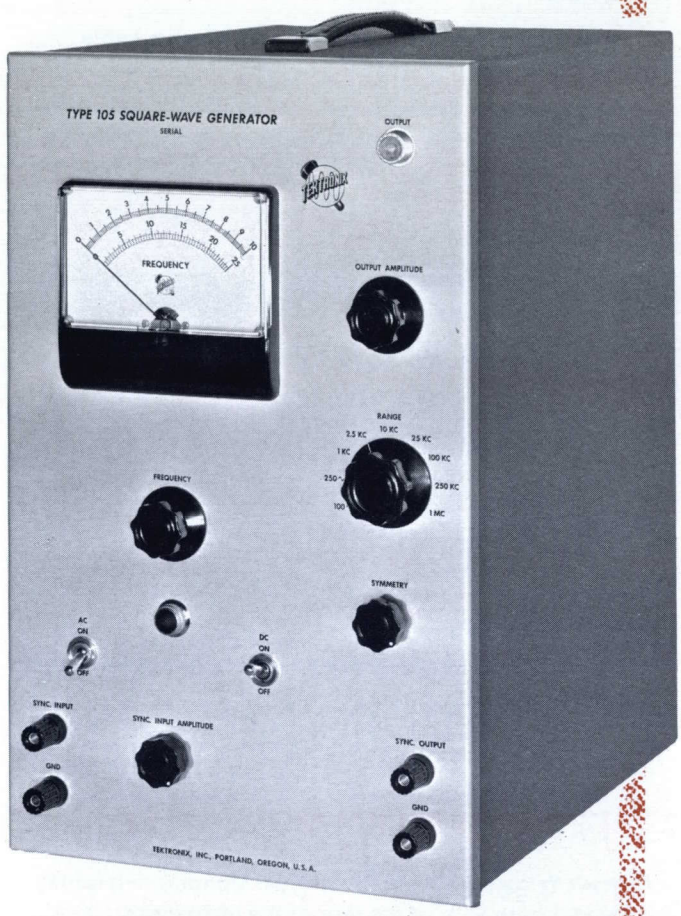


Fig. 1. 13-nanosecond risetime of the Type 105 displayed on 20 nsec/cm sweep. Generator connected to vertical deflection plates of T54P crt, sensitivity 7 v/cm, with 52-ohm cable terminated at both ends.

SQUARE-WAVE GENERATOR



Shaper amplifier		6AG7
Driver amplifier	2	6AG7
Output amplifier	3	6AG7
Sync input amplifier		6CB6
Sync coupling diode		6AL5
Meter amplifier		6CB6
Limiter and catching diode		6AL5
Cathode follower voltage regulator		6J6
Meter amplifier		6AL5
Sync output CF		6J6
Voltage reference		5651

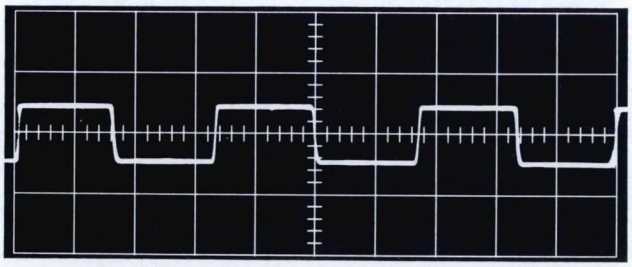


Fig. 2. Sharp leading edge, square corner, and flat top of 1-mc square-wave output of Type 105 displayed on 0.3 μsec/cm sweep Other conditions same as in Fig. 1.

Rectifiers	4	5V4G
Regulator amplifiers	2	6AU6
Series regulators	4	6AU5

MECHANICAL SPECIFICATIONS

Ventilation—Forced-air ventilation assures safe operating temperature. A minimum of 2" of unobstructed clearance around the instrument is recommended for adequate ventilation.

Construction—Aluminum-alloy chassis and cabinet.

Finish—Photo-etched andized front panel, blue wrinkle-finished cabinet.

Dimensions—16½" high, 10⅛" wide, 14⅞" deep.

Weight: Net 37 pounds
Shipping—49 pounds approx.

Power Requirements—105-125 v or 210-250 v, 50-60 cycles, 250 watts.

Price **$395**

Includes: 1—P93, 93-ohm 42" coaxial cable (012-004)
1—B93-R, 93-ohm terminating resistor (011-011)
1—Binding-post adapter (013-004)
1—3-conductor power cord (161-010)
1—Clip-lead adapter (013-003)
1—Instruction manual

Currently Available Extras

93-ohm cable and resistor normally furnished.
If specified on purchase order, 52-ohm cable and resistor or 75-ohm cable and resistor will be supplied instead of 93-ohm cable and resistor. . . . no extra charge.

Recommended Additional Accessories

When a Type 105 is used to check the transient response of the Type 513D Vertical Amplifier, the following accessories should be used to interconnect the two instruments.

1—P52, 52-ohm 42" coaxial cable $4.00

1—B52-R, 52-ohm terminating resistor 8.50

1—B52-L5, 52-ohm "L" attenuator, 5:1 ratio . . . 8.50

1—B52-T10, 52-ohm "T" attenuator, 10:1 ratio 11.50

A selection of terminating resistors, attenuators, and coaxial cables designed to be used with the Type 105 will be found in the Accessory Section of this catalog. Within certain technical limits, special terminating resistors and attenuators can be supplied upon request.

Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).

MAIN FEATURES

Risetime

Less than 3 nsec into a terminated 52-ohm cable.

Frequency Range

Approximately 400 kc to 1 mc, uncalibrated.

Output Voltage

0.1 to 0.5 v, approximately, when cable is terminated in 52 ohms.

GENERAL DESCRIPTION

The Tektronix Type 107 Square-Wave Generator is basically intended as a Test Accessory for Type 540-Series and Type 550-Series Oscilloscopes. For examination of high-frequency response, a square wave having a risetime faster than that of the amplifier being tested is necessary. The Type 540-Series and Type 550-Series Oscilloscopes with the Type 53/54K or Type K Plug-In Preamplifier have a combination risetime of 14 nanoseconds or better. The Type 107, with its risetime of 3 nanoseconds, provides a suitable square wave for checking and adjusting the high-frequency response of the Type 540-Series and Type 550-Series Oscilloscopes and Tektronix Wide-Band Preamplifiers.

CHARACTERISTICS

Risetime—Less than 3 nanoseconds when the output 52-ohm cable is terminated.

Frequency Range—A front-panel control varies the frequency over an uncalibrated range of approximately 400 kc to 1 mc.

Output Voltage—When the output cable is terminated the output voltage range is approximately 0.1 v to 0.5 v. If the cable is not terminated, the voltage range is 0.2 v to 1 v.

Output Trigger—An output trigger signal is available at a coaxial connector at the rear of the instrument.

Waveform—Special design consideration has been placed on the shape of the positive portion of the waveform. Therefore, only this portion should be used in transient response testing.

SQUARE-WAVE GENERATOR

ELECTRON-TUBE COMPLEMENT

Multivibrator		6BQ7A
Amplifier		12BY7
Shaper amplifier		12BY7
Driver amplifier		12BY7
Output amplifier		6AU6
Rectifiers	2	6BW4
Output voltage regulator		OA2

MECHANICAL SPECIFICATIONS

Ventilation—Forced-air ventilation assures safe operating temperature. A minimum of 2" of unobstructed clearance around the instrument is recommended for adequate ventilation.

Construction—Aluminum-alloy chassis and cabinet.

Finish—Photo-etched panel, wrinkle-finished cabinet.

Dimensions—11" long, 6¾" wide, 10½" high.

Weight: Net—13 pounds
Shipping—19 pounds approx.

Power Requirements—105-125 v or 210-250 v, 50-60 cycles, 100 watts.

Price **$175**

Includes: 1—P52, 52-ohm 42" coaxial cable (012-001)
1—B52-R, 52-ohm terminating resistor (011-001)
1—3-conductor power cord (161-010)
1—Instruction manual

Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).

TYPE 110 PULSE GENERATOR

MAIN FEATURES

PULSE GENERATOR

Pulse risetime—less than 0.25 nsec.

Pulse length—approximately 0.5 nsec, minimum, 40 nsec maximum at full repetition rate, 300 nsec at half repetition rate (one charge line disabled).

Output impedance—50 ohms.

Repetition rate—720 pulses/sec, nominally.

TRIGGER TAKEOFF SYSTEM

Input impedance—50 ohms.

Output signal to trigger system—amplitude approximately 20% of input signal.

Input signals through system—20 mv to 50 volts (transmission losses and reflections less than 2½ %).

Direct external trigger input—4 mv to 10 volt signal.

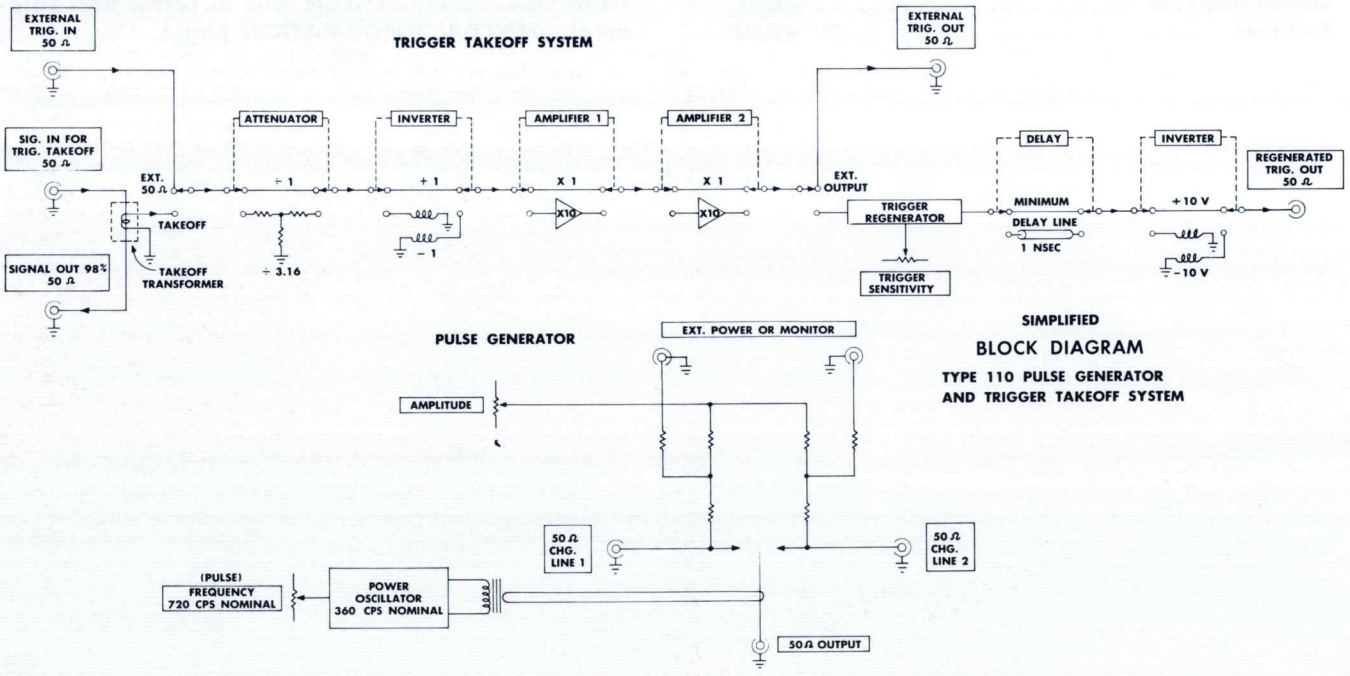
Regenerated trigger out signal—±10 v, 4 nsec 50% risetime, 225 nsec duration.

GENERAL DESCRIPTION

Designed for high-speed pulse applications, the Tektronix Type 110 Pulse Generator and Trigger Takeoff System is capable of generating pulses of less than one-fourth nsec risetime by means of a high-repetition-rate mercury relay. Repetition rate is nominally 720 pulses/sec. Output impedance is 50 ohms. The system is capable of generating alternate pulses of different lengths, amplitudes, or polarity.

The independent Trigger Takeoff System utilizes two amplifiers combined with an attenuator. This assures stable triggering over a wide range of signal amplitudes. A flexible switching system permits polarity change and trigger signal amplification, necessary to drive the trigger regenerator. The trigger regenerator output of nominally 10 volts for 225 nsec is adequate for triggering oscilloscopes with relatively slow trigger responses and for starting the Type N Sampling Unit (when the source cannot supply the necessary trigger). Maximum random repetition rate is about 100 kc, but the system counts down from a considerably higher uniform rate (approximately 100 mc). Trigger-response impulse speed is about 1 nsec without amplifiers and 3 nsec with amplifiers switched in. Normal triggering occurs on signals down to 50 mv.

With its calibrated output, the Type 110 Pulse Generator and Trigger Takeoff System facilitates measurement of amplifier linearity, and trigger sensitivity to amplitude or pulse-width changes. The system is useful not only for sampling applications (with many pulses needed to produce one display), but also for conventional applications with oscilloscopes having inadequate triggering characteristics.



SIMPLIFIED BLOCK DIAGRAM
TYPE 110 PULSE GENERATOR AND TRIGGER TAKEOFF SYSTEM

AND TRIGGER TAKEOFF

OTHER CHARACTERISTICS

Charge Lines—One or two charge lines can be used to provide equal or unequal pulses alternately as desired. Equal charge lines produce 720 pulses/sec repetition rate free running or line synchronized. Unequal charge lines produce alternate pulses of different widths. External charge voltage permits alternate pulses of different amplitudes and polarity.

Trigger Takeoff—The signal is patched into a 50-ohm "loop through" arrangement. Approximately 98% of the input voltage appears at the output after passing through the takeoff (a 2% reflection appears at the input). This is due to an equivalent 2 ohms being inserted in series with the outer conductor of a 50-ohm coaxial transmission line. The equivalent 2 ohms is transformed to 50 ohms for use in the trigger system. Since approximately 4% of the signal energy was available to the trigger channel, approximately 20% of the signal voltage appears as a trigger signal.

Regenerated Trigger—A regenerated trigger signal of ±10 volts amplitude and 225 nsec duration is available from the output of the REGENERATOR OUT connector. Timing delay is nominally 20 nsec, with an additional nsec available from a front-panel switch.

The recovery time is 10 μsec, with count down from approximately 100 mc at a uniform repetition rate. Below 100 kc, a random repetition rate is permissible.

MECHANICAL SPECIFICATIONS

Construction—Three-piece compact unit constructed of light-weight, shock-resistant aluminum alloy. Side panels and bottom panel are easily removable. Transistors and other components are readily accessible.

Finish—Photo-etched anodized front panel with colored control knobs, blue vinyl-finish cabinet.

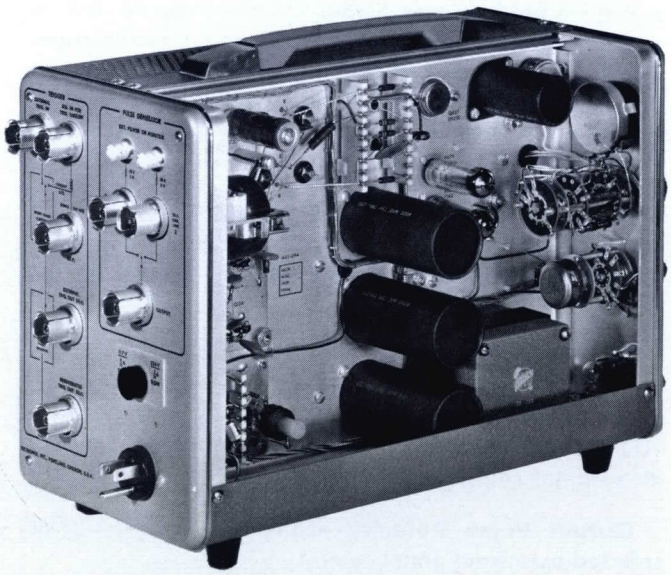
Dimensions—Only 10⅝" high by 6⅞" wide by 16⅛" deep.

Weight: Net—18 pounds.
Shipping—22 pounds approx.

Power Requirements—Operates from 105 to 125 v or 210 to 250 v, 50 to 60 cycles, 48 watts at 117 v.

Price **$650**

Includes: 1—2 nsec 50 Ω coax cable RG58A/U with G.R. connectors (017-505)
1—5 nsec 50 Ω coax cable RG8A/U with G.R. connectors (017-502)
1—20 nsec 50 Ω coax cable RG8A/U with G.R. connectors (017-504)
1—3-Conductor power cord (161-010)
1—Instruction manual



Price f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).

TYPE 111 PRETRIGGER PULSE GENERATOR

GENERAL DESCRIPTION

The Type 111 is a high-repetition rate, fast-rise pulse generator. It is primarily intended for use with the Tektronix Type N Sampling Plug-In Unit; however, its characteristics make it ideally suited for use with conventional oscilloscopes and other equipment as well. The unit provides two pulse outputs: the fast-rising Output Pulses and the Pretrigger Pulses. The Pretrigger Pulses occur from 30 to 250 nanoseconds ahead of each Output Pulse. These Pretrigger Pulses can be used as a Regenerated Trigger Signal for the Type N Unit or as a triggering signal for a conventional oscilloscope. The amount of delay between the Pretrigger Pulse and the Output Pulses is variable by means of a front panel control. This eliminates the need in most applications for low loss delay cables.

Output Pulse Risetime—Equal to or less than 0.5 nsec when the OUTPUT POLARITY Switch is in the (+) position. When the switch is in the (—) position, the risetime is slightly longer.

Output Pulse Duration—Minimum, approximately 2 nsec with no external charge line. Maximum, 100 nsec at low repetition rates decreasing to 20 nsec at 100 kc repetition rate. Maximums are obtained with an external charge line.

Output Pulse Polarity—Either (+) or (—) as selected by a front panel control.

Output Pulse Repetition Rate—Four repetition rate ranges and a vernier control provide a continuous range of adjustment from approximately 10 pps to approximately 100 kc. Overlap between ranges is about 5%.

Output Pulse Aberrations—When the output is properly terminated, overshoot and other aberrations are less than 5% of the peak amplitude of the Output Pulses (as observed on a 600 mc oscilloscope).

Pulse Amplitude—More than ±5 volts. The output voltage is fixed by the particular avalanche transistor used. External attenuators are necessary to vary the output amplitude. Suitable for this purpose are the Type N accessories—the optional variable attenuator and the supplied fixed attenuators.

Pretrigger Pulse Characteristics—Amplitude is about 10 volts, duration is about 250 nsec, and half-amplitude risetime is about 4 nsec.

Pulse Delay—The Output Pulse is delayed from 30 to 250 nsec after generation of the Pretrigger Pulse. The delay is continuously variable by means of a front panel control. Time jitter between the Pretrigger and the Output Pulse is less than 100 picoseconds.

Output Impedance—50 ohms.

External Trigger Signal Requirements—Positive 5 volts with rise rate of 3 volts/μsec, and repetition rate from dc to about 100 kc.

Power Requirements—Operates from 105 to 125 volts or 210 to 250 volts, 50 to 60 cycles, 35 watts at 117 v.

MECHANICAL SPECIFICATIONS

Construction—Three-piece compact unit constructed of light-weight, shock-resistant aluminum alloy. Side panels and bottom panel are easily removable. Transistors and other components are readily accessible.

Finish—Photo-etched anodized front panel with colored control knobs, textured-aluminum cabinet with blue-vinyl finish.

Dimensions—10⅜" high by 6⅝" wide by 11¼" deep.

Weight: Net—8 pounds.
Shipping—13 pounds approx.

Price **$365**

Includes: 1—9 nsec (72 inches) coax cable, RG58A/U with G.R. connector (017-506)
1—X10 attenuator, 50 ohms (017-001)
1—3-Conductor power cord (161-010)
1—Instruction manual

Price f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).

AMPLIFIERS

TYPE 1121 ..... M-2

TYPE 122 ..... M-4

TYPE RM122 ..... M-6

TYPE FM122 ..... M-6

TYPE 123 ..... M-7

MAIN FEATURES

Amplifier Gain

Accurately set at 100 x.

Input Attenuator

Input level attenuation from a net gain factor of 100 x to 0.2 x in 9 calibrated steps.

Gain Stability

Within ±1% over 24-hour period.

Frequency Response

5 cycles to 17 megacycles (3 db down) at 1X, 2X, 5X, and 10X attenuator settings.

Transient Response

Risetime—21 nanoseconds.

Internal Noise

50 μv with input grounded and INPUT ATTENUATOR at 1X.

Probe Power

Heater supply—6.3 v dc, 0.2 amp.
Plate supply—120 v dc, 10 ma regulated.

GENERAL DESCRIPTION

The Type 1121 Wide-Band Amplifier is a low-noise, cascode-input amplifier designed with Tektronix precision, quality, and style. It increases the amplitude of low-level wide-band signals; thus increases the sensitivity of the oscilloscope or other associated instrument with which it is operated.

The output, terminated in 93-ohm coaxial cable, allows separation of at least 100 feet between the Type 1121 and associated instrument without causing noticeable deterioration of the response. Output voltage of ±1 volt guarantees linear amplification of any input signal up to ±10 mv at full gain. Internal noise is no more than 50 μv peak-to-peak with the input grounded and the INPUT ATTENUATOR control in the 1-X position. As in all Tektronix instruments, optimum response is a prime consideration. Risetime is approximately 21 nsec, and passband extends from 5 cycles to over 17 mc with the INPUT ATTENUATOR control in the 1-X, 2-X, 5-X or 10-X positions.

Power is available at the front panel for a cathode-follower probe. For applications requiring both high impedance input and high gain or where the attenuation of an rc probe would be objectionable, a Tektronix P170CF cathode-follower probe is recommended.

Its compactness, improved tube reliability, and low-noise level adapt the versatile Type 1121 to almost any application involving wide-band amplification.

NEW FEATURES

A new turret-type step attenuator permits attenuation of the input level to a factor of 500X in nine calibrated steps. Unique design of the attenuator allows the series and shunt compensations to be conveniently set without removing the instrument side panels. Hum pick-up at the input is minimized by the inherently short internal leads. These leads are of the same length in all positions of the attenuator, thus lower more-stable values of circuit capacitance are realized. Input impedance is 1 megohm paralleled by approximately 22 pf at all step-attenuator positions. This feature enables the use of a probe with minimum circuit loading on the point measured. Other new features are a cascode-input circuit using a reliable frame-grid triode, and transistor-regulated heater supplies. Also, since there are two voltage amplifier stages, the polarity of the input is retained at the output.

OTHER AMPLIFIER CHARACTERISTICS

Internal Noise—Internally-generated noise is no more than 50 μv peak-to-peak with the input grounded and the INPUT ATTENUATOR control in the 1-X position.

Gain Stability—After initial warmup, and under all conditions of line voltage between 105 and 125 volts or 210 and 250 volts, gain stability of the Type 1121 is well within ±1% over a twenty-four hour period.

Input Attenuation—The newly-designed turret-type step attenuator permits accurate attenuation of the input level from a net gain factor of 100 x to 0.2 x in nine calibrated steps: 1X, 2X, 5X, 10X, 20X, 50X, 100X, 200X, and 500X. Attenuator accuracy is 1%. A screwdriver control at each attenuator position provides compensating adjustment for optimum square wave response. Access is via a hole in the front panel, behind the INPUT ATTENUATOR knob flange.

Probe Power—The front-panel PROBE POWER socket provides 0.2 amp dc at 6.3 volts for the heater supply and 10 ma regulated dc at 120 volts for the plate supply of a cathode-follower probe. The Tektronix P170CF cathode-follower probe is ideally suited for use with Type 1121 Amplifier.

Frequency Response—With the INPUT ATTENUATOR control in the 1-X, 2-X, 5-X, or 10-X positions, transient response is clean over a band extending from 5 cps to 17 mc (at 3 db down). Passbands for the remaining attenuator positions are as follows: 20X—5 cps

AMPLIFIER

to 16.5 mc, 50X—5 cps to 16.0 mc, 100X—5 cps to 15.5 mc, 200X—5 cps to 14.0 mc, and 500X—5 cps to 12.0 mc.

When a P170CF cathode-follower probe is used with a Type 1121 Amplifier ahead of a Type 540 or 540A-Series Oscilloscope and a Type L Plug-In Unit set at 0.05 v/cm, overall sensitivity of the combination is 1 mv/cm. Passband will be 5 cps to 16 mc. At this sensitivity, noise inherent in the Type 1121 will appear as 0.1 centimeter of deflection. With the L unit set at 0.005 v/cm, overall sensitivity is 0.1 mv/cm. Passband will be 5 cps to 15 mc and inherent noise will appear as 1 centimeter of deflection. Input impedance of the P170CF probe is 12 megohm paralleled by 5 pf.

Note: It is necessary to terminate the 170-ohm cable of the P170CF probe at the amplifier input. A Tektronix-made 170-ohm resistor (part No. 011-016) is recommended for this purpose.

Using a P6002 100-x attenuator probe with the same combination and the L unit set at 0.05 v/cm, overall sensitivity is 50 mv/cm. Passband will be 5 cps to 15.5 mc. Again, at this sensitivity, noise inherent in the Type 1121 will appear as 0.1 centimeter of deflection. With the L unit set at 0.005 v/cm, overall sensitivity is 5 mv/cm. Passband will be 5 cps to 14 mc and inherent noise will appear as 1 centimeter of deflection. Input impedance of the P6002 100-x attenuator probe is 9.1 megohms paralleled by 2.5 pf.

Output Voltage—Capable of a ±1 volt swing in a terminated 93-ohm coaxial cable, the Type 1121 reproduces any input signal up to ±10 mv at full gain. The ouput, via cathode followers, permits up to 100 foot separation between the amplifier and associated instrument without noticeable waveform distortion.

Output Connection—Output of the Type 1121 is connected to the associated instrument via a 93-ohm coaxial cable. A 93-ohm terminating resistor must be inserted between the 93-ohm cable and the associated instrument's input. If the cable is not properly terminated, waveform distortion results. A 42-inch, 93-ohm coaxial cable equipped with UHF connectors and a 93-ohm terminating resistor are included accessories. If additional cable length is required, insert a section of RG62U (93 ohm) cable between the Type 1121 OUTPUT and the 93-ohm terminating resistor.

Regulated Power Supplies—The Type 1121 embodies exceptionally stable power-supply voltage regulation. Transistor-regulated heater circuits limit the heater-supply ripple components to less than 4 mv. Electronically-regulated plate circuits insure stable operation over line fluctuations between 105 to 125 volts or 210 to 250 volts.

Input Impedance—Direct, 1 megohm paralleled by approximately 22 pf.

MECHANICAL SPECIFICATIONS

Construction—Compact, light-weight aluminum-alloy chassis with side panels and bottom panel easily removable, and components readily accessible.

Finish—Blue vinyl-finish cabinet with photo-etched aluminum front panel.

Weight: Net—18 pounds
Shipping—24 pounds, approx.

Dimensions—9¼" high by 6¾" wide by 12¾" deep.

Power Requirements—The Type 1121 operates from 105 to 125 volts or 210 to 250 volts, at 50 to 60 cycles, 150 watts.

Price **$425**

Includes: 1—93-ohm coaxial cable
1—93-ohm terminating resistor
1—3-wire power cord
1—Instruction Manual

Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).

MAIN FEATURES

Voltage Gain

High position—approximately 1000.
Low position—approximately 100.

Frequency Response

0.16 cycles to 40 kc maximum.

Noise Level

4 μv rms maximum referred to the input.

Output Voltage

Maximum 20 v (peak-to-peak).

Input Selection

Single ended or differential.

GENERAL DESCRIPTION

The Tektronix Type 122 Low-Level Preamplifier is a compact 3-stage battery-operated amplifier extending the usefulness of the oscilloscope into the microvolt region. The Type 122 is especially useful in biological research and other applications requiring the amplification of microvolt signals.

The Type 122 can be used with any dc-coupled oscilloscope, increasing its sensitivity by a factor of either 1000 or 100. When used with the Tektronix Type 512 Oscilloscope, sensitivity is increased to 5 μv/cm; with the Tektronix Type 360 Indicator, sensitivity is increased to 50 μv/cm. If the Type 122 is used with an ac-coupled oscilloscope, the overall low-frequency response will be limited to that of the oscilloscope.

Shock mounting, careful bypassing, and use of battery heater and plate-supply voltages reduce microphonics, noise, and hum to a low level.

CHARACTERISTICS

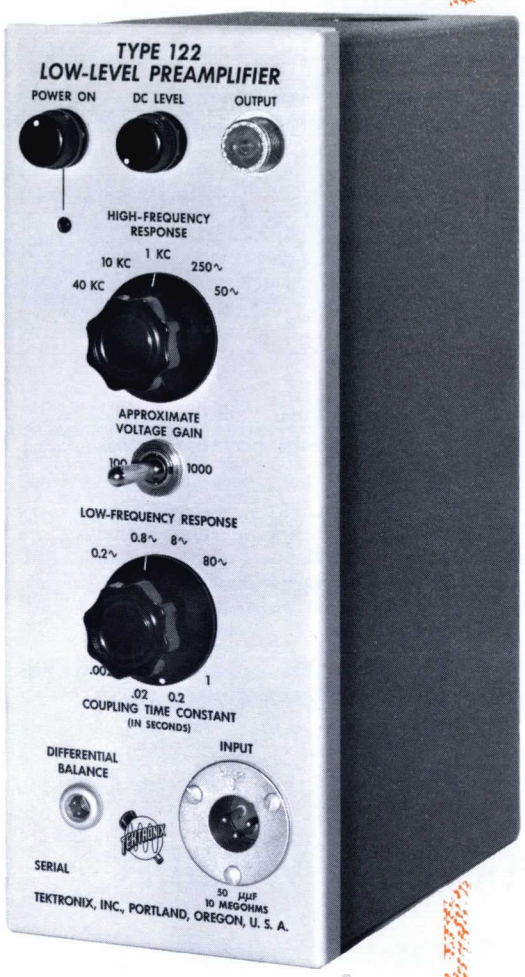
Frequency Response—Maximum passband is 0.16 cycles to 40 kc, with 5 high-frequency 3-db cutoff points . . . 50, 250 cps, 1, 10, and 40 kc; and 4 low-frequency 3-db cutoff points. . .0.2, 0.8, 8, and 80 cycles. Corresponding low frequency time constants are 1, 0.2, 0.02, and 0.002 seconds. High and low-frequency cutoff points are controlled by separate switches so a variety of frequency response characteristics can be obtained.

Voltage Gain—A toggle switch selects either a gain of 100 or 1000.

Rejection Ratio—80 to 100 db for in-phase signals from 5 cycles to 40 kc; maximum signal input is 10 v.

Signal Output—Maximum signal output is 20 v (peak-to-peak) for a maximum signal input of 0.02 v (peak-to-peak) in high gain position and 0.1 v (peak-to-peak) in low gain position. AC input signals up to these maximums or dc levels up to $\pm$0.1 v (either gain setting) can be handled by the Type 122 before waveform distortion occurs.

LOW-LEVEL PREAMPLIFIER



Input Impedance—With single-ended input, the impedance is 10 megohms paralleled by approximately 50 pf. Impedance for differential input is 20 megohms paralleled by approximately 50 pf.

Noise Level—Depending on the setting of the frequency response controls, the noise level, referred to the input, is 1 to 4 microvolts rms with the input terminals grounded.

ELECTRON-TUBE COMPLEMENT

Input amplifier . . . . . selected 12AX7
Second stage amplifier . . . . . selected 12AU7
Third stage amplifier and CF out . . . . . selected 12AU7

MECHANICAL SPECIFICATIONS

Construction—Aluminum-alloy chassis and cabinet.

Finish—Photo-etched anodized front panel, wrinkle-finished cabinet.

Dimensions—10⅝" high, 4½" wide, 7" deep.

Weight: Net—5½ pounds
Shipping—9 pounds approx.

Power Requirements—Battery powered through a standard octal plug: +135 v at 5 ma, −90 v at 4 ma, and 6.3 v at 0.9 amp. The battery cable furnished with the instrument is designed to be used with five 45-volt dry-cell batteries and one 6.3-volt storage battery. Batteries are not included with the Type 122.

Type 122 . . . . . **$125**
Includes: 1—W122 battery cable (012-009)
1—CON3P input plug (131-013)
1—P93 output cable (012-003)
1—Instruction manual

Currently Available Extras

Extra long battery cables, similar to Type W122, can be ordered as special items.

Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).

RM122 RACK-MOUNTING MODEL

GENERAL DESCRIPTION

The Type RM122 is a mechanically rearranged Type 122 Preamplifier for horizontal mounting in a standard 19-inch rack. The instrument is fastened to the front of the rack by four screws. It requires only 5¼ inches of rack height.

OTHER CHARACTERISTICS

Electrical characteristics of the Type RM122 are the same as described for the Tektronix Type 122 Preamplifier.

MECHANICAL SPECIFICATIONS

Construction—Aluminum-alloy chassis.

Finish—Photo-etched anodized front panel.

Dimensions—5¼" high, 19" wide, rack depth. (approximately additional required for power cord.)

Weight: Net 6 pounds
Shipping—12 pounds approx.

Type RM 122 ..... **$130**
Includes: 1—W122 battery cable (012-009)
1—CON3P input plug (131-013)
1—P93 output cable (012-003)
1—Instruction manual

Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).

FM122 FRAME-MOUNTING MODEL

GENERAL DESCRIPTION

The Type FM122 has a specially designed front panel and cabinet for use where mounting in a vertical position is required. It can be mounted in an existing support or adapted to mounting in a standard rack by a Tektronix Mounting Frame.

OTHER CHARACTERISTICS

Electrical characteristics of the Type FM122 are the same as described for the Tektronix Type 122 Preamplifier.

MECHANICAL SPECIFICATIONS

Construction—Aluminum-alloy cabinet.

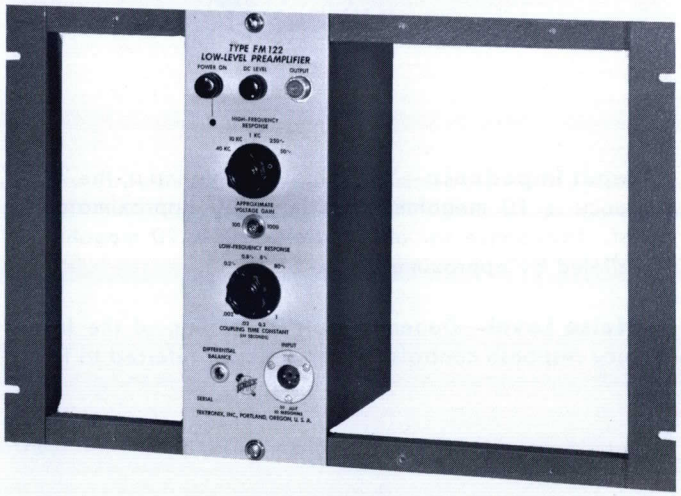
Finish—Photo-etched anodized panel, wrinkle-finished cabinet.

Dimensions—12¼" high, 4⅛" wide, 7" deep.

Mounting Holes—11½" between centers.

Weight: Net—5½ pounds
Shipping—9 pounds approx.

Type FM122 without Mounting Frame **$130**
Includes: 1—W122 battery cable (012-009)
1—CON3P input cable (131-013)
1—P93 output cable (012-003)
1—Instruction manual



Recommended Additional Accessories

Mounting Frame. Fits any standard 19-inch rack and is fastened to the front of the rack by four screws. Adapts Type FM122 Preamplifier to rack mounting. Capacity is four of any combination of Type 122 Preamplifier, Type 360 Indicator, and Type 160-Series units.

ORDER PART NO. 014-002 ..... $5.00

TYPE 123 PREAMPLIFIER

Compact

3⅝" high, 1½" wide, 2-3/16" deep.

Weighs only 10 ounces.

Voltage Gain

Accurately set at 100 times.

Passband

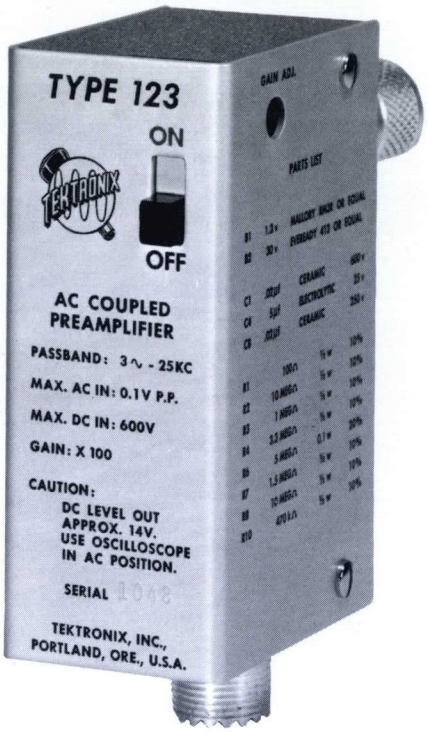
Within 2% from 15 cycles to 6 kc.
Within 3 db from 3 cycles to 25 kc.

Maximum Input Signal

0.1 v peak-to-peak.

Hum-Free Low-Level Amplification

Powered by miniature batteries.



GENERAL DESCRIPTION

The Tektronix Type 123 Preamplifier is a compact, light-weight, battery-operated amplifier for use in applications where a gain of 100 without additional hum signal is desired. Passband is 3 cycles to 25 kc. Etched wiring, miniature tubes and small batteries are combined in a unit about the size of 2 king-size cigarette packages. Where reduced high-frequency response is permissible, ground-loop hum pickup can be virtually eliminated by mounting the Type 123 close to the circuit under observation. Coaxial connectors permit the Type 123 to be connected directly to an oscilloscope or other instrument, and at reduced high-frequency response, in a connecting cable, or even for use as a probe. Shock-mounted chassis reduces the effects of microphonics, shift, and drift.

Applications of the Type 123 are confined to the audio range; for example, observing hum levels, transducer preamplifier, and other low-level applications where a gain of 100 is desired.

CHARACTERISTICS

Voltage Gain—Gain is 100, adjustable with screwdriver calibration control.

Passband—Within 3 db from 3 cycles to 25 kc. Within 2% from 15 cycles to 6 kc.

Battery Powered—A small mercury cell supplies the filament voltage and a miniature 30 v battery is the source of plate voltage. Life of the mercury cell is approximately 100 hours. Low plate current, 75 microamps, assures plate-supply battery life of more than 100 hours.

Noise Level—The maximum noise level, referred to the input, with the input grounded is less than 7.5 microvolts, rms.

Output Signal Level—DC level of output is approximately +15 v.

Maximum Input Signal—Maximum input signal for linear amplification is 0.1 v, peak-to-peak.

Input Impedance—10 megohms.

Effective Output Impedance—31 kilohms.

Vacuum Tube Complement—Two Type 512AX sub-miniature filament-type pentodes.

MECHANICAL SPECIFICATIONS

Construction—Aluminum-alloy cover and etched-wiring chassis.

Finish—Photo-etched anodized front panel.

Dimensions—3⅝" high, 4⅛" including coaxial connector; 1½" wide; 2-3/16" deep, 3¾" including coaxial connector.

Weight: Net—10 ounces
Shipping—3 pounds approx.

Power Requirements—One 1.345 v mercury cell and one 30 v miniature battery, included with the instrument.

Price **$50**

Includes: 1—Mercury cell
1—B battery

Prices f.o.b. factory. (Please refer to **Terms and Shipment**, ***GENERAL INFORMATION*** page.)

NOTES

Tektronix, Inc. **P. O. Box 500 • Beaverton, Oregon** **Printed in U. S. A.**

SPECIAL INSTRUMENTS

TYPE 130 . . . . . N-2

TYPE 160A N-4

TYPE 161 . . . . . N-6

TYPE 162 . . . . . N-6

TYPE 163 . . . . . N-8

TYPE 126 . . . . . N-8

TYPE 360 . . . . . N-10

TYPE 130 DIRECT-READING

MAIN FEATURES

Guard Voltage

Permits measuring an unknown capacitance while eliminating the effects of other capacitances from the measurements.

Five Ranges

Microhenries—0 to 3, 10, 30, 100, 300.
Picofarads—0 to 3, 10, 30, 100, 300.

Accuracy

Within 3% of full scale.

Coarse and Fine Zero Adjust

4½" Meter

APPLICATIONS

Saves engineering time in circuit development work by providing quick inductance and capacitance readings even while circuit changes are being made. Aids in correct placement of critical components and leads.

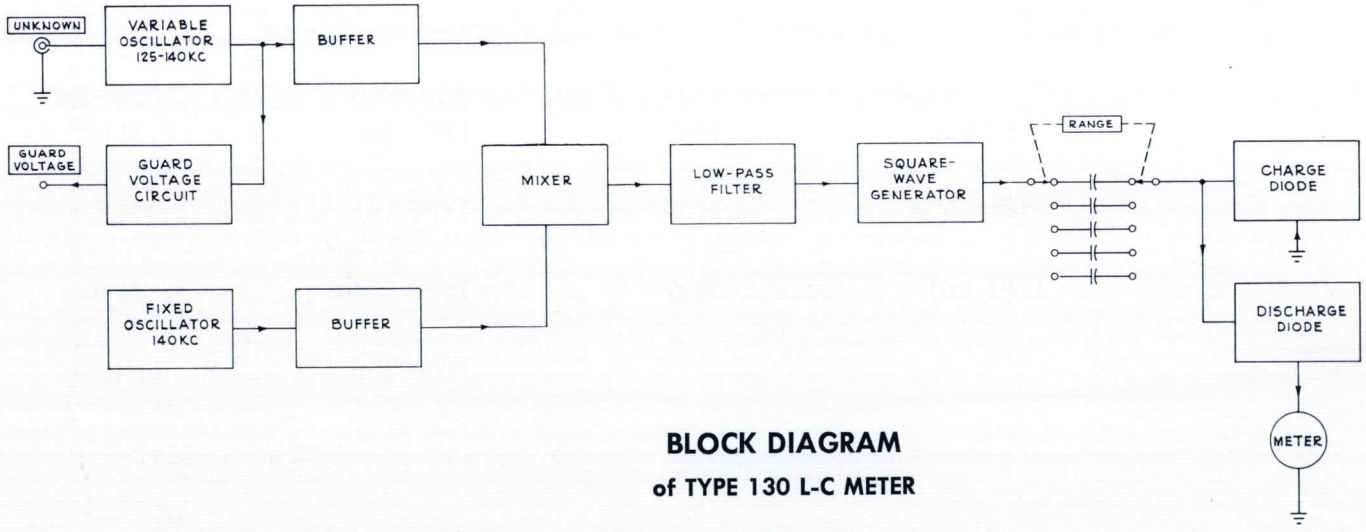
Guard circuit produces a voltage of the same amplitude and phase as the voltage at the UNKNOWN terminals, but isolated from the frequency determining portions of the rest of the circuit. This permits separation of the capacitance to be measured from other capacitances and strays. Accurate measurements of direct inter-electrode capacitance in vacuum tubes can be made with ease.

The Type 130 can also be used for component testing, sorting, and color-code checking on a production basis.

GENERAL DESCRIPTION

The unknown value to be measured will determine the frequency of the variable oscillator in the Type 130. This frequency is beat against a 140-kc fixed oscillator. The difference frequency is shaped and counted, causing meter deflection proportional to the difference frequency. The direct-reading meter is calibrated in microhenries and picofarads.

Small actual and stray capacitances have very little effect on inductance measurements made with the Type 130. For instance, the meter reading will be affected less than 1% on inductance measurements where the actual and stray capacitances are as great as 50 pf.



BLOCK DIAGRAM
of TYPE 130 L-C METER

INDUCTANCE and CAPACITANCE METER

Load Resistance Limits—The following loads will not appreciably alter the indication:

Capacitance, 0.1 megohm shunt.

Inductance, 20 k shunt, 10 ohms series.

A table included in the instruction manual provides corrections for greater loads.

ELECTRON-TUBE COMPLEMENT

Fixed oscillator	6U8
Buffer amplifier	6U8
Variable oscillator	6U8
Buffer amplifier	6U8
Mixer	6BE6
Bistable multivibrator	6U8
Guard circuit CF	6BH6
CF clamp and diode clamp	6DJ8
Rectifier	6X4
Voltage regulator	OA2

MECHANICAL SPECIFICATIONS

Construction—Aluminum alloy.

Finish—Photo-etched anodized front panel, blue wrinkle-finish cabinet.

Dimensions—7" wide, 10½" high, 10¾" deep.

Weight: Net—9 pounds
Shipping—17 pounds appr.

Power Requirements—105-125 v or 210-250 v, 50-60 cycles, 40 watts.

Price **$200**

Includes: 1—P93C probe (010-003)
1—W130R lead (012-015)
1—3-conductor power cord (161-010)
1—W130B lead (012-014)
1—Instruction manual

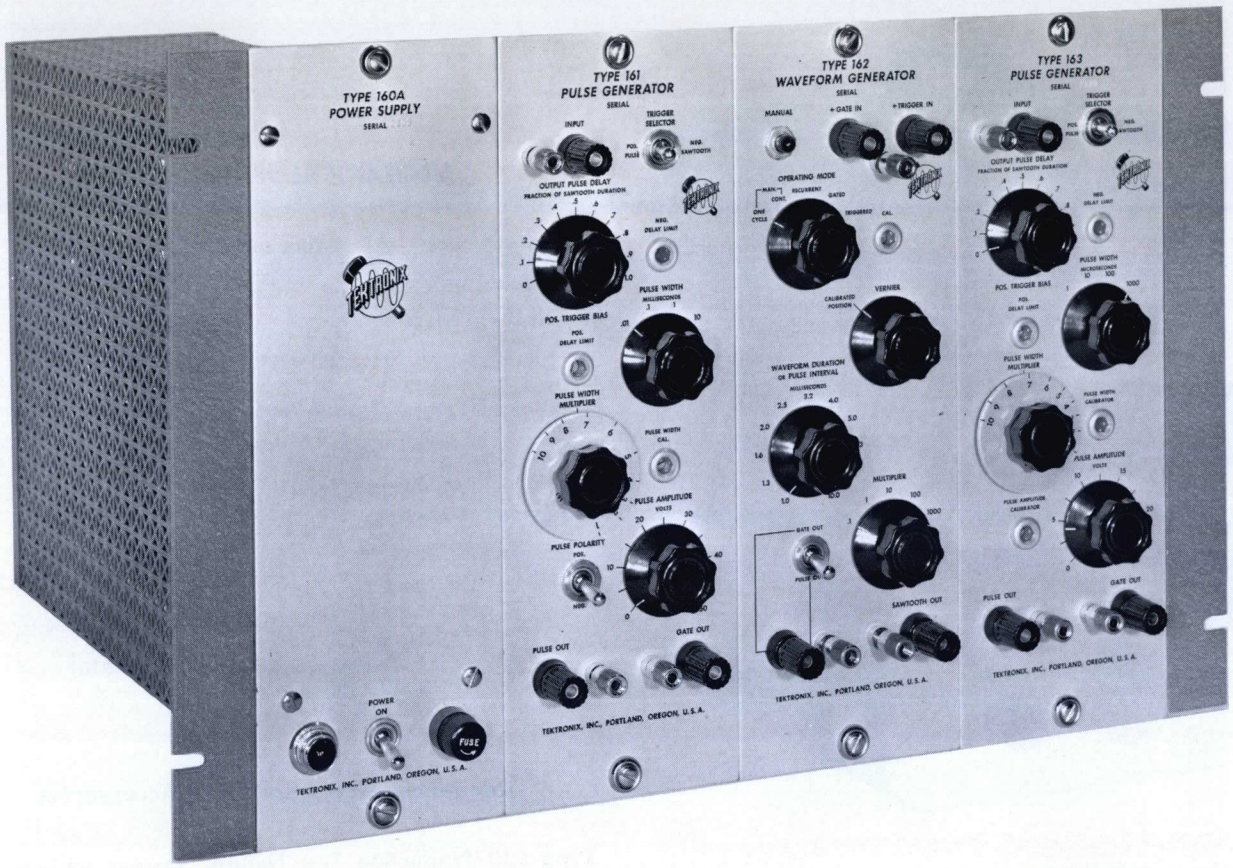
Recommended Additional Accessories

Type F30 Production Test Fixture. Speeds sorting and testing of capacitors and inductors.
ORDER PART NO.013-001 . . . . . $3.00

Type S30 Delta Standards, for calibration of Type 130 L,C Meters.

ORDER PART NO.015-001 . . . . . $22.00

Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page.)



TYPE 160A

Electronic Voltage Regulation

Four Output Terminals

Conveniently located at rear of chassis.

Large Load Capacity

+300 v dc, unregulated.

+225 v dc, regulated, at 225 ma.

+150 v dc, regulated, at 15 ma.

+80 v dc, unregulated.

—170 v dc, regulated, at 125 ma.

6.3 v ac, unregulated, at 20 amps.

GENERAL DESCRIPTION

The Type 160A Power Supply provides the required currents and voltages for one Type 360 Indicator Unit in combination with up to six Type 160-Series Generators. Power capability handles up to five Type 360 Indicator Units, up to five Type 163 Fast-Rise Pulse Generators, up to seven Type 162 Waveform Generators, or up to seven Type 161 Pulse Generators. Output terminals are four octal sockets on the back of the instrument.

Electronic regulation compensates for line-voltage variations between 105 and 125 v or 210 and 250 v, and for any current-demand differences between instruments.

The currents listed for the +225 volt supply (225 ma) and the —170 volt supply (125 ma) apply only with the series regulator external shunt resistors provided in the individual units.

ELECTRON-TUBE COMPLEMENT

Rectifiers	3	5V4
Amplifier		6AU6
Amplifier and series regulator		6AW8
Series regulator		6080
Series regulators	2	12B4
Amplifier and CF		6U8
Voltage reference		5651

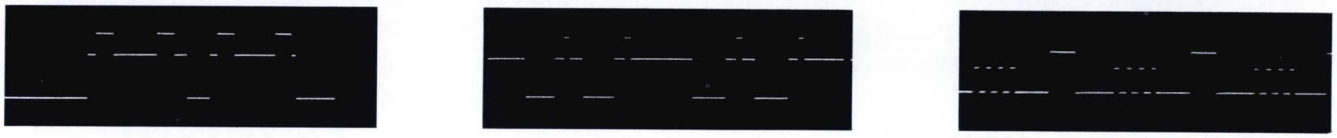
and MONITORING SYSTEM

Designed for complex measurement applications, the system consists of the Type 160-Series instruments and the Type 360 Indicator Unit. The Type 160-Series produces accurate timed pulses of adjustable amplitude, duration, and repetition rate. The series includes power-supply unit, pulse generator, waveform generator and fast-rise pulse generator. The Type 360 Indicator Unit displays accurately any information generated by the Type 160-Series instruments. Power for any one of the Type 160 Series instruments or Type 360 Indicator can be supplied by the optional Type 126 Power Supply thus augmenting the system for mounting outside a rack.

Using several Type 160-Series instruments together produces many complex waveform patterns. The flexible system fits a wide variety of applications, including nerve stimulation in neurophysical experiments, timed gating devices for complex equipment, component testing for quality control, and data recording in the biophysical and geophysical fields, among others.

Rack-mounting the Sequence Control and Monitoring System offers compact convenience. The Type 360 Indicator Unit and the illustrated Type 160-Series instruments bolt quickly and easily to a Type FA160 Mounting Frame, which bolts to a standard nineteen-inch rack. As shown in the picture, the mounting frame securely holds four instruments. An additional accessory to cover openings in rack-mount sets is the Type FAP160 Blank Panel.

If rack-mounting is not desired, separate housing for the units is available by using the optional Type 126 Power Supply and included cabinet. This optional feature permits individual use of the units separately housed and separately powered and adds versatility to the system.



Some of the waveform combinations possible with Tektronix Type 160-Series Waveform Generators

POWER SUPPLY

MECHANICAL SPECIFICATIONS

Ventilation—forced-air cooling.

Mounting—fits the Type FA160 Mounting Frame for rack-mounting.

Construction—aluminum-alloy chassis.

Finish—photo-etched anodized front panel, blue wrinkle-finish cabinet.

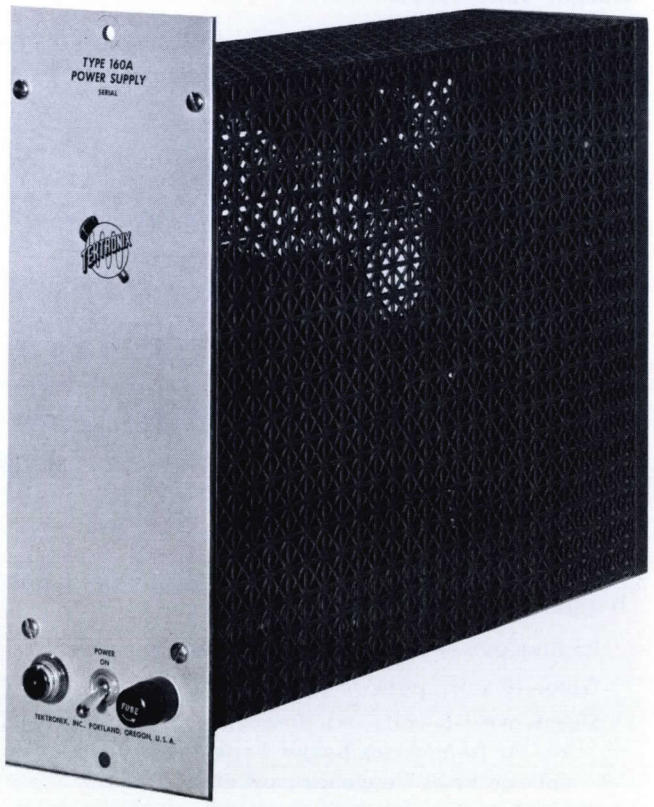
Dimensions—12 ¼" high by 4 ⅛" wide by 13 ½" deep.

Weight: Net 21 pounds.
Shipping—27 pounds appr.

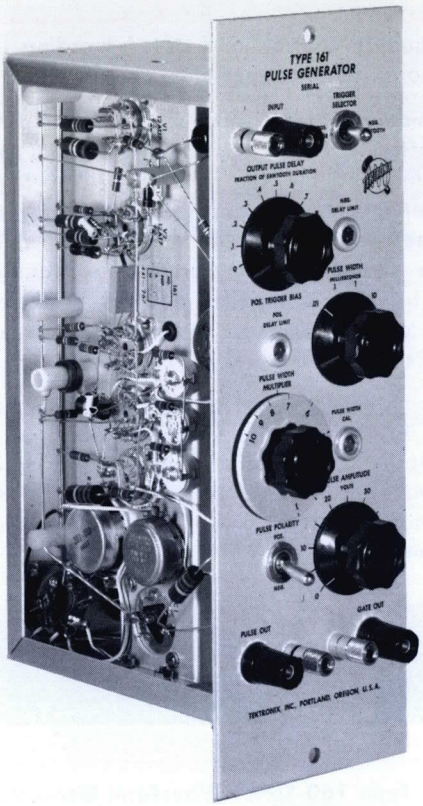
Power Requirements—105-125 or 210-250 v, 50-60 cycles, 350 watts max.

Price **$175**

Includes: 1—Cabinet
2—W160-20 connecting cables (012-016)
1—Set mounting screws and cup washers
1—3-conductor power cord (161-010)
1—Instruction manual



TYPE 161



Output Waveforms

Variable-amplitude positive or negative pulse.
Fixed-amplitude positive gate.

Output Characteristics

Risetime—less than 0.5 μsec, overshoot less than 5%.

Duration—calibrated, variable, 10 μsec to 0.1 sec.

Delay—continuously variable, 0 to 100% of triggering sawtooth waveform.

Amplitude Peak-to-Peak

Pulse—calibrated, continuously variable, 0 to 50 v.

Gate—fixed, 50 v positive, peak-to-peak.

Trigger Requirements

Positive pulse, 3-volt peak-to-peak minimum. Negative-going positive sawtooth minimum rate of change, 15 v/sec. Maximum repetition rate, 50 kc.

Power Requirements

—170 v dc at 17 ma, +225 v dc at 22 ma, 6.3 v ac at 1.65 amps.

TYPE 162

Output Waveforms

Positive pulse, positive gate, and negative-going positive sawtooth.

Output Characteristics

Risetime—1-μsec minimum.

Duration—pulse, 10 μsec to 0.05 sec, gate and sawtooth, 100 μsec to 10 sec.

Repetition Rate—0.1 cps to 10 kc, recurrent operation.

Amplitude

Pulse and gate—50 volts positive from ground.

Sawtooth—decreases linearily with time from +150 volts to approximately +20 volts.

Cathode-Follower Outputs

Trigger Requirements

Positive pulse—12 volts peak-to-peak minimum.

Gate—8 volts, peak-to-peak minimum.

Sine wave—6 volts rms, frequency from 5 cps to 50 kc. At frequencies below 5 cps, the product of rms voltage times frequency must exceed 10.

Power Requirements

—170 v dc at 7 ma. +150 v dc at 1 ma.
+225 v dc at 28 ma. 6.3 v ac at 1.7 amps.

GENERAL DESCRIPTION

The Type 162 Waveform Generator produces three types of calibrated positive output waveforms. Both the duration and repetition rate of the output waveforms—pulse, gate, and negative-going positive sawtooth—are adjustable. Triggering can occur from an external electrical impulse or by front-panel push button. An excellent trigger source is the Type 161 Pulse Generator or the Type 163 Fast-Rise Pulse Generator. The unit is designed to operate as a delay generator in conjunction with one of these instruments, and to supply a sweep voltage for the Type 360 Indicator Unit. It is useful for initiating chains of events electrically, for controlling their duration and repetition rate, and for generating waveforms recurrently. As such it is a stable repetition rate generator.

Amplitude of the pulse and gate waveforms is 50 volts, with minimum risetime of 1 μsec. Amplitude of the sawtooth waveform decreases linearly from +150 volts to +20 volts. A calibrated control indicates waveform duration. Shortest pulse duration is approximately 10 μsec.

PULSE GENERATOR

GENERAL DESCRIPTION

The Type 161 Pulse Generator produces two types of calibrated rectangular output pulses when an external trigger of required voltage is received. Both the duration and amplitude of the output pulse—negative-going sawtooth or positive pulse—are adjustable. An excellent trigger source is the Type 162 Waveform Generator.

When triggered by a negative-going sawtooth, the output pulse and gate can be adjusted to occur at any designated point along the sawtooth. A calibrated control indicates output delay as a fraction of the triggering sawtooth duration. Other calibrated controls indicate pulse and gate width (in milliseconds) and pulse amplitude (in volts). When triggered by a positive pulse, the same output waveforms are available. In this instance the delay control functions as a triggering-level selector.

Voltages necessary to operate the Type 161 can be obtained from the Type 160A Power Supply (for up to seven instruments), or the Type 126 Power Supply (for a single instrument).

ELECTRON-TUBE COMPLEMENT

Comparator	12AU7
Regenerative amplifier	12AT7
Coupling diode and mulitivibrator	12AT7
Multivibrator and + pulse amplifier	12AT7
Negative-pulse amplifier	6DJ8

MECHANICAL SPECIFICATIONS

Mounting—fits the Type FA160 Mounting Frame for rack-mounting, or the Type 126 Power Supply cabinet for separate housing.

Construction—aluminum-alloy chassis.

Finish—photo-etched anodized front panel, etched chassis.

Dimensions—12 1/4" high by 4 1/8" wide by 7 1/2" deep.

Weight: Net—3 1/2 pounds.
Shipping—7 pounds appr.

Price **$125**

Includes: 1—W160-10 connecting cable (012-017)
1—Set mounting screws and cup washers
1—Instruction manual

WAVEFORM GENERATOR

Voltages necessary to operate the Type 162 can be obtained from the Type 160A Power Supply (for up to seven instruments), or the Type 126 Power Supply (for a single instrument).

ELECTRON-TUBE COMPLEMENT

Regenerative trigger	12AU7
Trigger amplifier and multivibrator	12AU7
Multivibrator and pulse and gate shaper	12AU7
Phantastron	6BH6
Pulse and gate amplifier and sawtooth CF	12AU7
Pulse and gate CF and catching diode	12AU7

MECHANICAL SPECIFICATIONS

Mounting—fits the Type FA160 Mounting Frame for rack-mounting, or the Type 126 Power Supply cabinet for separate housing.

Construction—aluminum-alloy chassis.

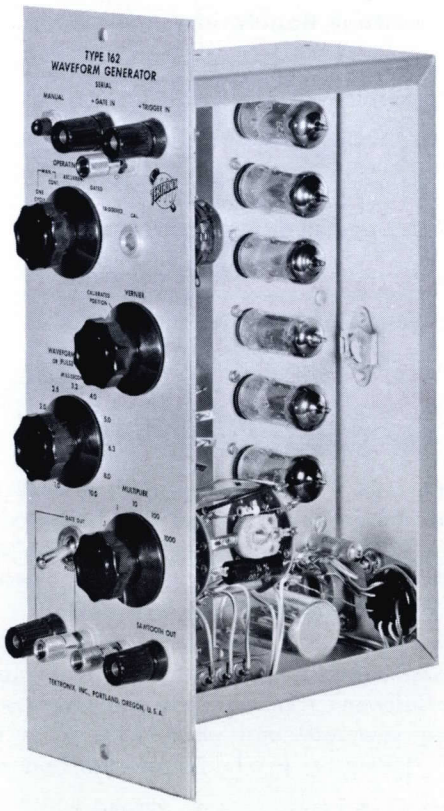
Finish—photo-etched anodized front panel, etched chassis.

Dimensions—12 1/4" high by 4 1/8" wide by 7 1/2" deep.

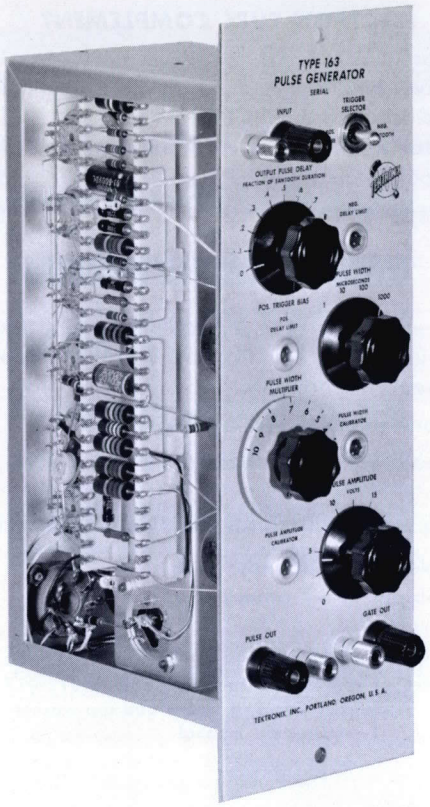
Weight: Net—3 1/2 pounds.
Shipping—7 pounds appr.

Price **$125**

Includes: 1—W160-10 connecting cable (012-017)
1—Set mounting screws and cup washers
1—Instruction manual



TYPE 163



Output Waveform

Variable-amplitude positive pulse.

Fixed-amplitude positive gate.

Output Characteristics

Risetime—less than 0.2 μsec (without load capacitance), overshoot can be adjusted to zero.

Duration—calibrated, variable, 1 μsec to 10,000 μsec.

Delay—continuously variable, 0 to 100% of triggering sawtooth duration.

Decay Time—0.2 to 0.5 μsec.

Amplitude Peak-to-Peak

Pulse—calibrated, continuously variable, 0 to 25 v.

Gate—fixed, 25 v.

Cathode-Follower Outputs

Trigger Requirements

Positive pulse, 2 v peak-to-peak minimum.

Negative-going sawtooth; must include dc bias sufficient to keep voltage positive.

Power Requirements

—170 v dc at 26 ma. +225 v dc at 45 ma.
6.3 v ac at 3.6 amp.

TYPE 126

Electronic Voltage Regulation

Output Voltages

+300 v dc, unregulated.

+225 v dc, regulated, 45 ma maximum.

+150 v dc, regulated, 5 ma maximum.

—170 v dc, regulated, 30 ma maximum.

6.3 v ac, unregulated, 4 amps maximum.

GENERAL DESCRIPTION

The Type 126 Power Supply and cabinet provide power and housing for one Type 360 Indicator or any one of the Type 160 Series Generators. The compact supply mounts beneath the unit to be powered and adds only 2½" in height.

A Type 126 Power Supply combined with a Type 360 Indicator makes a compact slave unit for any Tektronix oscilloscope. (The oscilloscope has the necessary sweep sawtooth and unblanking pulse for the Type 360 Indicator available at front-panel connectors.)

ELECTRON-TUBE COMPLEMENT

Rectifiers	2	6BW4
Regulator amplifier		6AU6
Regulator amplifier and voltage regulator CF		6AN8
Series regulators	2	12B4
Voltage reference		5651

MECHANICAL SPECIFICATIONS

Construction—aluminum-alloy chassis.

Finish—photo-etched anodized front panel, blue wrinkle-finish cabinet.

Dimensions—2½" high by 4⅛" wide by 15½" deep. Height of the cabinet is 14¾".

Power Requirements—105 to 125 volts, or 210 to 250 volts, 50 to 60 cycles, 50 watts.

Weight: Net—7 pounds.
With cabinet—11 pounds.
Shipping—20 pounds appr.

Price **$100**

Includes: 1—Cabinet
1—3-conductor power cord (161-010)
1—Instruction manual

FAST-RISE PULSE GENERATOR

GENERAL DESCRIPTION

The Type 163 Fast-Rise Pulse Generator produces two types of calibrated rectangular output pulses of less than 0.2 μsec risetime. These two—a variable pulse and a fixed gate—occur when an external source provides the proper trigger voltages (a negative-going sawtooth and a positive pulse).

An excellent trigger source is the Type 162 Waveform Generator.

When triggered by a negative-going sawtooth, the output pulse and gate can occur at any designated point along the sawtooth. A calibrated control indicates output delay as a fraction of the triggering sawtooth duration. Other calibrated controls indicate pulse and gate width (in microseconds) and pulse amplitude (in volts).

The Type 163 operates up to 50% duty cycle at the minimum time setting on any range. With higher multiplier-control settings, the duty cycle is correspondingly higher. Maximum repetition rate is 500 kc—with a generated pulse of 1 μsec duration.

Voltages necessary to operate the Type 163 can be obtained from the Type 160A Power Supply (for up to five instruments), or the Type 126 Power Supply (for a single instrument).

ELECTRON-TUBE COMPLEMENT

Comparator and pulse amplifier		6U8
Regenerative trigger amplifier		6U8
Disconnect diode and charge diode		6AL5
Monostable multivibrator	2	12BY7
Output CF		6BQ7A

MECHANICAL SPECIFICATIONS

Mounting—fits the Type FA160 Mounting Frame for rack-mounting, or the Type 126 Power Supply cabinet for separate housing.

Construction—aluminum-alloy chassis.

Finish—photo-etched anodized front panel, etched chassis.

Dimensions—12 1/4" high by 4 1/8" wide by 7 1/2" deep.

Weight: Net 3 1/2 pounds.
Shipping—7 pounds appr.

Price **$125**

Includes: 1—W160-10 connecting cable (012-017)
1—Set mounting screws and cup washers
1—Instruction manual

POWER SUPPLY

Type 126 with Type 360 Indicator

MAIN FEATURES

GENERAL DESCRIPTION

The Type 360 Indicator Unit in combination with the Type 126 Power Supply forms a compact unit, as shown on the preceding page. In combination with Type 160-Series generators, the Type 360 becomes an integral building block in a complex sequence control and monitoring system. As such, it can supplant a bulkier general-purpose oscilloscope in single monitoring applications.

Several indicators can be driven by a single Type 162 Waveform Generator. The Type 162, an indicator, and a Type 161 Pulse Generator provide calibrated sweep delay. The indicator used with a Type 122 Preamplifier permits low-level applications and increases the sensitivity of the unit to 50 microvolts per division.

The compact indicator contains a flat-faced, 3-inch cathode-ray tube, accelerating-voltage supply, vertical amplifier and a calibrated vertical attenuator, among other features. It is designed to receive its sweep and unblanking voltages from a Type 162 Waveform Generator.

The Type 360 Indicator Unit will operate effectively with the Type 126 Power Supply for simple applications that require a compact separately-housed unit. The Type 160A Power Supply (or its predecessor, the Type 160 Power Supply) is recommended for more complex applications that require a compact rack-mounted combination. Any source of proper voltage and waveforms can power the indicator. In system use, up to five Type 360 Indicator Units can operate from a single Type 160A Power Supply, (or up to three indicators from the earlier Type 160 Power Supply).

Vertical-Deflection System

Input Impedance—

Direct, 1 megohm paralleled by approximately 40 pf.

Probe, 10 megohms paralleled by approximately 14 pf.

Frequency Response—

dc to 500 kc.

Deflection Factor—

0.05 volts/div to 50 volts/div.
4 calibrated steps.

Continuously variable between steps, and to approximately 500 volts/div.

Maximum Input Voltage—

600 volts (dc plus peak ac).

Horizontal-Deflection System

Waveforms Required—

Positive or negative-going sawtooth, 110 to 150 volts excursion within the limits of —95 volts to +170 volts.

Gate, 45 to 75 volts positive same duration as the sawtooth.

Frequency Response—

dc to 100 kc.

Power Requirements—

DC Power

+300 volts at 20 ma (unregulated)
+225 volts at 35 ma (regulated)
—170 volts at 23 ma (regulated).

AC Power

6.3 volts at 3.5 amps.

VERTICAL-DEFLECTION SYSTEM

DC-Coupled Amplifier—Main vertical passband is dc to 500 kc. Frequency-compensated rc attenuators are switched into the amplifier input circuit by the VOLTS/DIV switch. Two attenuators are used singly or cascaded to produce four calibrated sensitivities in steps of 0.05, 0.5, 5, and 50 volts/div. A vernier control provides for continuously variable adjustment between steps, and to approximately 500 volts/div.

Signal Input—A front-panel coaxial connector is provided for the input signal. Input impedance is 1 megohm paralleled by approximately 40 pf.

AC-DC Switches—A toggle switch is provided to insert or remove coupling capacitor for ac-coupled or dc-coupled operation.

Probe—One low-capacitance probe is supplied with the indicator. It provides an additional ten-times attenuation and reduces the loading on the circuit under test.

Vertical Gain—A screwdriver front-panel adjustment is provided to calibrate the gain of the vertical amplifier.

HORIZONTAL-DEFLECTION SYSTEM

The Type 162 Waveform Generator, any Tektronix oscilloscope, or any other source of proper waveforms

INDICATOR UNIT

at the necessary dc levels, is required to supply the waveforms for the horizontal deflection system.

Input Waveforms—The horizontal amplifier will accommodate either a positive-going or a negative-going sawtooth and the total sawtooth excursion and dc level can vary within limits. The minimum sawtooth excursion is about 110 volts, and the excursion must be within the range of −95 volts to +170 volts. The maximum practical sawtooth excursion is about 150 volts, and the excursion must be within the range of −90 volts to +160 volts. Necessary for unblanking is a 50-volt positive pulse with the same duration as the sweep waveform.

Horizontal Calibration—A screwdriver front-panel adjustment is provided to calibrate the sweep.

OTHER CHARACTERISTICS

Cathode-Ray Tube—A flat-faced, 3-inch cathode-ray tube, Type 3WP__, provides a bright trace. Accelerating potential is 1.8 kv. The phosphor normally supplied with the instrument is a P2, but a P1, P7, or P11 will be furnished instead, if requested.

DC-Coupled Unblanking—The external unblanking waveform, dc-coupled to the grid of the crt, assures uniform bias for all sweep speeds and repetition rates at any setting of the intensity control.

Illuminated Graticule—Edge-lighting of the graticule is adjusted by the SCALE ILLUM. control. Display area of the graticule is marked in eight vertical and ten horizontal one-fourth inch major divisions. Centerlines are further marked in five minor divisions per major division.

Positioning Controls—Separate knobs for vertical and horizontal positioning are provided on concentric controls.

ELECTRON-TUBE COMPLEMENT

Vertical input amplifiers	2	6AU6
Vertical output amplifiers	2	6AU6
Voltage setting CF and horizontal amplifier		6AN8
Horizontal feedback amplifier		6AU6
High-voltage oscillator		6AQ5
High-voltage regulator		12AT7
High-voltage rectifiers	2	5642
Cathode-ray tube		3WP2

MECHANICAL SPECIFICATIONS

Mounting—fits the Type FA160 Mounting Frame for rack-mounting, or the Type 126 Power Supply cabinet for separate housing.

Construction—aluminum-alloy chassis.

Finish—photo-etched anodized front panel, blue wrinkle-finish cabinet.

Size—12½" high by 4⅛" wide by 16" deep.

Weight: Net—9 pounds.
Shipping—17 pounds appr.

Price **$250**

Includes: 1—Cabinet
1—10X attenuator probe
1—W160-20 connecting cable (012-016)
1—Instruction manual

Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).

NOTES

Tektronix, Inc. P. O. Box 500 • Beaverton, Oregon Printed in U. S. A.

TIME-MARK and SINE-WAVE GENERATORS

TYPE 180 A P-2

TYPE 181 . . . . . P-4

TYPE RM181 . . . . . P-5

TYPE 190A P-6

4/60

MAIN FEATURES

14 Time-Mark Intervals
Two per decade from 1 μsec to 5 sec, available separately or in combinations as a timing comb.

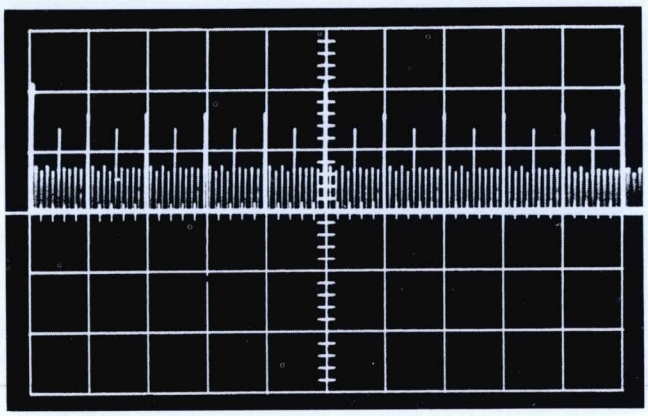
Three Sine-Wave Frequencies
5 mc, 10 mc, and 50 mc.

Six Trigger-Rate Frequencies
1, 10, 100 cycles, 1, 10, 100 kc.

Accuracy Within 0.001 %
Stability of 3 ppm over a 24-hour period.

GENERAL DESCRIPTION

The Type 180A Time-Mark Generator is a high-quality source of time markers, sine waves and trigger impulses. Fourteen time markers, 3 sine-wave frequencies and 6 trigger-rate frequencies provide instrument versatility for a large number of applications in the laboratory or on the production line. With its frequency accuracy of .001% and stability of 3 ppm, the Type 180A is an ideal calibrating source for oscilloscope sweeps, oscillators, and counters. It can also be used as a time-measuring instrument and as a trigger-rate generator. Markers can be presented separately or mixed into a timing-comb combination.



Timing comb formed by a combination of 100, 500 μsec, 1, and 5 msec markers. Sweep time/cm, 1 msec.

CHARACTERISTICS

Time Markers—Time markers occur at intervals of 1, 5, 10, 50, 100, 500 μsec, 1, 5, 10, 50, 100, 500 millisec, 1 sec and 5 sec. Markers are available separately and simultaneously through banana jacks, or mixed into a timing combination through a push-button arrangement and available at a coaxial connector.

Sine Waves—Push-button switches connect the sine-wave frequencies of 5 mc, 10 mc or 50 mc to the output connector. Output is 3 volts minimum across 52 ohms.

Trigger-Rate Generator—Trigger-rate frequencies of 1, 10, 100 cycles, 1, 10, and 100 kc are derived from the dividing multivibrators. Output is through a front-panel coaxial connector.

Stability—All outputs are derived from a 1-mc crystal-controlled oscillator with a frequency tolerance of about 0.001%. The 1-mc crystal is mounted in a temperature-stabilized oven and a trimmer capacitor provides a means of adjusting the crystal frequency to zero beat with W.W.V. Stability is within 3 parts per million over a 24-hour period.

Regulated Power Supply—Electronically-regulated dc supplies insure stable operation over line-voltage and load variations between 105 and 125 v or 210 and 250 v, 50-60 cycles.

ELECTRON TUBES AND SEMICONDUCTORS

* denotes "or equivalent"

Oscillator and Cathode follower		6AN8
Frequency multipliers	3	6DK6
Trigger cathode follower		5965
Cathode follower and buffer		6AN8
Divider multivibrators	13	5965
Coupling diode and clamp	13	6AL5
Marker cathode follower	12	12AU7
Marker cathode follower & —17 v bias		12AU7
Rectifiers	12	1N2070*

TIME-MARK GENERATOR

Series regulator		6080
Series regulator	2	12B4
Regulator amplifier	2	6AU6
Difference amplifier		6AN8
Voltage reference		5651

MECHANICAL SPECIFICATIONS

Ventilation—Filtered, forced-air ventilation assures safe operating temperature. A minimum of 2" of unobstructed clearance around the instrument is recommended for adequate ventilation.

Construction—Aluminum-alloy chassis and 3-piece cabinet.

Finish—Photo-etched anodized front panel, blue wrinkle-finished cabinet.

Dimensions—9 ¾" wide, 13 ½" high, 17" deep.

Weight: Net—31 pounds
Shipping—43 pounds appr.

Power Requirements—105-125 v or 210-250 v, 50-60 cycles, 240 watts.

Price **$575**

Includes: 2—P93 output cables
1—Clip-lead adapter (013-003)
1—3-conductor power cord (161-010)
1—Instruction manual

Rack Mount Adapter

A cradle mount to adapt the Type 180A Time-Mark Generator for rack mounting is available. It consists of a cradle to support the instrument in any standard 19" relay rack and a mask to fit around the regular instrument panel. Tektronix blue wrinkle finish. Rack height requirements 17 ½".

ORDER PART NO. 040-193 . . . . . $45.00

Prices f.o.b. factory. (Please refer to **Terms and Shipment**, **GENERAL INFORMATION** page.)

Nominal Voltage, Impedance and Risetime Values

	Open Circuit Voltage	Impedance at Half-Voltage	Risetime *	Open Circuit Voltage (jacks)	Impedance
Markers	3 volt minimum	390 Ω or less	varies from 0.07 μsec at 1 μsec to 1.7 sec at 5 seconds	25 volts minimum Using a P6000 probe	390 Ω at 1 μsec to 680 Ω at 5 seconds
Trigger Pulses	6 volt minimum	56 Ω or less	0.08 μsec at 100 kc to 0.30 μsec at 1 cps		
Sine Waves	3 volt minimum across 52-ohms				

* With MARKER OUT and TRIGGER OUT terminated in 93 Ω

TYPE 181 TIME-MARK GENERATOR

Five Time-Mark Intervals
1, 10, 100, 1000, and 10,000 microseconds, plus 10-mc sine wave.

Small Size
8¾" high, 5⅝" wide, 17½" deep.

Low Weight
Only 17½ pounds.

GENERAL DESCRIPTION

The Type 181 provides accurate markers that can be displayed on an oscilloscope for sweep calibration or comparison time measurements. All six outputs are available at a common coaxial connector through use of a selector switch. The five time-markers are also available separately at front-panel binding posts for convenient utilization as trigger impulses, or for other purposes.

All outputs are derived from a 1-mc crystal-controlled oscillator with a frequency tolerance of about 0.03% and after initial warmup, a short time stability of about 0.005% per hour. For applications requiring greater stability, a directly interchangable crystal is availible as an accessory. This plug-in crystal is mounted in a temperature-controlled oven, and provides a stability of 2 parts per million over a 24-hour period.

OTHER CHARACTERISTICS

Nominal Output Values

Marker	Amplitude	Risetime	Impedance
0.1 μsec	2 v	sine wave	150 ohms
1 μsec	2 v	0.05 μsec	80 ohms
10 μsec	2 v	0.13 μsec	80 ohms
100 μsec	2 v	0.2 μsec	80 ohms
1000 μsec	2 v	0.4 μsec	80 ohms
10,000 μsec	2 v	0.4 μsec	80 ohms

Regulated Power Supply—DC voltages are electronically regulated to compensate for line-voltage and load variations between 105 and 125 v or 210 and 250 v.

Power Requirements—105 to 125 or 210 to 250 volts, 50 to 60 cycles, 100 watts.

ELECTRON-TUBE COMPLEMENT

Oscillator		6AU6
Shaper and multiplier		6AN8
Buffer and amplifier		6AN8
Disconnect and limiting diodes	4	6AL5
Frequency dividers	4	6BQ7A
Output CF	2	12AU7
Rectifier		6AX5
Rectifier		6X4
Voltage reference		5651
Regulator amplifiers	2	6AU6
Series regulators	2	12B4

MECHANICAL SPECIFICATIONS

Construction—Aluminum-alloy chassis.
Finish—Photo-etched anodized panel, blue wrinkle-finished cabinet.
Size—10½" high, 6⅞" wide, 18" deep.
Weight: Net—17½ pounds
Shipping—24 pounds appr.

Type 181 ..... **$240**
Includes: **1—P93 output cable**
1—W130B lead (012-014)
1—W130R lead (012-015)
1—3-conductor power cord (161-010)
1—Instruction manual

Type 181, with Type CO181A Crystal-Oven Combination installed, ... **$260**

Recommended Additional Accessories

Type CO181A Crystal-Oven Combination—A 1-mc crystal mounted in a temperature-stabilized oven. Directly interchangeable with standard crystal. Plugs into crystal socket of the Type 181—no wiring changes necessary. A trimmer capacitor provides a means of adjusting the crystal frequency to zero beat with W.W.V. Accuracy is 0.001% and frequency stability is 3 parts per million over a 24-hour period.
ORDER PART NO. 158-007 ..... $27.00

Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page.)

TYPE RM181 RACK-MOUNTING TIME-MARK GENERATOR

GENERAL DESCRIPTION

The Type RM181 is a mechanically rearranged Type 181 Time-Mark Generator for mounting in a standard 19-inch rack. The instrument is fastened to the front of the rack by four screws. It requires only 5¼ inches of rack height.

OTHER CHARACTERISTICS

Electrical characteristics of the Type RM181 are the same as described for the Tektronix Type 181 Time-Mark Generator. Outputs are: 1, 10, 100, 1000, 10,000 microseconds, and a 10-mc sine wave.

MECHANICAL SPECIFICATIONS

Construction — Aluminum-alloy chassis.

Finish — Photo-etched anodized panel.

Dimensions — 5¼" high, 19" wide, 9¼" rack depth (approximately 3" additional required for power cord), 11" overall depth.

Weight: Net—18 pounds
Shipping—33 pounds appr.

Type RM181 ..... **$265**

Includes: 1—P93 output cable
1—W130B lead (012-014)
1—W130R lead (012-015)
1—Set mounting hardware
1—3-conductor power cord (161-010)
1—Instruction manual

Type RM181, with Type CO181A Crystal-Oven Combination installed, ... **$285**

Recommended Additional Accessories

Type CO181A Crystal-Oven Combination — A 1-mc crystal mounted in a temperature-stabilized oven. Directly interchangeable with standard crystal. Plugs into crystal socket of the Type RM81—no wiring changes necessary. A trimmer capacitor provides a means of adjusting the crystal frequency to zero beat with W.W.V. Accuracy is 0.001% and frequency stability is 3 parts per million over a 24-hour period.

ORDER PART NO. 158-007 ..... $27.00

Prices f.o.b. factory. (Please refer to **Terms and Shipment**, ***GENERAL INFORMATION*** page.)

MAIN FEATURES

GENERAL DESCRIPTION

The Tektronix Type 190A supplies a constant-amplitude sine-wave signal over the frequency range of 350 kc to 50 mc. In addition, it supplies a 50-kc sine-wave output for reference purposes. Principal application of this instrument is the measurement of high-frequency response and other characteristics of wide-band amplifiers, attenuators, and delay networks.

The Type 190A is housed in an attractive three-piece cabinet, designed for easy access to the interior of the instrument. All controls are located for maximum operator convenience. The attenuator is a separate unit, connecting to the main unit through a 36" cable.

Amplitude Variation

When load resistance is at least 52 ohms, and when the load-shunt capacitance does noe exceed 10 pf, the output amplitude varies less than ±2% from 50 kc to 30 mc; less than ±5% from 30 mc to 50 mc. Peak-to-peak level of the output signal at the input to the attenuator is indicated on the amplitude meter. The Output Amplitude control sets the amount of signal voltage applied to the input of the external attenuator head. The signal voltage at the attenuator-head input is automatically held constant at the value you select by means of the Output Amplitude control. Therefore, you don't have to readjust the Output Amplitude control when you change the generator frequency. The output source impedance of the attenuator head varies with attenuator setting approximately as follows:

Output impedance

Nominal, 52 ohms. Actual values:

Attenuator setting volts, peak-to-peak	Output impedance in ohms, approx.
10	0
5	39
2.5	49
1.0 to .1	52

Output Frequency

Continuously variable from 350 kc to 50 mc in 6 ranges. Additional setting at 50 kc, variable over a narrow band. Indication accurate within 2%.

Output Amplitude

Continuously variable from 40 millivolts to 10 volts peak-to-peak in 7 ranges. Amplitude indication accurate within 10% of full scale.

Harmonic Content

Maximum harmonic content is not specified. The harmonic content on a typical instrument will not exceed 5%.

Regulated Power Supply

Electronic regulation compensates for line-voltage and load variations between 105 and 125 v or 210 and 250 v.

ELECTRON-TUBE COMPLEMENT

Oscillator		6C4
Meter amplifier		12AU7
Compensating diode		6AL5
Sampling diode		6110
Voltage regulator		0B2
Regulator amplifiers	2	6AU6
Series regulator		12AU7
Power rectifier		5Y3G

SINE-WAVE GENERATOR

MECHANICAL SPECIFICATIONS

Size—9 ¾" wide, 13 ½" high, 11" deep. Attenuator unit—2 ⅝" x 2 ¼" x 2". Connecting cable—36" long.

Weight: Net—24 pounds
Shipping—36 pounds appr.

Construction—Aluminum alloy.

Finish—Photo-etched anodized panel, blue wrinkle-finished cabinet.

Power Requirements—105-125 v, or 210-250 v, 50-60 cycles, 100 watts.

Price **$300**

Includes: 1—Attenuator unit
1—3-conductor power cord (161-010)
1—Instruction manual

Rack Mount Adapter

A cradle mount to adapt the Type 190A Signal Generator for rack mounting is available. It consists of a cradle to support the instrument in any standard 19" relay rack and a mask to fit around the regular instrument panel. Tektronix blue wrinkle finish. Rack height requirements 15 ½".

ORDER PART NO. 040-193 ..... $45.00

Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page.)

NOTES

Tektronix, Inc. P. O. Box 500 • Beaverton, Oregon Printed in U. S. A.

ACCESSORIES

FOR TEKTRONIX INSTRUMENTS

6/60

MOBILE OSCILLOSCOPE TABLES

Type 500/53A

The Tektronix Type 500/53A Scope-Mobile is a sturdy, mobile support for Tektronix 5" Oscilloscopes. Convenient observation of the crt face is achieved by a 20-degree backward tilt of the top surface. The front panel has two supporting cradles to accommodate Tektronix Preamplifier Plug-In units. A drawer, felt-lined and operating on roller bearings, provides handy storage for probes, cables, manuals etc. An open shelf, 14 5/8" wide, 12 1/2" high, and 23 5/8" deep, topped with tough linoleum, is located at the bottom. Power input and three convenience outlets are mounted at the rear. Total weight is 35 pounds. Dimensions are 17 3/4" wide, 38" high and 27" deep. Space requirements for height and depth will vary with the type of instrument being used.

Includes: 1—3-conductor power cord (161-014)

Type 500/53A **$110.00**

Scope-Mobile Panel—for Type 500A Scope-Mobiles. Converts the Type 500A to a Type 500/53A by replacing the standard blank panel.

ORDER PART NO. 014-005 ..... $10.50

Type 500A

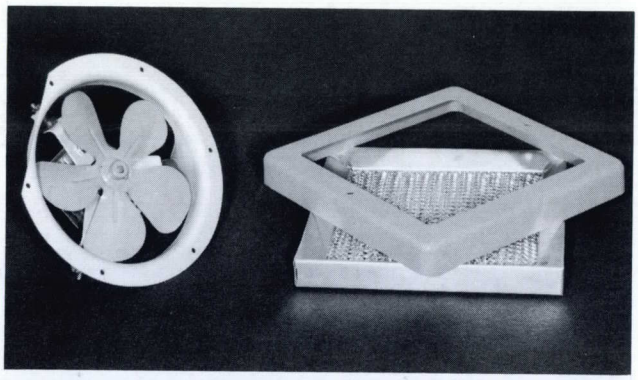
The Tektronix Type 500A Scope-Mobile is identical to the Type 500/53A, except for the front panel. Auxiliary equipment can be mounted behind the blank front panel in a space 13 3/4" wide, and 8 1/2" high for the first 5 1/2" of depth and tapering in height from this point, on a 20 degree angle to a minimum height of 2 1/2" at a depth of 19 1/2". It will usually be necessary to provide forced-air ventilation for the equipment compartment. A fan kit, 040-161, is recommended for this purpose.

Includes: 1—3-conductor power cord (161-014)

Type 500A **$100.00**

Scope-Mobile Panel—For Type 500 Scope-Mobiles only. Converts the earlier Type 500 model to a Type 500/53 by replacing the standard blank panel.

ORDER PART NO. 014-004 ..... $10.50



Scope-Mobile Fan Kit—for forced-air ventilation of the equipment compartment of the Type 500A Scope-Mobile. Provides an air flow of 84 cfm with the Scope-mobile drawer in place. With the drawer removed and a panel covering the drawer opening, the air flow is increased to 94 cfm. Contains motor, 5" blade, filter and mounting hardware.
ORDER PART NO. 040-161 ..... $15.00

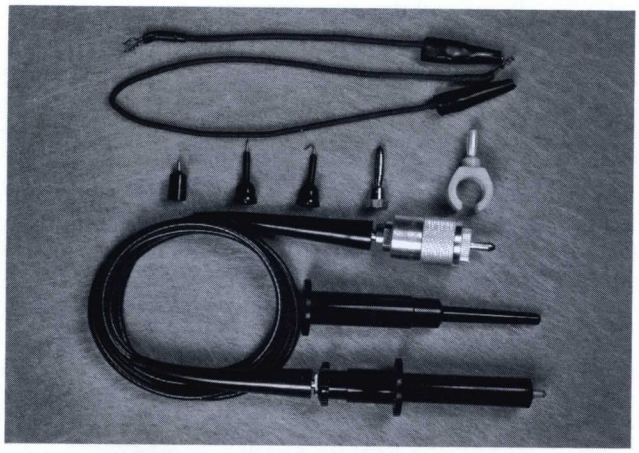
Scope-Mobile Trays For Type 500A and 500/53A Scope-Mobiles

Two sizes available. When installed on a Type 500A or 500/53A Scope-Mobile, each size furnishes a secure positioning mount for a type of Tektronix oscilloscope, smaller in size than those for which the Scope-Mobile was originally designed. Trays are installed with 2 self-tapping screws. Requires drilling of two #36 holes.

For Type 503, 504, 515A and 516
ORDER PART NO. 436-017 ..... $7.50

For Type 502 Oscilloscope
ORDER PART NO. 436-016 ..... $7.50

PROBES



Low-Capacitance High-Performance Probe—The P6000 to P6005 probes preserve the transient response of Tektronix fast-rise, wide-bandpass instruments. These probes are free of overshoot and ringing and have uniform frequency response. They are easy to handle, of rugged construction, and weigh about one ounce. Compensation is accomplished by the rotation of a tubular capacitor; no tools are necessary.

Physical dimensions of the probe body are 7/16 inch in diameter and 3⅝ inches in length without the tip. The standard cable length is 42 inches.

Five interchangeable tips—two straight, one hooked, one pincher, and one banana tip are included with the probe. A 5-inch and a 12-inch ground lead are also included.

PROBE SPECIFICATIONS

PROBE With 42-inch cable	CON-NECTOR	RATIO ATTEN.	PART NO.	INPUT IMPEDANCE			DB Loss	Voltage Rating (Max.)	PRICE
				Resist. Meg Ω	Capacitance—pf Min. *	Max. **			
P6000 P6003	UHF BNC	10X	010-020 010-027	10	11.5	14.5	1.2 at 30 mc.	1200	$19.50
P6001 P6004	UHF BNC	1X	010-023 010-028	1	68	95	3 at 15 mc	600	19.50
P6002 P6005	UHF BNC	100X	010-024 010-029	9.1	2.5	2.8	1.2 at 30 mc	2000	21.50

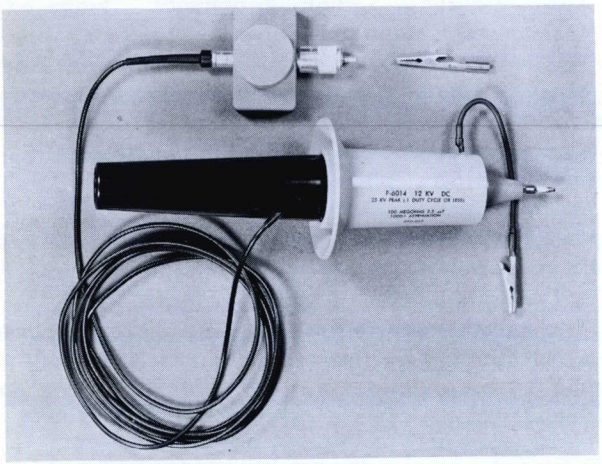
* When connected to instruments with 20 pf input capacitance.
**When connected to instruments with input capacitance up to 50 pf.

ACCESSORIES

P6000 to P6005 probes with 6, 9, or 12-foot cable are also available to fill those applications where long-cable probes are necessary. Insertion loss is an additional 3 db at 20 mc for cables up to 12 ft.

PROBE SPECIFICATIONS

PROBE	CABLE LENGTH	CON-NECTOR	PART NO.	INPUT CAPACITANCE Min—pf	Max—pf	PRICE
P6000 P6003	6 ft.	UHF BNC	010-030 010-031	12.5	15.5	$20.50
P6000 P6003	9 ft.	UHF BNC	010-035 010-045	15.0	18.0	21.75
P6000 P6003	12 ft.	UHF BNC	010-041 010-046	17.5	20.0	23.00
P6001 P6004	6 ft.	UHF BNC	010-032 010-047	94	121	20.50
P6001 P6004	9 ft.	UHF BNC	010-033 010-048	120	147	21.75
P6001 P6004	12 ft.	UHF BNC	010-042 010-049	146	173	23.00
P6002 P6005	6 ft.	UHF BNC	010-034 010-050	2.8	3.25	22.50
P6002 P6005	9 ft.	UHF BNC	010-043 010-051	3.5	4.0	23.75
P6002 P6005	12 ft.	UHF BNC	010-044 010-052	3.8	4.0	25.00



The Type P6014 High-Voltage Probe—This new probe provides a means of observing, on an oscilloscope, waveforms of high amplitudes and relatively short duty cycle. DC amplitudes up to 12 kv or short pulses with peak amplitudes up to 25 kv can be measured without damage to the probe.

Attenuation Ratio—1000 to 1.

Frequency Response—dc to over 30 mc.

Input Impedance—10 megohms and 3 pf.

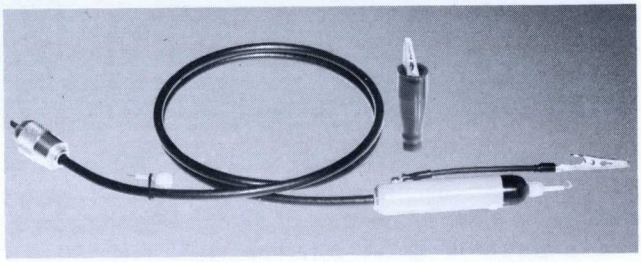
Pulse Rating—10% or less duty cycle with maximum pulse duration of 0.1 sec.

A compensating box on the oscilloscope end enables the P6014 probe to be properly compensated to any oscilloscope having an input capacitance of 20 to 47 pf. The probe introduces no ringing or overshoot.

Probe body length is 12 inches, coaxial cable length is 10 feet.

The probe includes 2 banana-plug tips, an alligator-clip assembly, and an attached 7½ inch ground lead.

P6014, PART NUMBER 010-025 . . . . . $50.00



P510A Attenuator Probe—Provides an attenuation of ten times when used with Tektronix oscilloscopes and amplifiers. The P510A is small and streamlined, and presents an input impedance of 10 megohms paralleled by 14 pf. The probe is completely insulated—made of high-impact-strength fiberglass-reinforced alkyd — and has an internal brass shield. Two interchangeable Tek-tips—a straight tip and a hooked tip, and an alligator clip assembly are furnished. Probe has a 42" cable with coaxial connector, and is rated at 600 v maximum.

P510A, PART NUMBER 010-001 . . . . . 8.50

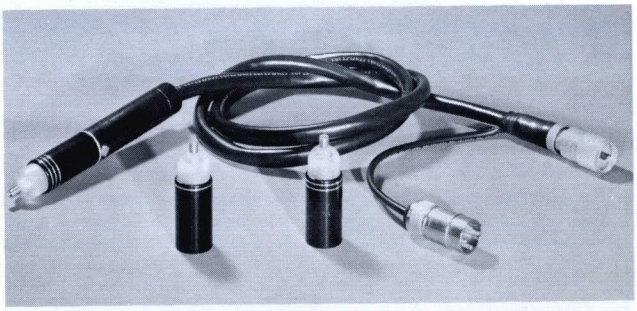
P510A PROBES WITH LONG CABLES

P510A probe cables ring at a period that depends on the cable length and, to a lesser degree, on the input capacitance of the oscilloscope used. Each particular cable length will be satisfactory only when zero transmission of the oscilloscope does not extend to a frequency that includes the resonant frequency of the probe.

P510A with 6′ cable, Tek 010-004 . . . . . 9.00

P510A with 8′ cable, Tek 010-005 . . . . . 9.50

Prices for P510A Probes with other cable lengths available on request.



P170CF Cathode-Follower Probe—Developed for use with the Type 517 Oscilloscope. The cathode-follower tube is a 5718 triode whose cathode load is the 170-ohm termination of the preamplifier grid line in the Type 517. Plate and heater voltages for this tube are provided at a four-terminal socket on the panel of the oscilloscope. The signal is attenuated by 2 times when

using the P170CF. The input impedance of the probe will depend on the attenuator head being used, also since transit time in the cathode-follower tube is involved, it will decrease appreciably at the higher frequencies. When the probe is used without an attenuator head, the input looks like 12 megohms shunted by 5 pf. The probe cable is 42" long. Probe complete with 3 attenuator heads.

ORDER PART NO. 010-101 ..... $86.00

REPLACEMENT ATTENUATOR HEADS

PAX-I Attenuator Head for P170CF, attenuation can be varied between 4 times and 40 times.

ORDER PART NO. 010-301 ..... $11.00

PAX-II Attenuator Head for P170CF, attenuation can be varied between 20 times and 200 times.

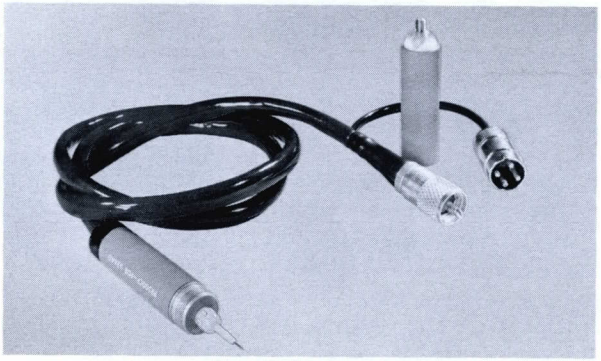
ORDER PART NO. 010-302 ..... $11.00

PAX-III Attenuator Head for P170CF, attenuation can be varied between 200 times and 2000 times.

ORDER PART NUMBER 010-303 ..... $11.00

P170CF can be used with the Type 513 Oscilloscope, but low-frequency response will suffer somewhat, depending on the attenuator head being used. It is necessary to terminate the 170-ohm cable at the oscilloscope input. The Tektronix 011-016, 170 ohm, 0.5 w terminating resistor is designed for this. (See terminations.) A rectifier kit is recommended for installation in Type 513 to rectify the 6.3 volt heater supply.

ORDER PART NO. 040-044 ..... $4.50



P500CF Cathode-Follower Probe—Presents low capacitance with minimum attenuation. Input impedance is 40 megohms paralleled by 4 pf, gain 0.8 to 0.85. Input to probe is ac-coupled, limiting its low-frequency response to 5 cycles. Amplitude distortion is less than 3% on unidirectional signals up to 5 volts. 10x attenuator head is included with probe, and should be used on signals exceeding a few volts to minimize amplitude distortion. With the attenuator head attached, the probe input impedance is approximately 10 megohms paralleled by 2 pf. Probe output level is 11 v positive, making it necessary to use the ac-coupled position of the oscilloscope AC-DC switch. Probe cable is 42" long.

ORDER PART NO. 010-105 ..... $64.00

A modification kit is available to equip the Type 524D oscilloscope with a front-panel connector to power the P500CF Probe.

ORDER PART NO. 040-059 ..... $5.00

TYPE 128 PROBE POWER SUPPLY

Type 128 Probe Power Supply—For P500CF and P170CF cathode-follower probes. The Type 128 supplies the necessary plate and filament voltages for one or two probes, making it possible to use the cathode-follower probes with oscilloscopes not equipped with a probe-power outlet.

DC Output Voltages:
+120 v regulated, at 25 ma
Two +6.3 v unregulated, at 150 ma

The two cathode-follower probe connections have separate +6.3 v dc voltage supplies.

When a P170CF probe is to be used with an instrument other than the Tektronix Type 517, a 170-ohm terminating resistor is required. The Tektronix 011-016, 170 ohms, 0.5 w Terminating Resistor is recommended for this purpose.

Ripple—Ripple on the 120 v supply is not more than 5 mv peak-to-peak, and not more than 75 mv peak-to-peak on the 6.3 v supplies.

Power Requirements—105 to 125 v or 210 to 250 v, 50 to 60 cycles, 25 watts using two P500CF probes.

Dimensions—4 3/4" wide, 7 3/4" high, 9" overall depth.

Weight—6 lbs.

Includes: 1—3-conductor power cord (161-010)

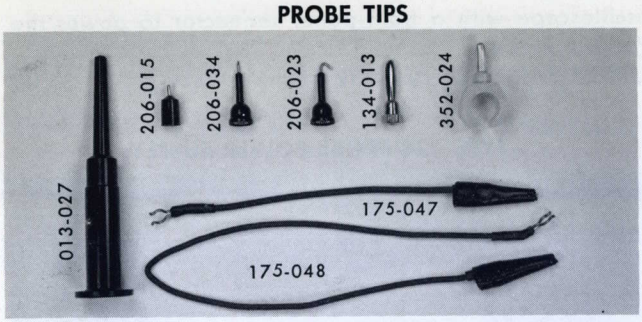
Price **$95.00**

Probe Power-Cable Extension—A 24" 3-conductor power-cable extension for Tektronix cathode-follower probes. Permits wider separation of the probe power source from the instrument signal input.

ORDER PART NO. 012-030 ..... $5.00

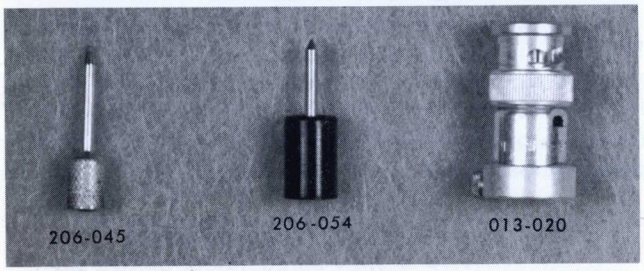
ACCESSORIES

PROBE TIPS



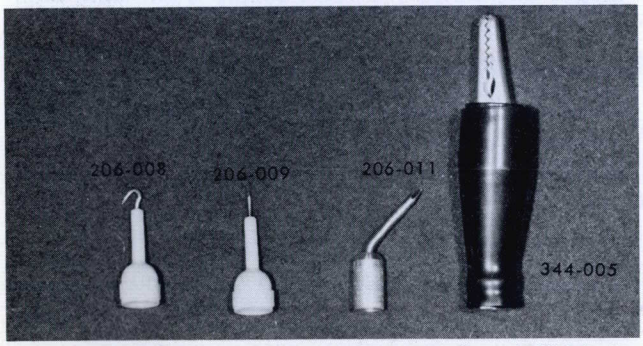
Standard Items for P6000 to P6005 High-Performance Probes.

ORDER PART NO. 206-015 Short Straight Shank $ .25
206-034 Long Straight Shank .25
206-023 Hook Shank ..... .25
134-013 Banana ..... .10
013-027 Pincher 2.00
352-024 Holder ..... .25
175-047 5-inch ground lead .75
175-048 12-inch ground lead .75



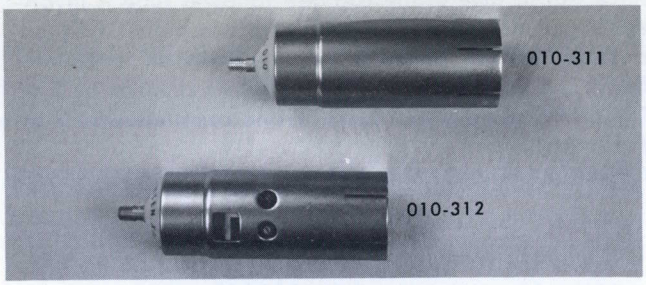
Special-Purpose Items for P6000 to 6005 High-Performance Probes.

ORDER PART NO. 206-045 Straight Shank, fits 0.082" pin jacks ..... .25
206-054 Straight Shank, fits 0.082" pin jacks Similar to 206-045 with insulation ..... .25
013-020 Adapts the probe to a male BNC connector 4.25



For P400-Series Low-Capacitance Probes, P510A Attenuator Probe, P500 CF and P170 CF Cathode-Follower Probe.

ORDER PART NO.
206-008 Hook shank ..... .25
206-009 Straight Shank ..... .25
206-011 Bent Shank ..... .25
(fits 0.082" pin jacks)
344-005 Alligator-Clip Assembly .40

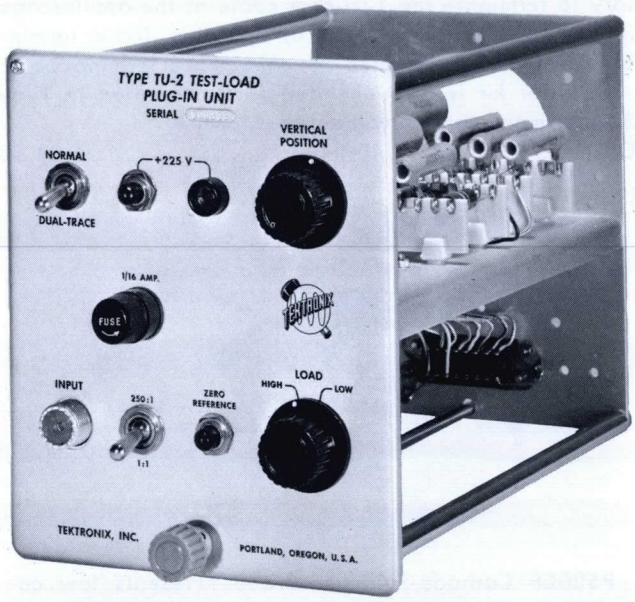


P80 Standard 10-x Attenuator Head permits an additional 10-x attenuation to be stacked between the P80 probe and associated attenuation heads. Proper impedance matching is provided with this attenuator.

ORDER PART NO. 010-311 ..... $20.00

P80 Capacitor-Coupler Head improves low frequency 3-db point. Where stacked on the P80 probe, low frequency response is 15 cycles. Response will be further improved when attenuator heads are used between the probe and capacitor coupler.

ORDER PART NO. 010-312 ..... $6.00

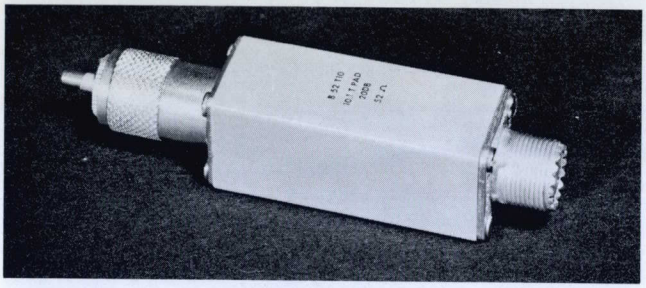


The Type TU-2 Test-Load Plug-In Unit is a convenient special-purpose test tool for the maintenance of Tektronix Type 530, 540, 550-Series Oscilloscopes. The unit is used to check power-supply regulation under high load and low load demands of all A to Z plug-in units. It can also be used to check vertical amplifier balance, vertical amplifier gain, and dual-trace function of the oscilloscope. It eliminates the need to keep plug-in preamplifiers in the maintenance area to make these checks.

ORDER PART NO. 015-012 ..... $75.00

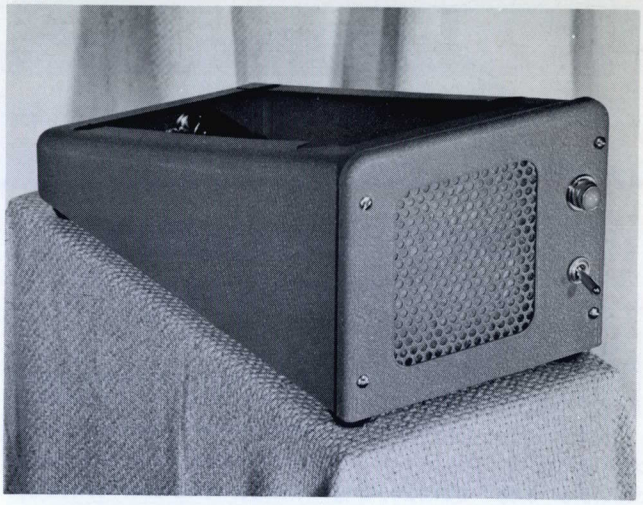
Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).

TERMINATIONS and ATTENUATORS



PART NO.	DESCRIPTION	PRICE
011-001	52-ohm termination, 1.5 w	$8.50
011-002	52-ohm 'L' attenuator, 5 to 1 voltage ratio, 1.5 w	8.50
011-003	52-ohm 'L' attenuator, 10 to 1 voltage ratio, 1.5 w	8.50
011-004	Minimum-loss termination, 52 ohms to 75 ohms	11.50
011-005	Minimum-loss termination, 52 ohms to 170 ohms	11.50
011-027	52-ohm 'T' attenuator, 5 to 1 voltage ratio, 1.5 w	11.50
011-006	52-ohm 'T' attenuator, 10 to 1 voltage ratio, 1.5 w	11.50
011-026	52-ohm to 170 ohm termination, 10 to 1 voltage ratio, 1.5 w	11.50
011-007	75-ohm termination, 1.5 w	8.50
011-023	75-ohm termination for Type 525, 0.5 w	4.00
011-008	75-ohm 'L' attenuator, 5 to 1 voltage ratio, 1.5 w	8.50
011-009	75-ohm 'L' attenuator, 10 to 1 voltage ratio, 1.5 w	8.50
011-010	75-ohm 'T' attenuator, 10 to 1 voltage ratio, 1.5 w	8.50
011-011	93-ohm termination, 1.5 w	8.50
011-012	93-ohm 'L' attenuator, 5 to 1 voltage ratio, 1.5 w	8.50
011-013	93-ohm 'L' attenuator, 10 to 1 voltage ratio, 1.5 w	8.50
011-014	Minimum-loss termination, 93 ohms to 52 ohms, 1.5 w	11.50
011-015	93-ohm 'T' attenuator, 10 to 1 voltage ratio, 1.5 w	11.50
011-016	170-ohm termination, 0.5 w	8.50

011-017 170-ohm π-attenuator, using 2% precision resistors, 1 to 64 db in 1 db steps, 0.25 w $45.00

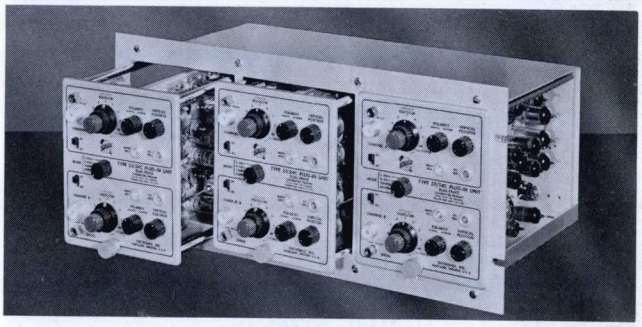


Fan Base—For Type 310, and Type 310A Oscilloscopes. Provides filtered, forced-air ventilation to assure safe operating temperature when the Type 310 or Type 310A Oscilloscope is being used continuously over long periods, or in hot or limited ventilation areas. The fan base tilts the oscilloscope to a convenient viewing angle. For use on 105-125 v, 50 to 60 cycle only.

ORDER PART NO. 016-012 ..... $35.00

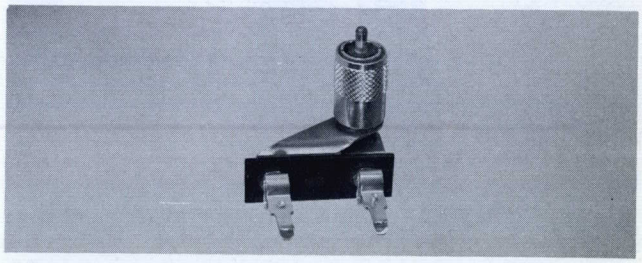
For use on 210-250 v, 50 to 60 cycles only.

ORDER PART NO. 016-013 ..... $35.00



Plug-In Preamplifier Storage Cabinet—Mounts in standard rack, holds three Tektronix Plug-In Preamplifiers. Dimensions: 19" wide, 8¾" high, 9⅜" deep.

ORDER PART NO. 437-031 ..... $25.00



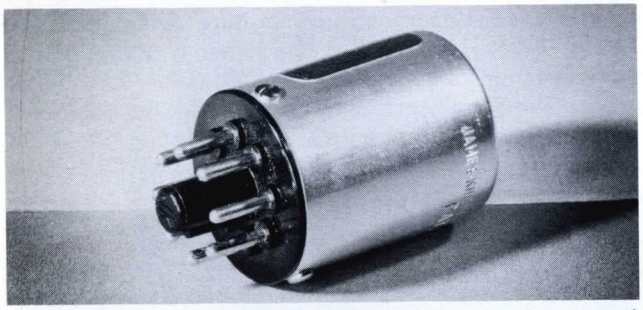
Production Test Fixture—For use with the Type 130 L-C Meter. Speeds sorting and testing of capacitors and inductors.

ORDER PART NO. 013-001 ..... $3.00

ACCESSORIES

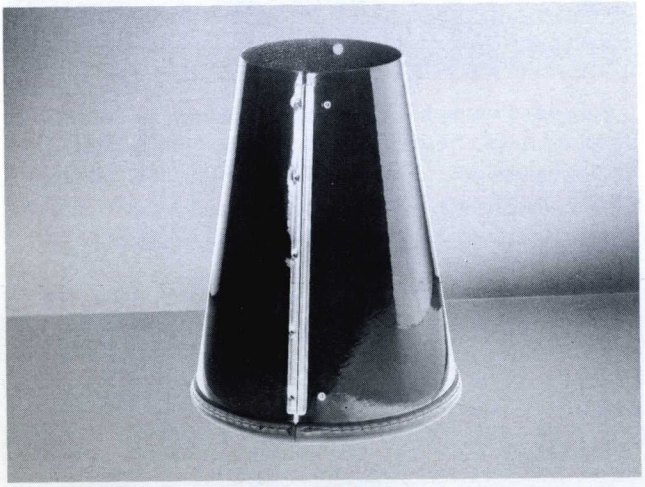
Bezel—For mounting camera on Tektronix *5"* oscilloscopes. Dimensions—5 7/8" square; ring 7/8" deep, diameter 5 5/8" outside, 5 1/8" inside. Die-cast construction, wrinkle finish, felt lined.

ORDER PART NO. 014-001 ..... $4.50



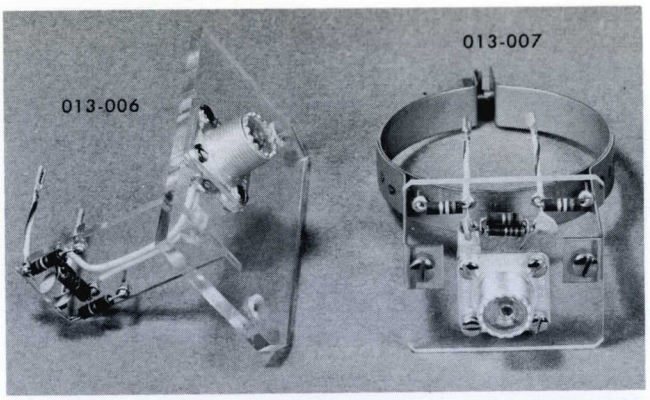
Crystal-Oven Combination—A 1-mc crystal mounted in a temperature-stabilized oven. Directly interchangeable with standard crystal. Plugs into crystal socket of the Type 181—no wiring changes necessary. Accuracy is 0.001% and frequency stability is 3 parts per million over a 24-hour period.

ORDER PART NO. 158-007 ..... $27.00



Collapsible Viewing Hood—For Tektronix 3" Oscilloscopes except Type 321. It is made of black acrylic plastic with handy fastening arrangement.

ORDER PART NO. 016-010 ..... $3.50



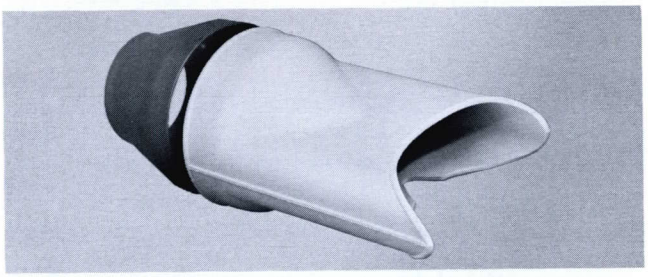
Deflection Plate Connectors—For Types 530, 540, 530A, and 540A-Series Oscilloscopes. A convenient means of making a connection directly to the cathode-ray tube vertical deflection plates to realize the maximum frequency response of the crt. Designed for use with high-frequency, fast-rise pulses or transient signals. Under these conditions the function of the vertical position control of the oscilloscope is retained. The connectors are designed for use with 52-ohm cables. The connectors are not recommended for use with frequencies below 8 kc or pulses with correspondingly slow risetimes.

For instruments with serial numbers below 5001,

ORDER PART NO. 013-006 ..... $5.00

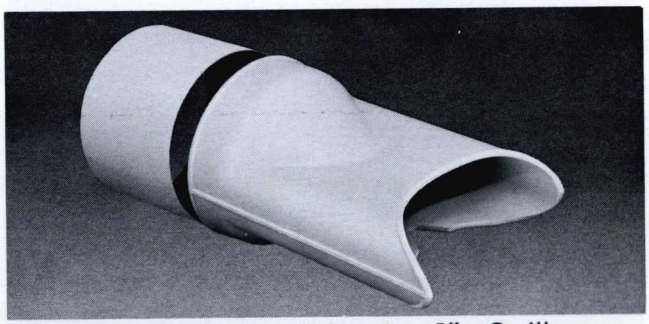
For instruments with serial numbers 5001 and above,

ORDER PART NO. 013-007 ..... $5.00



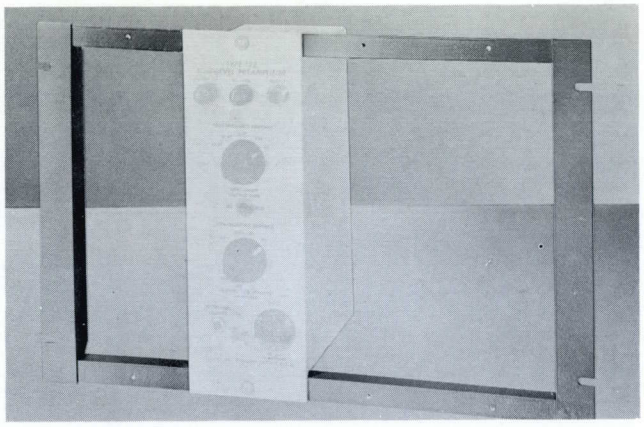
Viewing Hood—For Tektronix 3" Oscilloscopes except Type 321. Includes molded rubber eye-piece and spun-aluminum light shield.

ORDER PART NO. 016-002 ..... $4.50



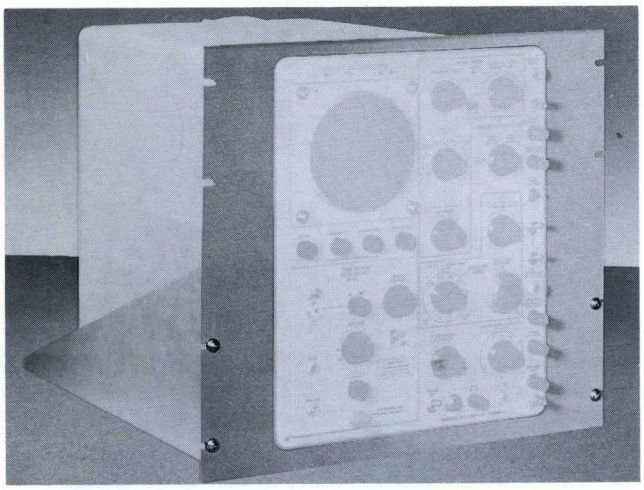
Viewing Hood—For Tektronix *5"* Oscilloscopes. Includes molded rubber eye-piece and aluminum light shield.

ORDER PART NO. 016-001 ..... $4.50



Mounting Frame—Holds four of any combination of Type FM122, Type 360, and Type 160-Series units. Mounts to standard instrument rack.

ORDER PART NO. 014-002 ..... $5.00



Cradle-Mount—For rack mounting cabinet-type oscilloscopes. Each cradle-mount consists of a cradle (or "shelf") to support the instrument in any standard 19" relay rack, and a mask to fit over the regular instrument panel. Tek blue wrinkle finish.

For Type 524AD, Type 530-series, Type 540-series, and Type 570 with serial numbers above 5000, Type 530A-series, Type 540A-series, Type 575 and Type 580-series all serial numbers (1 mask, 1 cradle). Rack height requirements 17½".

ORDER PART NO. 040-182 ..... $45.00

For Type 507 and Type 551 instruments (2 masks, 2 cradles). Rack height requirements; Indicator mask 17½", Power Supply mask 12½".

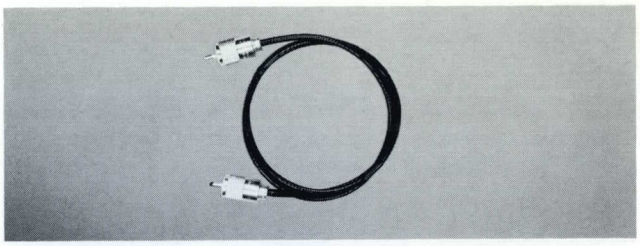
ORDER PART NO. 040-183 ..... $85.00

For Type 180A, Type 190A, Type 503, Type 504, Type 515A and Type 516 instruments (1 mask, 1 cradle). Rack height requirements 15½".

ORDER PART NO. 040-193 ..... $45.00

For Type 502 instruments (1 mask, 1 cradle). Rack height requirements 17½".

ORDER PART NO. 040-194 ..... $45.00



52 ohms nominal impedance, 42 inches long.

ORDER PART NO. 012-001 ..... $4.00

75 ohms nominal impedance, 42 inches long.

ORDER PART NO. 012-002 ..... $4.00

93 ohms nominal impedance, 42 inches long.

ORDER PART NO. 012-003 ..... $4.00

93 ohms, 42 inches long, terminated with variable attenuator.

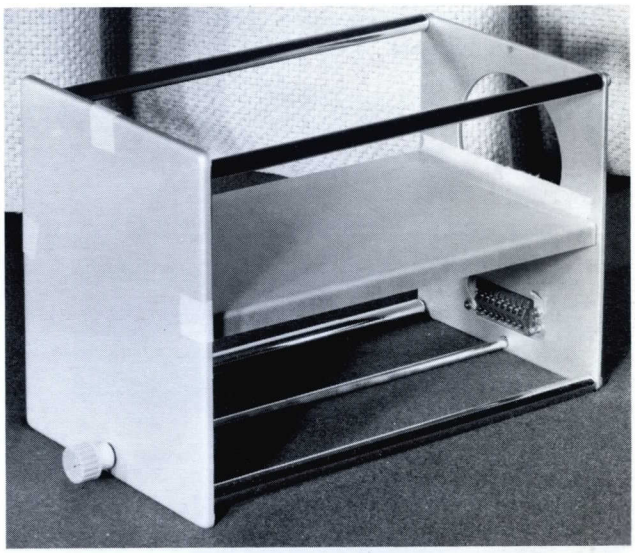
ORDER PART NO. 012-004 ..... $13.50

93 ohms, 42 inches long, terminated with ½ watt 93 ohm resistor.

ORDER PART NO. 012-005 ..... $5.00

170 ohms nominal impedance, 42 inches long.

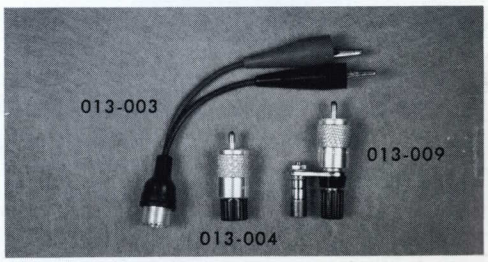
ORDER PART NO. 012-006 ..... $9.50



Blank Plug-in Skeleton

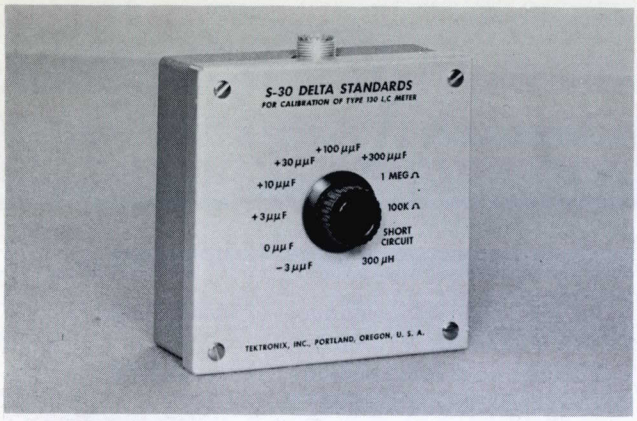
ORDER PART NO. 040-065 ..... $15.00

MISCELLANEOUS



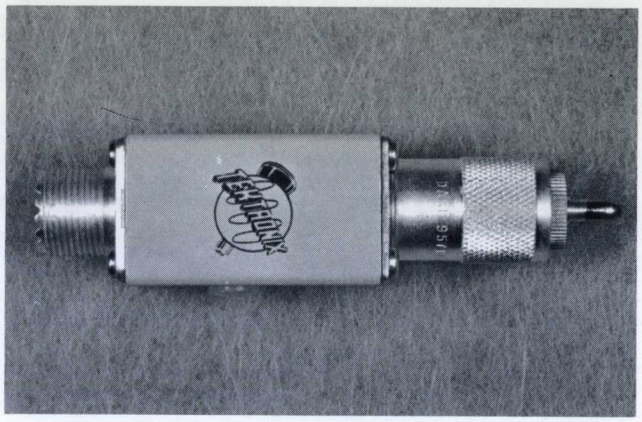
013-003	Adapter, clip lead	$2.00
013-004	Adapter, binding post	2.00
013-009	Binding Post Adapter with ground terminal, ¾" spacing	$3.00

ACCESSORIES



Delta Standards—For calibration of the Type 130 L-C Meter. The unit provides accurately adjusted steps of capacitance and inductance, selected by a rotary selector switch. Values of the capacitance steps correspond to the full-scale adjustments required on the five scales of the Type 130. Two resistors of identical manufacture and similar capacitance, values of 1 megohm and 0.1 megohm, are provided for the resistance compensation adjustment. A 300-μh standard permits proper adjustments of the inductance ranges.

ORDER PART NO. 015-001 ..... $22.00

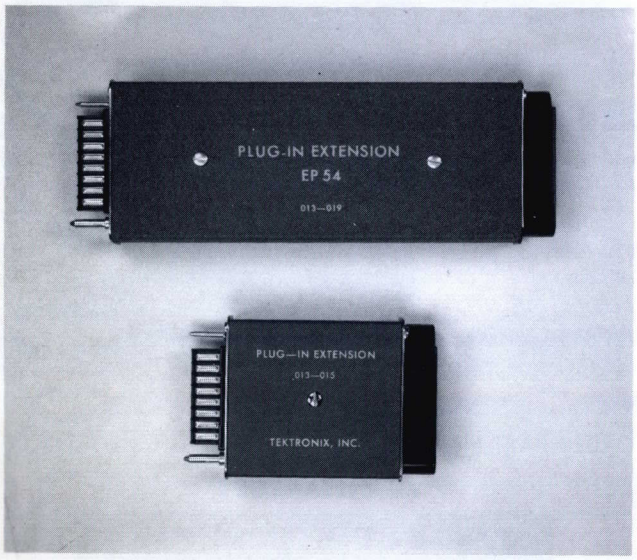


47 pf Input Capacitance Standardizer—For use with Type A to Z Plug-In Preamplifiers having an input capacitance of 47 pf. With this accessory the input capacitance of each preamplifier can be standardized to 47 pf.

ORDER PART NO. 011-021 ..... $11.50

20 pf Input Capacitance Standardizer—Similar to 011-021 for use with the Types C-A, K and L Plug-In Preamplifiers having 20 pf input capacitance.

ORDER PART NO. 011-022 ..... $11.50



Plug-in Extension—Six inches long and allows the plug-in preamplifier unit for the Type 530, 540, 550, and 580-Series Oscilloscopes to be operated partially out of its housing.

ORDER PART NO. 013-019 ..... $8.50

3 ¼-inches long and allows the Type R Transistor Risetime Unit to be operated partially out of its housing.

ORDER PART NO. 030-015 ..... $8.50

Gain Adjust Adapter—Permits an external calibrating signal to bypass the plug-in preamplifier, for calibrating the sensitivity of the main amplifier of Type 530, 540 and 550-Series Oscilloscopes.

ORDER PART NO. 013-005 ..... $10.00

Spare Time-Base Plug-In Units for Type 555 Oscilloscope—For technical description of the Type 21 and Type 22 Units, see page C-42.

Type 21 Time-Base Unit $270.00
Type 22 Time-Base Unit 280.00

UNRULED GRATICULES

For Types 310, 310A, 316, RM16, RS16, 317, RM17 and 360

ORDER PART NO. 386-395 ..... $1.00

For Types 315 and 315D

ORDER PART NO. 386-312 ..... $1.00

For Types 502, 507, 511A, 512, 513, 514, 514A, 524D, 524AD, 525, 526, 531, RM31, 532, RM32, 535, RM35, 536, 570 and 575

ORDER PART NO. 386-326 ..... $1.00

For Types 515, 515A, RM15, 516, 517A, 531A, RM-31A, 533, RM33, 535A, RM35A, 541, RM41, 541A, RM41A, 543, RM43, 545, RM45, 545A, RM45A, 551, 555, 581 and 585

ORDER PART NO. 386-451 ..... $1.00

CATHODE-RAY-TUBE LIGHT FILTERS

For Types 310, 310A, 316, RM16, RS16, 317, RM17, and 360

ORDER PART NO.

378-509	3" Green	$.50
378-510	3" Blue	.50
378-511	3" Amber	.50
378-512	3" Yellow	.50

For Type 315D

ORDER PART NO.

378-505	3" Green	$.50
378-506	3" Amber	.50
378-507	3" Blue	.50
378-508	3" Yellow	.50

For Type 321

ORDER PART NO.

378-521	3" Green	$.50

For Type 503, 504

ORDER PART NO.

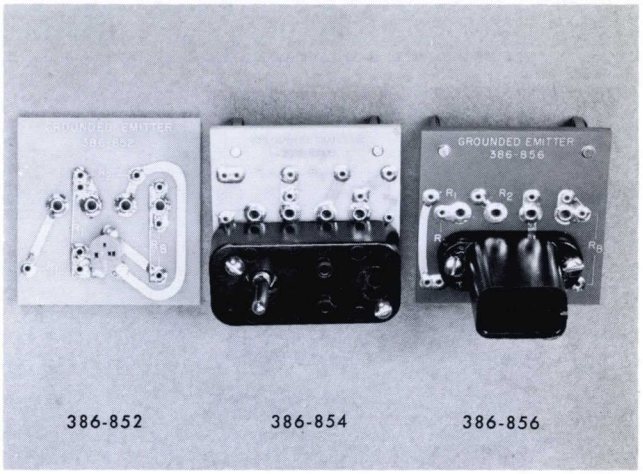
378-522	5" Green	$.90

For all 5-inch oscilloscopes except the Type 503, 504.

ORDER PART NO.

378-514	5" Green	$.90
378-515	5" Blue	.90
378-516	5" Amber	.90

TRANSISTOR MOUNTING BOARDS



For Type R Transistor Risetime Plug-In Unit—When large quantities of different types of transistors are to be checked, it is desirable to have a separate mounting board wired for each type. Each type of transistor requires a different value of collector-load resistor, voltage dividing resistor and base or emitter-driving resistor. These resistors are not supplied with the mounting boards.

PART NO.	TYPE	SOCKET TYPE	PRICE
386-852	Grounded Emitter	4-pin transistor socket	$1.50
386-853	Grounded Base	Same as 386-852	$1.50
386-854	Grounded Emitter	Socket for power transistor such as the 2N3-01 and 2N307	$2.50
386-855	Grounded Base	Same as 386-854	$2.50
386-856	Grounded Emitter	Funnel-type socket for standard transistors with long leads	$2.50
386-857	Grounded Base	Same as 386-856	$2.50

ACCESSORIES

TEKTRONIX CATHODE-RAY TUBES

Tektronix-manufactured cathode-ray tubes are normally available with phosphors 1, 2, 7, or 11. Please specify the phosphor desired when ordering. Price is the same regardless of phosphor unless otherwise designated. Other phosphors are available on special order; please consult your Tektronix Field Engineer for details.

Used in Types 513, 531, RM31, 535 and RM35

T51P__ $75.00
(formerly designated 5BGP__)

Used in Types 525, 532, RM32, 570 and 575

T52P__ $50.00
(formerly designated 5CAP__)

Used in Types 541, RM41, 545 and RM45

T54P__ $100.00
(formerly designated 5BHP__)

Used in Types 515A, RM15 and 516

T55P__ $60.00
(formerly designated 5CBP__)

Used in Types 316, RM16 and RS16

T316P__ $40.00
(formerly designated T32P__)

Used in Types 317 and RM17

T317P__ $65.00
(formerly designated T33P__)

Used in Type 502

T5021P__ $150.00
(replaced T502P__/T60P__)

Used in Types 503 and 504

T503P__ $60.00

Used in Type 517A

T517P__ $110.00
(formerly designated T54P__H)

Used in Type 526

T526P__ $100.00

Used in Types 531A, RM31A, 533, RM33, 535A and RM35A

T533P__ $90.00
(formerly designated T64P__)

Used in Type 536

T536P__ $60.00
(formerly designated T56P__)

Used in Types 541A, RM41A, 543, RM43, 545A and RM45A

T543P__ $110.00
(formerly designated T65P__)

Used in Type 551

T5511P__ $150.00
(replaced T551P__)

Used in Type 555

T555P__ $225.00
(formerly designated T59P__)

Used in Types 581 and 585

T581P__ $200.00

Used in Type 507

T507P__ $125.00

Available normally in P11 phosphor only. Some other phosphors are available on special order.
(formerly designated T53P__)

Prices f.o.b. factory. (Please refer to **Terms and Shipment, *GENERAL INFORMATION*** page).