INSTRUMENT REFERENCE BOOK

for the Tektronix type

453

oscilloscope

For all serial numbers

SALES

U.S. MARKETING SALES RELEASE

453 MOD 127C

The Type 524AD Television Oscilloscope has been dropped from our product line. Catalog 27 (March 68) will offer the Type 453 MOD 127C. The description of this instrument will be found in two places in the new catalog; in the rear portion of the 453 specifications and in the TV section, next to the 529, with a reference to the 453 specification page.

The 453 MOD 127C will be shown at IEEE, March 18 and NAB, March 31, 1968.

453 MOD 221-T FOR A. T. & T. ESS-1

Bell Telephone Laboratories has recommended to A. T. & T. maintenance engineering and to the Bell System operating companies, the 453, Mod 221-T as the maintenance and operating oscilloscope for their new central office Electronic Switching System Number I, ESS-1.

This consists of a standard 453 and a special probe package including the following:

2 - 9' P6010 Probe Package
1 - 9' P6019 Current Probe
1 - Passive Termination
2 - Special P6010 Probe Tip

This recommendation is not binding for the operating companies. Therefore, we want to encourage field engineers to call on A. T. & T. plant engineering departments to recommend use of the 453. The main reasons for their selection of the 453 are the following:

MEASUREMENT REQUIREMENTS - The 453 meets or exceeds their present and foreseeable future needs. X-Y ability of the 453 is useful to them in viewing their memory matrix.

RELIABILITY - Reliability and maintenance costs should be much better than on any other of our 50 MH_Z delay-sweep instruments.

SIZE - A. T. & T. has 20-inch aisles, which make it difficult for our scopemobiles; whereas, the 453 can be used on the floor or on a Western cart. Also, for unmanned satellite offices, they can transport the 453.

EASE OF OPERATION - Delay sweep is required and is much easier on the 453 than the 540 series they used previously.

IBM ICAR CENTER MAINTENANCE SUPPORT

During the next few months, you can expect increased requests for field engineer maintenance instruction assistance from the IBM instrument calibration and repair activities. The ICAR centers are becoming more active in the support of field engineering division 453 MOD 210H's as increased numbers of the oscilloscope have been in the field beyond the warranty period.

Our purpose here is to alert you to the anticipated increased need for normal field engineering maintenance support by the IBM ICAR centers. ICAR personnel have studied the 453 training package and manual. Some of them have attended a one-week 453 training class conducted by IBM in September, 1965. Generally we expect requests for field engineer maintenance assistance when the first complete 453 MOD 210H repair and recal is conducted in the ICAR center.

IBM ICAR centers are located as follows:

AREA 1 BOSTON

520 Boylston Street
Boston, Mass.
617-267-9400 X 280

AREA 2 NEW YORK

111 8th Avenue
New York, N. Y.
212-989-4400 X 17

AREA 3 NEWARK

570 Broad Street
Newark, N. J.
201-623-6500 X 315

AREA 4 PHILADELPHIA

302 N. 13th Street
Philadelphia, Pa.
215-923-1088 X 77

AREA 5 WASHINGTON

3833 N. Fairfax Drive
Arlington, Va.
703-524-8900 X 296

AREA 6 ATLANTA

1439 Peachtree Street, NE
Atlanta, Ga.
404-872-0731 X 306 or X 307

AREA 7 DETROIT

22720 Michigan Avenue
Dearborn, Mich.
313-CR8-9000 X 250

AREA 8 CHICAGO

310 West Madison Street
Chicago, Ill.
312-341-7617

AREA 9 KANSAS CITY

1400 Baltimore Avenue
Kansas City, Mo.
816-221-0575 X 317

AREA 10 DALLAS

2911 Cedar Springs Road
Dallas, Texas
214-526-7651 X 280

AREA 11 LOS ANGELES

5359 Sheila Street
Commerce, Calif.
213-264-2940

AREA 12 SAN FRANCISCO

340 Market Street
San Francisco, Calif.
415-932-0100

U.S. MARKETING SALES RELEASE

453 PRICE REDUCTION

The price of the 453 has been reduced from $2050 to $1950 effective January 16, 1967. The price of the R453 is reduced from $2135 to $2035 effective the same date.

This price reduction will be implemented as outlined in the sales policy on Page S-20 of the Field Administration Manual.

file 453 RB

date 11-30-66

U.S. MARKETING SALES RELEASE

TEKTRONIX

453 FSN

The United States Navy Aviation Supply Office in Philadelphia, Pennsylvania has advised us that, as of November 18, 1966, the new active Federal Stock Number for the 453 is RX6625-930-6637-T050.

The old FSN, RX6625-930-5576-T050, has been set aside but will remain in the files for reference only.

U.S. MARKETING SALES RELEASE

453 FEDERAL STOCK NUMBER

The 453 is the most recent instrument in our product line to be assigned a Federal Stock Number. The FSN has been assigned as a direct result of Field Engineer efforts in promoting acceptance of the 453 at the various Navy installations. The U. S. N. Federal Stock Number for the 453 is RX-6625-930-5576-T050.

The C30/453 combination has been assigned U. S. N. Federal Stock Number RX-6720-907-3600-T050.

The 453 is being purchased by the U. S. Navy Bureau of Weapons. It is approved by the Bureau of Weapons as a standard general purpose oscilloscope and is an acceptable equivalent to the AN/USM-140B which has been specified extensively by Navy contractors in recent years. The 453 is substantially less expensive than the AN/USM-140B, out-performs it, and is lighter and smaller (see HP EO 170B). Many of its features are attractive in naval requirements where high performance must be tucked into small spaces.

Provisioning Documentation for the 453 is being provided under separate contract with U. S. Navy Aviation Supply Office in Philadelphia.

U.S. MARKETING SALES RELEASE

U. S. NAVY INTEREST IN 453

During recent months, we have had numerous reports of active interest in the 453 on the part of U. S. Navy personnel at the user level. They seem particularly interested in the portable high performance capability of the 453. At this time our over-all interests can be well served by assuring that U. S. N. oscilloscope users at the Navy installations are familiar with our line of portable oscilloscopes.

Base avionics officers and individual squadron avionics groups at the Naval Air stations should become acquainted with the characteristics of these products. Calibration centers, Shop 67's, Standards Labs, and base communications officers are good prospects at the Navy shipyards. Efforts to gain acceptance of our instruments by Navy procurement will be aided by any support that might originate in these areas. Furthermore we are seeing increased willingness to purchase immediate oscilloscope requirements locally from operating funds.

Individual programs to serve this market should be developed and co-ordinated with the region sales manager.

TEKTRONIX

Inter-Office Communication

To: New Product Sales Release Distribution Date: June 24, 1965

From: Ted Brandt

BEAVERTON

Subject: U. S. Marketing New Product Sales Release 453 Oscilloscope

Major Sales Features: The 453 is a lightweight, compact 50 MC dual-trace oscilloscope with high writing rate and high sensitivity. It offers the sweep features (delaying sweep, magnifier......) and vertical features (alternate, chopped, added algebraic modes and single channel triggering) of a plug-in oscilloscope. Some additional features are:

1. A mesh filter for high contrast viewing in high ambient light. The contrast achieved with this filter is probably better than any offered before. In addition it provides shielding against radiated RFI.

2. A high accuracy calibrator providing ± 1% voltage and current sources at a ±0.5% repitition rate suitable for most amplitude and timing checks to be made on the 453.

3. External D.C. Z axis unblanking.

4. High frequency reject triggering.

5. High sensitivity XY applications from D.C. to 5 MC.

6. Power supply capabilities of 115 v and 230 v without having to make internal wiring changes; automatically accomplished when the correct power cord is selected. External switch provides optimum accommodation for high and low line regulation for both voltage ranges.

7. Approximately 100 watts power consumption.

8. Wide range environmental capabilities.

9. C-30 camera compatible with 453 size and weight.

10. Trace finder for vertically or horizontally overscanned signals.

11. Uses P6010 probe, a small lightweight probe suitable for probing in sub-miniature, etched board and micro-miniature circuits. Development of a high temperature capability will delay the pincher tip 12-16 weeks. Customers will receive a notice with the accessory package telling them that the pincer tip will be shipped later.

The IBM package 453 mod 210H differs from the standard 453 package as follows:

1. The addition of a 230 v power cord.

2. One instruction manual instead of two.

3. Front panel nomenclature will identify IBM's instruments as the property of IBM.

<u>Sales Strategy</u>: The 453 is to be promoted as a Today's State-of-the-Art High Performance Oscilloscope; a <u>combination</u> of performance, weight, size and price ($2000 or less). In addition to application areas based on its portability, we wish to stress its sales to customers in all usage areas with measurement requirements in the 15 to 50 MC range.

We wish to continue making the customer aware of the benefits of plug-in oscilloscopes - - we educated them and the plug-in advantages we have stressed in the past are still valid for many customers. However, without minimizing plug-in capability we want to direct the customer to take a look at the 453. The validity of needing plug-in capability may be true for many customers. However, many other customers may already have all the plug-in capabilities they need and will find greater value in the 453.

In examining the needs of our customers in the 15 to 50 MC range their best long term investment may be the 453.

<u>Markets</u>:

1. Service

a. Computer

During March the 453 was made available to the regions to be shown to computer manufacturers competitive with IBM. No type number appeared on the instrument and it was shown as an engineering model of our capability in 50 MC portable instrumentation. It was accompanied by the 422. Reactions were quite favorable in spite of the estimated price of $2400. We have since received some orders based on this price.

b. NASA, Defense, Nuclear, Commercial Aircraft

Potential sales exist in most field service activities where high performance with light weight are requirements. Specific areas with sales potential are the US Navy, US Air Force, US Army, NASA, FAA and the Atomic Energy Comm. The 453 without a type number was shown to the Navy Buships in Washington, D. C. during the week of 21 June.

2. R & D

Although this market is not as clearly defined as the computer service area, we anticipate major sales to this area based on the 453's performance/ price characteristic. It offers a high performance state-of-the-art general purpose laboratory instrument. For the majority that already has specialized plug-ins it offers a small package (less bench space) and low power consumption.

3. Production

This product use area is a question mark. Early feedback of customer needs and usage will enable us to identify further potential sales in this area.

Competition: Initial field forecasts based on an estimated $2400 price, and later forecasts on an estimated $2000 price indicated that the 453 would have a profound impact on the Tektronix product line as well as Fairchild's and H-P's.

Tektronix

The entire 540 series will be vulnerable to 453 penetration. Where plug-in compatibility is not a must requirement vulnerability will increase as the 453 price approaches the following combinations:

546/1A1 . . .	$2350.
544/1A1 . . .	2150.
545B/1A2 . .	1875.
545B/CA . . .	1810.
547/1A1 . . .	At a price of $2475 the customer will have to make a trade-off choice of dollars vs. sweep switching and plug-in capability.
647 line . . .	Ranging from $2475 to $2900 the customer will have a trade-off choice of his needs for superior environmental capabilities, better accuracy in lab and field use, somewhat more flexible performance vs. dollars, weight and size.

Hewlett-Packard

At a catalog price of $2225 the 175A/1755A/1781B combination with basic performance of 10 mv @ 50 MC, 5 mv @ 40 MC and delaying sweep should become an increasingly more difficult instrument to market. Customers who require special adaptive features - XY plotter driver, print out - will be paying a premium price for these features related to what they would get in a 453. Combination sales and sales at less than catalog can be expected and should be reported to Ted Brandt.

140A Series. Although not performance competitive with the 453, its catalog price of $1705 for 5 mv @ 20 MC dual trace and delaying sweep leaves it vulnerable to the performance/price characteristic of the 453.

Fairchild

765-6-7 Series. Primarily filling the need for a lightweight, high performance oscilloscope, Fairchild has been most successful in marketing their 766 main frame - the 76-02A - dual trace 25 MC, 5 mv/div plug-in and a sweep delay plug-in (74-13A). They also have added a dual trace 50 MC plug-in and more recently a dual trace 100 MC plug-in.

25 MC	766H/76-02A/74-13A	$1820 less probes, less delay line
50 MC	766H/76-08/74-13A	$1995 less probes
100 MC	766H/79-02A/74-13A	$2780 includes $235 mod kit* less probes

* the 79-02A priced at $1200 needs a vertical stabilization modification kit to optimize its performance with the 765H, 766H, 767H, 757 main frame. The $235 kit includes a new CRT and delay line termination.

With the 453's price and performance characteristic we should be able to fill most of the requirements Fairchild was getting.

Support Activities:

Advertising Program

Press Release - 1 August 1965

Spec. Sheet - Week 28 Preliminary; Week 31 Final (in the field)

Mailings - Week 34 - insert which will also appear in Electronics News.

Training Program

Training package - Week 27

Hot Line - Week 27

Lecture Notes - Week 36

Product Technical Information Program

PRB - Week 27

Marketing Product Administration Program

Demo availability - Start week 27 - All requirements filled by week 31

Customer instrument availability - We should be quoting stock position on PAL week 31.

Major Trade Show Program

1. Introduced at Wescon '65

We will make approximately 25 to 50 453's available for customer loan at Wescon. After public announcement on 1 August 1965 FE's can indicate to their customers requesting loaners that they can have the 453. As soon as we have used up our quota of 453's we will notify the field that no more are available for loan.

2. NEC '65
3. NEREM '65
4. IEEE '66
5. SWIEEECO '66

Information on the 453 cannot be made public to any customer prior to press release date of 1 August 1965.

Type 453: Specification Comparisons

(Characteristics not listed are minor or similar for all instruments listed)

Type	422	HP140A	DuF766H	HP175A	546	453	647
W/Plug-in Type	---	1402A/1421A	76-08/74-13A	1755A/1781B	1A1	---	10A2/11B2
Price (W/probes)	<$1325	$1750	$2060	$2275	$2350	$1950	$2795
Dual Trace							
Sensitivity for	10mv/div	5mv/div	50mv/div	1mv or 5 mv/div	5mv/div	5mv/div	10mv/div
Bandwidth for							
at 5 mv/div	---	20mc	---	40mc	28mc	40mc	---
at 10 mv/div	15mc	20mc	---	50mc	35mc	45mc	50mc
at 50 mv/div	15mc	20mc	50mc	50mc	50mc	50mc	50mc
Hi-Gain Mode	Ch2	None	Stacked	Dual Trace	Stacked	Stacked	Stacked
Sensitivity	1mv/div	---	5mv/div	1mv/div	∿0.5mv/div	∿1mv/div	∿1mv/div
Bandwidth	AC-5mc	---	DC-25mc	DC-20mc	AC-15mc	DC-25mc	DC-20mc
Single Channel Trigger	Ch 1	Ch A[1]	Ch B	Ch 1 (Ext)	Ch 1	Ch 1	Ch 2
Calibrator Range	2v&4div	1v&10v	1v&4cm	1v&10v	0.2mv-100v	0.1&1.0v1%	0.2mv-100v
Frequency	1kc±20%	line	line	1kc approx.	1 kc approx.	1kc±1%	1kc±0.1%
Sweep (Basic)							
Time/Div Range	0.5sec-0.5μsec	1sec-0.2μsec	2sec-0.1μsec	5sec-0.1μsec	5sec-0.1μsec	5sec-1μsec	5sec-0.1μsec
Mag	X10	X10	X10	X10	X2-5-10	X10	X10
Internal Trigger							
Coupling	AC,DC AC LF Rej.	AC	AC,DC AC Fast	AC	AC,DC AC LF Rej.	AC,DC AC LF Rej. AC HF Rej.	AC,DC AC LF Rej.
Bandwidth	DC->15mc	AC->20mc	DC->10mc	AC->50mc	DC->50mc	DC->50mc	DC->50mc
Sync			to>50mc				
Delay							
Range(Nominal)	---	0.2μsec-10sec	0.25μsec-20sec	0.5μsec-10sec	0.1μsec-50sec	1μsec-50sec	1μsec-50sec
Range(Useful)	---	(?)-10sec	(?)-20sec	2μsec-10sec	1μsec-50sec	1μsec-50sec	1μsec-50sec
Range(Max)	---	0.2μsec-25sec	(?)-20sec	0.5μsec-10sec	0.1μsec-120sec	0.1μsec-120sec	0.1μsec-120sec
Extra Features	---	Mixed Sweep	---	Mixed Sweep	---	---	---
CRT							
Graticule Div.	0.81cm	1.0cm	1.0cm	1.0cm	1.0cm	0.81cm	1.0cm
Graticule	8x10 Int.	10x10[3] Int.	6x10 Ext.[2]	6x10 Int.	6x10 Int.	6x10 Int.	6x10 Int.
Illuminated?	yes	no	yes	no	yes	yes	yes
Accel. & Type	6 kv mesh	7.5 kv mesh	13 kv frame	12 kv mesh	10 kv post	10 kv frame	14 kv frame
Spot Size (Nom)	.011"	Unknown	.013"	.013"	.009"	.010"	.012"
Writing Speed Index	0.5[4]	Unknown	1.0	0.8	1.2	1.4[4]	1.6
Z Axis Input	DC[5]	AC	AC	AC	AC	DC	DC
Mechanical							
Size (approx)	7x9x14+handle	9x17x18	14x10x22	12x17x24	17x13x24	7x11x19+handle	14x10x23
Weight	20.2 lb.	48 lb.	41 lb.	70 lb.	70 lb.	29 lb.	52 lb.
Power	40 W	285 W	200 W	425 W	510 W	100 W	185 W
Frequency	50-60 and 360-440 cps	50-60 cps[6]	48-450 cps	50-60 cps[6]	50-60 cps [6]	45-440 cps	50-400 cps
Regulation Range	±10%	±10%	±9%	±10%	±10%	±13%	±13%
Environmental Class	Field	Lab	Lab	Lab	Lab	Field	Field

(1) In alternate and chop modes only.
(2) Internal graticule optional at $35 extra.
(3) Less corners. 88 cm^2 total area.
(4) Tentative. No measurements yet from production instruments
(5) To deflection blanking plates -- useful for 2-value system only.
(6) 50-400 cps modification optional at extra cost.

Tony Bryan/PRB

PERFORMANCE

453 COMPETITIVE PERFORMANCE ADVANTAGES

Dan Welch, 9-22-66

The 453 possesses several superior competitive advantages over its nearest competitor which may not be very well known but which can result in extending the capability and therefore the sales of the instrument.

In comparative tests with other competitive instruments, the 453 was superior in VHF unmodulated and modulated carrier tests.

The application of 200 millivolts of 135 MHz RF carrier resulted in a stable display of 50 millivolts of the applied signal on the CRT.

Using the HF Reject Triggering mode to attenuate the RF carrier, the 453 was capable of displaying 1 kHz amplitude modulation applied to the 135 MHz RF carrier.

Oscilloscopes which do not possess HF Reject capability in the trigger circuits have a difficult, if not impossible, task of maintaining stable triggering in the presence of both high and low frequency signals.

The X-Y feature of the oscilloscope is very useful for obtaining a trapezoidal modulation pattern for percent of modulation measurements on amplitude modulated transmitters.

These features extend the use of the 453 in transmitter and receiver trouble-shooting, dme transponder adjustment, weather radar equipment, maintenance and repair for F.A.A., commercial airlines and private companies.

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453 DESIGN IMPROVEMENTS

John Thompson, 8-15-67

A number of electrical and mechanical changes are being incorporated into the 453. They will help to maintain the competitive status of the instrument and also effect some production economies.

These improvements are effective at SN 20,000. Due to the extensive nature of the changes involved there are presently no plans to produce equivalent field modification kits.

Principal advantages offered by the changes are as follows:

1. Nuvistors in Vertical Amplifier, Trigger and Sweep Generator circuits are replaced by FET's. This minimizes drift and microphonics and also reduces the heat generated within the instrument. Warm-up time is reduced and a useful display is obtained approximately 5 seconds after switch-on. This period is essentially the CRT and HV supply warm-up time.

2. The Delay Pick-off circuit is redesigned. This reduces the minimum sweep delay time from 0.5 to 0.2 times the A sweep TIME/DIV switch setting.

3. The VOLTS/DIV switches are replaced by a new type which will eliminate binding and squeaking.

4. Circuits are redesigned where possible to permit replacement of metal-case transistors by the more economical epoxy-case versions.

5. An additional mu-metal shield is fitted to the rear of the present CRT shield. This minimizes electrical interference with CRT gun operation.

6. Rubber shock mounts are fitted to the fan motor to reduce noise.

7. A new Line Voltage Selector assembly is added to the rear panel and the power cord is permanently attached to the instrument. Operation of the selector is shown in Figures 1 and 2.

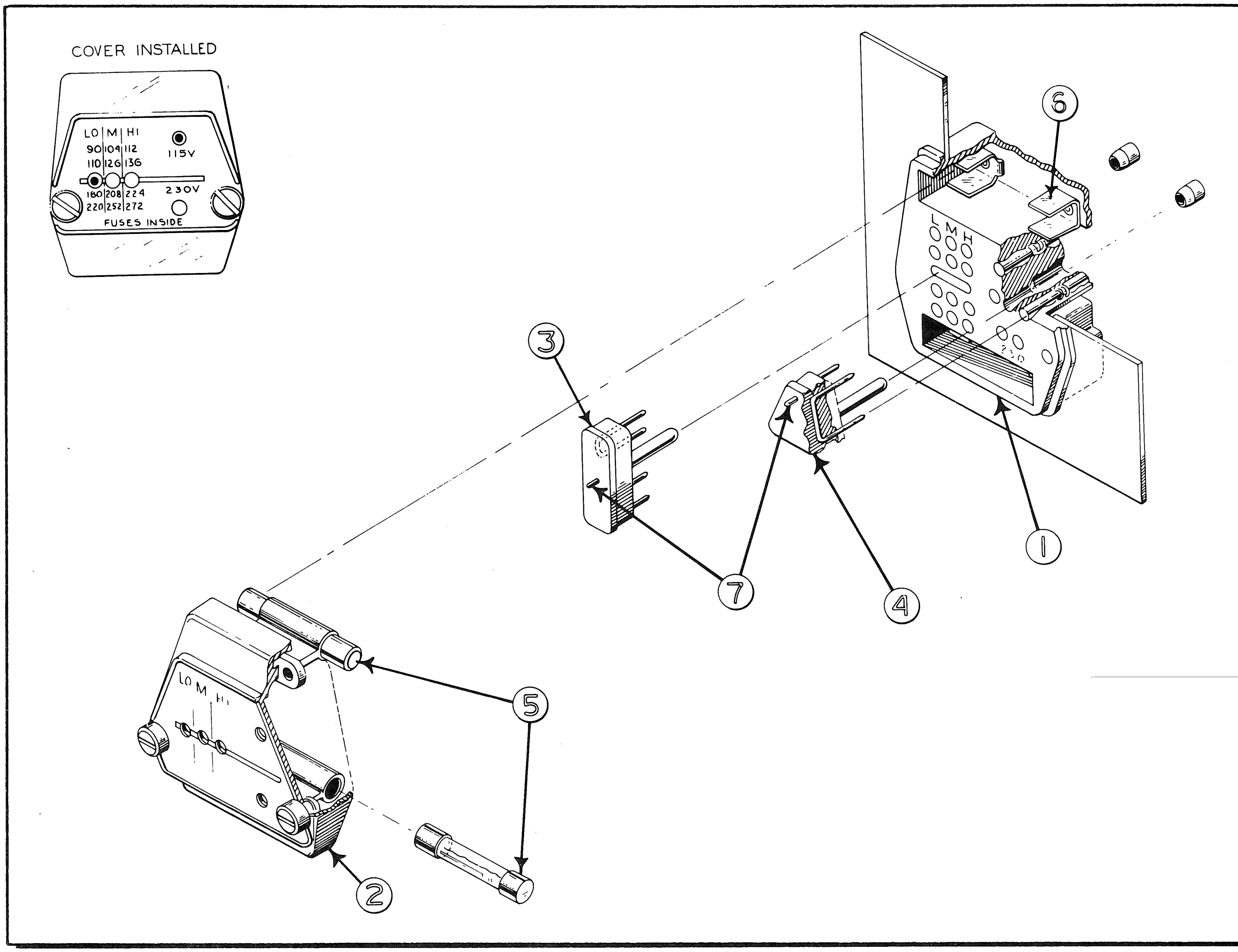

FIGURE 1.

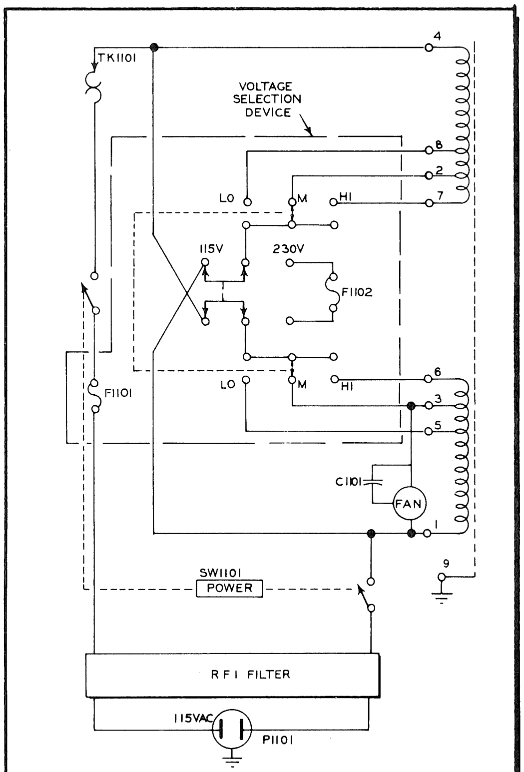

FIGURE 2.

The voltage selection device shown in Fig. 1 provides a rapid and convenient means for adapting an instrument to a wide variety of line voltage conditions. Input circuit combinations are clearly indicated for visual examination and appropriate line fuses are automatically selected when adaptive changes are made. It consists of four parts (1) selector body, (2) selector cover, (3) voltage range selection plug, and (4) 115V-230V selection plug.

Power transformer leads are terminated in the selector body. Rotating the 115V-230V selection plug 180° connects the primary windings in series or parallel configuration. Movement of the range selection plug to the left or right selects the transformer taps which accommodate the instrument to high, low, or medium (normal) line conditions. 115V and 230V line fuses (5), installed in the selector cover, are snapped into clips (6) in the selector body when the cover is installed. Red stubs (7) on the selector plugs project through apertures in the selector cover, indicating the combination of connections selected. The schematic for the 453 voltage selection is shown in Figure 2.

400-SERIES CRT's - PREMATURE FAILURES

John Thompson, 4-9-68

There have been many reports of CRT failures due to low emission after periods of use which are much shorter than can be considered satisfactory. The 422 presents the most serious problem but the 453 and 454 are affected also.

There are many contributing factors and the status of the problem is as follows:

(1) *Cathode loading.* Spot size and writing rate requirements dictate cathode loadings (A/cm^2) much higher than those used in CRT's of older design. It is unrealistic to expect more than about 5000 hours of operation under "average" conditions, which is roughly half the life expectancy of the old 545 CRT.

(2) *Cathode processing.* Our own life-test results show considerable variations in cathode quality. This is a very complex problem and it has not yet been resolved in spite of intensive effort. Average test results indicated 5000 hours life in early 1966, falling to 2000 hours in late 1966 and early 1967, and rising again to 3000 hours at the present time.

Life tests are run under standardized conditions and cannot be accurately related to hours of customer use but the figures are a rough indication of what to expect.

(3) *Cathode temperature.* There is evidence that cathode temperature is running above the designed figure when correct heater voltage is applied and this will restrict cathode life. Use of a lower-current heater structure to correct this is being evaluated.

There are many possible causes for this departure from design predictions. Variations in vendor-supplied items is the most likely.

Design requirements in 400-series instruments dictate the use of highly efficient low-power cathode assemblies. Maintenance of optimum temperature in these is a much more critical problem than in the relatively massive structures used in older tube designs.

(4) *Heater voltage* (422 only). 422's below SN 4330 produced excessive CRT heater voltage when used with the AC-only power supply. This can significantly reduce cathode life.

The remedy is to install Mod 10517-2 (see PRB Mod Summary) or, more simply, to fit a series resistor to reduce CRT heater voltage to 6.3 volts. If the resistor is used, its value may have to be adjusted whenever the CRT is replaced.

(5) *Deflection blanking.* (422 only). The use of deflection blanking in the 422 causes the CRT cathode to emit as long as the instrument is turned on, whether or not a display is produced.

Cathode current is determined entirely by the setting of the INTENSITY control. If this is left in the extreme CW position the CRT will fail in just a few hundred hours even though the sweep is never triggered. It is most important therefore, that customers be educated to turn the INTENSITY control counterclockwise except when actually making measurements.

Customer satisfaction with CRT performance tends to be related to months of use rather than hours of operation and the number of complaints is still small compared to the total of instruments sold. Problems arise where instruments are used from 8 to 24 hours a day and for this reason many complaints concern rackmount instruments.

400-SERIES CRT's - PREMATURE FAILURES - continued

Progress is necessarily slow in correcting life expectancy problems since many weeks of like testing are required to evaluate each modification which is introduced. It must be recognized that even when cathode life is restored to the level we would like to see, a 400-series tube, especially a T4220, will still fail in less than a year in a 24-hour/day application which requires above average intensity. This performance will necessarily compare unfavorably with older instruments such as the 545.

We are naturally concerned in increasing the inherent life expectancy of our tubes. Developments in cathode material are reported from time to time with exciting claims for increased life at high current densities. Those we have evaluated have disadvantages, such as high operating temperature, which restrict their suitability for instrument CRT's. The most promising approach is to attempt to modify the electron-gun design so that a greater proportion of the total cathode current is converted into useful beam current. Much work is being done on this and first results are encouraging but at best this will be a long-term solution to the problems discussed here.

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453 MOD 127C TV GRATICULES

John Thompson, 4-9-68

Two light-filter TV graticules are included in the standard accessories for 453 Mod 127C. Part numbers are:

378-0576-04 (NTSC)
378-0576-05 (CCIR)

Catalog #27 is in error in listing only one graticule.

These graticules are essentially smoke gray light filters to which white markings have been added on the outside surface. They snap into the CRT ornamental ring (354-0269-00) in the same way as a regular light filter or faceplate protector. This arrangement imposes two limitations which prevent photography of the TV graticule and which may not be recognized by customers when reading the catalog description:

a) Graticule illumination is not possible. The existing graticule lamps will not provide useful illumination of the external TV graticule and in any case the SCALE ILLUM control must be turned off to avoid illumination of the CRT internal graticule.

b) Parallax errors. The spacing between the graticule markings and the CRT phosphor is greater than is usual with external graticule instruments due to the CRT lightpipe and the fact that the markings are on the outside of the TV graticule. Care must be taken to avoid parallax errors.

(Characteristics not listed are minor or similar for all instruments listed)

Type	422	HP140A	DuF766H	HP175A	546	453	647
W/Plug-in Type	---	1402A/1421A	76-08/74-13A	1755A/1781B	1A1	---	10A2/11B2
Price (W/probes)	<$1325	$1750	$2060	$2275	$2350	$1950	$2795
Dual Trace							
nsitivity for	10mv/div	5mv/div	50mv/div	1mv or 5 mv/div	5mv/div	5mv/div	10mv/div
andwidth for							
at 5 mv/div	---	20mc	---	40mc	28mc	40mc	---
at 10 mv/div	15mc	20mc	---	50mc	35mc	45mc	50mc
at 50 mv/div	15mc	20mc	50mc	50mc	50mc	50mc	50mc
Hi-Gain Mode	Ch2	None	Stacked	Dual Trace	Stacked	Stacked	Stacked
Sensitivity	1mv/div	---	5mv/div	1mv/div	∿0.5mv/div	∿1mv/div	∿1mv/div
Bandwidth	AC-5mc	---	DC-25mc	DC-20mc	AC-15mc	DC-25mc	DC-20mc
Single Channel Trigger	Ch 1	Ch A(1)	Ch B	Ch 1 (Ext)	Ch 1	Ch 1	Ch 2
Calibrator Range	2v&4div	1v&10v	1v&4cm	1v&10v	0.2mv-100v	0.1&1.0v1%	0.2mv-100v
Frequency	1kc±20%	line	line	1kc approx.	1 kc approx.	1kc±1%	1kc±0.1%
Sweep (Basic)							
Time/Div Range	0.5sec-0.5μsec	1sec-0.2μsec	2sec-0.1μsec	5sec-0.1μsec	5sec-0.1μsec	5sec-1μsec	5sec-0.1μsec
Mag	X10	X10	X10	X10	X2-5-10	X10	X10
Internal Trigger Coupling	AC,DC AC LF Rej.	AC	AC,DC AC Fast	AC	AC,DC AC LF Rej.	AC,DC AC LF Rej. AC HF Rej.	AC,DC AC LF Rej.
Bandwidth	DC->15mc	AC->20mc	DC->10mc	AC->50mc	DC->50mc	DC->50mc	DC->50mc
Sync			to>50mc				
Delay							
Range(Nominal)	---	0.2μsec- 10sec	0.25μsec- 20sec	0.5μsec- 10sec	0.1μsec- 50sec	1μsec-50sec	1μsec-50sec
Range(Useful)	---	(?)-10sec	(?)-20sec	2μsec-10sec	1μsec-50sec	1μsec-50sec	1μsec-50sec
Range(Max)	---	0.2μsec- 25sec	(?)-20sec	0.5μsec- 10sec	0.1μsec- 120sec	0.1μsec- 120sec	0.1μsec- 120sec
Extra Features	---	Mixed Sweep	---	Mixed Sweep	---	---	---
CRT							
Graticule Div.	0.81cm	1.0cm	1.0cm	1.0cm	1.0cm	0.81cm	1.0cm
Graticule	8x10 Int.	10x10(3) Int.	6x10 Ext.(2)	6x10 Int.	6x10 Int.	6x10 Int.	6x10 Int.
luminated?	yes	no	yes	no	yes	yes	yes
Accel. & Type	6 kv mesh	7.5 kv mesh	13 kv frame	12 kv mesh	10 kv post	10 kv frame	14 kv frame
Spot Size (Nom)	.011"	Unknown	.013"	.013"	.009"	.010"	.012"
Writing Speed Index	0.5(4)	Unknown	1.0	0.8	1.2	1.4(4)	1.6
Z Axis Input	DC(5)	AC	AC	AC	AC	DC	DC
Mechanical							
Size (approx)	7x9x14+handle	9x17x18	14x10x22	12x17x24	17x13x24	7x11x19+handle	14x10x23
Weight	20.2 lb.	48 lb.	41 lb.	70 lb.	70 lb.	29 lb.	52 lb.
Power	40 W	285 W	200 W	425 W	510 W	100 W	185 W
Frequency	50-60 and 360-440 cps	50-60 cps(6)	48-450 cps	50-60 cps(6)	50-60 cps (6)	45-440 cps	50-400 cps
Regulation Range	±10%	±10%	±9%	±10%	±10%	±13%	±13%
Environmental Class	Field	Lab	Lab	Lab	Lab	Field	Field

(1) In alternate and chop modes only.
(2) Internal graticule optional at $35 extra.
(3) Less corners. 88 cm^2 total area.
(4) Tentative. No measurements yet from production instruments
(5) To deflection blanking plates -- useful for 2-value system only.
(6) 50-400 cps modification optional at extra cost.

Tony Bryan/PRB

TECHNIQUES

453/TV SYNC SEPARATOR
(015-0062-00)

The versatility of the 453 can be extended by the use of the TV sync separator. The 453 must be modified to supply power for the sync unit.

To modify the 453, first remove the coax that is soldered to the 'A' Gate BNC connector. Slip a piece of spagetti over the end of this wire to eliminate the possibility of a short. Cut the leads on a 6.8K 1/2W 10% resistor to about 1/8". Solder this resistor in a vertical position, to the +150V side of R1209 (12K 1/2W), see Fig 1 for location. Solder a 13" length of #22 stranded wire from the top end of the 6.8K resistor. Dress the wire under the horizontal EC board toward the front of the instrument. Solder the free end of this wire to the center conductor of the 'A' Gate BNC connector.

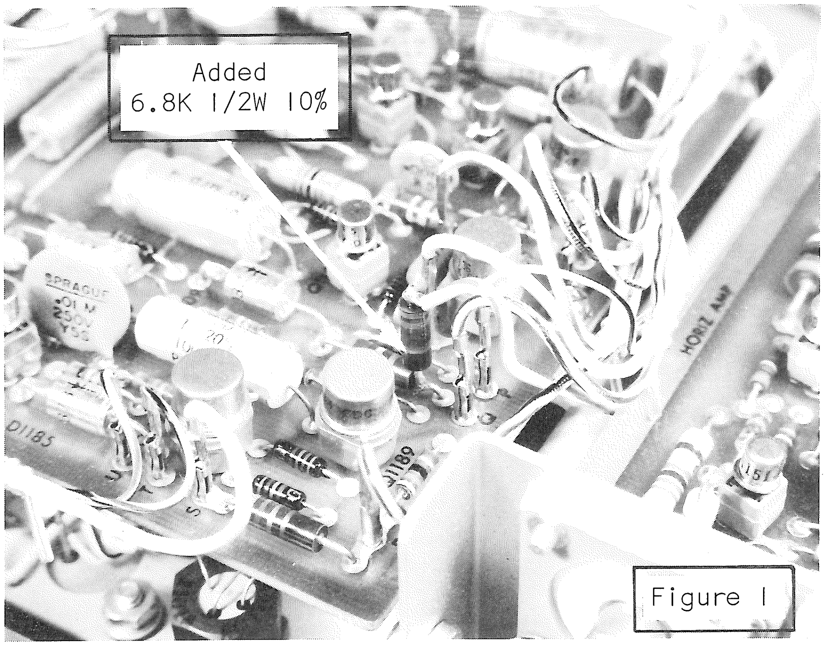


Figure 1

To operate, the units should be connected as shown in Figure 2.

The composite video signal must be fed to both vertical inputs. Channel 1 will be used to amplify the video to the required level at the Channel 1 out connector. This output level must be at least .5V peak to peak and can be determined by temporarily connecting Channel 1 out signal to Channel 2 input. Switch the mode switch to Channel 2 and vary the Channel 1 attenuator until .5V peak to peak signal is observed on Channel 2. Reconnect the equipment as previously indicated. The 453 should be operated in the Delay Sweep mode of operation and the vertical signal will be viewed on Channel 2.

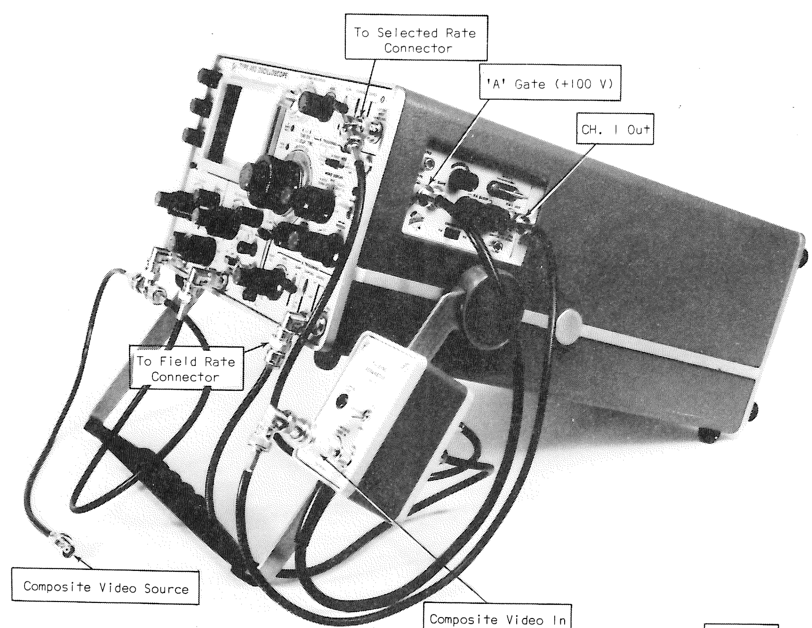


Figure 2

---Dan Welch

MODIFIED

MODIFIED PRODUCTS

	Product	Mod	Description
	453	120H	Sawtooth out.
##	453	127C	Internal Sync Separator for TV applications.
	453	152J	Special panel with "Property of Friden, Inc." lettering to be added to panel in standard 453 type style wherever it will fit.
##	453	165M	Watertight combination case; EMI to MIL-I-6181D.
	452	172Z	External graticule.
##	453	208A	Deeper panel cover and handle (Mod 147A); P6019 and 3 9' P6010, vibration test (Mod 799H).
##	453	208B	Deeper panel cover and handle (Mod 147A); vibration test; probes changed to P6019, 9' P6006 and 2 9' P6007.
	453	210H	IBM package. P6010.
##	453	221T	Probes changed to one 9-foot P6019 w/passive termination, and two 9-foot P6010, w/5" probe tip cables.
##	RM453	127C	Internal Sync Separator for TV applications.
##	RM453	153F	Oversize rack panel, special handles, MS power connector, tracks with extra travel.

INSTRUCTION MANUAL

Serial Number ____________

MODIFICATION INSERT

TYPE 453
MOD 165M

This insert has been written to supplement the Instruction Manual furnished with this modified instrument. The information given in this insert will supersede that given in the manual.

TYPE 453 MOD 165M

Tektronix, Inc.
S.W. Millikan Way ● P. O. Box 500 ● Beaverton, Oregon ● Phone MI 4-0161 ● Cables: Tektronix

INSTRUCTION MANUAL

Serial Number ____________

MODIFICATION INSERT

TYPE 453
MOD 163D

This insert is provided as a supplement to the Instruction Manual furnished with this modified instrument. The information given in this insert supersedes that given in the manual.

TYPE 453
MOD 163D

Tektronix, Inc.
S.W. Millikan Way ● P. O. Box 500 ● Beaverton, Oregon 97005 ● Phone 644-0161 ● Cables: Tektronix

be

04228

TYPE 453
MOD 163D

This manual insert describes the features of MOD 163D as installed in the Type 453. The instrument is modified to reduce conducted and radiated interference in accordance with MIL-I6181D and MIL-I-16910 over the frequency range of 150 kHz to 30 MHz (conducted) and 14 kHz to 1 GHz (radiated). The following changes and additions are made to this instrument:

A line filter is added between the AC connector and the power supply.

The rear-panel Z AXIS INPUT connector is changed to BNC type. A shorting chain cap is added to the connector.

Captive covers are added to the three BNC connectors on the calibrator chassis.

Conductive finishes, securing, shielding, and metal gasketing are added to frame and cabinet parts to minimize interference radiation.

CALIBRATION

This modification does not affect the operation of the instrument. Therefore, it can be calibrated as directed in the Calibration section of the manual.

PARTS LIST

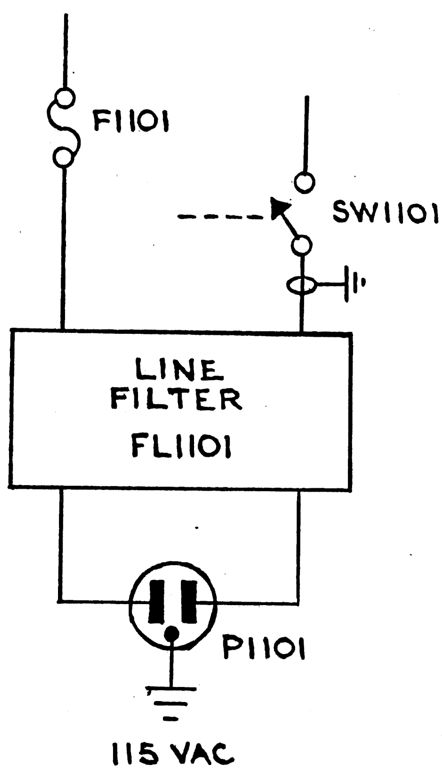
The following changes should be made to the appropriate parts list for this modified instrument. When ordering replacement parts, specify instrument type, MOD number, and serial number. Include the circuit number, part number, and description of the desired item.

INDUCTORS

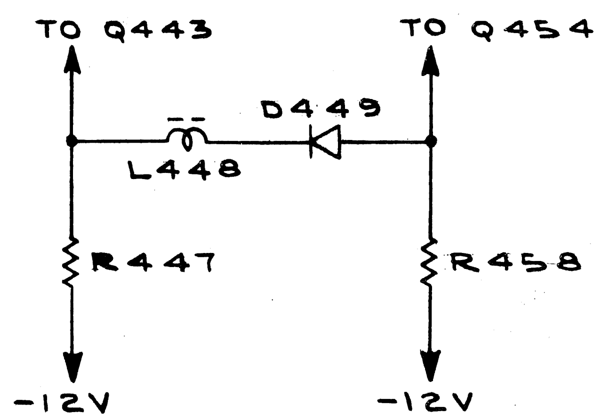
L448	Add	276-0507-00	Ferrite
FL1101	Add	119-0094-03	AC Line Filter

MECHANICAL

BRACKET, outer support	Add	1	407-0150-02
CABINET, bottom	Change	1	390-0003-00
CABINET, top	Change	1	390-0004-00
CONNECTOR, BNC	Change	1	131-0106-01
COVER, connector, shorting	Add	1	200-0672-00
COVER, connector	Add	3	200-0678-00
COVER ASSY., Line Voltage Selector	Change	1	200-0764-00
FRAME, cabinet, rear	Change	1	426-0317-04
PLATE, rear panel	Change	1	386-1403-00
PLATE, subpanel	Change	1	386-0207-04
STRAP, connector cover	Add	3	346-0045-00



PART. POWER SUPPLY



PARTIAL
A TRIG. GEN.

TYPE 453
MOD 165M

This manual insert describes the features of MOD 165M, as installed in the Type 453. The instrument is modified to provide a watertight (submersible) transit case. Electromagnetic interference is also minimized. The following changes and additions are made to the instrument:

The cabinet is changed to a combination transit and operating case capable of being sealed against entry of water by installation of the front-panel cover. With the panel cover in place, the instrument and normal operating accessories are watertight according to the test methods and criteria of MIL-STD-108.

Gasketing and drain plugs are added to the rear and bottom of the instrument for release of internal condensation, in accordance with MIL-STD-108.

The case is provided with a breather valve for the release of excessive pressure differentials which would interfere with panel cover removal after air transit.

Signal inputs, operating controls, power input, and ventilating holes are confined to the front of the instrument and are sealed against moisture entry by installation of the front-panel cover.

A sealed rear-panel access port is provided for the line voltage range switch, line fuses, and Z AXIS INPUT. A sealed access port is also provided for the side-panel controls and connectors.

The instrument meets interference requirements of MIL-I-6181D and MIL-I-16910A, Power line conducted: 150 kHz - 25 MHz. Radiated (with mesh filter installed): 14 kHz - 1000 MHz.

An allen wrench to fit all case fittings is added to the accessories. A power cord, which mates with the front-panel power input connector, is supplied.

NOTE

With the panel cover in place, this modified instrument is watertight, but not necessarily vaportight, and so may tend to accumulate internally condensed moisture unless the drain plugs are left open during extended periods of storage. Where condensation has accumulated, a dryout period with panel cover removed may be required before operation.

CHARACTERISTICS

Dimensions

Height: Cabinet only - 9 1/8" ; Overall - 10 3/8" (handle in forward position).
Width: Cabinet only - 12 15/16" including access port; Overall - 14 13/16" including handle.
Length: Without panel cover (including knobs) - 21" ; With panel cover - 22 1/2" ; With handle in forward position - 26".

Weight

Net weight, including panel cover and electrical and viewing accessories (less manuals), approximately 47 pounds; shipping weight approximately 57 pounds.

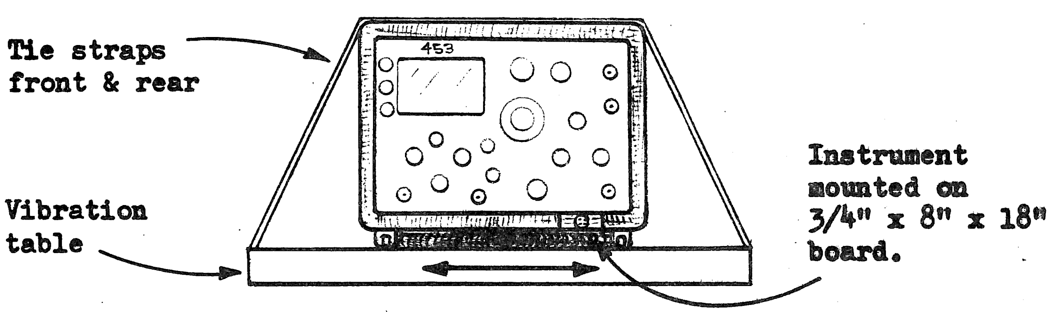
ENVIRONMENTAL TESTING

Humidity

For humidity tests, drain plugs are removed from waterproof case.

Vibration

For vibration tests, instrument is mounted as shown below.



PARTS LIST

The following changes and additions should be made to the mechanical parts list of this modified instrument. When ordering replacement parts, specify instrument type, serial number, and MOD number. Include the part number and description of the desired item.

Refer to the WATERPROOF CASE drawing on page 5:

Ref. No.	Description	Qty.	Part No.
1	CABINET ASSEMBLY	1	390-0027-00
	Includes:		
2	VALVE, Relief	1	214-0976-00
3	PORT, Drain	2	
	Gasket, vent plug		214-0979-00
	Plug, vent		214-0985-00
	O-Ring		354-0317-00
	Washer, port		210-1051-00
	Washer, flat		210-1050-00
4	DOOR LATCH	3	
	Bushing, door latch		358-0255-00
	Screw, thumb		213-0174-00
5	CONNECTOR, Bendix, 4-pin	1	131-0281-00
6	PLATE, Mounting	1	386-1323-00
7	ROD, Spacer	2	385-0168-00
8	FILTER, AC Line	1	119-0094-01
9	HANDLE, Carrying	1	367-0081-00
10	INDEX, Handle Ring	2	214-0513-00
11	HUB, Handle Index	2	214-0578-00
12	SPRING, Handle Index	2	214-1006-00
13	COVER, Handle	2	200-0602-00
14	CABLE, w/rt-angle female conn.	1	161-0041-00
15	GROMMET, Plastic, 3/8"	1	348-0056-00

Refer to the WATERPROOF COVER drawing on page 6:

Ref. No.	Description	Qty.	Part No.
1	COVER, Front, Assembly	1	200-0809-00
	Includes:		
2	HOLDER, Fuse	1	352-0109-00
3	BODY, Latch	1	204-0282-00
4	STEM, Latch	1	214-0787-00
	PIN, Hinge (not shown)	2	214-0756-00

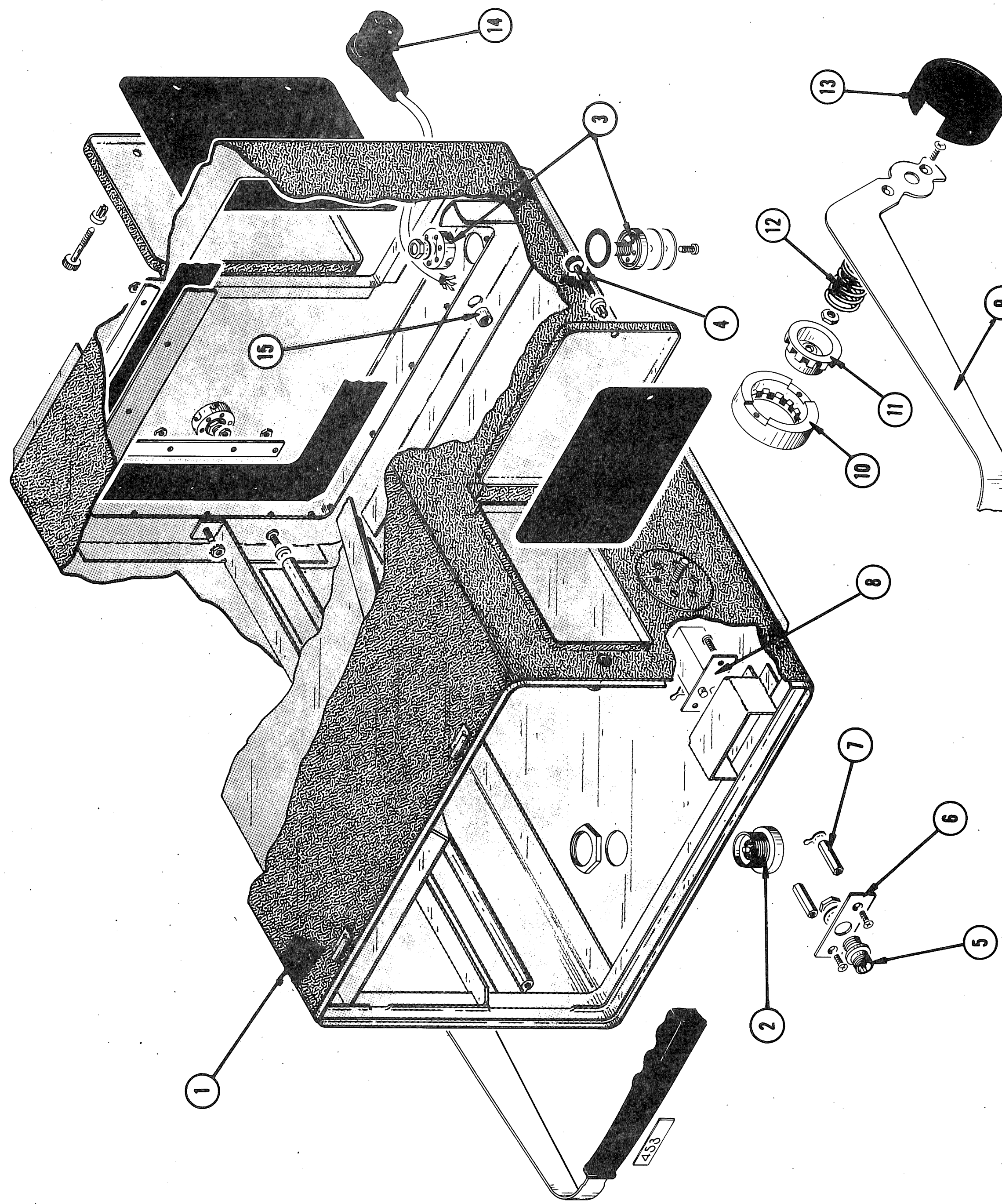
Refer to the MAIN CHASSIS drawing on page 7.

Ref. No.	Description	Qty.	Part No.
1	SHIELDING, Gasket, Assembly	1	348-0135-00
	Includes:		
2	LATCH, Shielding	4	
	Housing, latch		380-0124-00
	Nut, latch		220-0481-01
	Screw, 6-32 x 1 PHS		211-0517-00
	Thumbscrew		213-0175-00
	Washer, shouldered		210-0061-00
3	PLATE, Identification	1	334-1144-00
4	RAIL, Guide, Right	1	351-0134-00
5	RAIL, Guide, Left	1	351-0135-00
6	IMPELLER, Fan, Axial	1	369-0027-00
7	PLATE, Rear Overlay	1	386-1308-00
8	POWER CORD, 9-inch	1	161-0042-00

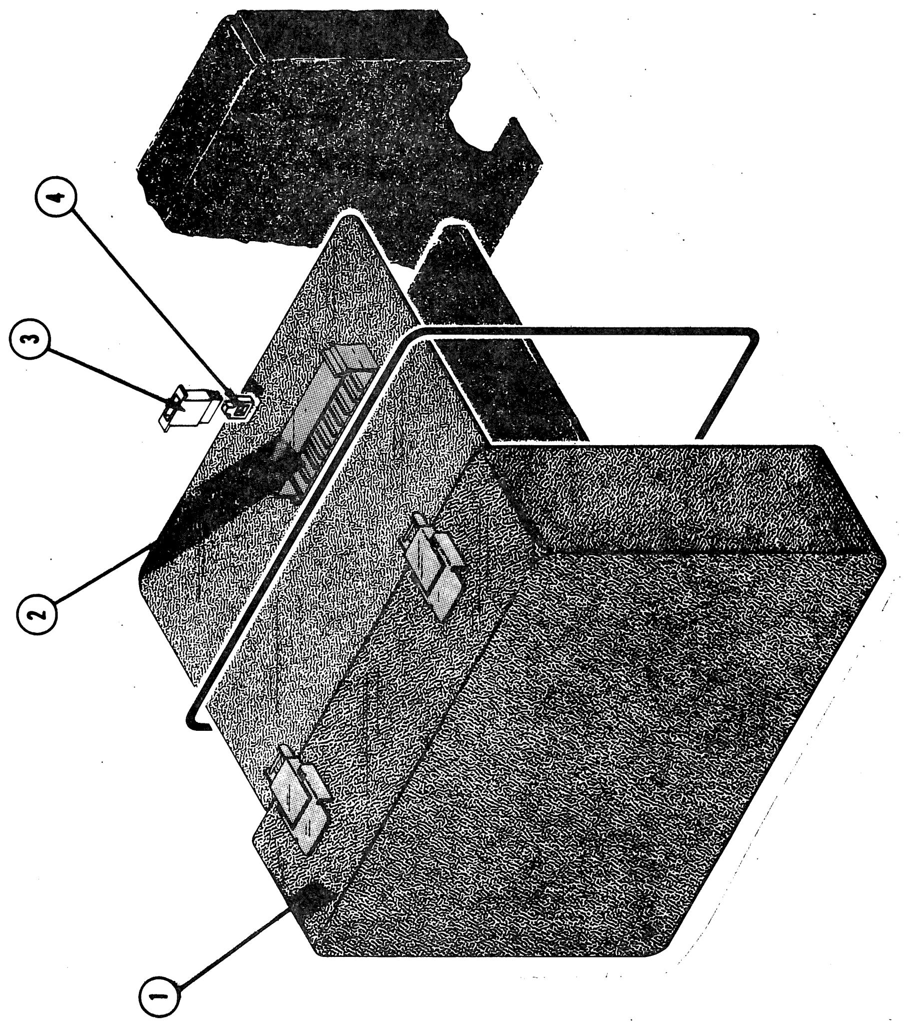
Accessory kit addition:

CABLE, Power, w/Bendix connector	1	161-0039-00
WRENCH, Hex, 5-32	1	003-0104-00

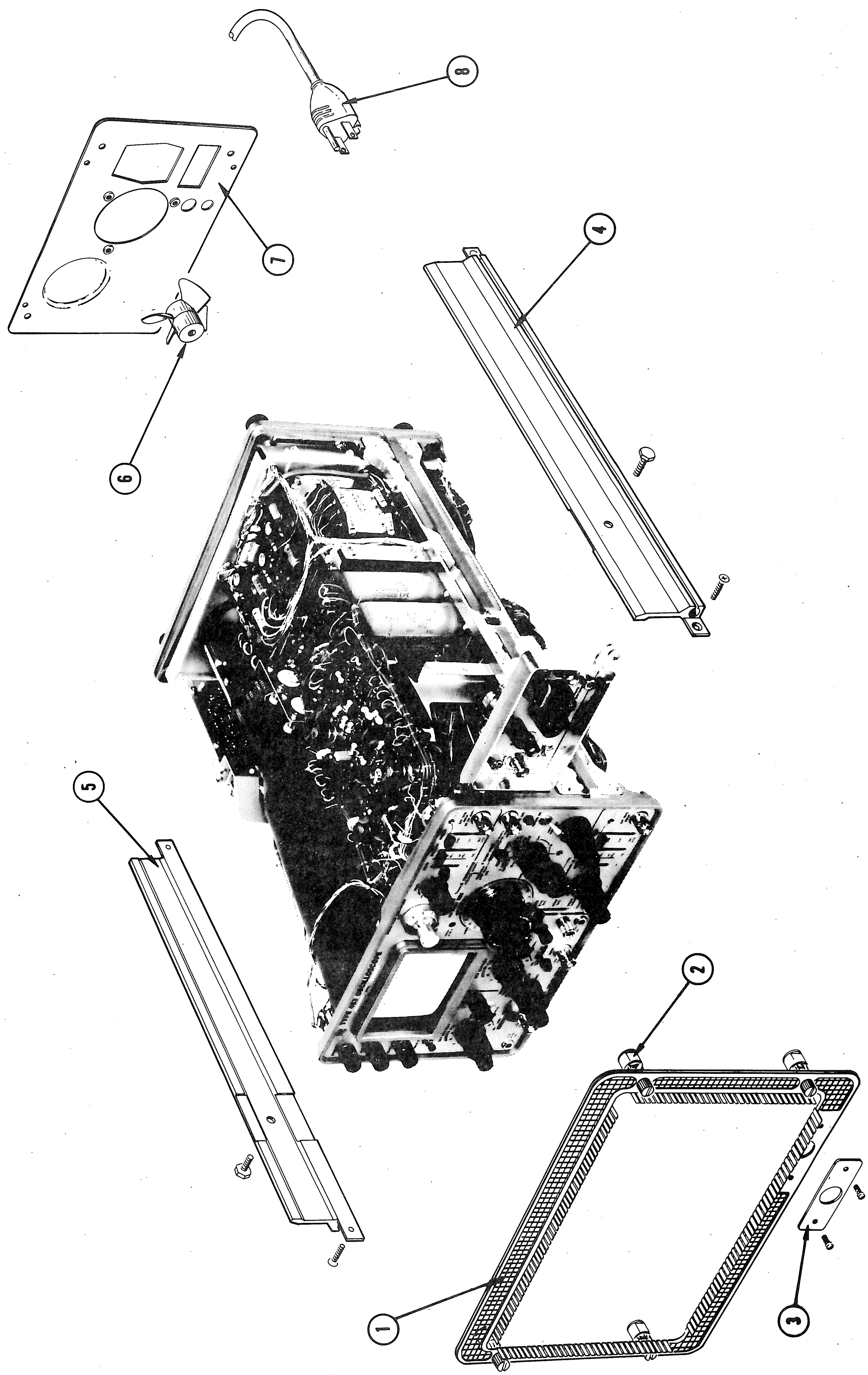
WATERPROOF CASE

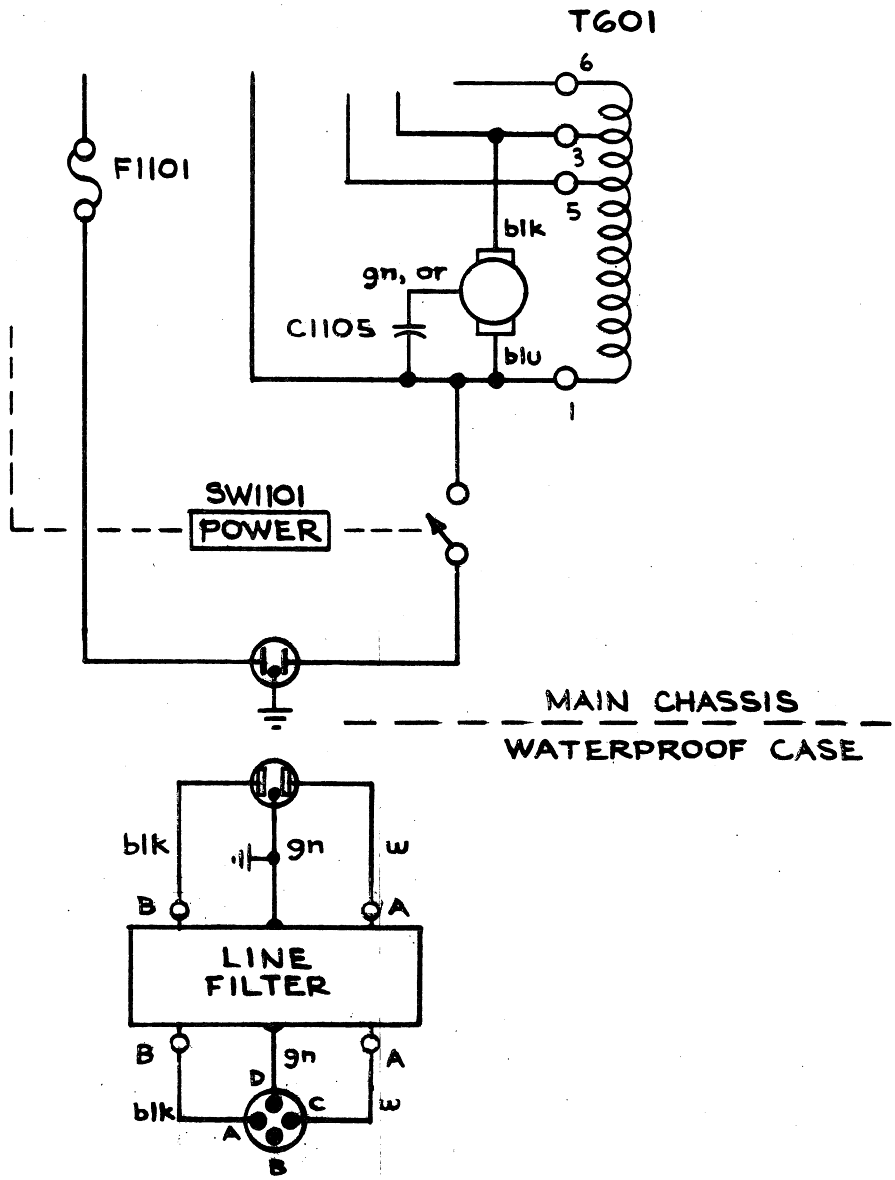


WATERPROOF COVER



MAIN CHASSIS



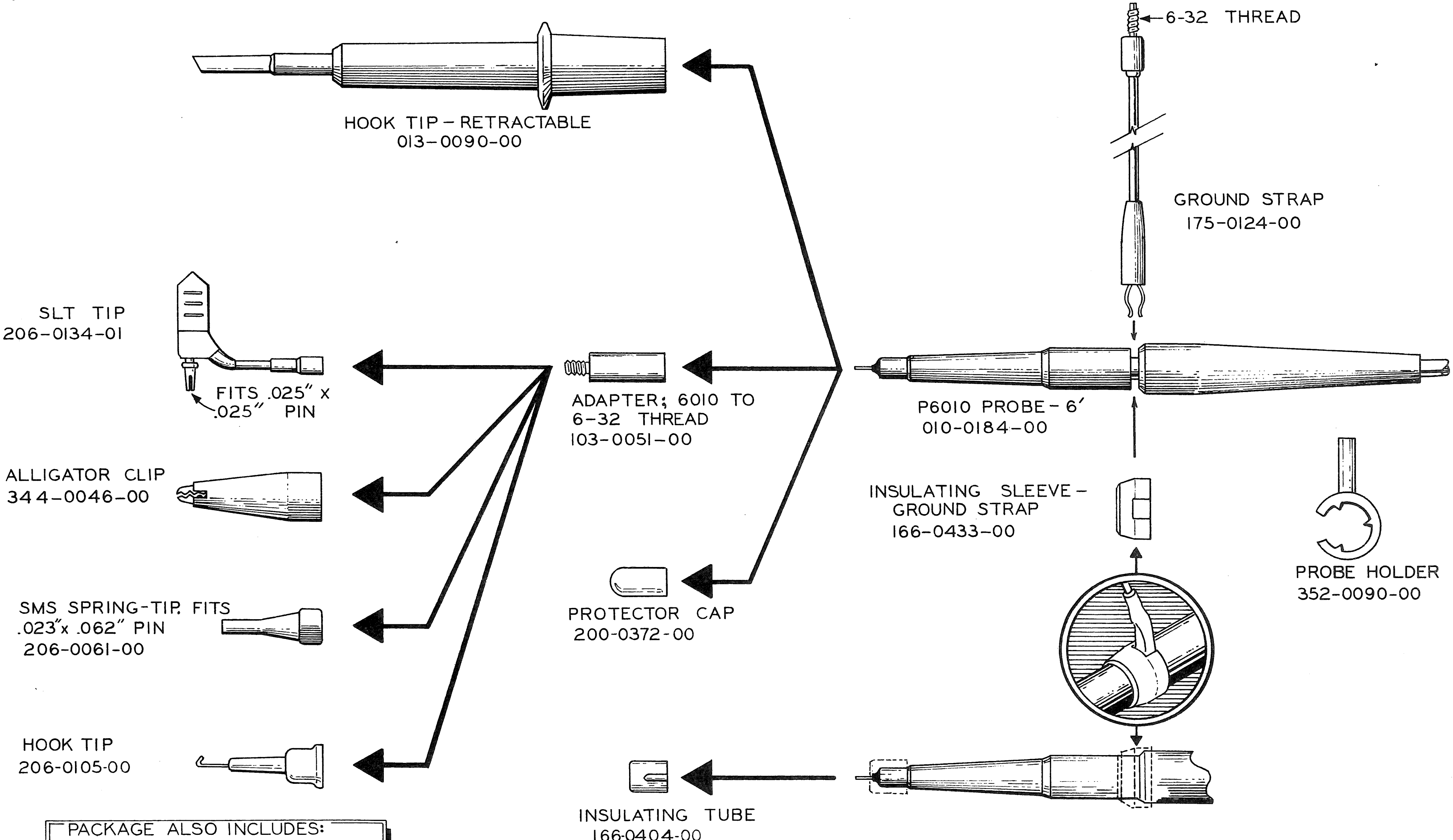


PART. POWER SUPPLY

P6010

IBM ACCESSORIES AND PROBE PACKAGE

INCLUDED IN 453 MOD 210H 010-0186-00



PACKAGE ALSO INCLUDES:
1 EA. MANUAL— 070-0495-00
1 EA. PLASTIC BAG— 006-0351-00

PRODUCT TECHNICAL INFORMATION – 6/19/66
Rem

ENG SPEC

SPECIFICATION ADDENDUM

R453 OPERATING TEMPERATURE SPEC.

Tony Bryan, 11-19-65

Due to the operating conditions that might be expected and due to the restrictions of air flow that result from rackmounting the R453, the operating temperature spec will be +45° C instead of +55° C. If the user mounts the R453 above a hot power supply, he may expect the performance to be affected.

Because of such possibilities and the oft-times restricted air flow in rackmount situations it will be wise to make users aware of this change in specifications. Storage temperature will remain unchanged.

ENGINEERING INSTRUMENT SPECIFICATION

TYPE 453 OSCILLOSCOPE

FOR INTERNAL USE ONLY

TEKTRONIX, INC.

Specification 133

April 23, 1965

ENGINEERING

INSTRUMENT SPECIFICATION

TYPE 453

OSCILLOSCOPE

Prepared by Techanical Writing Dept.

Preproduction Engineering

Sunset Ext. 279 Gary Wright ______ Gary Wright

Approval:

Project Manager Gene Andrews for O.D. ______ Oliver Dalton

Project Engineers, Electrical

Gene Andrews ______ Gene Andrews

James Goodwin for CB ______ Carl Battjes

Lawrence L Mayhew ______ Larry Mayhew

Project Engineer, Mechanical Dick Duggan ______ Dick Duggan

Evaluation Engineer, Electrical Bill Snell ______ Bill Snell

Evaluation Engineer, Mechanical Jim Russo ______ Jim Russo

<u>FOR INTERNAL USE ONLY</u>

TEKTRONIX, INC.

CONTENTS

INTRODUCTION

This is the Instrument Specification of the Type 453 Oscilloscope , and is the reference document for all company activity concerning performance requirements. This specification of for internal use only. It replaces the rough draft of the Type 453 Instrument Specification dated February 26, 1965.

General Information

The Type 453 is a general purpose, high performance, portable wide-band oscilloscope. It combines a dual-channel vertical amplifier with a delaying sweep feature. The Type 453 has been designed and tested to meet certain Tektronix "environmental instrument specifications".

Characteristics Summary

Vertical System (Ch 1 and Ch 2)	
Calibrated Deflection Factors	5 mv/div through 10 v/div in a 1-2-5 sequence
Variable Attenuator Range	≥ 2.5:1
Frequency Reponse	
5 mv/div	DC to ≥ 40 mc
10 mv/div	DC to ≥ 45 mc
20 mv/div through 10v/div	DC to ≥ 50 mc
Display Modes	Ch 1, Ch 2 (normal or inverted) Alternate, Chopped (@ 500 kc) Added Algebraically
Trigger Source	Normal (displayed signal) Ch 1 (pickoff ahead of channel switching)
Ch 1 Out	≥ 25 mv/div signal can be connected into Ch 2 to obtain 1 mv/div, 25 mc performance
Signal Delay	140 nsec
Calibrated Scan	6 divisions
Horizontal System	
Calibrated Sweep Rates	
Time Base "A"	5 sec/div to 0.1 μsec/div (A is the main and delaying sweep) in a 1-2-5 sequence

Characteristics Summary (continued)

Time Base B	0.5 sec/div to 0.1 µsec/div in a 1-2-5 sequence (B is displayed only in the delayed or intensified modes)
A Sweep Length	Variable from 4 to 10 divisions
Variable Range (A & B)	≥ 2.5:1
Trigger Coupling (A & B)	AC, DC, AC LF Reject, AC HF Reject
Trigger Slope (A & B)	+ and -
Trigger Source (A & B)	Ch 1 and 2, Ch 1, Line External, External ÷ 10
A Sweep Mode	AUTO TRIG, NORMAL TRIG, Single Sweep
Sweep Magnification	X10 (extends sweep rate to 10 nsec/div)
Amplitude and Time Calibrator	0.1 v and 1.0 v, 1 kc square wave
CRT	
Tube Type	T4530-31-1
Accelerating Potential	10 kv
Graticule	Internal, illuminated, 6 X 10 div 1 division = 0.8 cm
External Horizontal Amplifier (Input is Ch 1 Vertical or Ext Input)	
Calibrated Sensitivity Range	
Input Ch 1	5 mv/div to 10 v/div in a 1-2-5 sequence
Ext Input	270 mv/div (2.7 v/div in EXT ÷ 10)
Frequency Response	DC to ≥ 5 mc
Z Axis Input	
Sensitivity	5 v p-p causes noticeable modulation at normal intensity
Usable Frequency Range	DC to 50 mc
Input Resistance	47 k Ω

Characteristics Summary (continued)

Cooling	Filtered, forced air
Environment	
Storage	-55°C to +75°C, to 50,000 ft
Operating Temperature	-15°C to +55°C
Operating Altitude	to 15,000 ft
Maximum Overall Dimensions	
Length (with front cover, handle in carrying position)	22.4"
(with front cover, excluding handle)	20.4"
Width	12.5"
Height	7.2"
Weight, with Front Cover	28 lbs 12 oz
Power Source	
Line Voltage Ranges (selected by switches at back panel)	96 to 127 vac 103 to 137 vac 192 to 254 vac 206 to 274 vac
Line Frequency	45 cycles to 440 cycles
Power Consumption	100 Watts at 115 vac 60 cycles

Specification 133/127C

February 22, 1968

ENGINEERING
INSTRUMENT SPECIFICATION

TYPE 453/R453 MOD 127C

OSCILLOSCOPE

Only the characteristics of this modified product that differ from the standard product are included in this specification.

Engineering Writer Gary Wright Gary Wright

Approval:

Project Manager Glenn Pelikan Glenn Pelikan

FOR INTERNAL USE ONLY

TEKTRONIX, INC.

INTRODUCTION

Description

The Type 453 Mod 127C is a general purpose, portable wide-band oscilloscope equipped with an internal Sync Separator circuit, permitting internal triggering from a composite video signal. The Sync Separator circuit is compatible with V and H sync signals of standard 405,625,819 line/50 Hz, 525 line/60 Hz broadcast systems, and 405 to 1201 line closed circuit systems.

Functions of Controls

A Sweep TRIGGER SOURCE Switch

EXT ÷ 10 position has been replaced with TV FIELD OR LINE SYNC position.

B Sweep TRIGGER SOURCE Switch

EXT ÷ 10 position has been replaced with TV LINE SYNC position.

Side Panel

TV SYNC SEPARATOR Switch has been added

Selects LINE signals or FIELD sync signals as a trigger source for A Sweep.

CHARACTERISTICS

1.1 ELECTRICAL

1.1.1 SYNC SEPARATOR

ITEM	QUOTABLE	MAINTENANCE & OPERATION	TEST RATE	VAL. STEP	ENGINEERING NOTES
Trigger Sensitivity	2 div or less will provide stable V or H triggering				For sync-positive operation, apply signal to CH 2 set INVERT and - SLOPE

SECTION 2

ELECTRICAL PERFORMANCE VALIDATION

2.1 Equipment Required

1	Video Receiver	:	Conrac

2.2 Trigger Sensitivity

Connect Video signal to CH 1 INPUT. Set A TRIGGERING SLOPE to -. Set A TRIGGERING SOURCE for TV FIELD OR LINE SYNC and TV SYNC SEPARATOR to LINE. Check that 2 div or less of composite video provides stable triggering. Set TV SYNC SEPARATOR to FIELD. Check that 2 div or less of composite video provides stable triggering.

Connect Video signal to CH 1 INPUT. Set TV SYNC SEPARATOR to FIELD and B TRIGGERING SLOPE to -. Set A sweep rate for 2 ms/div, B sweep rate for 10 μs/div, and HORIZ DISPLAY for DELAYED SWEEP (B) and B MODE for B STARTS AFTER DELAY TIME. Adjust DELAY-TIME MULTIPLIER to display leading edge of H sync pulse. Set B MODE for B TRIGGERABLE AFTER DELAY TIME. Check for stable triggering.

SECTION 1

1.0 Performance Requirements

1.1 Electrical Characteristics

Performance requirements listed for the characteristics in this section are valid throughout the environment specified in Section 1.2 unless there is a statement to the contrary.

Performance requirements are validated by Engineering according to Sections 3 and 4. Production test methods may differ.

The following codes are used to categorize performance requirements.

G (General Use)	This performance requirement may, but not necessarily will, be quoted to a customer.
I (Internal Use Only)	This is a customer type performance requirement (not a factory test limit), but will not be quoted to a customer.
A (All)	It is recommended by Engineering that electrical testing of this performance requirement be performed on 100% of instruments. Environmental testing is performed on a sample basis.
S (Sampled)	This performance requirement carries a high confidence level and may be tested on a sample basis.

Conditions under which a performance requirement is valid may be listed under Supplemental Information or in Section 3 (Electrical Test Methods). These conditions are an essential part of the performance requirement.

This page revised May 17, 1965. Revised portion/s denoted with asterisk.
Specification 133 dated April 23, 1965. Engineering Instrument specification, Type 453 Oscilloscope.

1.1.1 VERTICAL AMPLIFIER

Characteristic	Performance Requirement		Code	Supplemental Information
Calibrated Deflection Factor Accuracy	± 3% (5 mv/div to 10 v/div in 1-2-5 sequence)		GA	with gain adjusted at 20 mv/div
Input R and C	1 megohm ± 2% paralleled by 20 pf ± 3%		GS	*P 6010 3½' = ≈ 10 pf 6' = ≈ 12 pf
Variable Range	≥ 2.5:1		GA	
Frequency Response to 30% down	@ input connector	*with P6010 probe		AC coupling 30% down at ≈ 1.6 cps
5 mv/div	*DC to ≥ 41 mc	DC to ≥ 40 mc	GA/GS	*≈ 0.16 cps with P6010
10 mv/div	*DC to ≥ 46.5 mc	DC to ≥ 45 mc	GA/GS	
20 mv/div	*DC to ≥ 52.5 mc	DC to ≥ 50 mc	GA/GS	*Measured using a 067-506
50 mv/div through 10 v/div	*DC to ≥ 52.5 mc	DC to > 50 mc	GS	*1 v/div to 10 v/div frequency response is calculated
Added Mode	*DC to ≥ 52.5 mc	DC to ≥ 50 mc	GA/GS	
Ch 1 OUT @ 5 mv/div	DC to ≥ 25 mc (terminated in 50 Ω)		GS	
Ch 1 out connected to Ch 2	DC to ≥ 25 mc (unterminated)		GA	
Risetime	@ input connector	* with P6010 probe		
5 mv/div	*≤ 8.5 nsec	≤ 8.75 nsec	GS	
10 mv/div	*≤ 7.5 nsec	≤ 7.8 nsec	GS	
20 mv/div through 10 v/div	*≤ 6.7 nsec	≤ 7 nsec	GS	
Added Mode	*≤ 6.7 nsec	≤ 7 nsec	GS	Measured at 20 mv/div

1.1.1 VERTICAL AMPLIFIER

Characteristic	Performance Requirement	Code	Supplemental Information
Ch 1 OUT @ 5 mv/div (terminated in 50 Ω)	≤ 14 nsec	GS	
Ch 1 OUT connected to Ch 2 (unterminated)	≤ 14 nsec @ ≤ 1 mv/div (both channels at 5 mv)	GS	
Added Mode	≤ 7 nsec	GS	Measured at 20 vm/div
Transient Response			4 div step centered
20 mv/div	≤ 2% peak-to-peak overshoot, rolloff, ringing or tilt	IA	
10 mv/div	≤ 2%	IA	
5 mv/div	≤ 2%	IA	
50 mv/div to 2 v/div	≤ 3%	IA	
5 v/div to 10 v/div	≤ 6%	IA	
Added Mode	≤ 6%	IA	Measured at 20 mv/div
Attenuator Compensation			
50 mv/div to 10 v/div	≤ 1%	IA	
Position Effect on Transient Response	≤ 5% peak-to-peak overshoot, rolloff, ringing or tilt	IA	6 div step
Low Frequency Linearity	≤ 0.15 divisions compression or expansion	IS	Includes CRT linearity
Position Range	±13.5 div to ±16.5 div	IA	VAR ATTEN in CAL, after STEP ATTEN bal check
Maximum Input Voltage	600 volts combined DC + peak AC	GS	

See page 1-1 for coding legend

1.1.1 VERTICAL AMPLIFIER				
Characteristic	Performance Requirement		Code	Supplemental Information
Trace Drift (after 20 minute warm-up	Time	Temperature		
5 mv/div	≤ 1 div/hr	≤ 0.1 div/°C	GS	
10 mv/div	≤ 0.5 div/hr	≤ 0.05 div/°C	GS	
20 mv/div through 10 v/div	≤ 0.25 div/hr	≤ 0.025 div/°C	GS	
Microphonics at 5 mv/div	≤ 1 div		IA	
STEP ATTEN BAL Reserve Range at 20 mv/div	≥ 5 div from either end of range		IA	
Variable Bal Centering	±1 div of graticule center		IA	
Invert Zero Shift Point	±1 div of graticule center		IA	
GAIN Range	≥ ±5% from calibrated value		IA	Gain set at 20 mv/div
Input Grid Current	≤ 2 namps		GS	
Amplifier Crosstalk	≥ 100:1, DC to 20 mc		GS	
Attenuator Isolation	≥ 10,000:1, DC to 20 mc		GS	
Common Mode Rejection Ratio	≥ 20:1 at 20 mc for common mode signals up to 8 divisions		GA	With optimized setting of GAIN adjustment
Linear Dynamic Range in Added Mode	≥ ±10 times the VOLTS/DIV setting for ≤ 10% distortion		GS	
Signal Delay				≈ 140 nsec
Chopped Repetition Rate	500 kc ± 20%		GA	

See page 1-1 for coding legend

1.1.2 SWEEP GENERATORS A & B (A Sweep is the main & delaying sweep)			
Characteristic	**Performance Requirement**	**Code**	**Supplemental Information**
Calibration Accuracy	0°C to + 40°C — - 15°C to + 55°C		
5 sec/div to 0.1 sec/div	± 3% — ± 5%	GA	
50 msec/div to 0.1 µsec/div	± 3% — ± 5%	GA	
X10 Magnified	1% in addition to specified sweep accuracies	GA	
Sweep Linearity	± 1.5%	GA	
Variable Range	≥ 2.5:1	GA	
Sweep Length A	Variable from ≤ 4 div to (11.0 ± 0.5 div)	GA	Measured at 1 msec/div
Sweep Length B	11.0 ± 0.5 div	GA	Measured at 1 msec/div
A Sweep Hold-off Time			
10 µsec/div to 5 sec/div	≤ 1 X the A TIME/DIV Setting	GA	
5 µsec/div to 0.1 µsec/div	≤ 2.5 µsec	GA	

See page 1-1 for coding legend

1.1.3 VARIABLE TIME DELAY				
Characteristic	Performance Requirement		Code	Supplemental Information
Delay Time Range	Calibrated, 50 sec to 1 µsec in 1-2-5 sequence with a 10-turn multiplier		GA	
Accuracy	0°C to + 40°C	- 15°C to + 55°C		
5 sec/div to 0.1 sec/div	± 2.5%	± 3.5%	GA	
50 msec/div to 1 µsec/div	± 1.5%	± 2.0%	GA	
Multiplier Incremental Linearity	± 0.2%	± 0.3%	GA	
Jitter	≤ 1 part in 20,000 of 10 times the "A" TIME/DIV setting		GA	

See page 1-1 for coding legend

1.1.4 HORIZONTAL AMPLIFIER			
Characteristic	Performance Requirement	Code	Supplemental Information
Sweep Magnification Accuracy	See Sweep Generator A & B (page 1-5)	GA	Extends fastest sweep rate to 10 nsec/div
Normal/Magnified Registration	≤ ± 0.2 div	GA	
Position Range			
X1 clockwise	Start of sweep must position to the right of graticule center	GA	Measured at 1 msec/div, A sweep
X1 counterclockwise	End of sweep must position to the left of graticule center	GA	
X10 FINE control range	5 div to 8 div	GA	
	1.1.5 EXTERNAL HORIZONTAL AMPLIFIER		
Input to Vert Ch 1			
Calibrated Deflection Factor Range	5 mv/div to 10v/div in 1-2-5 sequence	GA	Variable control is by-passed
Accuracy	± 5% (0°C to +40°C) ± 8% (-15°C to +55°C)	GA	Ext Horiz Gain set @ 20 mv
Input R and C	See Ch 1 vertical performance requirement		
Frequency Response	DC to ≥ 5.0 mc at 30% down	GA	
Phase Shift	≤ 3° @ 50 kc	GS	Between Ch 1 and Ch 2

See page 1-1 for coding legend

1.1.5 EXTERNAL HORIZONTAL AMPLIFIER			
Characteristic	**Performance Requirement**	**Code**	**Supplemental Information**
Input to EXT HORIZ Connector			
Deflection Factor			
EXT	270 mv/div ± 15%	GA	
EXT ÷ 10	2.7 v/div ± 20%	GA	
Input R and C			≈ 1 meg Ω paralleled by ≈ 20 pf
Frequency Response	DC to ≥ 5.0 mc at 30% down	GS	
Phase Shift	≤ 3° at 50 kc	GS	Between EXT HORIZ and Ch 2
Max Input Voltage	See Triggering A & B		

See page 1-1 for coding legend

1.1.6 TRIGGERING A & B

Characteristic			Performance Requirement	Code	Supplemental Information
Trigger Sensitivity					
	INT	DC	0.2 div to 10 mc, increasing to 1 div at 50 mc	GA	
	INT	AC	0.2 div from 30 cps to 10 mc, increasing to 1 div at 50 mc	GA	Lower 30% down point of coupling is ≈ 16 cps
	INT	AC LF Reject	0.2 div from 30 kc to 10 mc, increasing to 1 div at 50 mc	GA	Lower 30% down point of coupling is ≈ 16 kc
	INT	AC HF Reject	0.2 div from 30 cps to 50 kc		Lower 30% down point of coupling is ≈ 16 cps Upper 30% down point of coupling is ≈ 100 kc
	EXT	DC	50 mv to 10 mc increasing to 200 mv at 50 mc	GA	
	EXT	AC	50 mv from 30 cps to 10 mc, increasing to 200 mv at 50 mc	GA	Lower 30% down point of coupling is ≈ 16 cps
	EXT	AC LF Reject	50 mv from 30 kc to 10 mc, increasing to 200 mv at 50 mc	GA	Lower 30% down point of coupling is ≈ 16 kc
	EXT	AC HF Reject	50 mv from 30 cps to 50 kc	GA	Lower 30% down point of coupling is ≈ 16 cps Upper 30% down point of coupling is ≈ 100 kc
Auto (A only)			Usable with signals above 20 cps	GA	Free runs A Sweep in absence of triggering signal
Jitter			≤ 1 nsec at 10 nsec/div	GA	

See page 1-1 for coding legend

1.1.6 TRIGGERING A & B

Characteristic	Performance Requirement	Code	Supplemental Information
Maximum Input Voltage	600 v combined DC + peak AC	GS	
Single Sweep (A only)	Triggering level same as normal sweep Performance Requirements	GA	
External Trigger Input			
R and C			≈ 1 meg paralleled by ≈ 20 pf except AC LF Rej
Level Range			
EXT	≥ ± 2 v	GA	
EXT ÷ 10	≥ ± 20 v	GA	

1.1.7 CALIBRATOR

Characteristic	Performance Requirement		Code	Supplemental Information
Intial Setting	1 v ± 0.3% at 25°C ±5°C			
	0°C to + 40°C	-15°C to + 55°C		
Output Voltage 1 v or 0.1 v	± 1%	± 1.5%	GA	switch on side panel
Output Current 5 ma	± 1%	± 1.5%	GA	loop on side panel
Repetition Rate 1 kc	± 0.5%	± 1%	GA	
Risetime	≤ 1 μsec		GA	
Duty Cycle	49% to 51%		GA	
Output Resistance				≈ 200 Ω in 1 v position ≈ 20 Ω in 0.1 v position

See page 1-1 for coding legend

1.1.8 Z AXIS INPUT			
Characteristic	Performance Requirement	Code	Supplemental Information
Sensitivity	≥ 5 v peak-to-peak causes noticeable modulation at normal intesity	GA	Positive signal blanks CRT
Usable Frequency Range	DC to ≥ 50 mc	GS	Maximum Input Voltage 200 v combined DC + peak AC
Input Resistance at DC			≈ 47 k Ω
	1.1.9 SIGNAL OUTPUTS		
A & B Gates			
Output Voltage	12 v ± 10%	GA	
Output Resistance			≈ 1.5 k
Vertical Signal Out (Ch 1 only)			
Output Voltage	≥ 25 mv/div into 1 meg Ω	GA	Trigger at NORM, Ch 1 Variable at CALIBRATED
Output Resistance			≈ 50 Ω
Frequency Response	(see Vertical Amplifier page 1-2)		
	1.1.10 POWER REQUIREMENTS		
Line Voltage Ranges	96 to 127 vac 103 to 137 vac 192 to 254 vac 206 to 274 vac	GA	Applicalbe when line contains ≤ 2% total harmonic distortion Power consumption ≈ 100 watts
Line Frequency	45 cps to 440 cps	GS	

See page 1-1 for coding legend

1.1.11 INTERNAL POWER SUPPLY PERFORMANCE

Characteristic	Performance Requirement			Code	Supplemental Information
Power Supply Tolerances at 25°C ± 5°C	- 12 v	+ 12.1 v	+ 75 v		
Initial Setting	± 0.27%	± 1.0%	± 0.37%	GA	
Long Term	± 1%	± 1.7%	± 1%	GS	For any 500 hr period after the first 200 hr at 25°C
Ripple	≤ 2 mv	≤ 2 mv	≤ 2 mv	IA	
Variation from 25°C value -15°C to + 55°C	± 0.5%	± 0.75%	± 0.75%	IS	
High Voltage Tolerance					
Initial Setting at 25°C ± 5°C	-1.95 kv ± 1%			IA	
Long Term	-1.95 kv ± 3%			GS	
Fuse Data	Two, 0.8 amp slow blow for 115 vac or 230 vac				Located on side panel

See page 1-1 for coding legend

1.1.12 CRT DISPLAY

Characteristic	Performance Requirement	Code	Supplemental Information
Type T4530-1-31			
Performance			
Writing Rate	Capable of single transient recording at ___ sec/div, using Type ___ camera and Type ___ film	GS	Performance Requirement undetermined
Luminance	Performance Requirement undetermined		
Trace Width	≤ 0.030" at graticule center	IA	At normal intensity
Horizontal Resolution	150 lines in 10 divisions	GA	
Geometry			
Scan Area	≥ 6 X 10 div at 0.8 cm per div	GA	
Beam Intercept			
Vertical	At 6 div scan, max intercept per plate 35%	GA	
Horizontal	At 10 div scan max intercept per plate 50%	GA	
Spot Centering	≤ 0.5 div radius from graticule center	GA	
Linearity	≤ 0.5 minor div compression or expansion of 2 div signal	IA	
Orthogonality	90° ± 1°	GA	Of CRT alone. Y-axis alignment adj. sets orthogonality to 90°
Trace Rotation Range	≥ 6°	GA	
Raster Distortion	≤ 0.5 minor div total	GA	

See page 1-1 for coding legend

1.1.12 CRT DISPLAY

Characteristic	Performance Requirement	Code	Supplemental Information
Internal Graticule			
Luminance	Performance Requirement undetermined		
Contrast	Performance Requirement undetermined		
Display Defects			
Flare	No visible flare with CRT cut off or with low intensity level	IA	
Grid Emission	No visible effects of grid emission with CRT cut off or with low intensity level	IA	
Cathode Interface	No brightening of first 1 to 2 divisions of trace	IA	
Charging	None perceivable	IA	
Burrs	No burrs that cause beam to exceed trace-width and horizontal resolution requirements	IA	
Double Peaking	None	IA	
Heater Cathode Leakage	None	IA	
Electrical			
Electrode Voltages to Ground			<u>Typical Values</u>
Heater Voltage			6.3 v, 90ma (elevated to -1.95 kv ≈ 40 kc) pins 1, 14
Post Accelerator			+ 8.05 kv

See page 1-1 for coding legend

1.1.12 CRT DISPLAY			
Characteristic	Performance Requirement	Code	Supplemental Information
Cathode			-1.95 kv (pin 2)
Post Accelerator Mesh			0 v (pin 10)
D1-D2 Deflection Shield (Geometry)			0 v to +75 v (pin 9)
Average of Deflection Plates			+50 v
Astigmatism			0 v to +90 v (pin 5)
Accelerator (1st anode)			+50 v (pin 7)
Focus			-1.2 kv to -1.65 kv (pin 4)
Grid No. 1			-2.055 kv to -1.98 kv (pin 3)
Deflection Factors			
Vertical	4.1 v/div to 5.1 v/div	IA	CRT alone 4.3 v/div to 4.9 v/div
Horizontal	10.7 v/div to 13.0 v/div	IA	CRT alone 11.0 v/div to 12.6 v/div

See page 1-1 for coding legend

1.1.12 CRT DISPLAY

Characteristic	Performance Requirement	Code	Supplemental Information
Interelectrode Capactiance CRT ONLY			<u>Typical Values</u>
Grid to all			9.5 pf
Cathode to all			2.6 pf
D1 to D2			1.9 pf
D1 to all			5.0 pf
D2 to all			4.9 pf
D3 to D4			1.5 pf
D3 to all			3.2 pf
D4 to all			3.3 pf
D3 to D4 Eff Cap	6.8 pf max	I	Not tested
D1 to D2 Eff Cap	9.8 pf max	I	Not tested
Helix Resistance	200 Meg Ω Min	IS	
Mechanical			
Length	15 3/4 " ± 1/8"	IA	
Light Pipe-to-Graticule Alignment	Undetermined		
Face Plate Tilt	0.032"	IA	

See page 1-1 for coding legend

1.1.12 CRT DISPLAY

Characteristic	Performance Requirement	Code	Supplemental Information
Neck Pins	No broken, bent or loose neck pins	IA	
	No cracks around neck pins		
Base	No movement between base and bulb	IA	
	No loose, bent or broken base pins		
Faceplate Defects Inside Graticule Area (maximum allowable)	None over 0.025" dia	IA	Excluding scratches. Defects which prevent light from passing through the glass.
	3 defects 0.020" to 0.025" ≥ ½" apart		
	6 defects 0.010" to 0.025" ≥ ¼" apart		
	8 defects 0.007" to 0.010" ≥ ¼" apart		
	under 0.007" not to be rejected unless defects form a well-defined pattern		
Defects Outside Graticule Area (maximum allowable)	None over 0.025" dia	IA	Excluding scratches. Defects which prevent light from passing through the glass.
	6 defects 0.020" to 0.025" ≥ ½" apart		
	10 defects 0.010" to 0.020" ≥ ¼" apart		
	$15/cm^2$ 0.007" to 0.010"		
	under 0.007" not to be rejected		

See page 1-1 for coding legend

1.1.12 CRT DISPLAY

Characteristic	Performance Requirement	Code	Supplemental Information
Scratches Inside Graticule Area (maximum allowable)	None 0.004" to 0.005" wide 0.070" to 0.150" long	IA	
	3 defects 0.004" to 0.005" wide ≥ ½" apart 0.030" to 0.070" long		
	None 0.003" to 0.004" wide 0.150" to 0.200" long		
	2 defects 0.003" to 0.004" wide ≥ ½" apart 0.040" to 0.150" long		
	2 defects 0.002" to 0.003" wide ≥ ½" apart 0.150" to 0.200" long		
	3 defects 0.002" to 0.003" wide ≥ ½" apart less than 0.150" long		
	under 0.002" wide not cause for rejection		
Scratches Outside Graticule Area (maximum allowable)	4 defects 0.004" to 0.005" wide ≥ ½" apart 0.070" to 0.150" long	IA	
	6 defects 0.004" to 0.005" wide ≥ ½" apart 0.030" to 0.070" long		
	2 defects 0.003" to 0.004" wide ≥ ½" apart 0.150" to 0.200" long		
	4 defects 0.003" to 0.004" wide ≥ ½" apart 0.040" to 0.150" long		

See page 1-1 for coding legend

1.1.12 CRT DISPLAY				
Characteristic		Performance Requirement	Code	Supplemental Information
	Scratches Inside Graticule Area (maximum allowable)	4 defects 0.002" to 0.003" wide ≥ ½" apart 0.150" to 0.200 long	IA	
		6 defects 0.002" to 0.003" wide ≥ ½" apart less than 0.150" long		
		under 0.002" wide not cause for rejection		

See page 1-1 for coding legend

1.1.12 CRT DISPLAY

Characteristic	Performance Requirement	Code	Supplemental Information
Phosphor			
Outside Graticule Area	≤ 0.025" in any dimension	IA	
	≤ 0.020" x 0.025" (combined)		
	6 defects, (0.010" x 0.020") to (0.020" x 0.025") and ≥ ½" apart		
	10 defects, ≤ 0.010" x 0.020", and ≥ ¼" apart		
	10 defects, total over 0.010"		
Inside Graticule Area	≤ 0.025" in any dimensions	IA	
	≤ 0.020" x 0.025" combined dimensions		
	3 defects, (0.010" x 0.020") to (0.020" x 0.025"), and ≥ ½" apart		
	6 defects, 0.010" x 0.020" and ≤ ¼" apart		
	6 defects, total less 0.010"		
Total Screen	4 defects, 0.003" x 0.070" (≤ 2 of these may appear inside graticule limits)	IA	
Graticule			
Line Defects	≤ 2 defects, ≤ 0.008" x 0.015", ≥ 2 cm apart	IA	
	Graticule line width must not exceed 0.015" over length of 0.020" or greater		
Line Breaks	≤ 0.010" (with line thickness of 0.009" ±0.002"		

See page 1-1 for coding legend

1.1.12 CRT DISPLAY				
Characteristic		Performance Requirement	Code	Supplemental Information
	Line Waviness	≤ 20% of line thickness	IA	
	Glowing Spots & Frit (not in graticule line)	Max No. / Max Size / Min Separation 4 / 0.011" to 0.015" / 1 cm 8 / 0.006" to 0.010" / 1 cm $15/cm^2$ / 0.003" to 0.005" / none	IA	

See page 1-1 for coding legend

1.2 Environmental Characteristics

The Type 453 is an environmental instrument. The following environmental limits are applicable.

1.2.1 Storage

No visible damage or electrical malfunction after storage at -55°C to +75°C and 50,000 feet, as described in Section 4. Adjustments may be performed to meet required accuracy after storage tests.

1.2.2 Temperature

The instrument will perform to limits indicated in Section 1.1 over a range from -15°C to +55°C when tested according to Section 4.

1.2.3 Altitude

The instrument will perform to limits indicated in Section 1.1 to 15,000 feet. From 5,000 ft to 15,000 ft, derate temp. 1°C/1,000 ft.

1.2.4 Humidity

The instrument will perform to limits indicated in Section 1.1 following the humidity tests described in Section 4.

1.2.5 Vibration

The instrument will perform to limits indicated in Section 1.1 following the vibration tests described in Section 4.

1.2.6 Shock

Operating and nonoperating

Thirty g's, one-half sine, 11 millisecond duration. Two shocks each direction along each of the three major axes; total of 12 shocks.

1.2.7 Transportation

The instrument will be so packed so that it will meet the National Safe Transit requirements described in Section 4.

SECTION 2

ENVIRONMENTAL CHARACTERISTICS

The following Environmental Characteristics apply only when the instrument is tested as described in Section 4, Environmental Performance Validation. The Type 453/R453 is an environmental instrument.

Characteristic	Performance Requirement	Supplemental Information
Temperature		
Nonoperating	-55°C to +75°C	
Operating	-15°C to +55°C	
Altitude		
Nonoperating	To 50,000 feet	May be tested during nonoperating temperature tests. Derate temperature 1°/1,000 ft. above 5,000 ft.
Operating	To 15,000 feet	
Humidity		
Nonoperating	5 cycles (120 hours) of MIL-STD-202C, Method 106B. Omit freezing and Vibration, Post-test drying period at 25°C ±5°C at 20% to 80% relative humidity.	
Vibration		
# Operating	15 minutes along each of the 3 major axes at a total displacement of 0.025", P-P (4 g's at 55 c/s) with frequency varied from 10 to 55 to 10 c/s in 1 minute cycles. Hold for 3 minutes at 55 c/s. All major resonances must be above 55 c/s.	
Shock		
Nonoperating and Operating	30 g's, 1/2 sine, 11 ms duration, 2 guillotine-type shocks per axis each direction for a total of 12 shocks.	

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Characteristic	Performance Requirement	Supplemental Information
# Electromagnetic Interference (Mod 163D only) As Tested in MIL-I-6181D and MIL-I-16910C		
# Radiated Interference	From the instrument under test 14 kHz to 1000 MHz with Mesh Filter installed	
# Conducted Interference	Through the power cord, 150 kHz to 30 MHz	
Transportation		
Package Vibration	1 hour slightly in excess of 1 g	
Package Drop	30" (18" for R453) on any corner, edge or flat surface	

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SECTION 3

3.0 Electrical Test Methods

3.1 Vertical Amplifier

3.1.1 Volts/Div Accuracy

VARIABLE VOLTS/DIV is set at calibrated position. A Standard Square-Wave Calibrator signal is applied and the accuracy checked at each setting of the VOLTS/DIV switch. Use either 4 or 5 divisions of displayed signal amplitude, depending upon the combination of calibrator signal and VOLTS/DIV setting. Express deviation from correct amplitude as a percentage of correct amplitude.

3.1.2 Input R & C

Measured using a Resistance Bradge and a Capacitance Bridge (accuacy of 0.2% or better).

3.1.3 Variable Volts/Div Range

VARIABLE range is checked by applying 5 divisions of signal from a Type 105 with the Variable at CALIB. Turning the VARIABLE VOLTS/DIV control fully counterclockwise will result in equal to or less than 2 divisions of display.

3.1.4 Frequency Response

Frequency response is checked by applying a 50-kc signal from a Type 190B to a vertical input connector. Obtain 4 divisions of diaplay at 20 mv/div. Increase the frequency to 50 mc. A signal of 2.8 divisions or greater of signal will be displayed. Repeat the above step to check all attenautor ranges. To Check the low-frequency 30% down point use a Krohn-Hite low-frequency oscillator and monitor the output with a dc-coupled test oscilloscope to insure against changes in output amplitude. Obtain 4 divisions of 50-kc signal. Decrease the frequency until 2.8 divisions of signal are observed, then note the frequency.

3.1.5 Risetime

Measured using a pulse from a TU-5 centered vertically. Measure the time interval between the 10% and 90% amplitude points on the leading edge of the pulse. The oscilloscope time base error should be used as a correction factor when risetime is measured. The effects of trace orthogonality and start of sweep onolinearity should be taken into consideration when making risetime measurements.

3.1.6 Transient Response

Transient response is measured using a 4 to 5 div pulse from a TU-5 centered vertically. Adjust the TU-5 bias control so that a step waveform just occurs. Set the sweep rate to 20 nsec/div. Check transient response from 5 mv/div to 10 v/div. From 50 mv/div to 10 v/div use a Mercury Pulser (unterminated). Repeat for Ch 2. Transient response is determined by measuring the maximum peak-to-peak pulse aberration in the form of overshoot, rolloff, ringing, or tilt along the entire pulse top, expressed as a percentage of pulse amplitude.

Check transient response in the ADD mode using the same setup as the previous step except set Ch 2 deflection factor to 20 mv/div, Input Selector to Gnd. Set the Mode switch to ADD and measure total pulse aberration.

3.1.7 Attenuator Compensation

Connect a Type 105 set at 1 kc through a selected attenuator to a 50 Ω termination through a 20 pf normalizer to the vertical input connector. Set the sweep rate to 0.2 msec/div. Check attenuator compensation using a 5-division step centered vertically. Measure the maximum peak-to-peak pulse aberration in the form of overshoot, rolloff, ringing, or tilt along the entire pulse top, expressed as a percentage of pulse amplitude.

3.1.8 Position Effect on Transient Response

Connect a Type 105 to the Mercury Pulser 105 INPUT connector. Set the repetition rate of the Type 105 to ≈ 200 cps. Connect the Standard Square Wave Calibrator to the Mercury Pulser CAL INPUT connector. Connect the Mercury Pulser to the Vertical Input connector. Set the Standard Square Wave Calibrator to 0.2 v and +DC. Adjust the amplitude control on the Mercury Pulser to obtain a 6-div step. Position the top of the waveform to the bottom of the graticule and measure to pulse abberation.

Set the Standard Square Wave Calibrator to -DC. Position the bottom of the waveform to the top of the graticule and measure the pulse aberration. Measure the maximum peak-to-peak pulse aberration in the form of overshoot, rolloff, ringing, or tilt along the entire pulse top, expressed as a percentage of pulse amplitude.

3.1.9 Low Frequency Linearity

Measured by obtaining 2 divisions of deflection from the calibrator, centered vertically on the graticule. Position the bottom of the waveform to the bottom graticule line and note the change in pulse amplitude. Position the top of the waveform to the top graticule line and note the change in pulse amplitude. Linearity is the maximum change in pulse amplitude occruing at the defined limits.

3.1.10 Position Range

VAR ATTEN must be in the CAL position and STEP ATTEN BALANCE must be correctly adjusted. Set the Trigger Level control fully clockwise, Trigger Source to EXT, sweep mode to AUTO, sweep rate to 1 msec/div, vertical deflection factor to 0.1 v/div. Set the Position to zero volts at its wiper arm, measured with a 20,000 Ω/volt 3% meter. Adjust R55 (Ch 2 - R155) if necessary to position trace to graticule center. Set Input Selector to AC and connect the Type 105 output to a 10X ATTEN and a 50 Ω Termination to Ch 1 vertical input connector. Adjust the Type 105 amplitude and symmetry controls to obtain a 6 div display centered on screen. Do not adjust the vertical position control to center the display. Set the deflection factor to 20 mv/div and turn the position control fully clockwise. The top of the waveform must position within 1.5 divisions of graticule center.

Repeat the above with the position control fully counter-clockwise. Repeat the check for Ch 2.

3.1.11 Trace Drift with Time

After the 15 minute warm-up period, note that the trace drift does not exceed the limits stated in Section 1.1.1.

3.1.12 Trace Drift with Temperature

Checked during environmental test phase.

3.1.13 Microphonics

Set the deflection factor to 5 mv/div. Both input selectors are set at Gnd. The side of the Type 453 is then tapped lightly with the fingertips and the amplitude of any resulting microphonic noise is noted.

3.1.14 STEP ATTEN BAL Reserve Range

Checked at the 20 mv/div setting. Obtain a trace by setting the A SWEEP MODE to AUTO. Position the trace to the bottom of the graticule with the Vertical Position Control. Turn the STEP ATTEN BAL counterclockwise from the calibrated position and the trace will position at least 5 divisions. Recalibrate the STEP ATTEN BAL and position the trace to the top of the graticule with the Vertical Position Control. Turn the STEP ATTEN BAL clockwise from the calibrated position and the trace will position at least 5 divisions.

3.1.15 Variable Balance Centering

Set the vertical deflection factor to 20 mv/div, Input Selector to GND. Adjust the Position Control to obtain a minimum trace shift while turning the Variable Volts/Div control through its range. When balanced note the trace position from graticule center. Repeat the above step for Ch 2.

3.1.16 Invert Zero-Shift Point

Using the same setup as in the previous step, adjust the Ch 2 Position Control to obtain a mimimum trace shift while switching the PULL TO INVERT from normal to inverted. When balanced note the trace position from graticule center.

3.1.17 Gain Range

Checked by setting the vertical deflection factor to 20 mv/div and applying a 0.1 v signal from the calibrator. Set the Input Selector to DC and position the bottom of the display to the bottom of the graticule. Check for 5 divisions of deflection. Turn the GAIN adjust fully clockwise and note that the display increases to 5.25 divisions or greater. Set the GAIN adjust fully counterclockwise and the display will decrease to 4.75 divisions or less. Readjust the GAIN for 5 divisions. Repeat the above to check Ch 2.

3.1.18 Input Grid Current

Checked at the 5 mv/div setting. The trace is centered on the graticule with the Input Selector in the GND position. The Input Selector is then switched to DC and the voltage indicated by the trace shift is noted. Indicated voltage is then divided by the 1-megohm input resistance to determine grid current. Trace shift must be 2 minor divisions or less..

3.1.19 Amplifier Crosstalk

Set Ch 1 vertical deflection factor to 0.2 v/div and apply a 20-mc signal from a Type 190B. Adjust the AMPLITUDE control of the Type 190B to obtain a 2-division display. Set the Ch 1 and Ch 2 VOLTS/DIV to 20 mv/div and the Input Selector to Ch 2. Check for 0.2 div or less of amplifier crosstalk to be within performance requirements stated in Section 1.1. Repeat the above for Ch 2.

3.1.20 Attenautor Isolation

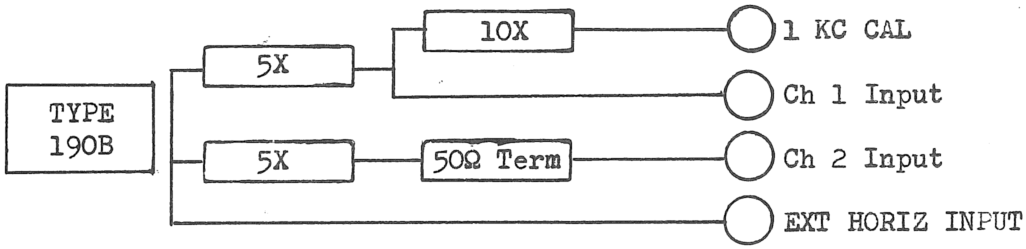
Set the Ch 1 Input Selector switch to DC, deflection factor to 5 mv/div. Set the Ch 2 Input Selector switch to AC, deflection factor to 5 v/div. Apply a 20 mc, 10-volt signal from a Type 190B to the Ch 2 vertical input connector. Set the Vertical Mode switch to Ch 1 and check for less than 1 minor division of deflection. Repeat the above step to check Ch 2.

3.1.21 Linear Dynamic Range in Added Mode

Checked using the following equipment:

1	Type 190B
2	5X Attenuators
1	10X Attenuator
3	BNC "T" Connectors
1	50 Ω Termination

Necessary 50 Ω BNC cables are used to connect the above items as follows:



Set the HORIZ DISPLAY to EXT HORIZ, Trigger Source to EXT, and the Calibrator to 1v. Set the Type 190B to 50 kc, attenuator to 10, amplitude to minimum, and Ch 1 and Ch 2 vertical coupling to AC. Note: The vertical gains must be optimized, and the vertical positions must be centered. Set Ch 2 to inverted and both vertical deflection factors to 20 mv/div, A Sweep Mode to AUTO. The display will be two parallel lines, about one division apart. Increase the amplitude of the Type 190B until the vertical separation of the two lines at either extreme bows into 90% of midscreen value. Switch the HORIZ DISPLAY to A. Measure the peak-to-peak amplitude of the Type 190B signal. Measured value is linear dynamic range where 10% non-linearity occurs. Linearity is expressed as the amplitude ratio of the 50 kc signal to the calibrator signal. Repeat for Ch 2.

3.1.22 Common Mode Rejection Ratio

Apply a 20-mc signal from a Type 190B to the Ch 1 and Ch 2 vertical input connectors. Set the Ch 1 and Ch 2 deflection factors to 20 mv/div. Obtain 8-divisions of signal in both vertical channels. Invert Ch 2 and set the channel selector to ADD. Common mode rejection is expressed as a ratio of 8 divisions to the signal observed.

3.1.23 Chopped Repetition Rate

Checked by setting the sweep rate to 0.5 µsec/div and the in ut selector switch to CHOPPED. Obtain 2 divisions of triggered display using the Ch 1 and Ch 2 POSITION controls. Turn the intensity to an above normal setting. Check for one cycle over 3.3 div to 5.0 div of calibrated sweep.

3.2 Sweep Generators A & B

3.2.1 Calibration Accuracy

Determined by applying time markers from a Type 180A to a vertical input connector. Time Marks and graticule lines are counted beginning with zero (0-1-2-3-ect). Time markers should be selected so that there is 1 mark/div at all "1,5,10" ranges, and 2 marks/div at all 2 and 20 ranges with the exception of the 0.5 µsec/div range where a 1-µsec marker for every 2 divisions will be displayed. All timing measurements are made over the middle 8-divisions of the graticule. The first and last divisions should not be included in the measurement. Sweep accuracy is defined as the displacement of the 9th graticule line's respective marker from the 9th graticule line when the 1st graticule line's respective marker is positioned behind the 1st graticule line, expressed as a percentage of 8 divisions.

3.2.2 Magnified Accuracy

Checked using the same setup as the Sweep Accuracy check. Apply 100 µsec markers from a Type 180A and set the sweep rate to 1 msec/div, Magnfier to X10. One marker/div will be displayed. Magnified sweep accuracy is expressed as a percentage of 8 divisions.

3.2.3 Sweep Linearity (normal)

Checked at the 1 msec sweep rate by applying 1 msec markers from a Type 180A to the Ch 1 vertical input connector. Position the 1st graticule line's respective marker behind the 1st graticule line and the 9th graticule line's respective marker behind the 9th graticule line. Note any displacement of the markers from their respective graticule lines. Note: It may be necessary to change the sweep rate to 0.5 msec/div and switch the VARIABLE to uncalibrated to accurately time the sweep between the 1st and the 9th graticule lines. Linearity is the displacement of any marker from any graticule line when the sweep is correctly timed, expressed as a percentage of 8 divisions.

3.2.4 Sweep Linearity (Mag X10)

Magnified sweep linearity is checked at two sweep rates. At a sweep rate of 1 msec/div, apply 1 msec, 5 msec, and 100 µsec markers from a Type 180A to the vertical input connector. Adjust the Trigger Level control until the sweep is triggered on a 5 msec marker. This time mark represents zero time. Set the Mag to X10 and horizontally position the zero time mark behind the zero graticule line. Position the 1st graticule line. Note any displacement of the markers from their respective graticule lines. Note: It may be necessary to change the sweep rate to 0.5 msec/div and switch the VARIABLE to uncalibrated to accurately time the sweep between the 1st and the 9th graticule lines. Linearity is the displacement of any marker from any graticule line when the sweep is correctly timed, expressed as a percentage of 8 divisions.

Note any displacement of the markers from their respective graticule lines. Position the middle 5 msec marker approximately to the center of the graticule and again align markers behind the 1st and 9th graticule lines. Note any displacement of the markers from their respective graticule lines. Position the last 5 msec marker approximately to the 10th graticule line and again align markers behind the 1st and 9th graticule lines. Note any displacement of the markers from their respective graticule lines. Horizontal linearity is defined as the displacement of any marker from any graticule line when the sweep is correctly timed, expressed as a percentage of 8 divisions.

Set the sweep rate to 0.1 µsec/div and apply 50 mc from a Type 180A. Establish a sweep start reference by over-riding the unblanking with the Intensity control. Position the sweep start to the zero graticule line. Determine the 3rd cycle and position it behind the 1st graticule line and the 7th cycle behind the 9th graticule line. Note any displacement of the markers from their respective graticule line. Horizontal linearity is defined as the displacement of any cycle from any graticule line when the sweep is correctly timed expressed as a percentage of 8 divisions.

Set the MAG to X1 and horizontally position the start of the sweep to the zero graticule line. Set the MAG to X10 and check linearity. Set the MAG to X1 and horizontally position the 47th cycle to graticule center. Set the MAG to X10 and check linearity.

3.2.5 Variable Time/Div Range

Checked by applying 10 msec markers from a Type 180A to the Ch 1 vertical input connector. Set the sweep rate to 1 msec/div and obtain a stable display. Two 10 msec markers will be displayed. Position the 1st marker behind the zero graticule line and the 2nd marker behind the 10th graticule line. Turn the Variable control fully counterclockwise and note that the 2nd marker positions on or to the left of the 4th graticule line.

3.2.6 Sweep Length A

Checked at 1 msec/div sweep rate by applying 1 msec, and 100 µsec markers from a Type 180A. Each 100 µsec marker represents 1/10 of a major division. Turn the A SWEEP LENGTH control fully clockwise and note the A sweep length. Turn the A SWEEP LENGTH control counterclockwise, not to the detent, and the sweep length will be 4 divisions or less.

3.2.7 Sweep Length B

Measured using the same setup as A Sweep Length. Set the A TIME/DIV to 2 msec/div and TIME/DIV to 1 msec/div, HORIZ

DISPLAY to DELAYED SWEEP (B), B SWEEP MODE to B SWEEPS AFTER DELAY TIME, and the DELAY-TIME MULTIPLIER fully counterclockwise. Using the B Trigger Level obtain a stable display. The B sweep length will be 11.0 ± 0.5 divisions long.

3.2.8 A Sweep Hold-off Time

Checked using the Test Oscilloscope to monitor the + A GATE. Measure the interval between + Gate waveforms to determine hold-off time.

3.3 Variable Time Delay

3.3.1 Delay Time Accuracy

Checked by applying 1 msec markers from a Type 180A to the Ch 1 vertical input connector. Set the A Sweep rate to 1 msec/div, HORIZ DISPLAY to A INTEN DURING B, B Sweep Mode to B SWEEPS AFTER DELAY TIME, and B sweep rate to 10 µsec/div. Set the DELAY-TIME MULTIPLIER to 1.00 and note that the first time mark is intensified. Set the HORIZ DISPLAY to DELAYED SWEEP (B) and adjust the DELAY-TIME MULTIPLIER so that the 1st, 1-msec marker is at the start of the sweep. Note the dial setting of the DELAY-TIME MULTIPLIER. Set the HORIZ DISPLAY to A INTEN DURING B, and the DELAY-TIME MULTIPLIER to 9.00. The 9th time mark will be intensified. Set the HORIZ DISPLAY to DELAYED SWEEP (B) and adjust the DELAY-TIME MULTIPLIER so that the 9th, 1-msec marker is at the start of the sweep. Note the dial reading from the second dial reading. Delay time accuracy is the percent of deviation from 800 divisions.

3.3.2 Multiplier Incremental Linearity

Checked by applying 1 msec markers from a Type 180A to the Ch 1 vertical input connector. Set the A sweep rate to 1 msec/div, HORIZ DISPLAY to A INTEN DURING B, B Sweep Mode to B SWEEPS AFTER DELAY TIME, and B sweep rate to 10 µsec/div. Set the DELAY-TIME MULTIPLIER TO 1.00 and the HORIZ DISPLAY to DELAYED SWEEP (B). Horizontally position the displayed time mark to a reference point on the graticule. Set the DELAY-TIME MULTIPLIER to position the 9th time mark to the reference point. Note the dial reading, and convert to minor divisions by multiplying by 100. Subtract 100 from this reading (the first 100 minor divisions are not included in linearity measurements) and divide by 10 to determine the minor divisions between each periodic major division for perfect linearity.

At each periodic major division, position the time mark with the DELAY-TIME MULTIPLIER to the reference point. Note the dial reading at each periodic major division and subtract the measured dial reading from the previously calculated perfect linearity. The difference must be ± 1.6 minor divisions or less to be within the performance requirement as stated in Section 1.1.3.

3.3.3 Jitter

Checked by applying 1-msec markers from a Type 180A to the Ch 1 vertical input connector. Set the A sweep rate to 1 msec/div, HORIZ DISPLAY to A INTEN DURING B, B Sweep Mode to B SWEEPS AFTER DELAY TIME, and B sweep rate to 1 μsec/div. Set the DELAY-TIME MULTIPLIER to 1.00 and the HORIZ DISPLAY to DELAYED SWEEP (B). It may be necessary to adjust the DELAY-TIME MULTIPLIER to display a 1-msec marker in the graticule area. Measure the horizontal excursion of the 1-msec marker in the graticule area. Measure the horizontal excursion of the 1-msec marker disregarding the drift. The horizontal jitter of the 1-msec marker must be 2.5 minor divisions or less to be within the performance requirement as stated in Section 1.1.3.

Set the HORIZ DISPLAY to A INTEN DURING B, and the DELAY-TIME MULTIPLIER to 9.00. Set the HORIZ DISPLAY to DELAYED SWEEP (B). It may be necessary to adjust the DELAY-TIME MULTIPLIER to display a 1-msec marker in the graticule area. Measure the horizontal excursion of the 1-msec marker disregarding the drift. The horizontal jitter of the 1-msec marker must be 2.5 minor divisions or less to be within the performance requirement as stated in Section 1.1.3.

3.4 Horizontal Amplifier

3.4.1 Sweep Magnification Accuracy

See 3.2.2 for test method.

3.4.2 Normal/Magnified Registration

Checked by applying 5-msec markers from a Type 180A to a vertical input connector with the sweep rate at 1 msec/div and the Mag in X10. Horizontally position the magnified sweep so that the middle 5-msec marker falls behind the center vertical graticule line. Change the Mag to NORM and note the deviation of the 5-msec marker from graticule center.

3.4.3 Position Range

The sweep length must be within its performance requirements as stated in Section 1.1 prior to the position range check. Apply 1 msec, and 100-μsec markers from a Type 180A to the Ch 1 vertical input connector. Set the sweep rate to 1 msec/div, HORIZ DISPLAY to "A", and A SWEEP MODE to AUTO. Turn the coarse and fine Horizontal Position controls fully clockwise and note that the start of the sweep must position to the right of the graticule center.

Turn the Coarse and Fine Horizontal Position controls fully counterclockwise and note that the end of the sweep must position to the left of the graticule center. Set the Magnifier to X10, FINE control fully counterclockwise, and horizontally position a 1-msec marker to the zero graticule line with the Coarse control. Turn the FINE control fully clockwise. The 1-msec marker must position from 5 divisions to 6 divisions to the right.

3.5 External Horizontal Amplifier

3.4.1 Input to Vert Ch 1

See Vertical Amplifier for Calibrated Deflection Factor Range and Accuracy.

3.5.2 Frequency Response

Checked by setting Ch 1 VOLTS/DIV to 20 mv. Apply a 50-kc 6-division signal from a Type 190B to the Ch 1 vertical input connector. Set the B TRIGGERING SOURCE to INT, HORIZ DISPLAY to EXT HORIZ, Input Selector to Ch 2. Increase the frequency of the Type 190B until 4.2 divisions are observed. Note the frequency of the Type 190B.

3.5.3 Phase Shift

Checked by applying a 4-division, 50-kc signal from a Type 190B to the Ch 1 and Ch 2 vertical input connector. Set the B TRIGGERING SOURCE to INT, HORIZ DISPLAY to EXT HORIZ, CH 1 and CH 2 VOLTS/DIV to 20 mVOLTS, Input Selector to Ch 2. Measure the maximum separation of the displayed ellipse along the vertical graticule line. The maximum separation measured vertically must be 1 minor division or less, to be within performance requirement as stated in Section 1.1.5.

3.5.4 Deflection Factor, TRIGGER INPUT or EXT HORIZ

Set the HORIZ DISPLAY to EXT HORIZ, B TRIGGERING SOURCE to EXT and apply a 2-volt square wave from the Standard Calibrator to EXT HORIZ INPUT. The horizontal deflection must be from 6.3 to 8.5 divisions to be within the performance requirement stated in Section 1.1.5.

Set the B TRIGGERING SOURCE to EXT ÷ 10, and apply a 20-volt square wave from the Standard Calibrator. The horizontal deflection must be from 6.0 to 8.8 divisions to be within the performance requirement stated in Section 1.1.5.

3.5.5 Frequency Response

Set the B TRIGGERING Source to EXT, HORIZ DISPLAY to EXT HORIZ. Checked by applying a 6-division, 50-kc signal from a Type 190B to the EXT TRIG INPUT or EXT HORIZ connector. Increase the frequency of the Type 190B until 4.2 divisions are observed. Note the frequency of the Type 190B.

3.5.6 Phase Shift

Apply a 50-kc signal from a Type 190B to the EXT TRIG INPUT or EXT HORIZ connector, HORIZ DISPLAY to EXT HORIZ, and adjust the amplitude of the Type 190B for 4 divisions of horizontal display. Apply the same signal to the Ch 2 vertical input connector through a BNC "T" connector and two equal length cables. Set the HORIZ DISPLAY to "A", Ch 2 VOLTS/DIV to 20 mVOLTS and adjust the Variagle to obtain 4 divisions of vertical display. Set the HORIZ DISPLAY to EXT HORIZ and measure the maximum separation of the diaplayed ellipse along the vertical graticule line. The maximum separation measured vertically must be 1 minor division or less to be within the performance requirement as stated in Section 1.1.5.

3.6 Triggering A & B

3.6.1 Trigger Sensitivity (Internal)

Checked by applying a signal from a Type 190B to the Ch 1 vertical input connector. Select the proper mode of coupling, signal frequency, and amplitude as stated in Section 1.1.6. Trigger Sensitivity is defined as the minimum peak-to-peak signal required to obtain a stable display with an adjustment of the LEVEL control while switching from + slope to - slope. To measure the lower point of AC coupling it may be necessary to use a Krohn-Hite oscillator applied to the vertical input connector. Monitor the amplitude of the Krohn-Hite oscillator with a DC coupled test oscilloscope to insure constant amplitude.

3.6.2 Trigger Sensitivity (External)

Check using the same setup as 3.6.1 except apply the signal to the Ch 1 Vertical and External trigger inputs. Observe minimum peak-to-peak signal required to obtain a stable display with an adjustment of the LEVEL control while switching from + slope to - slope.

3.6.3 Automatic Triggering and Recovery Time

Connect 50-msec markers from a Type 180A to the Ch 1 vertical input connector. Set the sweep rate to 1 msec/div, A SWEEP MODE to AUTO. Stable display must be obtained by triggering on the leading edge of the marker with an adjustment of the LEVEL control. Note that the trace free runs beyond triggered area and through the full range of the LEVEL control.

Set the Type 180A to 100-msec markers. It must not be possible to obtain a stable display by triggering on the leading edge of the time mark with the level control.

3.6.4 Jitter

Apply a 50-mc signal from a Type 180A to the vertical input connector. Set the A SWEEP MODE to NORM, Trigger Coupling to AC, sweep rate to 0.1 μsec/div, MAG to X10, and Triggering Source to INT. Using the LEVEL and HF STAB control obtain a stable display. There must be one-half minor divisions or less of horizontal jitter.

3.6.5 Maximum Input Voltage

The Type 453 will trigger to the limits as stated in Section 1.1 after applying 600 volts DC to the Ext Trigger input.

3.6.6 Single Sweep

Using the same setup as in 3.6.1 obtain a stable display. Set Input Coupling to GND. A SWEEP MODE to SINGLE SWEEP and depress the RESET button (Reset light will light). Set the Input Coupling to AC and note that the sweep runs once and once only.

3.6.7 Level Range

Apply a 4-volt, 50-kc signal from the Type 190B to the vertical input connector and the EXT TRIG INPUT. Set the vertical deflection factor to 1 v/div, A TRIGGERING SOURCE to EXT, TRIGGER COUPLING to AC, A SWEEP MODE to AUTO. Obtain a stable display with the LEVEL control. Turn the LEVEL control fully clockwise and couterclockwise. The display must free run at the extremes of the LEVEL control.

Set the vertical deflection factor to 10 v/div and the A TRIGGERING SOURCE to EXT ÷ 10. Apply a 40-volt signal from the Type 105 Square Wave Generator to the vertical input connector and the EXT TRIG input. The display must free run at the extremes of the LEVEL control.

Check B TRIGGER LEVEL using the same setup as above. Set the B SWEEP MODE to TRIGGERABLE AFTER DELAY TIME, HORIZ DISPLAY to A INTEN DURING B, DELAY-TIME MULTIPLIER to 5.00, and B TRIGGERING SOURCE to EXT. Adjust the LEVEL control until the last half of the display intensifies. The display must return to normal intensity at the extremes of the LEVEL control. Set the vertical deflection factor to 10 v/div and the B TRIGGERING SOURCE to EXT ÷ 10. Apply a 20-volt signal from the Standard Square Wave Calibrator to the vertical input connector and the EXT TRIG input. The display must return to normal intensity at the extremes of the LEVEL control.

3.7 Calibrator

3.7.1 Initial Setting and Accuracy

Checked by removing Q 1255 and connecting the 1 v CAL 1 KC to the Input of a DC Voltage Bridge. Connect the DC Voltage Bridge Output to the Test Oscilloscope Vertical Input. Set the DC Voltage Bridge to the 11 v scale, 1 v range. Set the Test Oscilloscope vertical deflection factor to 5 mv/div and adjust the + 12 v (R 1152) control for minimum difference in chopped levels.

Set the Type 453 Calibrator to 0.1 v and connect a Standard Square Wave Calibrator to the CAL 1 DC connector. Set the Standard Square Wave Calibrator to + DC and Mixed at 0.1 v. Connect the output of the Standard Square Wave Calibrator to the Test Oscilloscope Vertical Input. Set the Test Oscilloscope vertical deflection factor to 5 mv/div and note the difference in the chopped levels. The chopped levels must be within 1 minor division to be within the Performance Requirement as stated in Section 1.1. Replace Q 1255.

3.7.2 Output Current

Monitored with a Current Probe. If the calibrator voltage accuracy is within its performance requirement and a current is present in the current loop, it is within its performance requirement as stated in Section 1.1.

3.7.3 Repetition Rate

Checked by applying 1-msec markers from a Type 180A to the Ch 1 vertical input connector. Apply the 1-volt calibrator signal to the Ch 2 vertical input connector. Set the TRIGGER MODE to NORM, Input Selector to ALT, sweep rate to 1 msec/div, and adjust the LEVEL control for a stable display. Position the last marker to graticule center and set the MAG to X10. Note the displacement of the leading edge of the Calibrator signal from the leading edge of the 1-msec marker. The displacement must be ½ division or less for the Calibrator to be within its performance requirement as stated in Section 1.1.7.

3.7.4 Duty Cycle

Checked by applying the 1-volt Calibrator signal to the Ch 2 vertical input connector. Set the vertical deflection factor to 0.2 v/div, A sweep rate to 0.1 msec/div and obtain a stable display. Vertically position the display about graticule center. Adjust the A VARIABLE to obtain 5 divisions of the positive half cycle of the Calibrator wave form. Invert Ch 2 and note that the displayed half cycle is 5 divisions ± 1 minor division to be within its performance requirement as stated in Section 1.1.7.

3.7.5 Risetime

Measured using the Test Oscilloscope. Measure the time interval between the 10% and 90% amplitude points on the leading edge of 1 volt and 0.1 volt Calibrator signal.

3.7.6 Output Resistance

Measured using a resistance bridge having an accuracy of 0.1% or better. Set the Calibrator to 1 volt and turn the oscilloscope power to OFF.

3.8 Z Axis Input

3.8.1 Sensitivity

Remove the ground strap from the Z Axis Input and apply a 5-volt signal from the Standard Square Wave Calibrator to the Ch 1 vertical input connector and the Z Axis Input. Set the A sweep rate to 0.5 msec/div, Ch 1 vertical deflection factor to 1 v/div, and obtain a stable display. The positive portion of the square wave must dim at a normal intensity level.

3.8.2 Usable Frequency Range

Checked by applying a 5-v signal from a Type 190B to the Z Axis Input (with the ground strap removed) and the A External Trigger Input. Set the A SWEEP MODE to NORMAL, A TRIGGERING SOURCE to EXT, and adjust the LEVEL control to obtain an intensity modulated sweep. Set the frequency of the Type 190B to 50 mc, sweep rate to 0.1 µsec/div, and MAG to X10. Check for 50 mc intensity modulation.

3.9 Signal Outputs

3.9.1 A & B Gates Output Voltages

Checked using a test oscilloscope.

3.9.2 Vertical Signal Out

Obtain 5-divisions of deflection using the 1v Calibrator. Monitor the Ch 1 OUT connector with the test oscilloscope for equal to or greater than 125 mv.

3.9.3 Frequency Response

See Vertical Amplifier test methods.

3.10 Power Requirements

3.10.1 Line Voltage Ranges

Checked using a TU-76 to vary the line voltage while monitoring the regulated DC power supplies with the Test Oscilloscope.

3.10.2 Line Frequency

Checked using a Tel-Instrument Type 4100-I-H10S or equivalent. Monitor the regulated DC supplies with the test oscilloscope at the frequency limits stated in Section 1.1.10.

3.11 Internal Power Supply Performance

3.11.1 Long Term Supply Tolerance

The supplies will be within the given tolerances at 25°C ±5°C for any 500 hour period after the first 200 hours.

3.11.2 Initial Setting

The -12 v, + 75v, and High Voltage are set using a DC Voltage Bridge. The + 12.1 v is measured after the 1 v CAL OUT is adjusted.

3.11.3 Temperature

Maximum variation from the value measured at 25°C ±5°C, checked from -15°C to +55°C.

3.12 CRT Display

3.12.1 Writing Rate

Intensity, Focus and Astig are adjusted for best resolution with free-running sweep at 0.1 msec/div. Sweep rate is then increased to ___ sec/div, and the Sweep Mode set to Single Sweep. Using Type ___ camera and Type ___ film, record a single display.

3.12.2 Luminance

Test Method not yet determined.

3.12.3 Trace Width

Apply a 2-divisions Calibrator signal to the Ch 1 vertical input connector. Set the sweep rate to 1 msec/div, FOCUS and ASTIG set for optimum focus, and position the display about graticule center. Using a Calibrated, hand-held telescope with a minimum usable intensity, measure the trace width along the top of the square wave.

3.12.4 Horizontal Resolution

Checked by applying 1-msec and 100-µsec markers from a Type 180A to the Ch 1 vertical input connector. Set the sweep rate to 1 msec/div. Using the VARIABLE VOLTS/DIV, obtain three 1-msec markers for every 2 divisions. Observe no overlap of the 100-µsec markers over the scan area when the center 4 divisions are focused.

3.12.5 Geometry

Scan Area

Set the sweep rate to 1 msec/div, A Sweep Mode to AUTO, and apply 10 mc from a Type 190B. Set the vertical deflection factor so that the 10-mc signal exceeds the vertical graticule limits. Set the MAG to X10. Note that the raster produced exceeds the limits stated in Section 1.1.12.

Beam Intercept

Check the vertical intercept by "floating" a special μamp meter (obtained through CRT Design Engineering) in the CRT anode circuit. Set the A sweep rate to 1 msec/div, A SWEEP MODE to AUTO, A SWEEP LENGTH to 4 divisions and position the focused trace to graticule center. Turn the INTENSITY fully counterclockwise and null the meter with the Helix Balance control. Turn the INTENSITY control clockwise to obtain 5 μamps of beam current. Position the trace to the top of the graticule and note the meter reading. Position the trace to the bottom of the graticule and note the meter reading. Intercept is defined as an offset reading expressed as a percentage of center reading.

Check the horizontal intercept by applying a sawtooth waveform from the test oscilloscope to the Ch 1 vertical input connector. Set the HORIZ DISPLAY to Ext Horiz, Ch 1 vertical deflection factor to 20 volts/div and the variable to uncalibrated to obtain 3 divisions of deflection. Horizontally position the display to graticule center and turn the INTENSITY fully counterclockwise. Null the meter with the Helix Balance control. Turn the INTENSITY control clockwise to obtain 5 μamps of beam current and note meter reading. Position the trace to the zero graticule line and note the meter reading. Position the trace to the right of the graticule and note the meter reading.

Intercept is defined as an offset reading expressed as a percentage of center reading.

Spot Centering

Set zero volts between Horizontal deflection plates and between vertical deflection plates (not to ground). Note the position of the spot from graticule center.

Linearity

See Test Method 3.1.9

Orthogonality

Obtain a free-running sweep at 0.5 msec/div. Align the trace horizontally with the trace rotation adjustment and apply

1-msec and 100-μsec markers from a Type 180A. With a triggered display, check to see that there are ten, 1-msec markers for every 10 graticule divisions. The 100-μsec markers will now be 0.5 minor divisions apart. Position a 100-μsec marker on the bottom center graticule line. The adjacent 100-μsec markers must not cross the top center graticule line.

Trace Rotation Range

Checked by turning the Trace Rotation control fully clockwise. Position the start of a free-running trace to the graticule center. Note where the trace intersects the 10th div graticule line below graticule center. Turn the Trace Rotation control fully counterclockwise and position the start of the trace to the graticule center. Note where the trace intersects the 10th div graticule line above graticule center. The total displacement must be equal to or greater than 1 div to be within the performance requirement stated in Section 1.1.

Raster Distortion

Checked by applying 1-msec and 100-μsec markers from a Type 180A to the Ch 1 vertical input connector, with sufficient amplitude to exceed the graticule height, at a triggered sweep rate of 1 msec/div. With the previously calibrated sweep, the 100-μsec markers will be 0.5 minor division apart. Position a 100-μsec marker to the bottom of a vertical graticule line. The adjacent 100-μsec markers must not cross the top of the same vertical graticule line. Horizontal trace distortion is checked by positioning a 0.5-msec/div free-running sweep to the top and bottom of the graticule and observing the amount of sweep bowing.

3.12.6 Internal Graticule

Luminance

Test Method not yet determined.

Contrast

Test Method not yet determined.

3.12.7 Display Defects

Flare

Checked by applying a 1-volt signal from the calibrator to the Ch 1 vertical input connector. Set the vertical deflection factor to 0.1 v/div and the VARIABLE VOLTS/DIV to uncalibrated to obtain a 6-division display. Set the sweep rate to 0.1 sec/div, A SWEEP MODE to AUTO, LEVEL control fully clockwise, MAN ON, INTENSITY at a normal level, and position the start of the sweep to graticule center. Cycle the free-running sweep for 5 minutes.

Set the Magnifier to OFF and horizontally center the display. Vertically position the display over the scan area and check for flare. If there is no evidence of flare turn the INTENSITY fully counterclockwise and observe the CRT using a viewing hood and check for presence of flare.

Grid Emission

Obtain a low intensity spot and position it to graticule center. Set the INTENSITY control fully counterclockwise and observe the screen using a viewing hood. There will be no grid emission present. Grid emission is defined as a spot, or locus of spots, around the main beam.

Cathode Interface

Checked by setting the sweep rate to 0.2 sec/div, A SWEEP MODE to AUTO, Ch 1 and Ch 2 Input Selector to GND, and set the Intensity to a minimum usable level. The first two divisions of the trace must be at the same intensity level as the remaining eight divisions.

Charging

Checked by applying a 1-volt calibrator signal to the Ch 1 vertical input connector. Set the Ch 1 deflection factor to 0.5 v/div, sweep rate to 1 msec/div, and obtain a stable display. Using the FOCUS and ASTIG controls and a low intensity level, obtain a well defined display.

Turn the INTENSITY fully counterclockwise and cycle for one minute. After one minute, increase the Intensity and note no de-focus or vertical gain change of the display.

Burrs

Vertically position a free-running trace over the vertical scan area and note that the trace does not exceed focus or trace width performance requirements stated in Section 1.12.

Double Peaking

Obtain a free-running trace at 0.1 msec/div. Turn the INTENSITY control fully counterclockwise. Turn the INTENSITY control clockwise, evenly, and observe that the intensity level increases evenly. As the Intensity control approaches full clockwise the intensity level may brighten then dim slightly.

Double peaking is defined as a brightening of the trace, dimming, then brightening again as the Intensity control is turned fully clockwise.

Heater Cathode Leakage

Set the sweep rate to 10 msec/div, TRIGGER SOURCE to LINE, and Input Selector to GND. Observe no 60 cps intensity modulation at normal intensity of the free-running trace.

3.12.8 Heater Voltage

Measured using an Iron Vane Voltmeter having an accuracy of 0.5% or better. Caution: The meter must be elevated to cathode potential.

3.12.9 Deflection Factors

Vertical

Checked by connecting a 200,000 Ω/volt meter across the vertical deflection neck pins. Set the voltmeter to the 40-volt range and position the trace to the bottom of the graticule and note the meter reading (meter polarity must be changed when positioning the spot above the center of the graticule). Position the spot to the 10th graticule line and note the meter reading. Divide the total voltage excursion by 6 to determine volts/div.

Horizontal

Checked by connecting a 20,000 Ω/volt meter across the horizontal deflection neck pins. Set the HORIZ DISPLAY to EXT HORIZ and obtain a low intensity spot. Set the voltmeter to the 160-volt range and position the spot to the 0 graticule line. Note the meter reading (meter polarity must be changed when positioning the spot to the right of graticule center). Position the spot to the 10th graticule line and note the meter reading. Divide the total voltage excursion by 10 to determine volts/division.

3.12.10 Helix Resistance

Measured using a resistance bridge capable of measuring 200 meg Ω or greater. Turn the oscilloscope off and measure from pin 7 to HV pin near face of CRT.

SECTION 4

4.0 Environmental Test Methods

4.1 Temperature

4.1.1 Nonoperating

Store at -55°C for 4 hours and at +75°C for 4 hours. Repeat this for a total of 4 cycles.

4.1.2 Operating

Perform complete electrical checks at room ambient. Turn off instrument and store at -15°C for 4 hours. After 20 minutes warm-up, perform complete electrical checks at -15°C. Raise the ambient temperature to +55°C with the instrument still operating and hold for 4 hours. Perform complete electrical checks. Return to room ambient and after 4 hours or temperature stabilization perform complete electrical checks.

4.1.3 Failure Criteria

Nonoperating

The instrument and components must meet electrical performance requirements before and after storage. (Adjustments may be performed if necessary to meet required accuracies). Cracking, warping, and significant discoloration or deformation which interferes with the normal mechanical function will not be permitted.

Operating

The instrument must be within electrical performance requirements at each step of the operating temperature check. Controls and switches shall be checked for ease of operation.

4.2 Altitude

4.2.1 Nonoperating

Store at 50,000 feet and -55°C for 4 hours. This should be accomplished during the temperature storage test and during each of the 4 cycles.

4.2.2 Operating

The instrument while operating will be maintained at an altitude of 15,000 feet for 4 hours. At the end of this period and while the above conditions are maintained, the most important electrical checks will be performed. When necessary, the vacuum chamber may be opened and the necessary switching performed as rapidly as possible. The instrument will then be allowed to stabilize for 1 hour at the above conditions before completing the electrical checks.

4.2.3 Failure Criteria

Nonoperating

The Type 453 must meet its electrical performance requirements before and after the 50,000 feet storage test.

Operating

The Type 453 must meet its electrical performance requirements during operation at altitude. Any evidence of malfunction will constitute failure, i. e. random trace modulation, noise, corona, etc.

4.3 Humidity

4.3.1 Nonoperating

Perform 5 cycles (120 hours) of Mil-Std-202B, Method 106A. Delete freezing and vibration. Allow to dry for 24 hours at room ambient conditions (25°C ± 5°C, 20% to 80% relative humidity) prior to operation. Allow one hour warm-up before making measurements.

4.3.2 Failure Criteria

Nonoperating

There shall be no significant deterioration of components, materials or finishes. Type 453 and its components must meet their electrical performance requirements before and after the humidity test. Deformation which interferes with normal mechanical function will not be permitted.

4.4 Vibration

4.4.1 Operating

Vibrate for 15 minutes along all 3 axes at 0.025" ± 0.003" total displacement (4 g at 55 cps) from 10-55-10 cps in 1 minute cycles. Held for 3 minutes at 55 cycles. Total vibration time 55 minutes.

Failure Criteria

Instrument will meet performance requirements before, during and after the operating altitude tests. Any evidence of malfunction constitutes failure.

4.3 Humidity

4.3.1 Nonoperating

Perform 5 cycles (120 hours) of Mil-Std-202C, Method 106B. Delete freezing and vibration. Allow to dry for 24 hours at room ambient conditions (25°C $\pm$5°C, 20% to 80% relative humidity) prior to operating. Allow one-hour warm-up before making measurements.

Failure Criteria

Nonoperating

There shall be no significant deterioration of components, materials or finishes. Type 453/R453 and its components must meet their electrical performance requirements before and after the humidity test. Deformation which interferes with normal mechanical function will not be permitted.

4.4 Vibration

4.4.1 Operating

Perform all electrical tests described in Section 3 before vibrating the instrument.

Fasten the instrument securely to the vibration platform.

With the instrument operating, vibrate for 15 minutes along each of the 3 axes at a total displacement of 0.025" (4 g's at 55 c/s), and with the frequency varied from 10-55-10 c/s in 1-minute cycles. Hold at any resonant point for 3 minutes.

If no resonances are present, vibrate at 55 c/s for 3 minutes in each axis for a total vibration time of approximately 55 minutes.

Turn off the vibration platform and repeat all electrical tests described in Section 3.

Failure Criteria

The instrument must meet performance requirements before and after the vibration tests. (Sporadic output during vibration is permissable.)

Mechanical failures are indicated by:

Broken leads
Broken chassis
Broken compoents
Loose parts
Excessive wear
Component fatigue
Change in component value outside rated tolerance
Deformation which interferes with a normal mechanical function

Test will be completely rerun after repairing any of these failures.

4.5 Shock

4.5.1 Nonoperating and Operating

Perform all electrical tests described in Section 3 before proceeding with the shock tests.

Subject the instrument to guillotine-type shocks of 30 g's 1/2 sine, 11 ms duration; 2 such shocks each direction along each of the 3 major axes for a total of 12 shocks.

Repeat all electrical tests described in Section 3.

Failure Criteria

The instrument will meet performance requirements before and after the shock tests.

There must be no cracked or broken chassis, components or leads; component deformation of 0.100" or more; nor any deformation which interferes with a normal mechanical function.

4.6 Electromagnetic Interference

4.6.1 Operating

Use the test set-up procedures and limits described in specification MIL-I-6181D. The tests will be peformed within an electrically shielded enclosure. The instrument must be equipped with a CRT mesh filter. EMI will be checked over the following frequency range:

Radiated Interference - from the instrument under test 14 kHz to 1000 MHz

Conducted Interference - through the power cord 150 kHz to 30 MHz

#11/13/67

Specification 133A
August 8, 1967

ENGINEERING

INSTRUMENT SPECIFICATION

TYPE 453/R453

OSCILLOSCOPE

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FOR INTERNAL USE ONLY

TEKTRONIX, INC.

PREFACE

This Engineering Instrument Specification is the reference document for all company activity concerning the electrical, environmental, and physical characteristics of the subject instrument. This document is printed in two issues: a tentative copy printed on or before Prototype Release of the instrument, and a final copy printed following Engineering Release. Occasionally, if justified by the number of changes, the final copy is updated and reissued following Pilot Production.

The major function of the Engineering Instrument Specification is to provide electrical, environmental, and physical characteristics to the following departments:

Manuals	Advertising
Product Technical Information	International Manufacturing Technical Support
Engineering Product Reliability	International Marketing
Marketing Technical Training	Manufacturing Quality Assurance
Product Manufacturing Staff Engineering	Manufacturing Management

Electrical and environmental characteristics listed in Section 1 are *worst case*, and are to be treated as described on page 1-1. *Factory test limits are excluded from the Engineering Instrument Specification.* Factory test limits are established by Product Manufacturing Staff Engineering, and appear in documents issuing from that department.

Periodically, an Engineering Instrument Specification may be revised and reprinted. The revised Engineering Instrument Specification will then have a 3-digit specification number followed by a capital letter printed in the upper right corner of the front cover, e.g. 000A for the first revision, 000B for the second revision, etc.

Changes in the Engineering Instrument Specification may be made *only* via the Instrument Performance Characteristic Change Request form of which 3 are included at the back of this document (contact the PE&M Engineering Writing Department for additional forms).

Abbreviations and symbols appearing in the Engineering Instrument Specification conform to Tektronix Standard No. A-100, *Recommended Short Forms*.

CHANGE INFORMATION LOG

This page is used as a guide to insure that all changes to the main body of this book have been made. When a change notice is received, log it on this page, then write in the actual change information on the appropriate page. Change Notice numbers are assigned in sequence. Absence of a number from the sequence indicates a change which has not been entered.

CHANGE NOTICE NUMBER	EFFECTIVE DATE OF CHANGE	PAGE NUMBER

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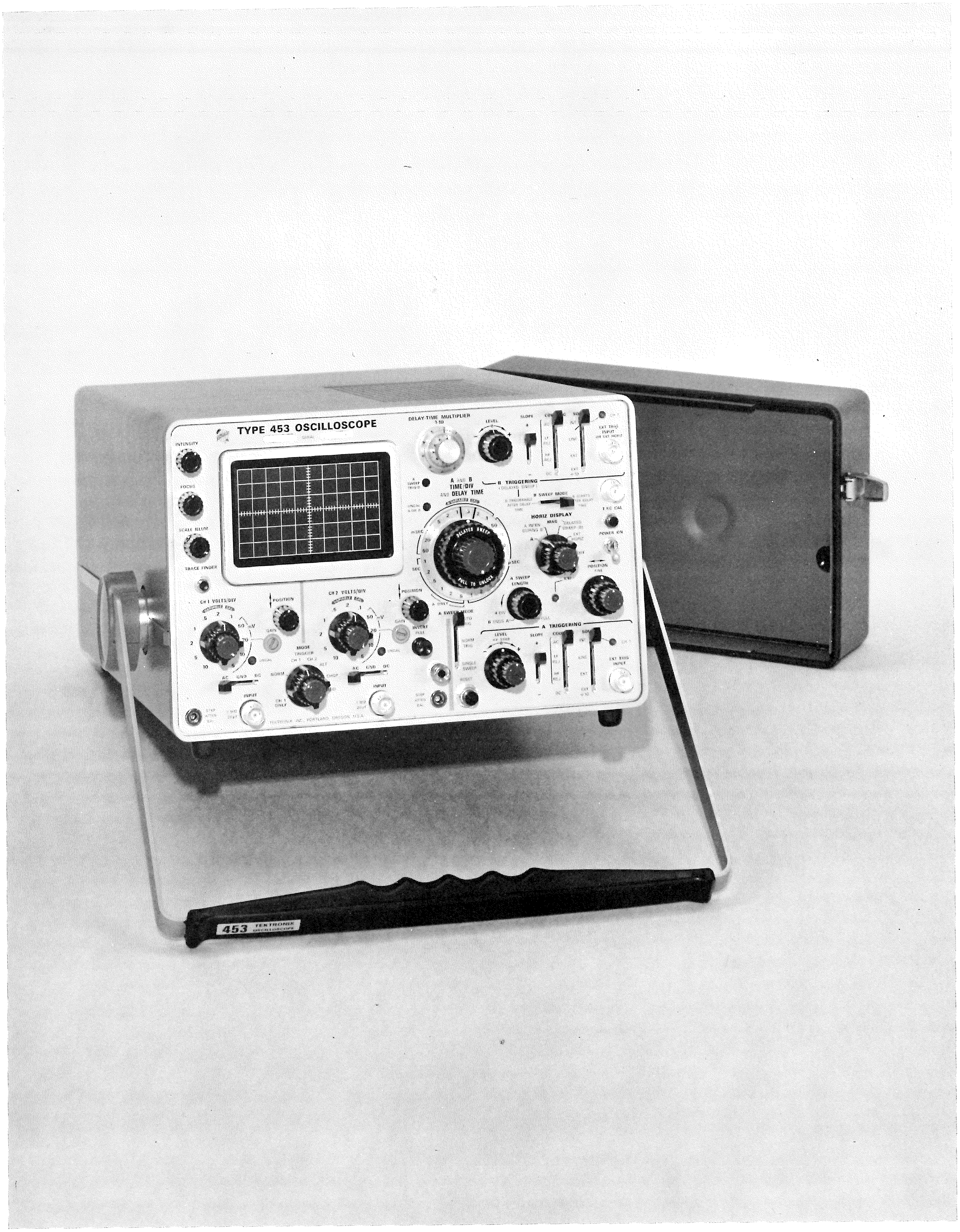

TYPE 453 OSCILLOSCOPE
453 TEKTRONIX OSCILLOSCOPE

INTRODUCTION

This is the Engineering Instrument Specification for the Type 453/R453 Oscilloscope, and is the reference document for all company activity concerning performance requirements. This specification is for *internal use only*. It replaces the Type 453 Instrument Specification dated April 23, 1965.

Description

The Type 453/R453 is a general purpose, high-performance, portable wide-band oscilloscope. It combines a dual-channel vertical amplifier with a delaying sweep feature. The Type 453/R453 has been designed and tested to meet certain Tektronix "environmental instrument specifications".

Function of Controls and Connectors

INTENSITY Control

Controls brightness of writing beam.

FOCUS Control

Permits adjustment of beam for optimum definition.

SCALE ILLUM Control

Controls light level of graticule.

TRACE FINDER Pushbutton

Compresses trace within graticule area independent of position control settings or signal applied.

CH 1 and CH 2

VOLTS/DIV

Selects calibrated deflection factors from 5 mV/div to 10 V/div in a 1-2-5 sequence.

VARIABLE VOLTS/DIV Control

Provides uncalibrated continuously variable deflection factor to ≃ 2.5 X the calibrated setting (uncalibrated deflection factor range) is extended to 25 V/div).

GAIN Control

Screwdriver adjustment allows calibration of vertical deflection factor.

Input Selector Switch

AC

Capacitively couples input signal to vertical amplifier.

GND

Grounds input attenuator.

DC

Signal is directly coupled to vertical amplifier.

INPUT Connector

BNC connector for applying external signals.

POSITION Control

Vertically positions the display. In X-Y mode CH 1 positions in X axis, CH 2 positions in Y axis.

MODE Switch

CH 1

Displays CH 1 only.

CH 2

Displays CH 2 only.

ALT

Selects alternate mode of operation (triggered electronic switching between channels during the beam retrace interval).

CHOP

Displays both vertical channels simultaneously by electronic switching.

ADD

Algebraically adds CH 1 and CH 2 input signals.

TRIGGER Switch

Selects NORMAL or CH 1 as an internal trigger source. CH 1 must be selected for X-Y operation.

STEP ATTEN BAL Control

Screwdriver adjustment balances the Input Amplifier in the 5-10 and 20 mV positions of the VOLTS/DIV switch.

INVERT PULL Switch (CH 2 only)

Inverts CH 2 display.

UNCAL Indicator

Lights when VARIABLE control is turned ccw from detent.

DELAY-TIME MULTIPLIER 1-10 Control

Varies sweep delay from 0.2 to 10.2 times the Time Base A TIME/DIV setting after A sweep start.

A SWEEP TRIG'D Indicator

Lights when A sweep is triggered.

UNCAL A OR B Indicator

Lights when A or B sweep is uncalibrated.

A & B TRIGGERING

LEVEL Control

Selects amplitude point on the triggering signal where sweep-triggering occurs.

HF STAB (A only)

Decreases display jitter when triggering on frequencies above approx. 10 MHz.

SLOPE Switch

+ and -

Permits triggering the sweep on the positive or negative-going portion of the trigger signal.

COUPLING Switch

AC

Blocks the DC component of the triggering signal and allows triggering only on the AC portion of the signal.

LF REJ

Attenuates trigger signal below about 30 kHz, allowing the trigger circuit to respond only to higher frequencies.

HF REJ

Rejects, DC, passes signals between 30 Hz and 50 kHz, and attenuates all other signals.

DC

Permits triggering on signals from DC to $\geq$ 50 MHz.

SOURCE Switch

INT

Uses a portion of the signal applied to the vertical channels as a triggering signal when TRIGGER is set at NORM. Uses a portion of the CH 1 signal as a triggering signal when TRIGGER is set at CH 1 ONLY.

LINE

Uses a portion of line-frequency voltage as a trigger signal.

EXT

Permits triggering on signals applied to the EXT TRIG INPUT connector.

EXT ÷ 10

Attenuates external trigger signal 10 times.

CH 1 Indicator

Lights when TRIGGER switch is set at CH 1 ONLY.

EXT TRIG INPUT Connector

Connector for applying external trigger signals.

B SWEEP MODE Switch

TRIGGERABLE AFTER DELAY TIME

Permits delayed sweep (B) triggering after delay time.

B STARTS AFTER DELAY TIME

Delayed Sweep (B) starts after delay time.

1 KC CAL Connector

Output BNC connector for calibrator signals.

A TIME/DIV Switch

Selects calibrated sweep rates and delay range from 5 s/div to 0.1 μs/div in a 1-2-5 sequence.

B TIME/DIV AND DELAY TIME Switch

Selects calibrated delayed sweep rates from 0.5 s/div to 0.1 μs/div in a 1-2-5 sequence.

A VARIABLE Control

Provides uncalibrated continuously variable A sweep rate to ≃ 2.5 X the calibrated setting (uncalibrated sweep rate is extended to 12.5 s/div).

HORIZ DISPLAY Switch

A

Displays the A sweep.

A INTEN DURING B

Intensifies the A sweep (after the delay time) for the duration of B sweep.

DELAYED SWEEP (B)

Displays delayed sweep (B).

EXT HORIZ

Permits external signals to deflect beam in Y axis.

MAG Switch

Expands the horizontal display from graticule center by a factor of 10. Extends the fastest sweep rate to 10 ns/div.

POSITION (horizontal) Control

Positions trace horizontally.

A SWEEP LENGTH Control

Varies A sweep length from 4 divisions to ≃ 11 divisions.

A SWEEP MODE Switch

AUTO TRIG

Permits normal triggering on waveforms with repetition rates ≥ 20 Hz. Sweep free-runs with no trigger signal or with a lower repetition rate.

NORM TRIG

Permits normal triggering.

SINGLE SWEEP

Displays one sweep only until reset.

RESET

Pushbutton resets sweep circuits when in Single Sweep mode.

SIDE PANEL

ASTIG Control

Permits adjustment of beam for optimum definition.

A GATE, B GATE CONNECTORS

BNC connectors provide a positive pulse of the same duration and coincident with the corresponding sweep during operation of the sweep generator.

B TIME/DIV VARIABLE Control

Provides uncalibrated continuously variable B sweep rate to ≃ 2.5 X the calibrated setting (uncalibrated sweep rate is extended to 1.25 s/div).

PROBE LOOP

Current loop provides a 5 mA squarewave current from calibrator circuit.

CH 1 OUT Connector

BNC connector for monitoring vertical signal when TRIGGERING is set to NORM. Cascade operation with CH2 provides 1 mV/div deflection factor.

TRACE ROTATION Adjustment

Screwdriver adjustment aligns trace with horizontal graticule lines.

CALIBRATOR Switch

Selects 1 V or 0.1 V calibrator signal.

REAR PANEL

Z AXIS INPUT Connector

Binding Post for applying Z-axis modulation signals to CRT (DC coupled). Negative signal intensifies.

Physical

Ventilation

Safe operating temperature is maintained by forced air cooling. Thermal cutout protects the instrument from overheating.

Finish

Front panel has an anodized finish; the cabinet is made of vinyl clad aluminum alloy.

Warm-up Time

20 minutes for rated accuracies.

TYPE 453

Overall Dimensions

Length: 22.4" Includes feet and carrying handle (extended)
20.5" Includes feet and front cover

Width: 12.5"

Height: 7.25" Includes feet

Weight

28 lbs. 12 oz. Includes front cover.

TYPE R453

Overall Dimensions

Length: 17.75"

Width: 19"

Height: 7"

Weight

≃ 35.5 lbs.

SECTION 1

ELECTRICAL CHARACTERISTICS

IMPORTANT

The following performance requirements and their related validation procedures in Section 3 apply only to a *calibrated system* operating within the environmental limits specified in Section 2, Environmental Characteristics, unless stated otherwise.

Performance requirements are validated by Engineering according to Section 3. Production test methods may differ.

Conditions under which a performance requirement is valid may be listed under Supplemental Information or in Section 3 (Electrical Performance Validation). These conditions are an essential part of the performance requirement.

The following codes are used to categorize performance requirements:

G	(General Use)	This performance requirement may be quoted to a customer.
I	(Internal Use Only)	This performance requirement will not be quoted to a customer.
A	(All)	It is recommended by Engineering that electrical testing of this performance requirement be performed on 100% of instruments.
S	(Sampled)	This performance requirement carries a high confidence level and may be tested on a sample basis.
N	(Not Tested)	

NOTE: Code column also provides step number of related validation procedure.

1.1 VERTICAL AMPLIFIER

Characteristic	Performance Requirement	Code	Supplemental Information
Attenuator Accuracy	±3% (5 mV/div to 10 V/div in 1-2-5 sequence)	3.2.1 GA	With gain adjusted at 20 mV/div
Input R and C	1 MΩ ±2% paralleled by 20 pF ±3%	3.2.2 GS	P6010 3-1/2' = ≃ 10 pF 6' = ≃ 12 pF
Variable Range	≥ 2.5:1	3.2.3 GA	
Bandwidth, 25 Ω source with and without P6010		3.2.4	AC coupling -3 dB at ≃ 1.6 Hz
5 mV/div	DC to ≥ 40 MHz	GS	≃ 0.16 Hz with P6010
10 mV/div	DC to ≥ 45 MHz		
20 mV/div through 10 V/div	DC to ≥ 50 MHz		1 V/div to 10 V/div frequency response is calculated
CH 1 OUT at 5 mV/div	DC to ≥ 25 MHz (terminated in 50 Ω)		
CH 1 OUT connected to CH 2	DC to ≥ 25 MHz (unterminated)	GA	

See page 1-1 for coding legend

1.1	VERTICAL AMPLIFIER (cont'd)		
Characteristic	Performance Requirement	Code	Supplemental Information
Risetime, 25 Ω source, with and without P6010		3.2.5 GS	
5 mV/div	≤ 8.75 ns		
10 mV/div	≤ 7.8 ns		
20 mV/div through 10 V/div	≤ 7 ns		
CH 1 OUT at 5 mV/div	≤ 14 ns (terminated in 50 Ω)		
CH 1 OUT connected to CH 2	≤ 14 ns at ≤ 1 mV/div (both channels at 5 mV, unterminated)		
Transient Response		3.2.6 IA	4 div step centered
20 mV/div	≤ 2% P-P		
10 mV/div	≤ 2% P-P		
5 mV/div	≤ 2% P-P		
50 mV/div to 2 V/div	≤ 3% P-P		
5 V/div to 10 V/div	≤ 6% P-P		
Added Mode	≤ 6% P-P		Measured at 20 mV/div

See page 1-1 for coding legend

1.1 VERTICAL AMPLIFIER (cont'd)

Characteristic	Performance Requirement	Code	Supplemental Information
Attenuator Compensation		3.2.7	
50 mV/div to 10 V/div	≤ 1%	IA	
Position Effect on Transient Response	≤ 5% P-P	3.2.8 IA	6 div step
Low-Frequency Linearity	≤ 0.15 divisions compression or expansion	3.2.9 IS	Includes CRT linearity
Position Range	±13.5 div to ±16.5 div	3.2.10 IA	VAR ATTEN in CAL, after STEP ATTEN bal check
Maximum Input Voltage	600 V DC + peak AC (P-P AC ≤ 600 V, ≤ 1 kHz)	GS	
Trace Drift		3.2.11 GS	
Time			
5 mV/div			Typically < 0.08 div/hr
10 mV/div			Typically < 0.05 div/hr
20 mV/div through 10 V/div			Typically < 0.03 div/hr
Temperature		3.2.12	
5 mV/div		GS	Typically < 0.02 div/°C
10 mV/div			Typically < 0.0125 div/°C
20 mV/div through 10 V/div			Typically < 0.0075 div/°C

See page 1-1 for coding legend

#

1.1 VERTICAL AMPLIFIER (cont'd)			
Characteristic	Performance Requirement	Code	Supplemental Information
STEP ATTEN BAL Range at 20 mV/div	≥ 10 div total range ≥ 2 div from calibrated setting	3.2.13 IA	
Variable Balance Centering	≤ ±1 div of graticule center	3.2.14 IA	
Invert Zero-Shift Point	≤ ±1 div of graticule center	3.2.15 IA	
GAIN Range	+5% to -5% from calibrated setting	3.2.16 IA	GAIN set at 20 mV/div
Input Gate Current at 25°C ±5°C	Negligible	3.2.17 GS	
Amplifier Crosstalk	≥ 100:1, DC to 20 MHz	3.2.18 GS	
Attenuator Isolation	≥ 10,000:1, DC to 20 MHz	3.2.19 GS	
Linear Dynamic Range in Added Mode	≥ ±10 times the VOLTS/DIV setting for ≤ 10% distortion	3.2.20 GA	
Common Mode Rejection Ratio	≥ 20:1 at 20 MHz for common mode signals up to 8 divisions	3.2.21 GA	With optimized setting of GAIN adjustment
Signal Delay		GN	≈ 140 ns
Chopped Repetition Rate	500 kHz ±20%	3.2.22 GA	

See page 1-1 for coding legend

1.2	SWEEP GENERATORS A & B (A Sweep is the main & delaying sweep)			
Characteristic	Performance Requirement		Code	Supplemental Information
Sweep Accuracy	0°C to + 40°C	-15°C to +55°C	3.3.1	
5 s/div to 0.1 s/div	±3%	±5%	GA	
50 ms/div to 0.1 μs/div	±3%	±4%	GA	
X10 Magnified Accuracy	≤ 1% in addition to specified sweep accuracies		3.3.2 GA	
Sweep Linearity (Normal and Magnified)	≤ ±1.5%		3.3.3 GA	
Variable Range	≥ 2.5:1		3.3.4 GA	
Sweep Length A	Variable from ≤ 4 div to (11.0 ±0.5 div)		3.3.5 GA	Measured at 1 ms/div
Sweep Length B	11.0 ±0.5 div		3.3.6 GA	Measured at 1 ms/div
A Sweep Hold-off Time			3.3.7	
10 μs/div to 5 s/div	≤ 1 x the A TIME/DIV Setting		GA	
5 μs/div to 0.1 μs/div	≤ 2.5 μs		GA	

See page 1-1 for coding legend

1.3	VARIABLE TIME DELAY			
Characteristic	Performance Requirement		Code	Supplemental Information
Delay Time Range	Calibrated, 50 s to 1 μs in 1-2-5 sequence with a 10-turn multiplier		3.4.1 GA	
DTM Range	0.2 to ≥ 10.2 times A TIME/DIV setting			
Accuracy	0°C to +40°C	-15°C to +55°C		
5 s/div to 0.1 s/div	±2.5%	±3.5%		
50 ms/div to 1 μs/div	±1.5%	±2.0%		
Multiplier Incremental Linearity	±0.2%	±0.3%	3.4.2 GA	
Jitter	≤ 1 part in 20,000 of 10 times the "A" TIME/DIV setting		3.4.3 GA	
1.4	HORIZONTAL AMPLIFIER			
Sweep Magnification Accuracy	See Sweep Generator A & B (page 1-6)		3.5.1 GA	Extends fastest sweep rate to 10 ns/div
Normal/Magnified Registration	≤ ±0.2 div		3.5.2 GA	
Position Range			3.5.3	
X1 fully cw	Start of sweep must position to the right of graticule center		GA	Measured at 1 ms/div, A sweep
X1 fully ccw	End of sweep must position to the left of graticule center			
X10 FINE control range	5 div to 8 div			

See page 1-1 for coding legend

1.5	EXTERNAL HORIZONTAL AMPLIFIER		
Characteristic	**Performance Requirement**	**Code**	**Supplemental Information**
Input to Vert Ch 1		3.6.1	
Calibrated Deflection Factor Range	5 mV/div to 10 V/div in 1-2-5 sequence	GA	Variable control is by-passed
Accuracy	±5% (0°C to +40°C) ±8% (-15°C to +55°C)		Ext Horiz Gain set at 20 mV
Input R and C	1 MΩ ±2% paralleled by 20 pF ±3%		
Bandwidth	DC to ≥ 5.0 MHz at -3 dB	3.6.2 GA	
Phase Shift	≤ 3° at 50 kHz	3.6.3 GS	Between Ch 1 and Ch 2
Input to EXT HORIZ Connector			
Deflection Factor		3.6.4	
EXT	270 mV/div ±15%	GA	
EXT ÷ 10	2.7 V/div ±20%		
Input R and C		GN	≈ 1 MΩ paralleled by ≈ 20 pF
Bandwidth	DC to ≥ 5.0 MHz at -3 dB	3.6.5 GS	
Phase Shift	≤ 3° at 50 kHz	3.6.6 GS	Between EXT HORIZ and Ch 2
Max Input Voltage	See Triggering A & B	GN	

See page 1-1 for coding legend

1.6	TRIGGERING A & B		
Characteristic	**Performance Requirement**	**Code**	**Supplemental Information**
Trigger Sensitivity		3.7.1	
INT DC	0.2 div to 10 MHz, increasing to 1 div at 50 MHz	GA	
INT AC	0.2 div from 30 Hz to 10 MHz increasing to 1 div at 50 MHz		Lower -3 dB point of coupling is ≈ 16 Hz
INT AC LF Reject	0.2 div from 30 kHz to 10 MHz increasing to 1 div at 50 MHz		Lower -3 dB point of coupling is ≈ 16 kHz
INT AC HF Reject	0.2 div at 30 Hz to 50 kHz		Lower -3 dB point of coupling is ≈ 16 Hz Upper -3 dB point of coupling is ≈ 100 kHz
EXT DC	50 mV to 10 MHz increasing to 200 mV at 50 MHz		
EXT AC	50 mV from 30 Hz to 10 MHz increasing to 200 mV at 50 MHz		Lower -3 dB point of coupling is ≈ 16 Hz
EXT AC LF Reject	50 mV from 30 kHz to 10 MHz increasing to 200 mV at 50 MHz		Lower -3 dB point of coupling is ≈ 16 kHz
EXT AC HF Reject	50 mV from 30 Hz to 50 kHz		Lower -3 dB point of coupling is ≈ 16 Hz Upper -3 dB point of coupling is ≈ 100 kHz
Automatic Triggering and Recovery Time (A only)	Usable with signals above 20 Hz	3.7.2 GA	Free-runs A Sweep in absence of triggering signal
Jitter	≤ 1 ns at 10 ns/div	3.7.3 GA	

See page 1-1 for coding legend

1.6	TRIGGERING A & B (cont'd)		
Characteristic	Performance Requirement	Code	Supplemental Information
Maximum Input Voltage	600 V combined DC + peak AC (P-P AC ≤ 600 V ≤ 1 kHz)	GN	
Single Sweep (A only)	Triggering level same as normal sweep Performance Requirements	3.7.4 GA	
External Trigger Input			
R and C			≈ 1MΩ paralleled by ≈ 20 pF except AC LF Rej
Level Range		3.7.5	
EXT	≥ ±2 V	GA	
EXT ÷ 10	≥ ±20 V	GA	

1.7	CALIBRATOR			
Initial Setting and Accuracy	1 V ±0.3% at 25°C ±5°C		3.8.1	
	0°C to +40°C	-15°C to +55°C		
Output Voltage 1 V or 0.1 V	±1%	±1.5%	GA	Switch on side panel
Output Current 5 mA	±1%	±1.5%	3.8.2 GA	Loop on side panel
Repetition Rate 1 kHz	±0.5%	±1%	3.8.3 GA	
Duty Cycle	49% to 51%		3.8.4 GA	

See page 1-1 for coding legend

1.7	CALIBRATOR		
Characteristic	Performance Requirement	Code	Supplemental Information
Risetime	≤ 1 μs	3.8.5 GA	
Output Resistance		3.8.6 GN	≃ 200 Ω in 1 V position ≃ 20 Ω in 0.1 V position

1.8	Z AXIS INPUT		
Sensitivity	≥ 5 V P to P causes noticeable modulation at normal intensity	3.9.1 GA	Positive signal blanks CRT
Usable Frequency Range	DC to ≥ 50 MHz	3.9.2 GS	Maximum Input Voltage 200 V combined DC + peak AC
Input Resistance at DC			≃ 47 kΩ

1.9	SIGNAL OUTPUTS		
A & B Gates		3.10.1	
Output Voltage	12 V ±10%	GA	
Output Resistance			≃ 1.5 kΩ
Vertical Signal Out (Ch 1 only)			
Output Voltage	≥ 25 mV/div into 1 MΩ	3.10.2 GA	Trigger at NORM, Ch 1 Variable at CALIBRATED
Output Resistance			≃ 50 Ω
Bandwidth	(See Vertical Amplifier page 1-2)		

See page 1-1 for coding legend

Characteristic	Performance Requirement			Code	Supplemental Information
1.10	**POWER REQUIREMENTS**				
Line Voltage Ranges	90 to 110 V 104 to 126 V 112 to 136 V			3.11.1 GA	Applicable when line contains ≤ 2% total harmonic distortion
	180 to 220 V 208 to 252 V 224 to 272 V				
Line Frequency	48 Hz to 440 Hz			3.11.2 GS	
Max Power Consumption	92 W at 115 VAC, 60 Hz, 1 Amp				
1.11	**INTERNAL POWER SUPPLIES**				
Power Supply Accuracy at 25°C ±5°C	-12 V	+12.1 V	+75 V		
Long Term	±1%	±1.7%	±1%	3.12.1 GA	
Initial Setting	±0.27%	±1.0%	±0.37%	3.12.2 GA	
Ripple	≤ 2 mV	≤ 2 mV	≤ 2 mV	IA	
Variation from 25°C value (-15°C to +55°C)	±0.5%	±0.75%	±0.75%	3.12.3 IS	
High Voltage Accuracy	25°C ±5°C			IA	
Initial Setting	-1.95 kV ±1%				

See page 1-1 for coding legend

1.11	INTERNAL POWER SUPPLIES (cont'd)		
Characteristic	Performance Requirement	Code	Supplemental Information
Long Term	-1.95 kV ±3%	GS	
Fuse Data	One 2 A Fast-blow (115 VAC line) One 1 A Fast-blow (230 VAC line)	GN	

1.12	CRT DISPLAY		
Type T4530-1-31			
Performance			
Writing Rate	Capable of single transient recording at ___ s/div using Type ___ camera and Type ___ film	3.13.1 GS	
Trace Width	≤ 0.030" at graticule center	3.13.2 IA	At normal intensity
Horizontal Resolution	150 lines in 10 divisions	3.13.3 GA	
Geometry		3.13.4	
Scan Area	≥ 6 x 10 div at 0.8 cm/div	GA	
Beam Intercept			
Vertical	At 6 div scan, max intercept per plate 35%		
Horizontal	At 10 div scan max intercept per plate 50%		

See page 1-1 for coding legend

1.12	CRT DISPLAY (cont'd)		
Characteristic	Performance Requirement	Code	Supplemental Information
Spot Centering	≤ 0.5 div radius from graticule center	GA	
Linearity	≤ 0.1 div compression or expansion of 2 div signal	IA	
Orthogonality	90° ±1°	GA	Of CRT alone. Y-axis alignment adjustment sets orthogonality to 90°
Trace Rotation Range	≥ 6°		
Raster Distortion	≤ 0.5 minor div total		
Electrical			
Electrode Voltages to Ground			<u>Typical Values</u>
Heater Voltage			6.3 V, 90 mA (elevated to -1.95 kV ≃ 40 kHz pins, 1, 14
Post Accelerator			+8.05 kV
Cathode			-1.95 kV (pin 2)
Post Accelerator Mesh			0 V (pin 10)
D1-D2 Deflection Shield (Geometry)			0 V to +75 V (pin 9)
Average of Deflection Plates			+50 V

See page 1-1 for coding legend

1.12	CRT DISPLAY (cont'd)		
Characteristic	Performance Requirement	Code	Supplemental Information
Astigmatism			0 V to +90 V (pin 5)
Accelerator (1st anode)			+50 V (pin 7)
Focus			-1.2 kV to -1.65 kV (pin 4)
Grid No. 1			-2.055 kV to -1.98 kV (pin 3)
Deflection Factors		3.13.5	
Vertical	4.1 V/div to 5.1 V/div	IA	CRT alone 4.3 V/div to 4.9 V/div
Horizontal	10.7 V/div to 13.0 V/div	IA	CRT alone 11.0 V/div to 12.6 V/div

See page 1-1 for coding legend

SECTION 2
ENVIRONMENTAL CHARACTERISTICS

The following Environmental Characteristics apply only when the instrument is tested as described in Section 4, Environmental Performance Validation. The Type 453/R453 is an environmental instrument.

Characteristic	Performance Requirement	Supplemental Information
Temperature		
Nonoperating	-55°C to +75°C	
Operating	-15°C to +55°C	
Altitude		
Nonoperating	To 50,000 feet	May be tested during nonoperating temperature tests. Derate temperature 1°/1,000 ft. above 5,000 ft.
Operating	To 15,000 feet	
Humidity		
Nonoperating	5 cycles (120 hours) of MIL-STD-202C, Method 106B. Omit freezing and Vibration, Post-test drying period at 25°C ±5°C at 20% to 80% relative humidity.	
Vibration		
Nonoperating	15 minutes along each of the 3 major axes at a total displacement of 0.025", P-P (4 g's at 55 c/s) with frequency varied from 10 to 55 to 10 c/s in 1 minute cycles. Hold for 3 minutes at 55 c/s. All major resonances must be above 55 c/s.	
Shock		
Nonoperating and Operating	30 g's, 1/2 sine, 11 ms duration, 2 guillotine-type shocks per axis each direction for a total of 12 shocks.	

Characteristic	Performance Requirement	Supplemental Information
Electromagnetic Interference	Not yet determined	
Transportation		
Package Vibration	1 hour slightly in excess of 1 g	
Package Drop	30" (18" for R453) on any corner, edge or flat surface	

SECTION 3

ELECTRICAL PERFORMANCE VALIDATION

3.1 Test Equipment Required

1	Oscilloscope	:	Tektronix Type 540-series
1	Sinewave Generator	:	Tektronix Type 191
1	Square Wave Generator	:	Tektronix Type 106
1	Time-Mark Generator	:	Tektronix Type 184
1	Standard Amplitude Calibrator	:	Tektronix Part No. 067-0502-00
1	Capacitance Bridge	:	ESI 250 DA
1	Dual-Trace Unit	:	Tektronix Type 1A1
1	Current Probe	:	Tektronix Type P6019
1	Line Voltage Control Unit	:	Tektronix Type TU-76
1	Line Frequency Control Unit	:	Tel-Instrument Type 4100-I-H10S
1	Low Frequency Oscillator	:	GR Model 1310A

3.2 Vertical Amplifier

3.2.1 Attenuator Accuracy

Performance Requirement: ±3% (5 mV/div to 10 V/div in 1-2-5 sequence)

Procedure: VARIABLE VOLTS/DIV is set at calibrated position. A Standard Square-Wave Calibrator signal is applied and the accuracy checked at each setting of VOLTS/DIV switch. Use either 4 or 5 divisions of displayed signal amplitude, depending upon combination of calibrator signal and VOLTS/DIV setting. Express deviation as percentage of correct amplitude.

3.2.2 Input R & C

Performance Requirement: 1 MΩ ±2% paralleled by 20 pF ±3%

Procedure: Measured using a Resistance Bridge and a Capacitance Bridge (accuracy of 0.2% or better). Turn instrument off.

3.2.3 Variable Range

Performance Requirement: $\geq$ 2.5:1

Procedure: VARIABLE range is checked by applying 5 divisions of signal from Type 106 with the Variable at CALIB. Turn VARIABLE VOLTS/DIV fully ccw. Check for $\leq$ 2 divisions of display.

3.2.4 Bandwidth 25 Ω source, with or without P6010

Performance Requirement:

5 mV/div	DC to $\geq$ 40 MHz
10 mV/div	DC to $\geq$ 45 MHz
20 mV/div through 10 V/div	DC to $\geq$ 50 MHz
CH 1 OUT at 5 mV/div	DC to $\geq$ 25 MHz (terminated in 50 Ω)
CH 1 OUT connected to CH 2	DC to $\geq$ 25 MHz (unterminated)

Procedure: Frequency response is checked by applying a 50 kHz signal from Type 191 to a vertical input connector. Obtain 4 divisions of display at 20 mV/div. Increase the frequency to 50 MHz. A signal of 2.8 divisions or greater will be displayed. Repeat the above step to check all attenuator ranges. To check the low-frequency -3 dB down point, use a GR 1310 frequency oscillator and monitor the output with a DC-coupled test oscilloscope to insure against changes in output amplitude. Obtain 4 divisions of 50 kHz signal. Decrease the frequency until 2.8 divisions of signal are observed, then note frequency is ≃ 1.6 Hz.

3.2.5 Risetime 25 Ω source, with or without P6010

Performance Requirement:

5 mV/div	$\leq$ 8.75 ns
10 mV/div	$\leq$ 7.8 ns
20 mV/div through 10 V/div	$\leq$ 7 ns
Ch 1 OUT at 5 mV/div	$\leq$ 14 ns (terminated in 50 Ω)
Ch 1 OUT connected to Ch 2	$\leq$ 14 ns at $\leq$ 1 mV/div (both channels at 5 mV)

Procedure: Connect Type 106 to input connector. Center the display. Measure the time interval between the 10% and 90% amplitude points on the leading edge of the pulse. The oscilloscope time base error should be used as a correction factor when risetime is measured. The effects of trace orthogonality and start of sweep nonlinearity should be taken into consideration when making risetime measurements.

3.2.6 Transient Response (overshoot, rolloff, ringing or tilt)

Performance Requirement:

20 mV/div	$\leq$ 2%
10 mV/div	$\leq$ 2%
5 mV/div	$\leq$ 2%
50 mV/div to 2 V/div	$\leq$ 3%
5 V/div to 10 V/div	$\leq$ 6%
Added Mode	$\leq$ 6%

Procedure: Transient response is measured using a 4 to 5 div pulse from a Type 106. Center the display vertically. Set the sweep rate to 20 ns/div. Check transient response from 5 mV/div to 10 V/div. Repeat for Ch 2. Transient response is determined by measuring the maximum peak-to-peak pulse aberration in the form of overshoot, rounding, ringing, or tilt along the entire pulse top, expressed as a percentage of pulse amplitude.

Check transient response in ADD mode using the same setup as the previous step except set Ch 2 deflection factor to 20 mV/div, Input Selector to Gnd. Set Mode switch to ADD and measure total pulse aberration.

3.2.7 Attenuator Compensation

Performance Requirement: 50 mV/div to 10 V/div $\leq$ 1%

Procedure: Connect Type 106---50 Ω termination---20 pF normalizer---vertical input connector. Set sweep rate to 0.2 ms/div. Check attenuator compensation using a 5-division step centered vertically. Measure the maximum peak-to-peak pulse aberration in the form of overshoot, rounding, ringing, or tilt along the entire pulse top, expressed as a percentage of pulse amplitude. Repeat without normalizer.

3.2.8 Position Effect on Transient Response (overshoot, rounding, ringing or tilt)

Performance Requirement: $\leq$ 5%

Procedure: Connect a Type 106 + FAST RISE OUTPUT to Vertical Input connector. Adjust amplitude control on Type 106 to obtain a 6-div step. Position top of waveform to bottom of graticule and measure total pulse aberration.

Connect Type 106 - FAST RISE OUTPUT to Vertical Input connector. Adjust amplitude for a 6-div display. Position bottom of waveform to top of graticule and measure pulse aberration. Measure maximum pulse aberration in the form of overshoot, rounding, ringing, or tilt along the entire pulse top, expressed as a percentage of pulse amplitude.

3.2.9 Low-Frequency Linearity

Performance Requirement: $\leq$ 0.15 divisions compression or expansion

Procedure: Set vertical deflection factor to 1 V/div. Apply 2 V from calibrator and center the dipslay. Position bottom of waveform to bottom graticule line and note change in pulse amplitude. Position top of waveform to top graticule line and note change in pulse amplitude. Linearity is the maximum change in pulse amplitude occurring at the defined limits.

3.2.10 Position Range

Performance Requirement: $\pm$13.5 div to $\pm$16.5 div

Procedure: Set LEVEL fully cw. TRIGGER SOURCE to EXT, MODE to AUTO, sweep rate to 1 ms/div, vertical deflection factor to 0.1 V/div. Set POSITION to 0 V at its wiper arm, measured with a 20,000 Ω/V, 3% meter. Adjust R55 (Ch 2 - R155) if necessary to position trace to graticule center. Set input selector to AC and connect Type 106 output 10X ATTEN---50 Ω termination---Ch 1 vertical input connector. Adjust Type 106 amplitude and symmetry controls to obtain a 6-div display centered on screen. Do not adjust the vertical position control to center the display. Set the deflection factor to 20 mV/div and turn POSITION fully cw. The top of the waveform must position within 1.5 divisions of graticule center.

Repeat the above with POSITION fully ccw. Repeat the check for Ch 2.

3.2.11 Trace Drift with Time

Performance Requirement:

5 mV/div	Typically 0.08 div/hr
10 mV/div	Typically 0.05 div/hr
20 mV/div through 10 V/div	Typically 0.03 div/hr

Procedure: After the 20 minute warm-up period, note that the trace drift does not exceed the limits stated in Section 1.1.

3.2.12 Trace Drift with Temperature

Performance Requirement:

5 mV/div	Typically 0.02 div/°C
10 mV/div	Typically 0.0125 div/°C
20 mV/div through 10 V/div	Typically 0.0075 div/°C

Procedure: Checked during environmental test phase.

3.2.13 STEP ATTEN BAL at 20 mV/div

Performance Requirement: $\geq$ 10 div total range
$\geq$ 3 div from calibrated setting

Procedure: Set A SWEEP MODE to AUTO, and vertical deflection factor to 20 mV/div. Turn STEP ATTEN BAL fully ccw and position trace to bottom graticule line with POSITION. Turn STEP ATTEN BAL cw until trace positions to top graticule line. Turn POSITION ccw to position trace 2 div down from top graticule line. Turn STEP ATTEN BAL fully cw. Trace must position above top graticule line. Recalibrate STEP ATTEN BAL and position trace to bottom graticule line. Turn STEP ATTEN BAL ccw from calibrated position and trace will position at least 3 divisions. Recalibrated STEP ATTEN BAL and position trace to top graticule line with POSITION. Turn STEP ATTEN BAL cw from calibrated setting. Turn STEP ATTEN BAL cw from calibrated position trace will position at least 3 divisions.

3.2.14 Variable Balance Centering

Performance Requirement: $\leq \pm 1$ div of graticule center

Procedure: Set the vertical deflection factor to 20 mV/div, Input Selector to GND. Adjust POSITION to obtain a minimum trace shift while turning VARIABLE VOLTS/DIV through its range. When balanced, note the trace position from graticule center. Repeat the above step for Ch 2.

3.2.15 Invert Zero-Shift Point

Performance Requirement: $\leq \pm$ div of graticule center

Procedure: Use the same setup as in the previous step. Adjust the Ch 2 POSITION to obtain a minimum trace shift while switching the PULL TO INVERT from normal to inverted. When balanced, note the trace position from graticule center.

3.2.16 GAIN Range

Performance Requirement: $\geq \pm 5\%$ from calibrated value

Procedure: Apply 0.1 V from calibrator. Set deflection factor to 20 mV/div, input selector to DC, and position the bottom of the display to the bottom of the graticule. Check for 5 divisions of deflection. Turn GAIN fully cw and note that the display increases to 5.25 divisions or greater. Set GAIN fully ccw, and the display will decrease to 4.75 divisions or less. Readjust GAIN for 5 divisions. Repeat the above to check Ch 2.

3.2.17 Input Grid Current

Performance Requirement: Negligible

Procedure: Checked at 5 mV/div setting. The trace is positioned to graticule center with the input selector in the GND position. The input selector is switched to DC, and the voltage indicated by the trace shift is noted.

3.2.18 Amplifier Crosstalk

Performance Requirement: $\geq$ 100:1, DC to 20 MHz

Procedure: Set Ch 1 vertical deflection factor to 0.2 V/div and apply a 20 MHz signal from a Type 191. Adjust AMPLITUDE of Type 191B to obtain a 2-division display. Set Ch 1 and Ch 2 VOLTS/DIV to 20 mV/div and input selector to Ch 2. Check for $\leq$ 0.2 div of amplifier crosstalk. Repeat the above for Ch 2.

3.2.19 Attenuator Isolation

Performance Requirement: $\geq$ 10,000:1, DC to 20 MHz

Procedure: Set Ch 1 input selector switch to DC, deflection factor to 5 mV/div. Set Ch 2 input selector switch to AC, deflection factor to 5 V/div. Apply 20 MHz 10 V signal from a Type 191 to Ch 2 vertical input connector. Set Vertical Mode switch to Ch 1 and check for $\leq$ 1 minor division of deflection. Repeat the above step to check Ch 2.

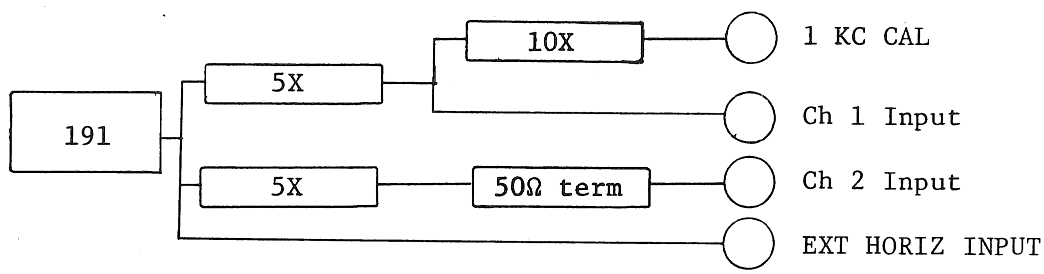
3.2.21 Linear Dynamic Range in Added Mode

Performance Requirement: $\geq \pm 10$ times the VOLTS/DIV setting for $\leq$ 10% distortion

Procedure: Checked using the following equipment:

1 Type 191
2 5X Attenuators
1 10X Attenuator
3 BNC "T" Connectors
1 50 Ω Termination

Necessary 50 Ω BNC cables are used to connect the above items as follows:



Set HORIZ DISPLAY to EXT HORIZ, Trigger Source to EXT, and Calibrator to 1 V. Set Type 191 to 50 kHz, attenuator to 10, amplitude to minimum, and Ch 1 and Ch 2 vertical coupling to AC. Note: The vertical gains must be optimized, and vertical positions must be centered. Set Ch 2 to inverted and both vertical deflection factors to 20 mV/div, A Sweep Mode to AUTO. The display will be two parallel lines, about one division apart. Increase amplitude of Type 191, until the vertical separation of the two lines at either extreme bows to 90% of midscreen amplitude. Switch the HORIZ DISPLAY to A. Measure the peak-to-peak amplitude of the Type 191 signal. Measured value is linear dynamic range where 10% nonlinearity occurs. Linearity is expressed as the amplitude ratio of the 50 kHz signal to the calibrator signal. Repeat for Ch 2.

3.2.22 Common Mode Rejection Ratio

Performance Requirement: $\geq$ 20:1 at 20 MHz for common mode signals up to 8 divisions

Procedure: Apply a 20 MHz signal from a Type 191 to Ch 1 and Ch 2 vertical input connectors. Set Ch 1 and Ch 2 deflection factors to 20 mV/div. Obtain 8 divisions of signal in both vertical channels. Invert Ch 2 and set the channel selector to ADD. Common mode rejection is expressed as a ratio of 8 divisions to the signal observed.

3.2.23 Chopped Repetition Rate

Performance Requirement: 500 kHz ±20%

Procedure: Checked by setting sweep rate to 0.5 μs/div, and input selector switch to CHOPPED. Obtain 2 divisions of triggered display using the Ch 1 and Ch 2 POSITION controls. Turn the intensity to an above normal setting. Check for one cycle over 3.3 div to 5.0 div of calibrated sweep.

3.3 Sweep Generators A & B

3.3.1 Sweep Accuracy

Performance Requirement:

	0°C to +40°C	-15°C to +55°C
5 s/div to 0.1 s/div	±3%	±5%
50 ms/div to 0.1 μs/div	±3%	±4%

Procedure: Apply time markers from Type 184 to Ch 1 input connector. Time Marks and graticule lines are counted beginning with zero (0-1-2-3 etc.). Time markers should be selected so that there is 1 mark/div at all "1,5,10" ranges, and 2 marks/div at all 2 and 20 ranges with the exception of the 0.5 μs/div range where a 1 μs marker for every 2 divisions will be displayed. All timing measurements are made over the middle 8 divisions of the graticule. The first and last divisions should not be included in the measurement. Sweep accuracy is defined as the displacement of the 9th graticule line's respective marker from the 9th graticule line when the 1st graticule line's respective marker is positioned behind the 1st graticule line, expressed as a percentage of 8 divisions.

3.3.2 X10 Magnified Accuracy

Performance Requirement: ≤ 1% in addition to specified sweep accuracies

Procedure: Use the same setup as Sweep Accuracy check. Apply 100 μs markers from Type 184, and set sweep rate to 1 ms/div, MAG to X10. One marker/div will be displayed. Magnified sweep accuracy is expressed as a percentage of 8 divisions.

3.3.3 Sweep Linearity (normal)

Performance Requirement: ≤ ±1.5%

Procedure: Apply 1 ms markers from Type 184 to vertical input connector. Set sweep rate to 1 ms/div. Position the 1st graticule line's respective marker behind the 1st graticule line and the 9th graticule line's respective marker behind the 9th graticule line. Note any displacement of the markers from their respective graticule lines. Note: It may be necessary to change the sweep rate to 0.5 ms/div and switch the VARIABLE to uncalibrated to accurately time the sweep between the 1st and the 9th graticule lines. Linearity is the displacement of any marker from any graticule line when the sweep is correctly timed, expressed as a percentage of 8 divisions.

3.3.4 Variable Range

Performance Requirement: $\geq$ 2.5:1

Procedure: Apply 10 ms markers from Type 184 to Ch 1 Vertical input connector. Set sweep rate to 1 ms/div and obtain a stable display. Two 10 ms markers will be displayed. Position the 1st marker behind the zero graticule line and the 2nd marker behind the 10th graticule line. Turn VARIABLE fully ccw and note that the 2nd marker positions on, or to the left of, the 4th graticule line.

3.3.5 Sweep Length A

Performance Requirement: Variable from $\leq$ 4 div to (11.0 $\pm$0.5 div)

Procedure: Apply 1 ms and 100 μs markers from Type 184 to Ch 1 input connector. Set sweep rate to 1 ms/cm. Each 100 μs marker represents 1/10 of a major divisions. Turn A SWEEP LENGTH fully cw and note the A sweep length. Turn A SWEEP LENGTH ccw, not to the detent, and the sweep length will be 4 divisions or less.

3.3.6 Sweep Length B

Performance Requirement: 11.0 $\pm$0.5 div

Procedure: Use the same setup as A Sweep Length. Set A TIME/DIV to 2 ms/div and TIME/DIV to 1 ms/div, HORIZ DISPLAY to DELAYED SWEEP (B), B SWEEP MODE to B SWEEPS AFTER DELAY TIME, and DELAY-TIME MULTIPLIER fully ccw. Adjust B Trigger LEVEL to obtain a stable display. The B sweep length will be 11.0 $\pm$0.5 divisions long.

3.3.7 A Sweep Hold-off Time

Performance Requirement:

10 μs/div to 5 s/div	$\leq$ 1 X the A TIME/DIV Setting
5 μs/div to 0.1 μs/div	$\leq$ 2.5 μs

Procedure: Use test scope to monitor the + A GATE. Measure the interval between + Gate waveforms to determine hold-off time.

3.4 Variable Time Delay

3.4.1 Delay Time Accuracy

Performance Requirement:

	0°C to +40°C	-15°C to +55°C
5 s/div to 0.1 s/div	±2.5%	±3.5%
50 ms/div to 1 μs/div	±1.5%	±2.0%

Procedure: Checked by applying 1 ms markers from a Type 184 to the Ch 1 vertical input connector. Set the A Sweep rate to 1 ms/div, HORIZ DISPLAY to A INTEN DURING B, B Sweep Mode to B SWEEPS AFTER DELAY TIME, and B sweep rate to 10 μs/div. Set the DELAY-TIME MULTIPLIER to 1.00 and note that the first time mark is intensified. Set the HORIZ DISPLAY to DELAYED SWEEP (B) and adjust the DELAY-TIME MULTIPLIER so that the 1st, 1 ms marker is at the start of the sweep. Note the dial setting of the DELAY-TIME MULTIPLIER. Set the HORIZ DISPLAY to A INTEN DURING B, and the DELAY-TIME MULTIPLIER to 9.00. The 9th time mark will be intensified. Set the HORIZ DISPLAY to DELAYED SWEEP (B) and adjust the DELAY-TIME MULTIPLIER so that the 9th, 1 ms marker is at the start of the sweep. Subtract the first dial reading from the 2nd dial reading. Delay time accuracy is the percent of deviation from 800 divisions.

3.4.2 Multiplier Incremental Linearity

Performance Requirement:

0°C to +40°C	-15°C to +55°C
±0.2%	±0.3%

Procedure: Apply 1 ms marker from a Type 184 to the Ch 1 vertical input connector. Set the A sweep rate to 1 ms/div, HORIZ DISPLAY to A INTEN DURING B, B Sweep Mode to B SWEEPS AFTER DELAY TIME, and B sweep rate to 10 μs/div. Set the DELAY-TIME MULTIPLIER to 1.00, and the HORIZ DISPLAY to DELAYED SWEEP (B). Horizontally position the displayed time mark to a reference point on the graticule. Set the DELAY-TIME MULTIPLIER to position the 9th mark to the reference point. Note the dial reading, and convert to minor divisions by multiplying by 100. Subtract 100 from this reading (the first 100 minor divisions are not included in linearity measurements) and divide by 10 to determine the minor divisions between each periodic major division for perfect linearity.

At each periodic major division, position the time mark with the DELAY-TIME MULTIPLIER to the reference point. Note the dial reading at each periodic major division and subtract the measured dial reading from the previously calculated perfect linearity. The difference must be ±1.6 minor divisions or less to be within the performance requirement as stated in Section 1.3

3.4.3 Jitter

Performance Requirement: $\leq$ 1 part in 20,000 of 10 times the "A" TIME/DIV setting

Procedure: Apply 1 ms markers from Type 184 to Ch 1 vertical input connector. Set A sweep rate to 1 ms/div, HORIZ DISPLAY to A INTEN DURING B, B sweep Mode to B SWEEPS AFTER DELAY-TIME, and B sweep rate to 1 μs/div. Set DELAY-TIME MULTIPLIER to 1.00 and note that the 1st, 1 ms marker is intensified. Set HORIZ DISPLAY to DELAYED SWEEP (B). Measure the horizontal excursion of the 1 ms marker disregarding the drift.

Set HORIZ DISPLAY to A INTENSE DURING B, and DELAY TIME MULTIPLIER to 9.00, and note that the 9th, 1 ms marker is intensified. Set HORIZ DISPLAY to DELAYED SWEEP (B). Measure the horizontal excursion of the 1 ms marker disregarding the drift.

3.5 Horizontal Amplifier

3.5.1 Sweep Magnification Accuracy

See 3.2.2 for validation procedure.

3.5.2 Normal/Magnified Registration

Performance Requirement: $\leq \pm 0.2$ div

Procedure: Apply 5 ms markers from Type 184 to Ch 1 input connector. Set sweep rate to 1 ms/div and MAG to X10. Horizontally position the magnified sweep so that the middle 5 ms marker falls behind the center vertical graticule line. Change MAG to NORM and note the deviation of the 5 ms marker from graticule center.

3.5.3 Position Range

Performance Requirement:

X1 fully cw	Start of sweep must position to the right of graticule center
X1 fully ccw	End of sweep must position to the left of graticule center
X10 FINE control range	5 div to 8 div

Procedure: The sweep length must be within its performance requirements as stated in Section 1.1 prior to the position range check. Apply 1 ms and 100 μs markers from a Type 184 to the Ch 1 vertical input connector. Set sweep rate to 1 ms/div, HORIZ DISPLAY to "A", and A SWEEP MODE to AUTO. Turn coarse and fine Horizontal POSITION fully cw and note that the start of the sweep must position to the right of the graticule center.

Turn Coarse and Fine Horizontal POSITION fully ccw and note that the end of the sweep must position to the left of the graticule center. Set MAG to X10, FINE fully ccw, and horizontally position a 1 ms marker to the zero graticule line with the Coarse control. Turn FINE fully cw. The 1 ms marker must position from 5 divisions to 8 divisions to the right.

3.6 External Horizontal Amplifier

3.6.1 Input to Vert Ch 1

See Vertical Amplifier for Calibrated Deflection Factor Range and Accuracy.

3.6.2 Bandwidth

Performance Requirement: DC to ≥ 5.0 MHz at -3 dB

Procedure: Set Ch 1 VOLTS/DIV to 20 mV. Apply a 50 kHz, 6-division signal from a Type 191 to Ch 1 vertical input connector. Set B TRIGGERING SOURCE to INT, HORIZ DISPLAY to EXT HORIZ, Input Selector to Ch 2. Increase the frequency of Type 191, until 4.2 divisions are observed. Note the frequency of the Type 191.

3.6.3 Phase Shift

Performance Requirement: ≤ 3° at 50 kHz

Procedure: Apply a 4-division, 50 kHz signal from a Type 191B to the Ch 1 and Ch 2 vertical input connector. Set B TRIGGERING SOURCE to INT, HORIZ DISPLAY to EXT HORIZ, CH 1 and CH 2 VOLTS/DIV to 20 mV, Input Selector to Ch 2. Measure the maximum separation of the displayed ellipse along the vertical graticule line. The maximum separation measured vertically must be 1 minor division or less to be within performance requirement as stated in Section 1.5.

3.6.4 Deflection Factor, TRIGGER INPUT or EXT HORIZ

Performance Requirement:	EXT	270 mV/div ±15%
	EXT ÷ 10	2.7 V/div ±20%

Procedure: Set HORIZ DISPLAY to EXT HORIZ, B TRIGGERING SOURCE to EXT AND APPLY a 2 V squarewave from the Standard Amplitude Calibrator to EXT HORIZ INPUT. The horizontal deflection must be from 6.3 to 8.5 divisions.

Set B TRIGGERING SOURCE to EXT ÷ 10, and apply a 20 V squarewave from the Standard Amplitude Calibrator. The horizontal deflection must be from 6.0 to 8.8 divisions.

3.6.5 Bandwidth

Performance Requirement: DC to $\geq$ 5.0 MHz at -3 dB

Procedure: Set B TRIGGERING Source to EXT, HORIZ DISPLAY to EXT HORIZ. Apply a 6-division 50 kHz signal from a Type 191 to EXT TRIG INPUT or EXT HORIZ. Increase the frequency of the Type 191, until 4.2 divisions are observed. Note the frequency of the Type 191.

3.6.6 Phase Shift

Performance Requirement: $\leq$ 3° at 50 kHz

Procedure: Apply a 50 kHz signal from a Type 191B to EXT TRIG INPUT or EXT HORIZ, HORIZ DISPLAY to EXT HORIZ, and adjust amplitude of Type 191 for 4 divisions of horizontal display. Apply the same signal to the Ch 2 vertical input connector through a BNC "T" connector and two equal length cables. Set HORIZ DISPLAY to "A", Ch 2 VOLTS/DIV to 20 mV and adjust the VARIABLE to obtain 4 divisions of vertical display. Set HORIZ DISPLAY to EXT HORIZ and measure the maximum separation of the displayed ellipse along the vertical graticule line. The maximum separation measured vertically must be 1 minor division or less to be within the performance requirement as stated in Section 1.5.

3.7 Triggering A & B

3.7.1 Trigger Sensitivity

Internal

Performance Requirement:

DC	0.2 div to 10 MHz, increasing to 1 div at 50 MHz
AC	0.2 div from 30 Hz to 10 MHz, increasing to 1 div at 50 MHz
AC LF Reject	0.2 div from 30 kHz to 10 MHz, increasing to 1 div at 50 MHz
AC HF Reject	0.2 div from 30 Hz to 50 kHz

Procedure: Apply a signal from Type 191 to the Ch 1 vertical input connector. Select the proper mode of coupling, signal frequency, and amplitude as stated in Section 1.6. Trigger Sensitivity is defined as the minimum peak-to-peak signal required to obtain a stable display with an adjustment of LEVEL while switching from + slope to - slope. To measure the lower point of AC coupling it may be necessary to use a Krohn-Hite oscillator applied to the vertical input connector. Monitor the amplitude of the Krohn-Hite oscillator with a DC coupled test oscilloscope to insure constant amplitude.

External

Performance Requirement:

AC	50 mV to 10 MHz increasing to 200 mV at 50 MHz
AC	50 mV from 30 Hz to 10 MHz increasing to 200 mV at 50 MHz
AC LF Reject	50 mV from 30 kHz to 10 MHz increasing to 200 mV at 50 MHz
AC HF Reject	50 mV from 30 Hz to 50 kHz

Procedure: Use the same setup as Internal Trigger Sensitivity except apply the signal to the Ch 1 Vertical and External trigger inputs. Observe minimum peak-to-peak signal required to obtain a stable display with an adjustment of LEVEL while switching from + slope to - slope.

3.7.2 Automatic Triggering and Recovery Time (A only)

Performance Requirement: Usable with signals above 20 Hz

Procedure: Connect 50 ms markers from Type 184 to the Ch 1 vertical input connector. Set the sweep rate to 1 ms/div, A SWEEP MODE to AUTO. Stable display must be obtained by triggering on the leading edge of the marker with an adjustment of LEVEL. Note that the trace free-runs beyond triggered area and through the full range of LEVEL.

Set the Type 184 to 100 ms markers. It must not be possible to obtain a stable display by triggering on the leading edge of the time mark with the LEVEL control.

3.7.3 Jitter

Performance Requirement: $\leq$ 1 ns at 10 ns/div

Procedure: Apply a 50 MHz signal from a Type 184 to the vertical input connector. Set A SWEEP MODE to NORM, Trigger Coupling to AC, sweep rate to 0.1 μs/div, MAG to X10, and Triggering Source to INT. Using LEVEL and HF STAB obtain a stable display. There must be $\leq$ 1/2 minor divisions of horizontal jitter.

3.7.4 Single Sweep (A only)

Performance Requirement: Triggering level same as normal sweep Performance Requirements

Procedure: Use the same setup as in Internal Trigger Sensitivity. Obtain a stable display. Set Input Coupling to GND. A SWEEP MODE to SINGLE SWEEP and depress RESET button (Reset light will light). Set Input Coupling to AC and note that the sweep runs once and once only.

3.7.5 LEVEL Range

Performance Requirement: EXT $\geq \pm 2$ V

EXT ÷ 10 $\geq \pm 20$ V

Procedure: Apply a 4 V, 50 kHz signal from Type 191 to vertical input connector and EXT TRIG INPUT. Set vertical deflection factor to 1 V/div, A TRIGGERING SOURCE to EXT, TRIGGER COUPLING to AC, A SWEEP MODE to AUTO. Obtain a stable display with LEVEL. Turn LEVEL fully cw and ccw. Display must free-run with LEVEL fully cw and fully ccw.

Set vertical deflection factor to 10 V/div and A TRIGGERING SOURCE to EXT ÷ 10. Apply a 40 V signal from Type 106 Square Wave Generator to vertical input connector and EXT TRIG. The display must free-run at the extremes of LEVEL.

Check B TRIGGER LEVEL using the same setup as above. Set B SWEEP MODE to TRIGGERABLE AFTER DELAY TIME, HORIZ DISPLAY to A INTEN DURING B, DELAY-TIME MULTIPLIER to 5.00, and B TRIGGERING SOURCE to EXT. Adjust LEVEL until the last half of the display intensifies. The display must return to normal intensity at the extremes of LEVEL. Set the vertical deflection factor to 10 V/div and the B TRIGGERING SOURCE to EXT ÷ 10. Apply a 20 V signal from the Standard Amplitude Calibrator to the vertical input connector and EXT TRIG. The display must return to normal intensity at the extremes of LEVEL.

3.8 Calibrator

3.8.1 Initial Setting and Accuracy

Performance Requirement: 1 V $\pm$0.3% at 25°C $\pm$5°C

Procedure: Remove Q 1255 and connect 1 V CAL 1 KC to Input of DC Voltage Bridge. Connect DC Voltage Bridge Output to test scope Vertical Input. Set DC Voltage Bridge to the 11 V scale, 1 V range. Set test scope vertical deflection factor to 5 mV/div and adjust +12 V (R 1152) for minimum difference in chopped levels.

Set Type 453 Calibrator to 0.1 V and connect a Standard Amplitude Calibrator to CAL 1 KC. Set Standard Amplitude Calibrator to + DC and Mixed at 0.1 V. Connect the output of Standard Amplitude Calibrator to test scope Vertical Input. Set test scope vertical deflection factor to 5 mV/div and note the difference in the chopped levels. The chopped levels must be within 1 minor division to be within the Performance Requirement as stated in Section 1.1. Replace Q 1255.

3.8.2 Output Current 5 mA

Performance Requirement:	0°C to +40°C	-15°C to +55°C
	±1%	±1.5%

Procedure: Monitored with a Current Probe. If the calibrator voltage accuracy is within its performance requirement and a current is present in the current loop, it is within its performance requirement.

3.8.3 Repetition Rate 1 kHz

Performance Requirement:	0°C to +40°C	-15°C to +55°C
	±0.5%	±1%

Procedure: Apply 1 ms markers from a Type 184 to Ch 1 vertical input connector. Apply 1 V calibrator signal to Ch 2 vertical input connector. Set TRIGGER MODE to NORM, Input Selector to ALT, sweep rate to 1 ms/div, and adjust LEVEL for a stable display. Position the last marker to graticule center and set the MAG to X10. Note the displacement of the leading edge of the Calibrator signal from the leading edge of the 1 ms marker. The displacement must be 1/2 division or less for the Calibrator to be within its performance requirement as stated in Section 1.7.

3.8.4 Duty Cycle

Performance Requirement: 49% to 51%

Procedure: Apply a 1 V Calibrator signal to Ch 2 vertical input connector. Set vertical deflection factor to 0.2 V/div, A sweep rate to 0.1 ms/div and obtain a stable display. Vertically position the display about graticule center. Adjust A VARIABLE to obtain 5 divisions of the positive half-cycle of the Calibrator waveform. Invert Ch 2 and note that the displayed half-cycle is 5 divisions ±1 minor division.

3.8.5 Risetime

Performance Requirement: ≤ 1 μs

Procedure: Monitor 1 KC CAL OUT with test scope. Measure the time interval between the 10% and 90% amplitude points on the leading edge of 1 V and 0.1 V Calibrator signal.

3.9 Z Axis Input

3.9.1 Sensitivity

Performance Requirement: ≥ 5 V P to P causes noticeable modulation at normal intensity

Procedure: Remove the ground strap from Z Axis Input and apply a 5 V signal from the Standard Amplitude Calibrator to the Ch 1 vertical input connector and the Z Axis Input. Set A sweep rate to 0.5 ms/div, Ch 1 vertical deflection factor to 1 V/div, and obtain a stable display. The positive portion of the squarewave must dim at a normal intensity level.

3.9.2 Usable Frequency Range

Performance Requirement: DC to $\geq$ 50 MHz

Procedure: Apply a 5 V signal from Type 191 to Z Axis Input (with the ground strap removed) and A EXT TRIGGER INPUT. Set A SWEEP MODE to NORMAL, A TRIGGERING SOURCE to EXT, and adjust LEVEL to obtain an intensity modulated sweep. Set the frequency of the Type 191 to 50 MHz, sweep rate to 0.1 μs/div, and MAG to X10. Check for 50 MHz intensity modulation.

3.10 Signal Outputs

3.10.1 A & B Gates Output Voltages

Performance Requirement: 12 V $\pm$10%

Procedure: Checked using a test scope.

3.10.2 Vertical Signal Out (CH 1 Only)

Output Voltage

Performance Requirement: $\geq$ 25 mV/div into 1 MΩ

Procedure: Obtain 5 divisions of deflection using the 1 V Calibrator. Monitor Ch 1 OUT with test scope for $\geq$ 125 mV.

Bandwidth

Performance Requirement: (See Vertical Amplifier page 1-2)

Procedure: See Vertical Amplifier test methods.

3.11 Power Requirements

3.11.1 Line Voltage Ranges

Performance Requirement:

90 to 110 V
104 to 126 V
112 to 136 V
180 to 220 V
208 to 252 V
224 to 272 V

Procedure: Vary line voltage with a TU-76. Monitor the regulated DC power supplies with the test scope.

3.11.2 Line Frequency

Performance Requirement: 45 Hz to 440 Hz

Procedure: Use a Tel-Instrument Type 4100-I-H10S to vary line frequency. Monitor the regulated DC supplies with test scope at the frequency limits stated in Section 1.10.

3.12 Internal Power Supply

3.12.1 Long Term

Performance Requirement:

-12 V	+12.1 V	+75 V
±1%	±1.7%	±1%

Procedure: The supplies will be within the given tolerances at 25°C ±5°C for any 500 hour period after the first 200 hours.

3.12.2 Initial Setting

Performance Requirement:

-12 V	+12.1 V	+75 V
±0.27%	±1.0%	±0.37%

Procedure: The -12 V, +75 V, and High Voltage are set using a DC Voltage Bridge. The +12.1 V is measured after the 1 V CAL OUT is adjusted.

3.12.3 Variation from 25°C value (-15°C to +55°C)

Performance Requirement:

-12 V	+12.1 V	+75 V
±0.5%	±0.75%	±0.75%

Procedure: Maximum variation from the value measured at 25°C ±5°C, checked from -15°C to +55°C.

3.13 CRT Display

3.13.1 Writing Rate

Performance Requirement: Capable of single transient recording at ___s/div, using Type ___ camera and Type ___ film

Procedure: Intensity, Focus and Astig are adjusted for best resolution with free-running sweep at 0.1 ms/div. Sweep rate is then increased to ___ s/div, and the Sweep Mode set to Single Sweep. Using Type ___ camera and Type ___ film, record a single display.

3.13.2 Luminance

Performance Requirement: Undetermined

Procedure: Not yet determined.

3.13.3 Trace Width

Performance Requirement: $\leq$ 0.030" at graticule center

Procedure: Apply a 2 division Calibrator signal to the Ch 1 vertical input connector. Set sweep rate to 1 ms/div, FOCUS and ASTIG set for optimum focus, and position the display about graticule center. Set INTENSITY at a minimum usable level. Use a calibrated, hand-held telescope and measure the trace width along the top of the squarewave.

3.13.4 Horizontal Resolution

Performance Requirement: 150 lines in 10 divisions

Procedure: Apply 1 ms and 100 μs markers from Type 184 to Ch 1 vertical input connector. Set sweep rate to 1 ms/div. Use a VARIABLE TIME/DIV and obtain three 1 ms markers for every 2 divisions. Observe no overlap of the 100 μs markers over the scan area when the center 4 divisions are focused.

3.13.5 Geometry

Scan Area

Performance Requirement: $\geq$ 6 x 10 div at 0.8 cm/div

Procedure: Set sweep rate to 1 ms/div, A Sweep Mode to AUTO, and apply 10 MHz from Type 191. Set vertical deflection factor so that the 10 MHz signal exceeds vertical graticule limits. Set MAG to X10. Note that the raster produced exceeds the limits stated in Section 1.12.

Beam Intercept

Performance Requirement:

Vertical : At 6 div scan max intercept per plate 35%

Horizontal: At 10 div scan max intercept per plate 50%

Vertical

Procedure: Check the vertical intercept by "floating" a special μA meter (obtained through CRT Design Engineering) in CRT anode circuit. Set A sweep rate to 1 ms/div, A SWEEP MODE to AUTO, A SWEEP LENGTH to 4 divisions and position the focused trace to graticule center. Turn INTENSITY fully ccw and null the meter with the Helix Balance control. Turn INTENSITY cw to obtain 5 μA of beam current. Position trace to top of graticule and note meter reading. Position trace to bottom of graticule and note meter reading. Intercept is defined as an offset reading expressed as a percentage of center reading.

Horizontal:

Check horizontal intercept by applying a sawtooth waveform from test scope to Ch 1 vertical input connector. Set HORIZ DISPLAY to Ext Horiz, Ch 1 vertical deflection factor to 20 V/div and VARIABLE to uncalibrated to obtain 3 divisions of deflection. Horizontally position display to graticule center and turn INTENSITY fully ccw. Null the meter with Helix Balance. Turn INTENSITY cw to obtain 5 μA of beam current and note meter reading. Position trace to zero graticule line and note meter reading. Position trace to right of graticule and note meter reading.

Intercept is defined as an offset reading expressed as a percentage of center reading.

Spot Centering

Performance Requirement: $\leq$ 0.5 div radius from graticule center

Procedure: Set 0 V between Horizontal deflection plates and between vertical deflection plates (not to ground). Note the position of the spot from graticule center.

Linearity

Performance Requirement: $\leq$ 0.5 minor div compression or expansion of 2 div signal

Procedure: See Test Method 3.2.9.

Orthogonality

Performance Requirement: 90° $\pm$1°

Procedure: Obtain a free-running sweep at 0.5 ms/div. Align trace horizontally with trace rotation adjustment and apply 1 ms and 100 μs markers from Type 184. Check for ten 1 ms markers for every 10 graticule divisions. The 100 μs markers will now be 0.5 minor divisions apart. Position a 100 μs marker on bottom center graticule line. The adjacent 100 μs markers must not cross the top center graticule line.

Trace Rotation Range

Performance Requirement: $\geq 6°$

Procedure: Checked by turning TRACE ROTATION fully cw. Position start of a free-running trace to zero vertical graticule center. Note where trace intersects the 10th div graticule line below graticule center. Turn TRACE ROTATION fully ccw and position start of trace to graticule center. Note where trace intersect the 10th div graticule line above graticule center. Total displacement must be $\geq$ 1 div.

Raster Distortion

Performance Requirement: $\leq$ 0.5 minor div total

Procedure: Apply 1 ms and 100 μs markers from a Type 184 to Ch 1 vertical input connector. Adjust amplitude to exceed graticule height. Set sweep rate to 1 ms/div. The 100 μs markers will be 0.5 minor division apart. Position a 100 μs marker to bottom of a vertical graticule line. The adjacent 100 μs markers must not cross the top of the same vertical graticule line. Horizontal trace distortion is checked by positioning a 0.5 ms/div, free-running sweep to top and bottom of graticule and observing the amount of sweep bowing.

3.13.6 Deflection Factors

Performance Requirement:

Vertical : 4.1 V/div to 5.1 V/div

Horizontal: 10.7 V/div to 13.0 V/div

Vertical

Procedure: Set HORIZ DISPLAY to EXT HORIZ and obtain a low-intensity spot. Position spot to graticule center. Connect voltmeter to lower deflection plate. Position spot to top graticule line. Note meter reading. Position spot to bottom graticule line (meter polarity must be changed when positioning the spot to bottom graticule line). Note meter reading. Divide total voltage excursion by 6 to determine VOLTS/div.

Horizontal

Procedure: Set HORIZ DISPLAY to EXT HORIZ and obtain a low-intensity spot. Position spot to 0 graticule line. Connect voltmeter to horizontal deflection plate. Note meter reading. Position spot to the 10th graticule line (meter polarity must be changed when positioning spot to right of graticule center). Divide total voltage excursion by 10 to determine VOLTS/div.

SECTION 4

ENVIRONMENTAL PERFORMANCE VALIDATION

4.1 Temperature

Perform all tests in a single chamber and, when changing chamber ambient temperature, do not exceed a change rate of 5°C per minute.

4.1.1 Nonoperating

Perform all electrical tests, described in Section 3, at 25°C. Then turn the instrument off and store at -55°C ambient for 4 hours.

Change ambient temperature to +75°C and again store for 4 hours.

Return the ambient temperature to 25°C, allow 4 hours for stabilization, and again perform all electrical tests.

Failure Criteria

Instrument and components must meet performance requirements before and after storage. If necessary, internal or external adjustments may be performed to meet required accuracies.

Cracking, warping, discoloration or any deformation which interferes with a normal mechanical function also constitutes failure.

4.1.2 Operating

Perform all electrical tests, described in Section 3 at 25°C.

With the instrument turned off, change ambient temperature to -15°C and allow the instrument to stabilize for 4 hours. At the end of this period, turn the instrument on, allow 20 minutes for warm-up, then check accuracy and operation of all front-panel functions.

With the instrument operating, change the chamber ambient temperature to +55°C and allow 4 hours for stabilization. (+45°C for Type 453/R453.)

At the end of 4 hours, again check the accuracy and operation of all front-panel functions.

Return the instrument to +25°C, allow 4 hours for stabilization, then perform all electrical tests described in Section 3.

Failure Criteria

Instrument must meet performance requirements at each step in the test. Controls and switches must operate normally.

4.2 Altitude

Altitudes described in this section are referred to sea level. "Normal altitude", when used, refers to the natural elevation (outside the chamber) of the test facility site.

4.2.1 Nonoperating

Perform all electrical tests described in Section 3 at 25°C and normal altitude. Then store, with the instrument turned off, for 4 hours at 50,000 feet and -55°C.

Return chamber to normal altitude and 25°C and allow 4 hours for stabilization. At the end of this period, repeat the electrical tests.

This test may be performed with the nonoperating temperature test (4.1.1).

Failure Criteria

This instrument must meet performance requirements before and after the altitude test, and must experience no cracking or warping, nor any deformation which interferes with normal mechanical function.

4.2.2 Operating

Perform all electrical tests described in Section 3 at 25°C and at normal altitude.

Operate the instrument 4 hours at 15,000 feet. At the end of this period maintain that altitude and measure accuracy and operation of front-panel functions.

When necessary, open the vacuum chamber and perform required switching as rapidly as possible. Then return the chamber to the specified altitude and allow 1 hour for stabilization before continuing the tests.

Return the instrument to normal altitude and repeat all electrical tests described in Section 3.

Failure Criteria

Instrument will meet performance requirements before, during and after the operating altitude tests. Any evidence of malfunction constitutes failure.

4.3 Humidity

4.3.1 Nonoperating

Perform 5 cycles (120 hours) of Mil-Std-202C, Method 106B. Delete freezing and vibration. Allow to dry for 24 hours at room ambient conditions (25°C $\pm$5°C, 20% to 80% relative humidity) prior to operating. Allow one-hour warm-up before making measurements.

Failure Criteria

Nonoperating

There shall be no significant deterioration of components, materials or finishes. Type 453/R453 and its components must meet their electrical performance requirements before and after the humidity test. Deformation which interferes with normal mechanical function will not be permitted.

4.4 Vibration

4.4.1 Operating

Perform all electrical tests described in Section 3 before vibrating the instrument.

Fasten the instrument securely to the vibration platform.

With the instrument operating, vibrate for 15 minutes along each of the 3 axes at a total displacement of 0.025" (4 g's at 55 c/s), and with the frequency varied from 10-55-10 c/s in 1-minute cycles. Hold at any resonant point for 3 minutes.

If no resonances are present, vibrate at 55 c/s for 3 minutes in each axis for a total vibration time of approximately 55 minutes.

Turn off the vibration platform and repeat all electrical tests described in Section 3.

Failure Criteria

The instrument must meet performance requirements before and after the vibration tests. (Sporadic output during vibration is permissable.)

Mechanical failures are indicated by:

Broken leads
Broken chassis
Broken compoents
Loose parts
Excessive wear
Component fatigue
Change in component value outside rated tolerance
Deformation which interferes with a normal mechanical function

Test will be completely rerun after repairing any of these failures.

4.5 Shock

4.5.1 Nonoperating and Operating

Perform all electrical tests described in Section 3 before proceeding with the shock tests.

Subject the instrument to guillotine-type shocks of 30 g's, 1/2 sine, 11 ms duration; 2 such shocks each direction along each of the 3 major axis for a total of 6 shocks.

Repeat all electrical tests described in Section 3.

Failure Criteria

The instrument will meet performance requirements before and after the shock tests.

There must be no cracked or broken chassis, components or leads; component deformation of 0.100" or more; nor any deformation which interferes with a normal mechanical function.

4.6 Electromagnetic Interference

4.6.1 Operating

Use the test set-up procedures and limits described in specification MIL-I-6181D. The tests will be peformed within an electrically shielded enclosure. The instrument must be equipped with a CRT mesh filter. EMI will be checked over the following frequency range:

Radiated Interference - from the instrument under test 150 kHz to 1000 MHz

Conducted Interference- through the power cord 150 kHz to 25 MHz

Failure Criteria

Radiated and Conducted Interference.

The instrument shall not exceed the limits described in MIL-I-6181D, figures 7,8,14 and 16.

4.7 Transportation

Perform all tests described in Section 3 before conducting the transportation tests, then place the instrument in the carton in the manner in which it is normally shipped.

4.7.1 Package Vibration

Vibrate for 1 hour in a manner causing the package to leave the vibration platform (slightly in excess of 1 g).

4.7.2 Package Drop

Drop the package from a height of 30" on one corner, on all edges radiating from that corner, and on all flat surfaces for a total of 10 drops.

After the transportation tests, repeat all electrical tests described in Section 3.

Failure Criteria

The instrument must meet performance requirements before and after the transportation tests. There must be no broken components, leads, or chassis members, nor any deformation which interferes with a normal mechanical function.

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INSTRUMENT PERFORMANCE CHARACTERISTIC

CHANGE REQUEST

This form requests changes in the Engineering Instrument Specification (salmon book) or in performance characteristics quoted to the customer via publications such as the Catalog or Instruction Manual. When the instrument has an Engineering Instrument Specification, then it is the controlling document.

Return completed form to Product Evaluation and Modification Engineering Writing 50/425 for approval and distribution.

Instrument Type: ______________________

Publication affected: ______________ No. ________ Dated ________

Requested by: ______________ Dept. ________ Date ________

Page no: ________ Item ______________

Now reads: ______________________

Change to/add: ______________________

Reason for change: ______________________

Approval: (Initial in proper space)

Make change immediately

Make change at next rewrite

Reject

or

____

Proj. Mgr.	Proj. Eng.	Eval. Mgr.	Eval. Eng.			

Date Received ________ Date Filed ________

ADVERTISING

MAINT NOTES

FACTORY TEST LIMITS

QUALIFICATION

Factory test limits are qualified by the conditions specified in the main body of the factory calibration procedure. Instruments may not meet factory test limits if calibration or checkout methods and test equipment differ substantially from those in the factory procedure.

These limits usually are tighter than advertised performance requirements, thus helping to insure the instrument will meet or be within advertised performance requirements after shipment and during subsequent recalibrations. Instruments that have left the factory may not meet factory test limits but should meet catalog or instruction manual performance requirements.

POWER SUPPLIES

-12 Volts:	±.02V, max
+12 Volts:	1V ±.002V, max 12V -0 +.2V, max
+75 Volts:	±.2V, max
Ripple and regulation:	2mV, max
High:	103 to 137Vac
Low:	96 to 127Vac

HIGH VOLTAGE:

±1%, max

TRACE ALIGNMENT

TRACE ROTATION:	Range: 6°, min
Geometry:	.1 div, max

SCALE ILLUM

no illumination ccw
max illumination cw

STEP ATTEN BAL

+ and -5 div range from proper setting, min

BALANCE

VARIABLE balance: ±1 div of graticule center

CH 2 INVERT balance: ±1 div of graticule center

GAIN

CH 1 GAIN	Range: ±5%, min
CH 2 GAIN	Range: ±5%, min
ADD gain	±1%, max

VOLTS/DIV

VOLTS/DIV accuracy:	±2%, max
VARIABLE range:	2.5:1, min

COMPRESSION, EXPANSION

.1 div, max

ALTERNATE

All sweep rates

MICROPHONICS AND GRID CURRENT

a. Microphonics: 1 div, max; no ringing type
b. Grid current: .4 div, max

VOLTS/DIV COMPENSATION

CH 1 compensation: ±1%, max
CH 2 compensation: ±1%, max

HIGH FREQUENCY COMPENSATION

CH 1 20mV hf compensation: ±2%, max
CH 2 hf compensation: ±2%, max
CH 1 5mV and 10mV compensation: ±2%, max

TRANSIENT RESPONSE

Added mode transient response: ±6%, max
-Polarity transient response ±2%, max
Positioning effect on transient response: ±5%, max
Attenuator transient response:
50mV to 2V: ±3%, max
5V and 10V: ±6%, max
Risetime: 6.6ns, max

BANDPASS

20mV/DIV bandpass: ≥52.5MHz 30% down

10mV/DIV bandpass: >46.5MHz 30% down

5mV/DIV bandpass: >41MHz at 30% down

CH 2 bandpass: within 5MHz of CH 1 at 20mV

Added mode bandpass: ≥52.5MHz 30% down

CH 1 OUT to CH 2 bandpass: >25MHz at 30% down

VERTICAL POSITION RANGE

Position range: 13.5 to 16.5 div

COMMON MODE REJECTION RATIO AND ATTENUATOR ISOLATION

Common mode rejection ratio: ≥20:1 at 20MHz

Attenuator isolation: 10,000: 1 min, at 20MHz

TRIGGERING

Internal triggering:
- 0.2 div at 10MHz
- 1 div at 50MHz
- 0.2 div from 30Hz to 10MHz AC
- 0.2 div from 30kHz to 10MHz AL LF REJ

External triggering:
- 50mV at 10MHz
- 200mV at 50MHz
- 50mV from 30Hz to 10MHz AC
- 50mV from 30kHz to 10MHz AC LF REJ

HF REJ: not triggered at 1MHz

SINGLE SWEEP: Same trigger level as NORM

LINE: correct polarity

LF REJECT: Not triggered at 60Hz

TRIGGERING LEVEL RANGE

EXT LEVEL range: + and - 2V, min

EXT ÷ 10 LEVEL range: + and - 20V, min

AUTO RECOVERY TIME

Recovery time: 50 to 100ms

DELAY TIME LINEARITY

±1.5 minor div, max

X10 MAG

Mag Gain: ±1%, max

Linearity: ±1%, max

Mag Regis: ±.1 div, max

SWEEP LENGTH

B sweep length: 11 ±.5 div

A sweep length: ≤4 div to 11 ±.5 div

VARIABLE RANGE

A VARIABLE range: 2.5:1, min

B VARIABLE range: 2.5:1, min

POSITION RANGE

X1 position range: ends of sweep to graticule center

X10 FINE range: 5 to 8 div

HIGH SPEED LINEARITY

.1 μSEC/DIV X10 MAG timing: ±3%, max

B SWEEP TIME/DIV

±2%, max

A SWEEP TIME/DIV

.1 μSEC to 1 μSEC/DIV: ±2%, max

1 μSEC to 50mSEC: ±1%, max

.1 SEC to 5 SEC: ±2%, max

Test Limits - continued

DELAY TIME JITTER

.3 div, max

EXT HORIZ

deflection factor EXT:	
	270mV/div ±15%
	EXT ÷ 10:
	2.7V/div ±20%
bandpass:	≥5MHz at 30% down

CHOPPED OPERATION

Chopped frequency: 500kHz ±20%

CALIBRATOR

Cal Freq:	1kHz ±.05%
Duty cycle:	50% ±1%
Risetime:	1μs, max
Voltage accuracy:	±.5%, max

Z AXIS

Sensitivity: 5V, min
max usable frequency: 50MHz, min

CH 1 OUT

Gain: 1mV/div, min

TRACE FINDER

trace must not position off
graticule

A AND B GATES

A GATE:	12V ±5%
B GATE:	12V ±5%

HOLDOFF

.1μSEC to 5μSEC:	less than 2.5s
10, 20 and 50μSEC:	3.5-10μs
.1, .2 and .5mSEC:	3.5-100μs
1, 2 and 5mSEC:	3.5-1ms
10, 20 and 50mSEC:	3.5-10ms
.1 SEC to 5 SEC:	3.5-100ms

MAINTENANCE NOTES

BEAVERTON

453 - 230 VOLT AC APPLIED TO 115 V AC CONNECTOR

PROBLEM: Damaging of components in the 453 because of the failure of fuses F1101 and F1102 to blow when 230 volts AC is mistakenly applied as a supply voltage to the 115 volt connector.

SOLUTION:

1. Install modification 10485-2 in instruments s/n 100-3439.
2. Remove diodes D1159 and D1167 from the circuit (part of Mod 12214).
3. Reduce the value of fuses F1101 and F1102 to 0.7 amp SLO-BLO.

NOTE: When the higher supply voltage is applied D1159 and D1167 are the first components to disintegrate. Their purpose was to protect the +12 volt supply in the event of a short occuring in the HV circuit. Effective with s/n 3440, Mod 10485-2 was installed, which changed the grounding of the HV circuitry eliminating the necessity for these two diodes.

Dan Welch

MAINTENANCE NOTES

EC BOARD REPAIR

Tony Bryan, 7-16-65

When and if it becomes necessary to replace a component on an EC Board in "Environmental" instruments, such as 422, care should be taken to remove all soldering flux.

Under environmental conditions of high humidity, considerable damage can result to the board from the combination of moisture and flux. This combination causes corrosion, resulting in an instrument which is designed as "Environmental", but will not play under those conditions.

The same advice applies to any Tek-made EC Boards. But, one could probably get away with less thorough cleaning in a "Lab Instrument".

EC BOARD STAND-OFFS

Tony Bryan, 8-27-65

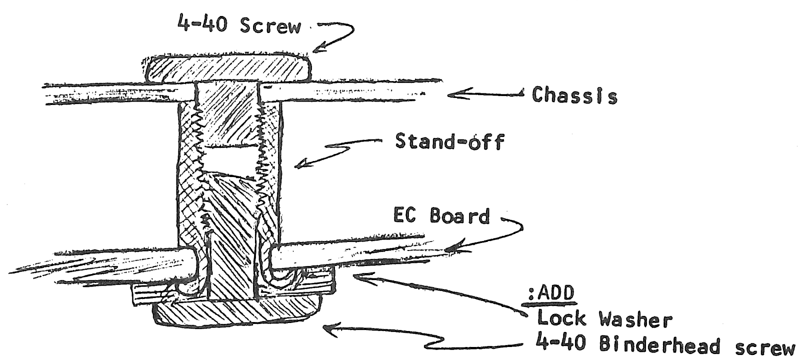
The stand-offs used for mounting the etched circuit boards in these instruments show signs of developing high resistance paths between the stand-off and the mating surface of the EC board.

Tests on samples and random stand-offs exhibiting enough resistance to warrant further examination, reveal passivated metal films (first stages of corrosion) present. Presence of lacquers was also evident.

The indications first noticed at the factory were excessive power supply ripples, hum, etc. Such problems in 422/453's may make these stand-offs suspect.

The repair solution is to install an internal lock-washer with a 4-40 binder head screw. All the standoffs are tapped with 4-40 threads inside since they are mounted to chassis, rails, etc., by 4-40 screws.

The lockwasher used should have an internal ID of sufficient size to clear the knurled edge of the stand-off.



USE OF HITACHI NUVISTORS IN ENVIRONMENTALIZED INSTRUMENTS

Tony Bryan, 10-6-65

Recent process changes to Hitachi Nuvistors make them usable again in the above environmental instruments. Their use was discontinued in June, 1965, due to the high incidence of corrosion of the pins in environmental conditions of high humidity. New pin materials, plating, etc., now make them acceptable devices. They are identifiable by a nickel alloy finish on the nuvistor pins.

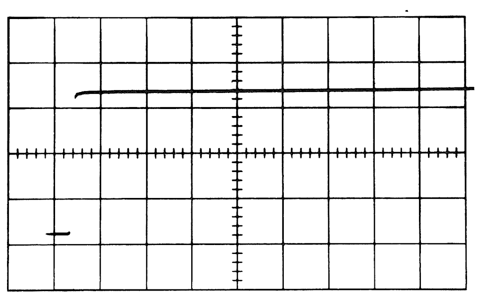
The following photographs were taken from three 453's selected at random in Plant 3's Q.C. Department.

Because of the specification of no more than 6% aberrations, overshoot, ringing, etc., it was felt some photos typical of a production instrument would be helpful. All photos were taken at .1 µsec/Div, MAG OFF and using a "Buzz Box", which is a Production Test Device consisting of a mercury switch, driven by a 105 square wave generator, which switches a DC voltage.

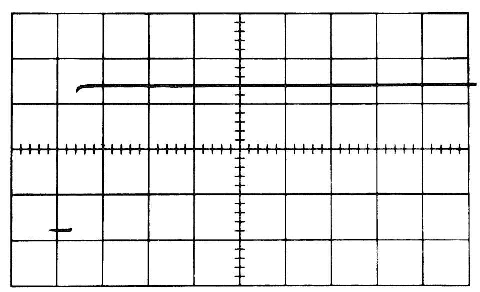
The 453 manual calibration procedure does not go into detail or explain that the stacking of previously adjusted attenuators may require some compromise settings for best results in the 5 V/Div and 10 V/Div positions. As a matter of fact, the manual is quite short on any facts about such adjustments. Neither the Performance Check nor Calibration Procedure detail the measurement of bandpass or transient response in those positions. However, Plant 3 Test Department does not have any experience to indicate problems in this area. They are really quite good considering the attenuation ratio together with the frequency response that is typical of the vertical amplifier.

Following the photographs is a graph of 3 dB points versus attenuator settings of 71 instruments, a total of 142 channels. As you can see, the average bandpass is somewhat better than the instrument specification. These figures are taken from test records.

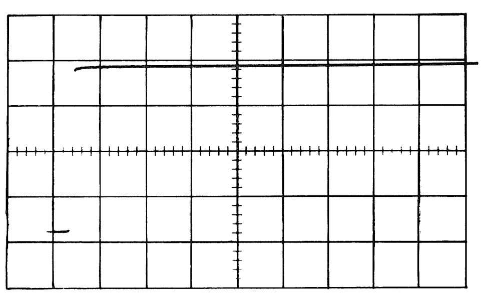
453 SN 325



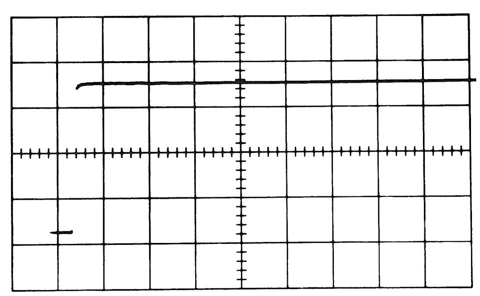
CH 1 5V/DIV



CH 2 5V/DIV

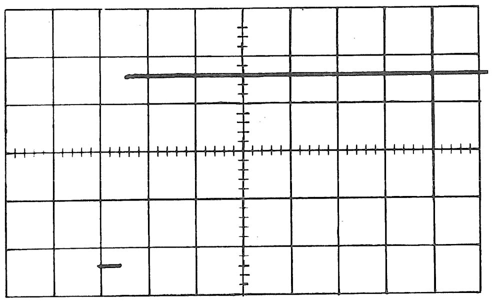


CH 1 10V/DIV

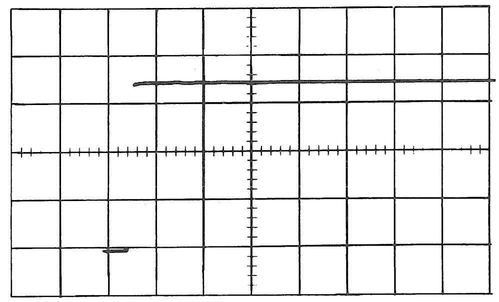


CH 2 10V/DIV

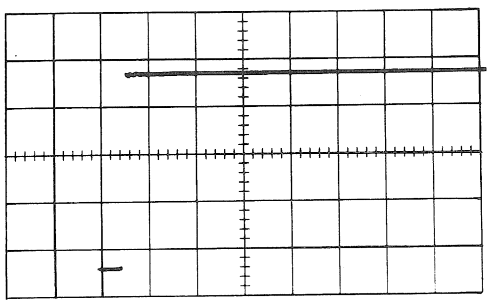
453 SN 349



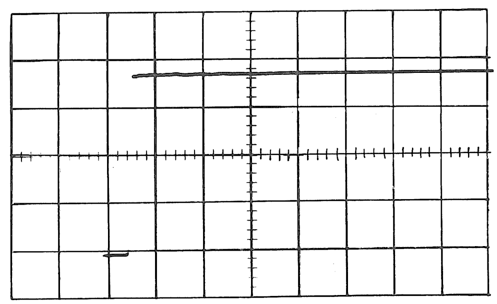
CH 1 5V/DIV



CH 2 5V/DIV

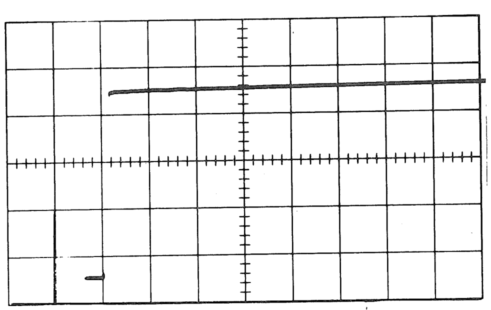


CH 1 10V/DIV

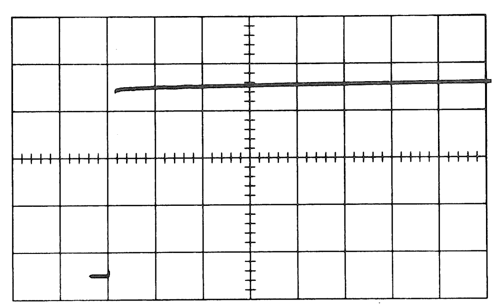


CH 2 10V/DIV

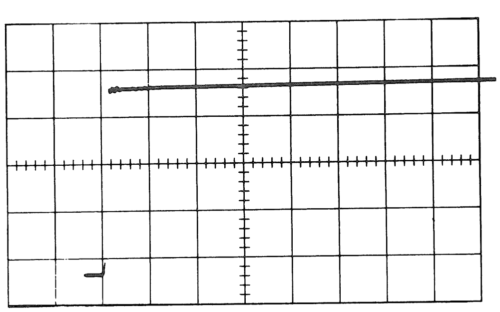
453 SN 516



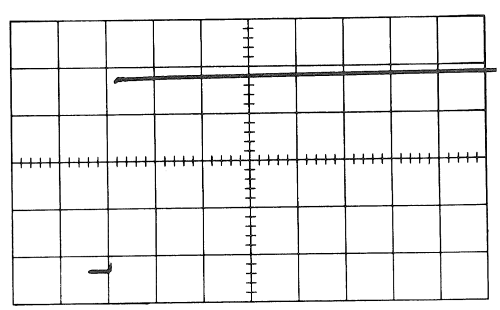
CH 1 5V/DIV



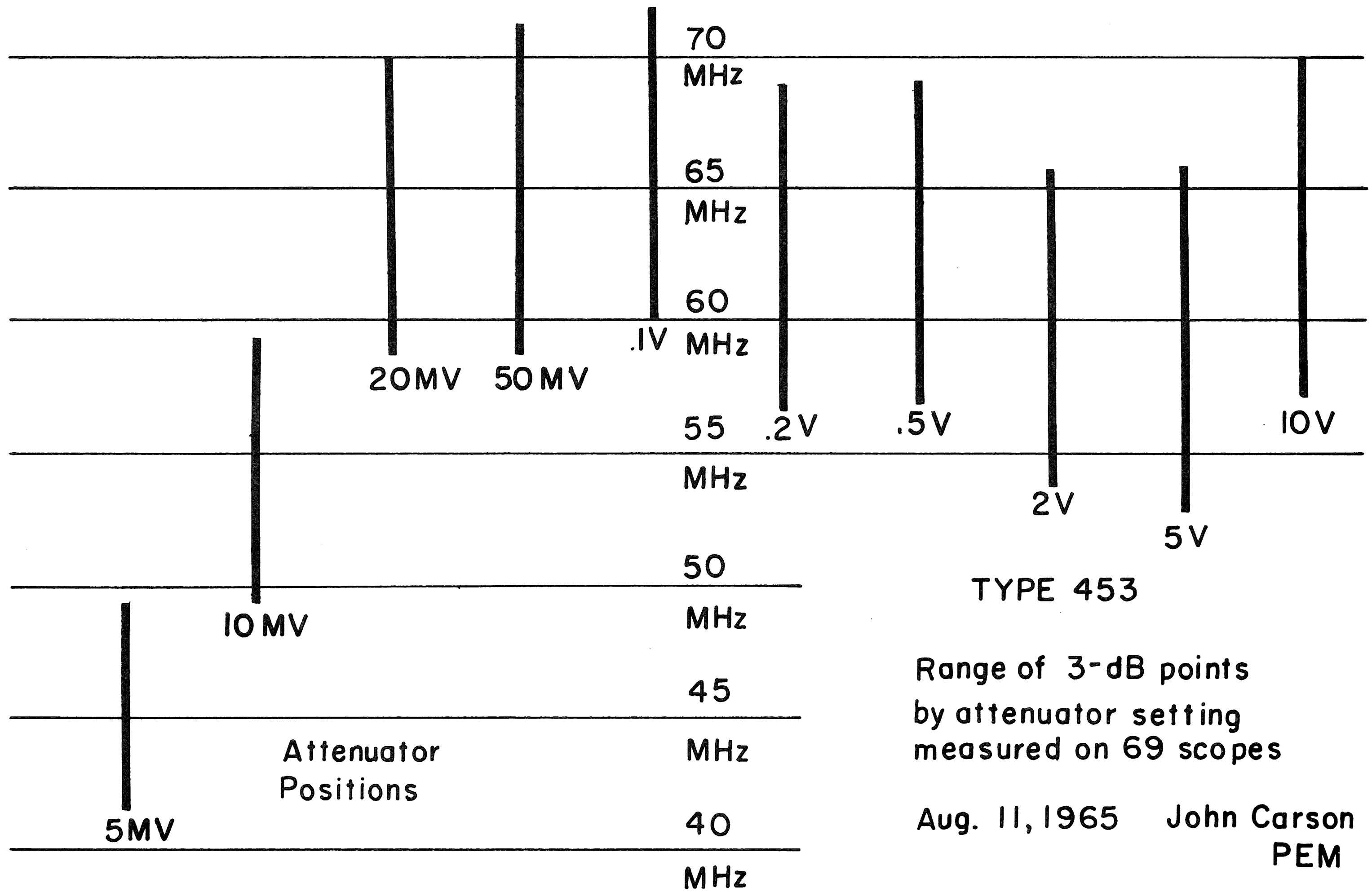
CH 2 5V/DIV



CH 1 10V/DIV



CH 2 10V/DIV



TYPE 453

Range of 3-dB points
by attenuator setting
measured on 69 scopes

Aug. 11, 1965 John Carson
PEM

DELAY TIME MULTIPLIER

Tony Bryan, 11-2-65

The "Delay Time Multiplier" has a CCW setting of 0.5 on the helidial. The CW end is 10.5 so that the coverage is a full 10 divisions. The reasons for starting at the 0.5 setting are two-fold.

1. So that there is always an intensified trace when the mode switch is placed in the "A Inten during B" position.
2. To prevent the "B" sweep from triggering on a small amount of ringing on the "A" sweep sawtooth when it returns to quiescent.

For these reasons, the dial is set at 0.5 and the "B" sweep start is set to coincide with the dial.

VERTICAL TRACE BOUNCE

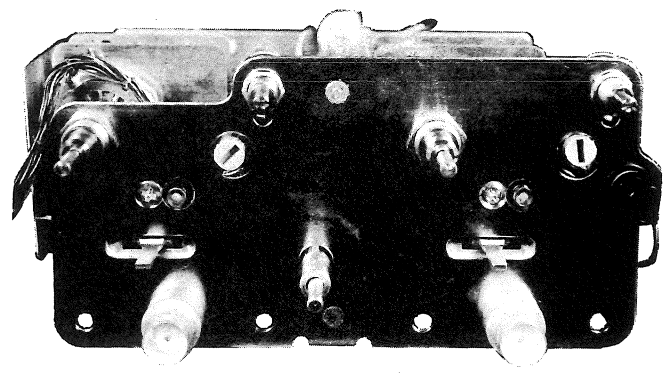
Tony Bryan, 11-29-65

R343 and R353 (267 ohm metal film) has exhibited some failures from one particular batch. Instruments to approximately S/N 500 may be suspect. At about that S/N, a new batch of resistors arrived and were used by production. The resistor will exhibit rather large changes in resistance by applying pressure to it, while measuring resistance.

VERTICAL POSITION POT REMOVAL

Tony Bryan, 12-6-65

A couple of Field Engineers have recently described their horrible experiences when trying to remove the vertical position pot by attempting to get at them after removing the front panel.



From the accompanying picture it will be seen that the input connectors, attenuators, and vertical position pots are secured to the bracket shown, which is a part of the attenuator-switch assembly. The attenuator shafts and vertical position pot shafts are then secured to the subpanel casting. To get to these components, it is important to remove the entire preamp assembly. The attenuator bracket is further fastened to the subpanel casting by four captive screws with lock washers and nuts from the back side. Note the four evenly spaced holes at the bottom of the bracket in the photo. Removing these fastenings, and the manual procedure for removing the preamp (page 4-3) should give you a complete vertical preamp assembly to work on. Do NOT remove the mode-trigger switch from the assembly as suggested in the manual procedure. Take out the whole thing as an assembly.

453 BOTTOM COVER FOOT ATTACHMENT

Dan Welch, 3-7-67

The problem of loose plastic feet was solved, effective SN 3260. The original assembly did not make use of a lock washer and the mounting screw (211-0504-00) often became free to cause damage inside the scope.

The problem was solved by adding a lockwasher (210-0055-00) between the plastic foot and the outer surface of the cabinet. To accommodate the addition of a washer a longer screw (211-0507-00) was required.

453 DELAY LINE SHORTS

Dan Welch, 4-27-67

Investigation of delay line failures at the plant has shown that the problem occurs just inside the ends of the outer shield and can usually be easily fixed. With a gentle unwinding motion pull out enough of both inner conductors to clear the short, then trim the excess and resolder.

A few delay lines were built using polyethylene to moisture seal the ends. These units cannot be repaired, so replacement is necessary.

About 22 inches of inner conductors are wound in each inch length of delay line. You may remove up to 10 inches of inner wire without changing the apparent delay or transient response.

The Teflon insulation on delay line wires is only 2 mils thick and is sometimes damaged during weaving or when the wires are pulled out of the finished assembly to form pigtails.

The line cannot be inspected for damage visually, once it is assembled. It is assumed that the delay line is satisfactory if it passes through the instrument test and calibration procedure. The insulation may break down later due to vibration and handling or if the wires are disturbed.

CRT FACE PLATE DISCOLORATION PROBLEMS

Nick Stadtfeld, 6-16-67

There have been several FEN articles on the CRT face-plate clouding and discoloration problems. This is an effort to consolidate and clarify them.

There are four different types of discoloration. Each has a slightly different cause and cure. All types are concerned with the silastic which is used to glue on the implosion shield.

1. TYPE DISCOLORATION

Fogging or milky white discoloration of the 647 CRT viewing area.

CAUSE

This fogging was caused by an incompatibility between the silastic which bonded the implosion shield to the face plate and the silastic which bonded a plastic mounting ring.

CURE

The problem was solved by using the same silastic for both gluing jobs. No more problems are anticipated.

2. TYPE DISCOLORATION

Fogging or milky white discoloration of 422 and 453 CRT.

CAUSE

This fogging was caused by discoloration of the silastic bonding material which glues the plastic implosion shield to the CRT face. The reaction in the silastic was caused by the four vinyl pads, which were used for CRT support near the face plate end of the tube. The rubber in the pad attacked the silastic.

CURE

This problem was cured by changing from the black vinyl pad to red silicone support cushions. The new pads are available through Mod #M9993.

3. TYPE DISCOLORATION

Browning or brown ring discoloration of the 561A, 581, 585, 581A, 585A, 555, 547 and 565. The browning or brown ring was also a discoloration of the silastic bonding material which glues the plastic implosion shield to the CRT face. The problem usually shows up after approximately six months to one year of use.

CAUSE

The silastic bonding material used for bond was affected by any rubber or rubber product nearby. Also some discoloration was caused by contaminents ingested during processing. The problem is thought to have multiple causes and all causes are not yet known.

CURE

A partial cure was obtained by changing the CRT rubber support pads to the four red silicone pads, Mod #M10946.

This problem is still under investigation. There is some chance that a CRT which has been repotted and placed in the scope with the new silicone pads will still develop a browning or brown rings.

CRT Production Engineering is investigating a protective seal for around the silastic. They are also looking into a new type of bonding material, possibly epoxy.

For a number of reasons, many CRT's are being converted from glass to ceramic envelopes. The new ceramic CRT's will not require the plastic implosion shield and thus will sidestep all possibility of each of the three types of discoloration discussed above.

CRT Face Plate Discoloration Problems - continued

4. <u>TYPE DISCOLORATION</u>

Yellow or yellowing of 453 CRT's. This has shown up in a limited number of instruments. Discoloration is rapid and develops much more quickly than the fogging or brown ring problems.

<u>CAUSE</u>

The yellowing was caused by a processing problem.

<u>CURE</u>

It was corrected by changing the process.

<u>FEEDBACK</u>

Any CRT which displays face plate discoloration should be reported via the failure card route. Pertinent information would be instrument type, serial number, date code on the CRT, type of discoloration and whether this problem appeared before or after the instrument was modified with red silicone support cushions. It was pointed out earlier that some CRT's which have been repotted and supplied with new cushions still develop discoloration. Information on these CRT's is particularly valuable.

<u>REPAIR</u>

If you decide to have a CRT repaired, the repair job can be done by returning the CRT to the CRT Quality Assurance Department. The implosion shield is removed and a new one glued on. The manufacturing cost is approximately $2.50 (shipping charges not included).

There have been some complaints from the field that the repair time is excessive. Typically, a CRT can be repotted in 48 hours, but shipping and handling time usually means that the total turnaround time, assuming air transportation, would be two weeks.

The turnaround time could be speeded up if the address label on the CRT box was marked with a "FOR REPAIR" or "REPOTTING" or "RUSH, CUSTOMER INSTRUMENT" or any such notation. This would alert the shipper, who sees hundreds of CRT's returned each week, and who can't easily determine which CRT's are for routine evaluation and which require speedy handling.

---

453 TIME/DIV WINDOW KNOB FAILURE

John Thompson, 8-28-67

There have been many reports of cracking in Window Knob Dial 331-0092-00. The crack is radial and always occurs slightly counterclockwise from the black reference lines. Cracked dials can rotate on their inserts and give erroneous TIME/DIV indications for A Sweep. The cause of the problem has been identified and corrected but many potential failures remain in the field.

This part is produced by an injection moulding process. Plastic material is introduced at one side of the annular mould and will divide into two streams which flow round the mould and meet opposite the injection gate. Incorrect temperature or pressure during this time will result in imperfect fusion of the two streams and a latent mechanical weakness at that point. This explains why cracks due to this cause always occur in the same place.

The problem was solved during July 1966 by tighter process control and a change of material from acrylic plastic to polycarbonate plastic, which is less susceptible to this trouble. The two materials are visually indistinguishable, the part number did not alter and no instrument serial number was assigned to the change. It was effective on the 453 at *approximate* SN 5500 and all replacement parts in Customer Service stock are now polycarbonate.

Not all of the 5000 or so acrylic dials in the field are necessarily defective. Mould temperature gradually stabilized as each batch was run and it is thought that only the first part of each batch may give trouble. The best estimates suggest that between 1000 and 2000 dials with latent weakness are presently with customers and it must be stressed that these are only potential failures. Cracking is not inevitable. These facts, plus the extreme difficulty of positively identifying weak dials, suggest the indiscriminate replacement would not be appropriate. However, in cases where a customer has already been inconvenienced by several failures you may want to consider replacement of other suspect specimens.

This part is also used on 3B1, 3B3, 11B2, 11B2A and 454 but of these only the 3B1, 3B3 and 11B2 were in production before the change to polycarbonate. Very few failures have in fact been reported on instruments other than the 453.

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422 AND 453 ACCESSORY COMPARTMENT LATCH ASSEMBLY REPLACEMENT

John Thompson, 10-6-67

Modification Instruction Sheets MI-11427 (422) and MI-11893 (453) describe the replacement of the old troublesome grommet-type latches by the improved version used on current instruments. It is necessary to convert the existing circular mounting holes to larger rectangular holes and a set of two Tektronix-manufactured chassis punches is required to do this.

The set of punches is identified by part no. 003-0506-00. They will be listed and priced in the NPR and are available for purchase by customers. However, a set of punches costs substantially more than a complete new cover assembly and purchase would only be appropriate if the customer has many instruments to modify. Also we would prefer not to have to manufacture large numbers of punches.

Customers with one or two instruments could have their covers modified at a Repair Center or else purchase new covers. Alternatively you may wish to modify covers yourself on site (should only take a few minutes) or to loan punches to the customer.

453 DELAY TIME MULTIPLIER REPLACEMENT

Rodney Reed, 5-9-68

Difficulty may be experienced when replacing the DTM potentiometer because of the special retaining nut used.

Wrench spanner 003-0409-00 listed in the Maintenance Hardware section of the Field Supplies and Equipment Manual, fits the nut. Replacement vernier-dial assemblies usually supply a similar "key-styled wrench" for the same special nut.

The wrench spanner will robably be useful for removing similar 10-turn potentiometers as used in the 454.

453-454 VERTICAL ATTENUATOR HOOK

Rodney Reed, 7-12-68

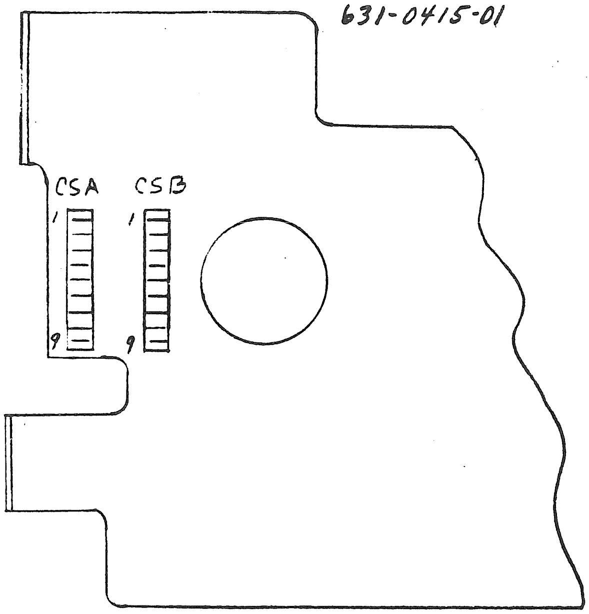
A recent batch of blue diallyl phthalate switches manufactured by Oak have been producing the well known "hook effect" as a result of surface contamination of the rotor, thought to be chloride in the form of calcium or sodium chloride.

Manufacturing removed the contamination, once the problem was discovered, by removing the preamplifier/attenuator assembly and washing the rotor under a jet of hot water at around 160°F. This remedy should also be satisfactory in the field.

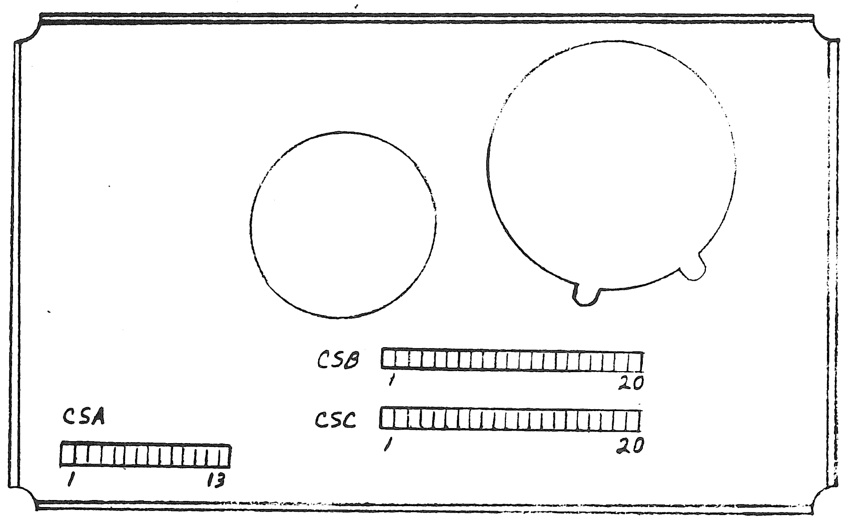
A suspect switch may be checked by measuring the insulation resistance between contacts on either side of the rotor or between the switch shaft and wiper contacts. Moisture, even from your breath, acting on the surface contamination will locate an affected switch by reducing the insulation resistance from the order of 100 MΩ to the 1 MΩ region.

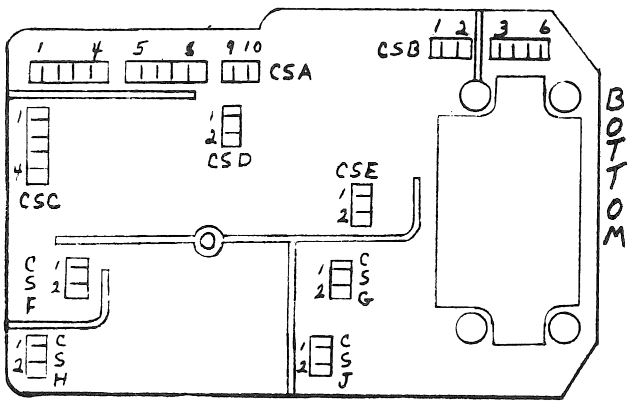
STRIP LAYOUT ~ 453/R 453-210H

CENTER SUPPORT PLATE
631-0415-01

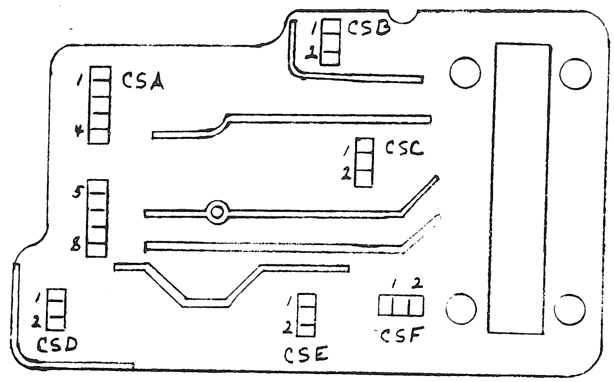


REAR BULKHEAD
631-0418-01

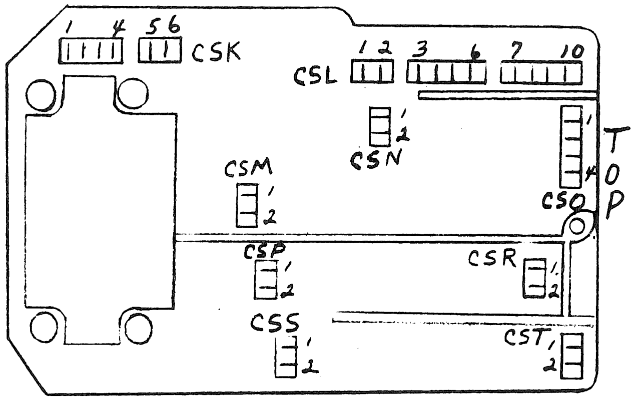




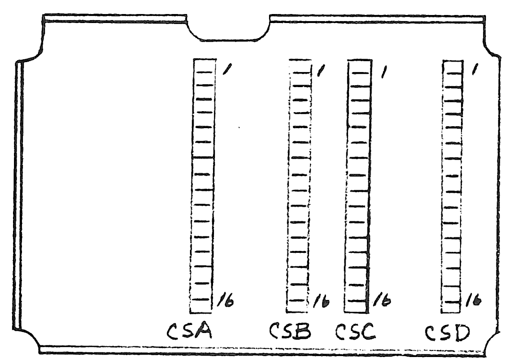
Upper H.V. Bd. ~ 621-0424-01



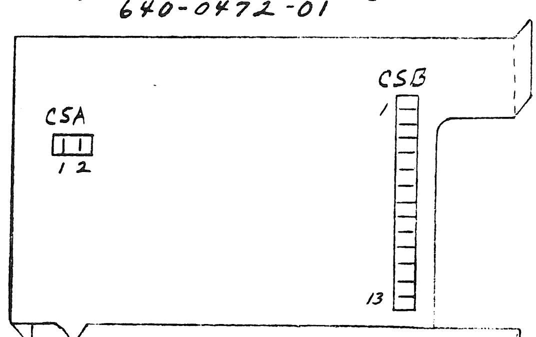
LOWER H.V. Bd.



Upper H.V. Bd.



Capacitor Mount'g Br'kt.
640-0472-01



Regulator Br'k't
640-0473-00

MOD #	correction	M11475	CORRECTION
DATE	1-12-66	6-13-67	8-22-67
KIT #	621-0424-00	ALL ~ EXCEPT #640-0473-00	621-0424-01

FACTORY TEST LIMITS

QUALIFICATION

Factory test limits are qualified by the conditions specified in the main body of the factory calibration procedure. Instruments may not meet factory test limits if calibration or checkout methods and test equipment differ substantially from those in the factory procedure.

These limits usually are tighter than advertised performance requirements, thus helping to insure the instrument will meet or be within advertised performance requirements after shipment and during subsequent recalibrations. Instruments that have left the factory may not meet factory test limits but should meet catalog or instruction manual performance requirements.

POWER SUPPLIES

-12 Volts:	±.02V, max
+12 Volts:	1V ±.002V, max
	12V -0 +.2V, max
+75 Volts:	±.2V, max
Ripple and regulation:	2mV, max
High:	103 to 137Vac
Low:	96 to 127Vac

HIGH VOLTAGE:

±1%, max

TRACE ALIGNMENT

TRACE ROTATION:	Range: 6°, min
Geometry:	.1 div, max

SCALE ILLUM

no illumination ccw
max illumination cw

STEP ATTEN BAL

+ and -5 div range from proper setting, min

BALANCE

VARIABLE balance:	±1 div of graticule center
CH 2 INVERT balance:	±1 div of graticule center

GAIN

CH 1 GAIN	Range: ±5%, min
CH 2 GAIN	Range: ±5%, min
ADD gain	±1%, max

VOLTS/DIV

VOLTS/DIV accuracy:	±2%, max
VARIABLE range:	2.5:1, min

COMPRESSION, EXPANSION

.1 div, max

ALTERNATE

All sweep rates

MICROPHONICS AND GRID CURRENT

a. Microphonics: 1 div, max; no ringing type
b. Grid current: .4 div, max

VOLTS/DIV COMPENSATION

CH 1 compensation:	±1%, max
CH 2 compensation:	±1%, max

HIGH FREQUENCY COMPENSATION

CH 1 20mV hf compensation: ±2%, max
CH 2 hf compensation: ±2%, max
CH 1 5mV and 10mV compensation: ±2%, max

TRANSIENT RESPONSE

Added mode transient response: ±6%, max
-Polarity transient response: ±2%, max
Positioning effect on transient response: ±5%, max
Attenuator transient response:

50mV to 2V:	±3%, max
5V and 10V:	±6%, max
Risetime:	6.6ns, max

Test Limits - continued

BANDPASS

20mV/DIV bandpass: ≥52.5MHz 30% down
10mV/DIV bandpass: ≥46.5MHz 30% down
5mV/DIV bandpass: ≥41MHz at 30% down
CH 2 bandpass: within 5MHz of CH 1 at 20mV
Added mode bandpass: ≥52.5MHz 30% down
CH 1 OUT to CH 2 bandpass: ≥25MHz at 30% down

VERTICAL POSITION RANGE

Position range: 13.5 to 16.5 div

COMMON MODE REJECTION RATIO

Common mode rejection ratio: ≥20:1 at 20MHz

TRIGGERING

Internal triggering:
.2 div at 10MHz
1 div at 50MHz
External triggering:
50mV at 10MHz
200mV at 50MHz
HF REJ: not triggered at 1MHz
SINGLE SWEEP: Same trigger level as NORM
LINE: correct polarity
LF REJECT: Not triggered at 60Hz

TRIGGERING LEVEL RANGE

EXT LEVEL range: + and - 2V, min
EXT ÷ 10 LEVEL range: + and - 20V, min

AUTO RECOVERY TIME

Recovery time: 50 to 100ms

DELAY TIME LINEARITY

±1.5 minor div, max

X10 MAG

Mag Gain: ±1%, max
Linearity: ±1%, max
Mag Regis: ±.1 div, max

SWEEP LENGTH

B sweep length: 11 ±.5 div
A sweep length: ≤4 div to 11 ±.5 div

VARIABLE RANGE

A VARIABLE range: 2.5:1, min
B VARIABLE range: 2.5:1, min

POSITION RANGE

X1 position range: ends of sweep to graticule center
X10 FINE range: 5 to 8 div

HIGH SPEED LINEARITY

.1 μSEC/DIV X10 MAG timing: ±3%, max

B SWEEP TIME/DIV

±2%, max

A SWEEP TIME/DIV

.1 μSEC to 1 μSEC/DIV: ±2%, max
1 μSEC to 50mSEC: ±1%, max
.1 SEC to 5 SEC: ±2%, max

DELAY TIME JITTER

.3 div, max

EXT HORIZ

deflection factor EXT:
270mV/div ±15%
EXT ÷ 10:
2.7V/div ±20%
bandpass: ≥5MHz at 30% down

Test Limits - continued

CHOPPED OPERATION

Chopped frequency: 500kHz ±20%

CALIBRATOR

Cal Freq:	1kHz ±.05%
Duty cycle:	50% ±1%
Risetime:	1μs, max
Voltage accuracy:	±.5%, max

Z AXIS

Sensitivity: 5V, min
max usable frequency: 50MHz, min

CH 1 OUT

Gain: 1mV/div, min

TRACE FINDER

trace must not position off graticule

A AND B GATES

A GATE:	12V ±5%
B GATE:	12V ±5%

HOLDOFF

.1μSEC to 5μSEC:	less than 2.5s
10, 20 and 50μSEC:	3.5-10μs
.1, .2 and .5mSEC:	3.5-100μs
1, 2 and 5mSEC:	3.5-1ms
10, 20 and 50mSEC:	3.5-10ms
.1 SEC to 5 SEC:	3.5-100ms

MOD KIT

MODIFICATION KIT

PORTABLE TO RACKMOUNT CONVERSION

For Tektronix Type 453 Oscilloscopes
Serial numbers 100-up

DESCRIPTION

This modification supplies the necessary mechanical components and hardware to construct an extremely solid and attractive frame which surrounds the instrument. The assembled frame permits rackmounting the 453 oscilloscope in a standard 19 in. open or closed relay rack on slide-out tracks.

The slide-out tracks used on the 453 consist of two assemblies, one each for the right and left sides. Each assembly consists of three sections. The stationary section attaches to the rack, the chassis section attaches to the surrounding instrument frame, and the intermediate section fits between the other two sections to allow the instrument to extend out of the rack.

Additional parts are included with this kit to provide rear support for the 453 rackmounted oscilloscope. NOTE: The Rear Support and Rackmounting installation instructions are included in the Manual insert section supplied with this kit.

When properly installed, the Rackmount Rear Support assembly permits the 453 to withstand an environmental shock of 30G's or vibration of 4G's. If the rackmounted 453 is not properly supported at the rear, then the instrument will not meet the given environmental characteristics.

The assembly of the frame which surrounds the instrument consists of: 1) removing the 453 from the cabinet, 2) moving the Calibrator Frame chassis to the Front Panel frame for easy access, and 3) assembling the Rackmount frame and support around the 453 oscilloscope.

040-0420-00

Publication:
Instructions for 040-0420-00
January 1966

RACKMOUNT CONVERSION PARTS LIST

Quantity		Description	Part Number
NOTE:		Part number 351-0104-00 consists of both the left and right slide-out chassis tracks with included hardware (see * below).	
1 ea		Assembly, casting, left support, consisting of:	
	3 ea	Screw, 6-32 x 3/16 PHS	211-0503-00
	1 ea	Track, chassis, left side only	*351-0104-00
	1 ea	Plate, shield	386-1059-00
	1 ea	Support casting, left	426-0291-01
1 ea		Assembly, frame, front rack, consisting of:	
	4 ea	Plug, "D" hole	134-0067-00
	4 ea	Screw, 10-32 x 1/2 Hex Head	213-0090-00
	2 ea	Handle	367-0022-00
	1 ea	Frame, front rack	426-0297-00
1 ea		Assembly, plate, rear, consisting of:	
	4 ea	Screw, 8-32 x 1/2 PHS	212-0008-00
	1 ea	Plate, rear	386-1065-00
	2 ea	Plate, retaining shaft	386-1066-00
1 ea		Assembly, plate, rack, right side, consisting of:	
	1 ea	Nut, Keps, 6-32 x 5/16	210-0457-00
	1 ea	Washer, brass, centering	210-0808-00
	1 ea	Screw, 6-32 x 5/16 PHS	211-0507-00
	1 ea	Track, chassis, right side only	*351-0104-00
	1 ea	Plate, rack, right side	386-1064-00
1 ea		Cover, instrument rack, top	200-0667-00
1 ea		Cover, instrument rack, bottom	200-0668-00
6 ea		Nut, Keps, 8-32 x 11/32	210-0458-00
2 ea		Screw, 6-32 x 3/16 FHS	211-0502-00
3 ea		Screw, 6-32 x 3/16 PHS	211-0503-00
1 ea		Screw, 6-32 x 5/16 PHS	211-0507-00
4 ea		Screw, 8-32 x 1/4 PHS	212-0001-00
2 ea		Screw, 8-32 x 1/4 FHS	212-0002-00
4 ea		Screw, 8-32 x 5/8 PHS	212-0010-00
1 ea		Screw, 8-32 x 3/8 PHS	212-0023-00
9 ea		Screw, 8-32 x 3/8 FHS	212-0040-00
4 ea		Screw, 8-32 x 1/2 FHS	212-0043-00
2 ea		Screw, 1/4-20 x 3/4 Allen socket head	213-0129-00
1 ea		Bushing, plastic molded, horseshoe	358-0215-00
2 ea		Spacer, stepped	361-0120-00
1 ea		Plate, hinge	386-1061-00
1 ea		Plate, frame panel backing, bottom	386-1062-00
1 ea		Plate, frame panel backing, top	386-1063-00
1 ea		Support casting, right	426-0291-02

RELAY RACK AND REAR SUPPORT PARTS LIST

Quantity	Description	Part Number
2 ea	Lockwasher, int 1/4	210-0011-00
4 ea	Washer, steel, flat #8	210-0804-00
4 ea	Washer, steel, flat #10	210-0805-00
4 ea	Washer, 0.264 ID x 1-1/8 OD x 0.1106	210-0866-00
2 ea	Washer, support, neoprene	210-0984-00
2 ea	Washer, flat, 7/8 OD x 0.512 ID x 0.054	210-0985-00
4 ea	Screw, 10-32 x 1-1/4 Hex Head	212-0520-00
2 ea	Screw, 1/4-20 x 3/4 Hex Head	213-0134-00
2 ea	Pin, support	214-0502-00
4 ea	Nut, Keps, 10-32 x 3/8	220-0410-00
1 ea	Track, chassis, left and right stationary section w/intermediate, 18 in.	351-0101-00
2 ea	Spacer, block	361-0119-00
2 ea	Bracket, angle support	407-0073-00

INSTRUCTIONS

REFER TO THE "FIG. 1 EXPLODED VIEW" FOLD-OUT DRAWING, LOCATED IN THE MANUAL INSERT RACKMOUNTING INFORMATION SECTION SUPPLIED WITH THIS KIT, WHILE PERFORMING THE FOLLOWING STEPS.

NOTE: It is important that all mechanical components and hardware be saved for future use, especially if the instrument is re-assembled into its original cabinet.

SEE FIG 1 FOR STEPS 1-5.

( ) 1. Remove the front cover assembly from the front of the instrument.

( ) 2. Remove the blue handle covers from the left and right sides of the instrument handle by prying up the corners of the open section.

( ) 3. Remove the cabinet top and bottom from the instrument by loosening the left and right cabinet latch screws.

( ) 4. Re-tighten the left and right cabinet latch screws and remove the "C" retaining rings.

( ) 5. Remove the left and right cabinet latch screws from their respective rail frames.

( ) Re-install the "C" retaining rings on the cabinet latch screws, for future re-use.

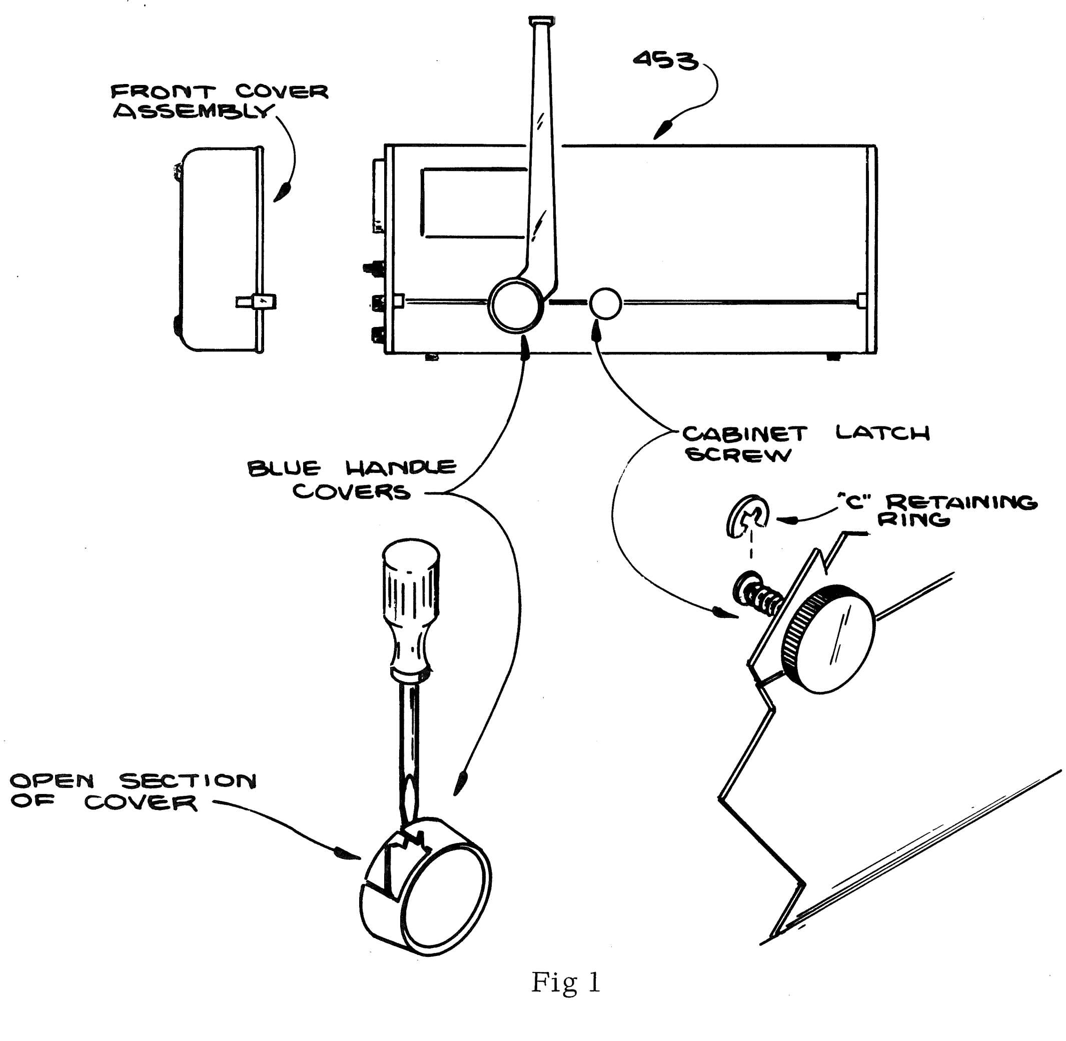


Fig 1

INSTRUCTIONS (con'd)

SEE FIG 2 FOR STEPS 6-9

( ) 6. Remove the two socket head Allen screws (save) which secure the handle to the left and right rail frames, and remove the handle from the instrument.

( ) 7. Remove the captive screw, nylon washer, and "C" retaining ring which fasten the calibrator frame chassis to the outer support bracket.

( ) 8. Remove the cable clamp which secures the calibrator frame chassis cable to the right rail frame.

( ) 9. Remove the "C" retaining ring and the hinge pin which secure the calibrator frame chassis to the front plate (save hinge pin and retaining ring).

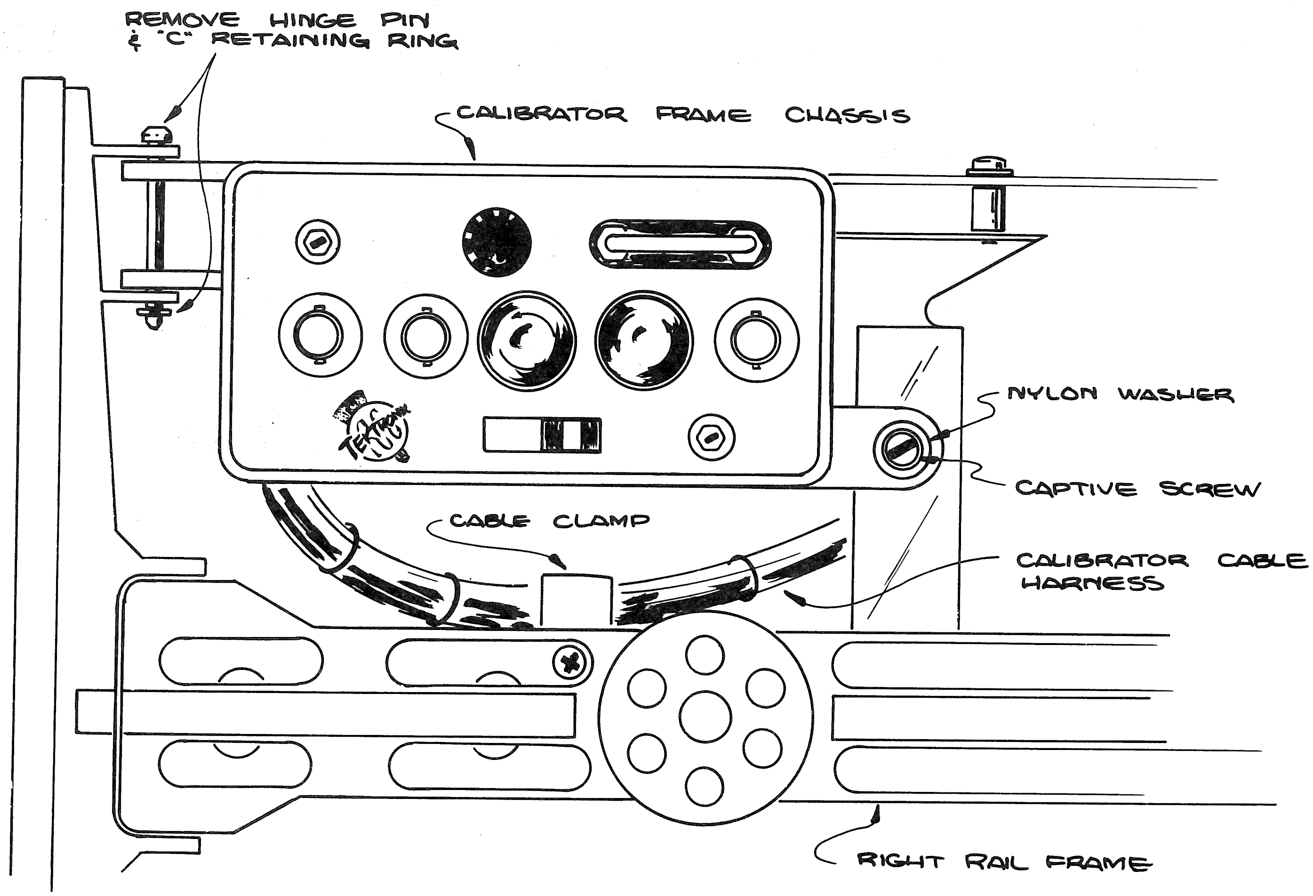


Fig 2

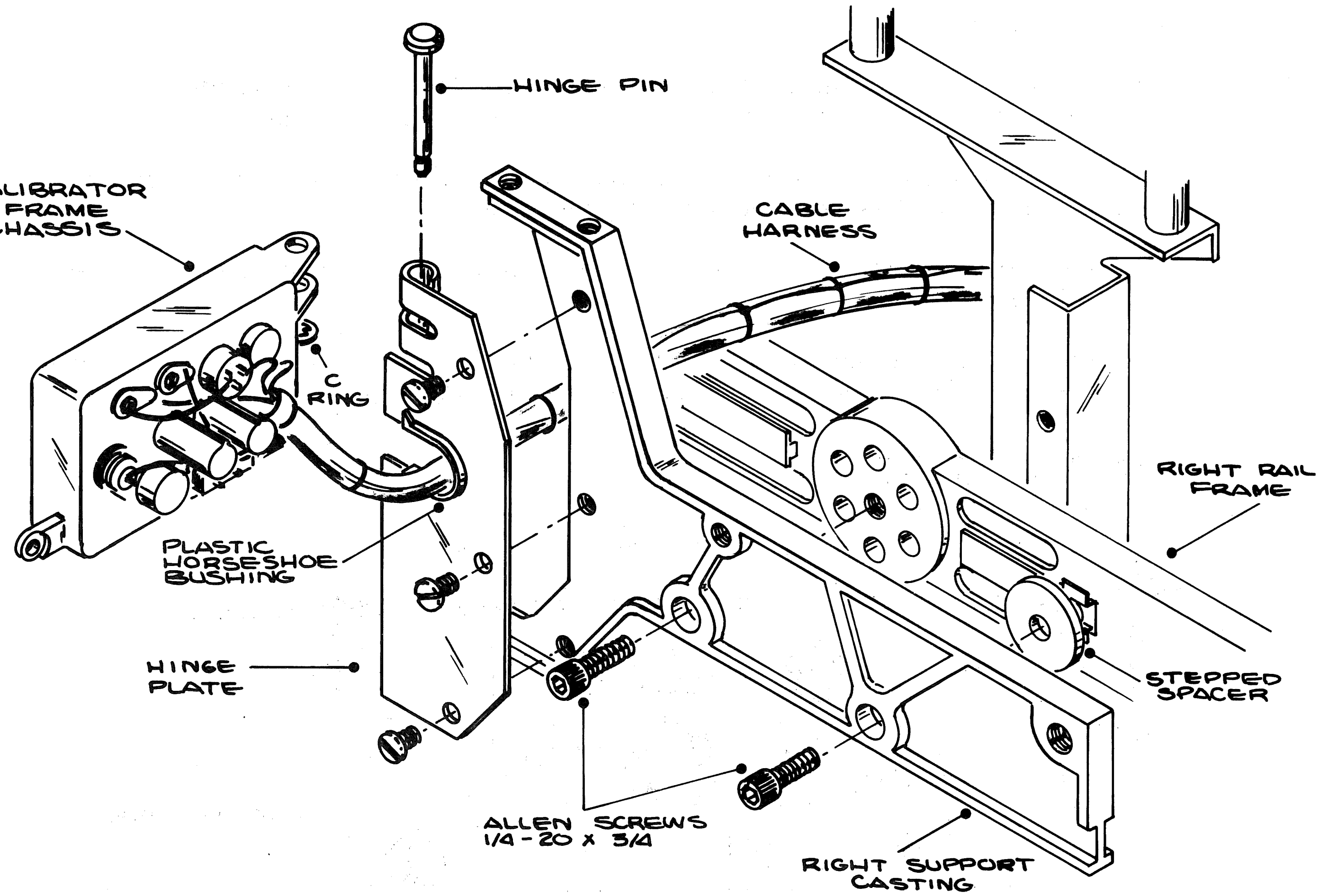

HINGE PIN
CALIBRATOR FRAME CHASSIS
CABLE HARNESS
C RING
RIGHT RAIL FRAME
PLASTIC HORSESHOE BUSHING
HINGE PLATE
STEPPED SPACER
ALLEN SCREWS 1/4 - 20 x 3/4
RIGHT SUPPORT CASTING

Fig 3

INSTRUCTIONS (con'd)

SEE FIG 3 FOR STEPS 10-15

( ) 10. Place the plastic horseshoe bushing (from kit) in the hinge plate from the kit.

( ) 11. Dress the calibrator frame chassis cable into the hinge plate horseshoe bushing.

( ) 12. Position the two calibrator frame chassis ears into the hinge plate and fasten together, using the hinge pin and "C" ring removed in step 9.

( ) 13. Secure the hinge plate to the right support casting (from kit), using three 6-32 x 3/16 PHS screws from the kit.

( ) 14. Place a stepped spacer (from kit) between the right rail frame and the right support casting, indented portion of spacer toward the frame, and secure the support casting to the rail frame with the two socket head Allen screws, removed in step 6.

( ) 15. Place a stepped spacer (from kit) between the left instrument rail frame and the left support casting assembly (from kit), indented portion of spacer toward rail frame, and secure the support casting to the rail frame with two 1/4-20 x 3/4 Allen screws from the kit.

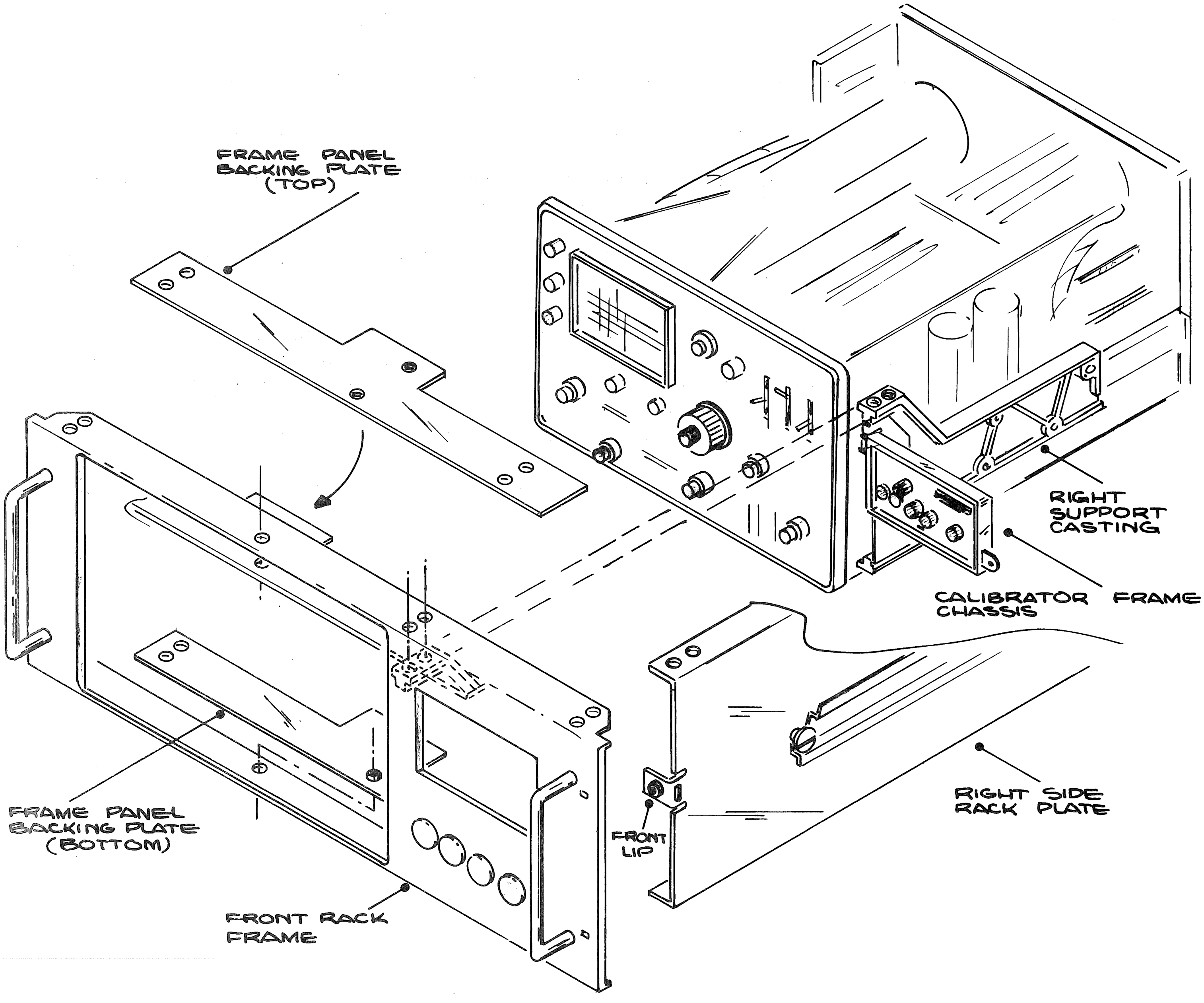


Fig 4

SEE FIG 4 FOR STEPS 16-32

( ) 16. Position the front rack frame assembly (from kit) over the front panel of the instrument.

( ) 17. Insert the top frame panel backing plate (from kit) between the top of the instrument and the top of the front rack frame.

( ) 18. Fasten the top of the front rack frame to the left and right support castings, using four 8-32 x 3/8 FHS screws from the kit.

( ) 19. Install an 8-32 x 1/4 FHS screw in the front rack frame hole between the left and right support casting holes.

INSTRUCTIONS (con'd)

( ) 20. Remove the four rear instrument feet.

( ) 21. Install the rear plate assembly (from kit) to the rear of the instrument, using four 8-32 x 5/8 PHS screws (from kit) through the four rear foot holes.

( ) 22. Position the right side rack plate assembly (from kit) so that its front lip is between the front rack frame and the calibrator frame chassis. Secure calibrator chassis to front lip with a 6-32 x 5/16 PHS screw from the kit.

( ) 23. Secure the top of the right side rack plate to the front rack frame, using two 8-32 x 1/2 FHS screws and #8 Keps nuts from the kit.

( ) 24. Secure the rear of the right side rack plate to the rear plate, using the 8-32 x 3/8 PHS and 8-32 x 3/8 FHS screws and two #8 Keps nuts from the kit.

( ) 25. Turn instrument upside down.

( ) 26. Insert the bottom frame panel backing plate (from kit) between the bottom of the instrument and the bottom of the front rack frame.

( ) 27. Fasten the bottom of the front rack frame to the left and right support castings, using four 8-32 x 3/8 FHS screws from the kit.

( ) 28. Install an 8-32 x 1/4 FHS screw in the front rack frame hole between the left and right support casting holes.

( ) 29. Secure the bottom of the right side rack plate to the front frame rack, using two 8-32 x 1/2 FHS screws and #8 Keps nuts from the kit.

( ) 30. Install the bottom instrument rack cover (from kit) fastening it as follows:
( ) Install a 6-32 x 3/16 FHS screw in the bottom frame panel backing plate.
( ) Install two 8-32 x 1/4 PHS screws into the left and right support castings.

( ) 31. Turn instrument right side up.

( ) 32. Install the top instrument rack cover (from kit), fastening it as follows:
( ) Install a 6-32 x 3/16 FHS screw in the top frame panel backing plate.
( ) Install two 8-32 x 1/4 PHS screws into the left and right support castings.

THIS COMPLETES THE INSTALLATION.

( ) Fasten the Manual insert section in the front of your Manual.

NOTE: SEE THE R453 MANUAL INSERT SECTION FOR RELAY RACK AND REAR SUPPORT INSTALLATION INSTRUCTIONS.

JB:cet

TYPE R453 RACKMOUNTING

Introduction

The Tektronix Type R453 Oscilloscope is a standard Tektronix Type 453 adapted for mounting in a standard 19-inch rack. This rackmounting information is provided to supplement the information given in the Type 453 Instruction Manual.

Characteristics

Electrical. Electrical characteristics of the Type R453 are the same as those given in Section 1 of the Type 453 Instruction Manual.

Environmental. The Type R453 will meet all environmental characteristics listed in the Type 453 Instruction Manual, except temperature, when mounted as described in this procedure. Maximum continuous operating temperature range is —15°C to +45°C.

Rack Dimensions

Width. Minimum width of the opening between the left and right front rails of the rack must be 17.625 inches. This allows room on each side of the instrument for the slideout tracks to operate freely, permitting the instrument to move smoothly in and out of the rack.

Depth. Total depth necessary to mount the Type R453 in a cabinet rack is 18 inches. This allows room for air circulation, power cord connections and the necessary mounting hardware.

Slideout Tracks

Fig. 2 shows the Type R453 installed in a cabinet-type rack. The slideout tracks provided with the Type R453 permit it to be extended out of the rack for maintenance or calibration without removing the instrument from the rack. In the fully extended position, the Type R453 can be tilted up so the bottom of the instrument can be reached for maintenance or calibration. To operate the Type R453 in the extended position, be sure the power cord and any interconnecting cables are long enough for this purpose. When not extended, the instrument is held in the rack with four securing screws (see Fig. 2A).

The slideout tracks consist of two assemblies—one for the left side of the instrument and one for the right side. Fig. 3 shows the complete slideout track assemblies. The stationary section of each assembly attaches to the front and rear rails of the rack, and the chassis section is attached to the instrument. The intermediate section slides between the stationary and chassis sections and allows the Type R453 to be extended out of the rack. When the instrument is shipped, the stationary and intermediate sections of the tracks are packaged as matched sets and should not be separated. To identify the left or right assembly, note the position of the automatic latch (see Fig. 3). When mounted in the rack, the automatic latch should be at the top of both assemblies. The chassis sections are installed on the instrument at the factory.

The hardware provided for mounting the slideout tracks is shown in Fig. 4. Since the hardware is intended to make the tracks compatible with a variety of cabinet racks and installation methods, not all of it will be needed for this installation. Use only the hardware that is required for the mounting method used.

Mounting Procedure

The following mounting procedure uses the rear support kit (see Fig. 5) to meet the environmental characteristics of the instrument (shock and vibration). Two alternative mounting methods are described at the end of this procedure. However, when mounted according to these alternative methods, the instrument will not meet the given environmental characteristics.

The front flanges of the stationary sections may be mounted in front of or behind the front rails of the rack, depending on the type of rack. If the front rails of the rack **are** tapped for 10-32 screws, the front flanges are mounted in front of the rails. If the front rails of the rack **are not** tapped for 10-32 screws, the front flanges are mounted behind the front rail and a bar nut is used. Fig. 6 shows these methods of mounting the stationary sections.

The rear of the stationary sections must be firmly supported to provide a shock-mounted installation. This rear support must be located 17.471 inches, ±0.031 inches, from the **front surface** of the front rail when the front flange is mounted **in front of** the rail, or 17.531 inches, ±0.031 inches, from the **rear surface** of the front rail when the front flange is mounted **behind** the front rail. If the cabinet rack does not have a strong supporting member located the correct distance from the front rail, an additional support must be added. The instrument **will not** meet the environmental specifications unless firmly supported at this point. Fig. 7 illustrates a typical rear installation using the rear support kit and gives the necessary dimensions.

Use the following procedure to install the Type R453 in a rack:

1. Select the proper front-rail mounting holes for the stationary sections using the measurements shown in Fig. 8.

2a. If the front flanges of the stationary sections are to be mounted in front of the front rails (rails **tapped** for 10-32 screws), mount each stationary section as shown in Fig. 6A.

2b. If the front flanges of the stationary sections are to be mounted behind the front rails (rails **not tapped** for 10-32 screws), mount each stationary section as shown in Fig. 6B.

3. Attach an angle bracket to both rear rails of the rack through the spacer block, stationary section and into the

rear rail of the rack. Note that the holes in the spacer block are not centered. Be sure to mount the block with the narrow edge toward the front of the rack; otherwise, the instrument may not slide all the way into the rack. Do not tighten the mounting screws. Fig. 5 shows the parts in the rear support kit and the order in which they are assembled.

4. Assemble the support pin to the angle bracket in the order shown in Fig. 5. Leave the spacer (washer) off, but install the neoprene washer.

5. Refer to Fig. 10 to insert the instrument into the rack. Do not connect the power cord or install the securing screws until all adjustments have been made.

6. With the instrument pushed all the way into the rack, adjust the angle brackets so the neoprene washers on the support pins are seated firmly against the rear of the instrument and the support pins are correctly positioned in the support block on the rear of the instrument. Tighten all screws.

7. Pull the instrument partially out of the rack.

8. Remove the neoprene washers from the support pins and place the spacers on the pins. Replace the neoprene washers.

9. Position the instrument so the pivot screws (widest part of instrument) are approximately even with the front rails.

10. Adjust the alignment of the stationary sections according to the procedure outlined in Fig. 9. (If the rear alignment is changed, recheck the rear support pins for correct alignment.)

11. After the tracks operate smoothly, connect the power cord to the connector on the rear panel.

12. Push the instrument all the way into the rack and secure it to the rack with the securing screws and washers as shown in Fig. 10C.

NOTE

The securing screws are an important part of the shock-mounted installation. If the front rails are not tapped for the 10-32 securing screws, other means must be provided for securing the instrument to the rack.

Alternative Rear Mounting Methods

CAUTION

Although the following methods provide satisfactory mounting under normal conditions, they do not support the rear of the instrument correctly. If the instrument is subjected to severe shock or vibration when mounted using the following methods, it may be damaged.

An alternative method of supporting the rear of the instrument is shown in Fig. 11. The rear support brackets supplied with the instrument allow it to be mounted in a rack which has a spacing between the front and rear rails of 11 inches and 24 inches. Fig. 11A illustrates the mounting method if the rear rails **are** tapped for 10-32 screws, and Fig. 11B illustrates the mounting method if the rear rails **are not** tapped for 10-32 screws. The rear support kit is not used for this installation.

If the rack does not have a rear rail, or if the distance between the front and rear rails is too large, the instrument may be mounted without the use of the slideout tracks. Fasten the instrument to the front rails of the rack with the securing screws and washers. This mounting method should be used only if the instrument will not be subjected to shock or vibration and if it is installed in a stationary location.

Removing or Installing the Instrument

After initial installation and adjustment of the slideout tracks, the Type R453 can be removed or installed by following the instructions given in Fig. 10. No further adjustments are required under normal conditions.

Slideout Track Lubrication

The slideout tracks normally require no lubrication. The special finish on the sliding surfaces provides permanent lubrication. However, if the tracks do not slide smoothly even after proper adjustment, a thin coating of paraffin may be rubbed onto the sliding surfaces for additional lubrication.

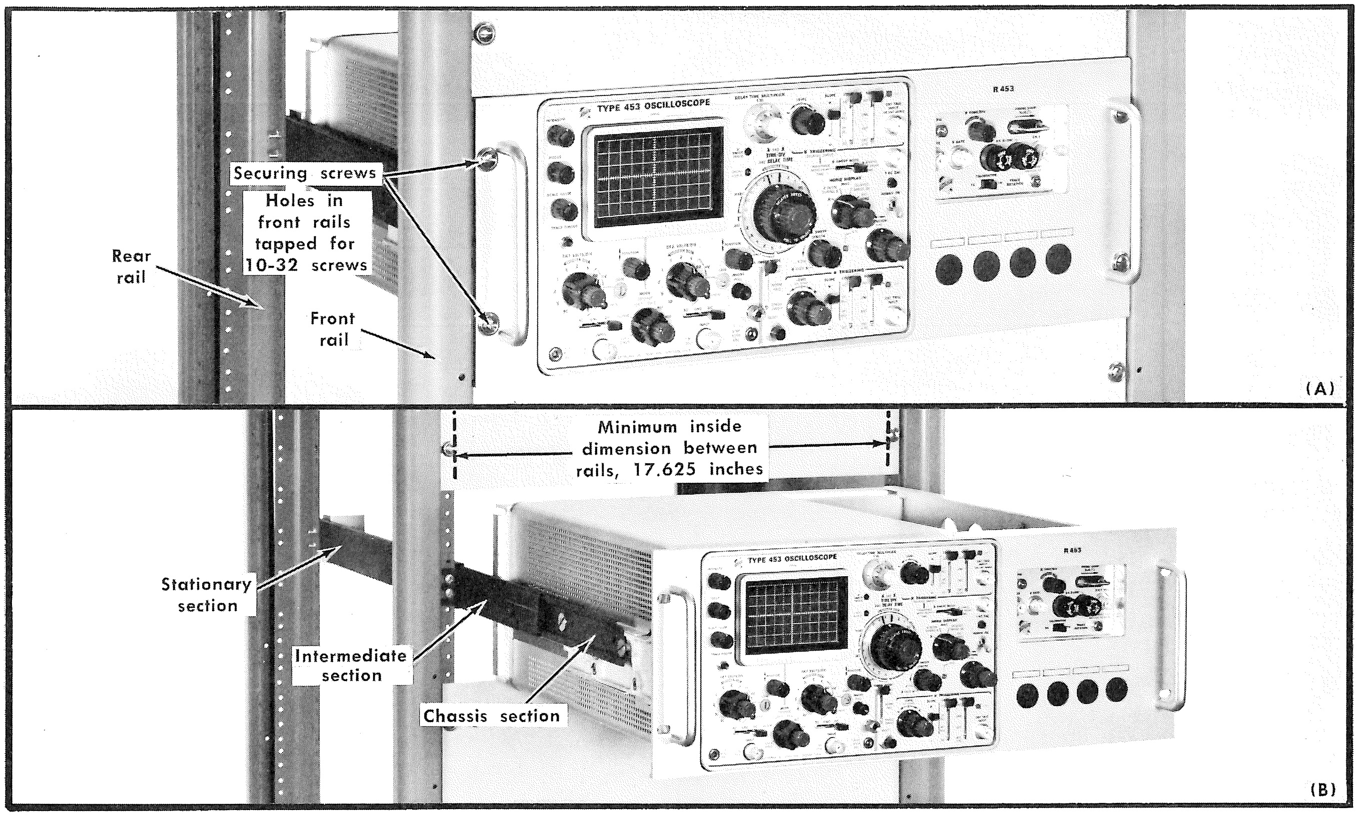


Fig. 2. The Type R453 installed in a cabinet rack (sides removed): (A) Held into rack with securing screws; (B) extended on slideout tracks.

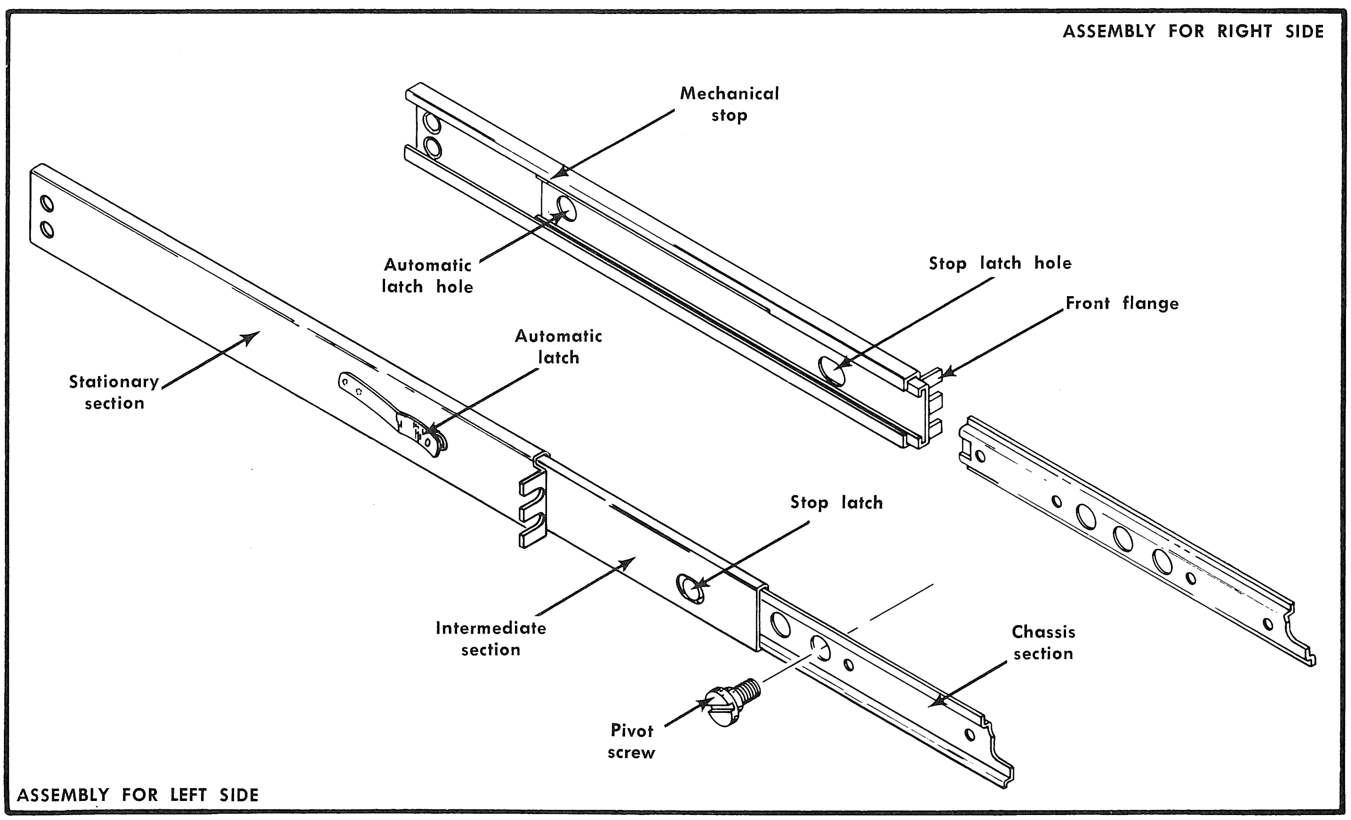


Fig. 3. Slideout track assemblies.

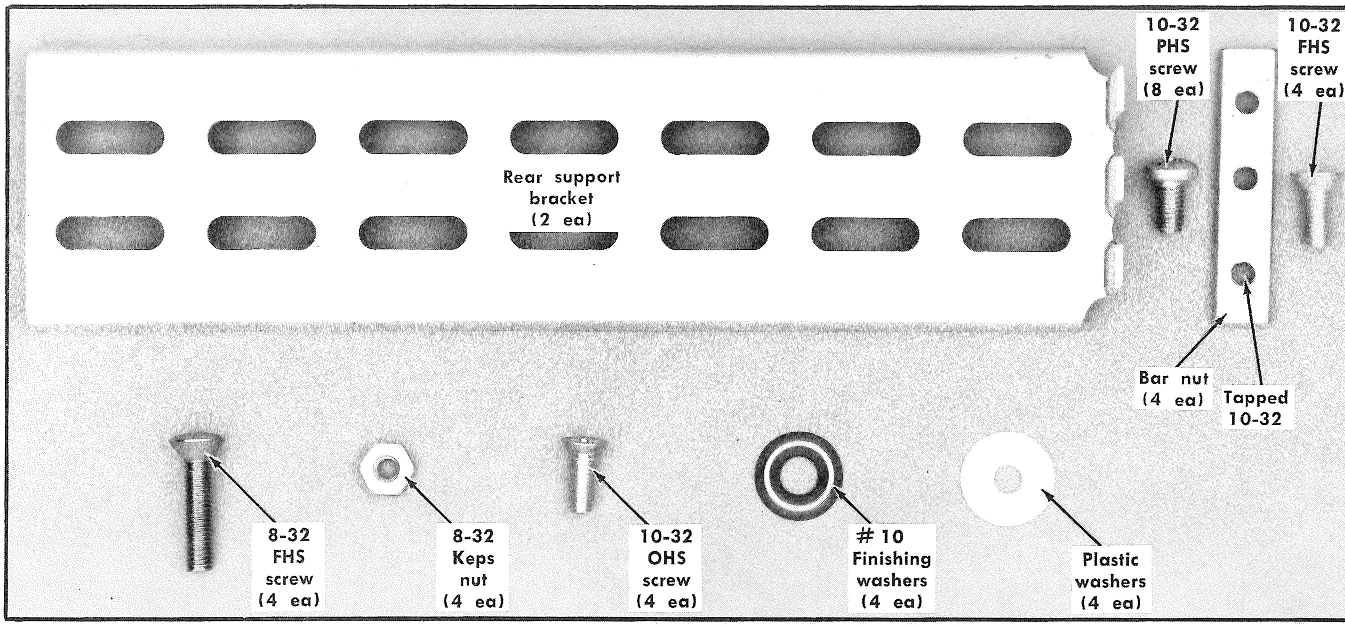


Fig. 4. Hardware provided for mounting the instrument in the cabinet rack.

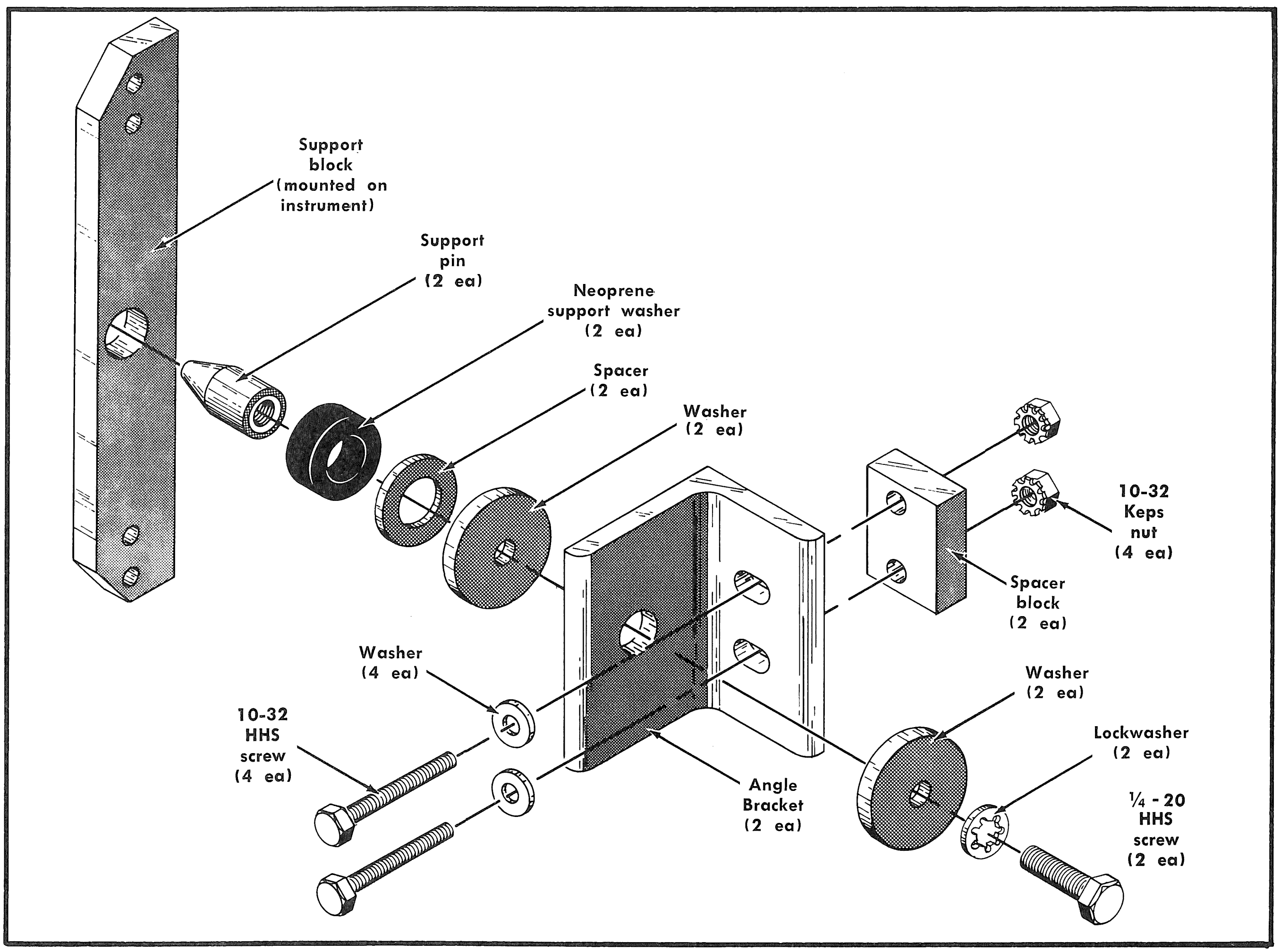


Fig. 5. Rear support kit.

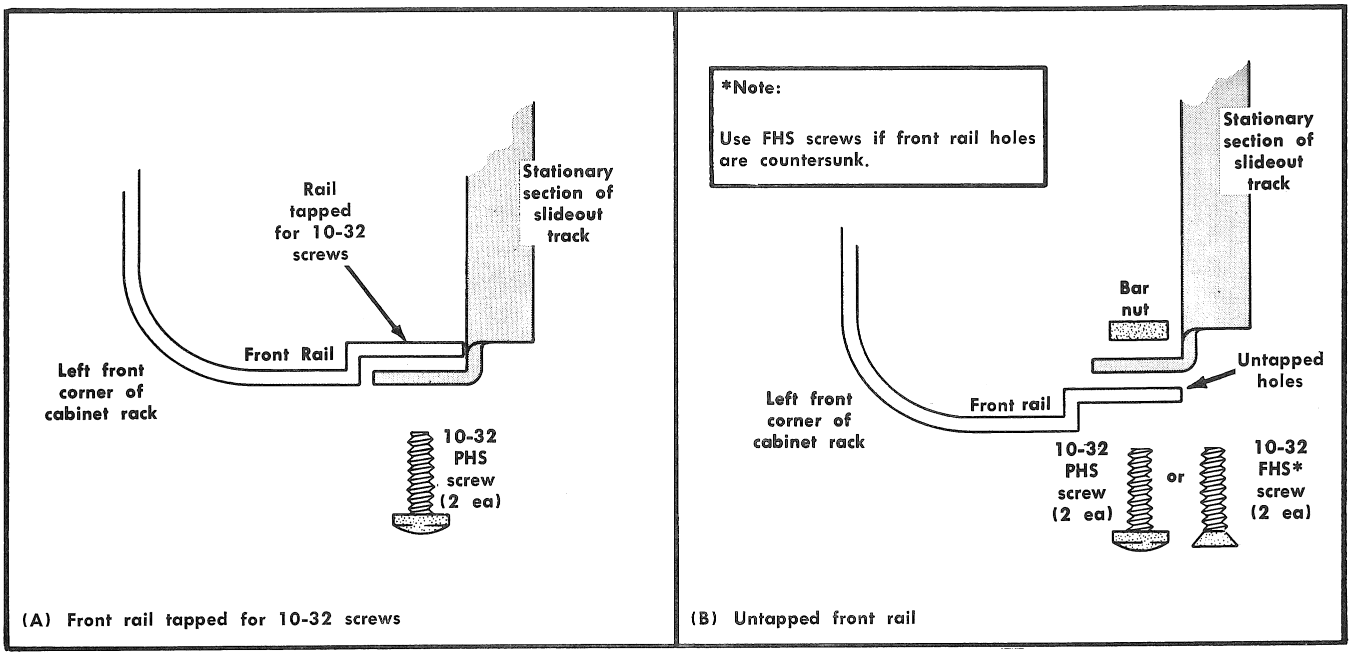


Fig. 6. Methods of mounting the stationary section to the front rails.

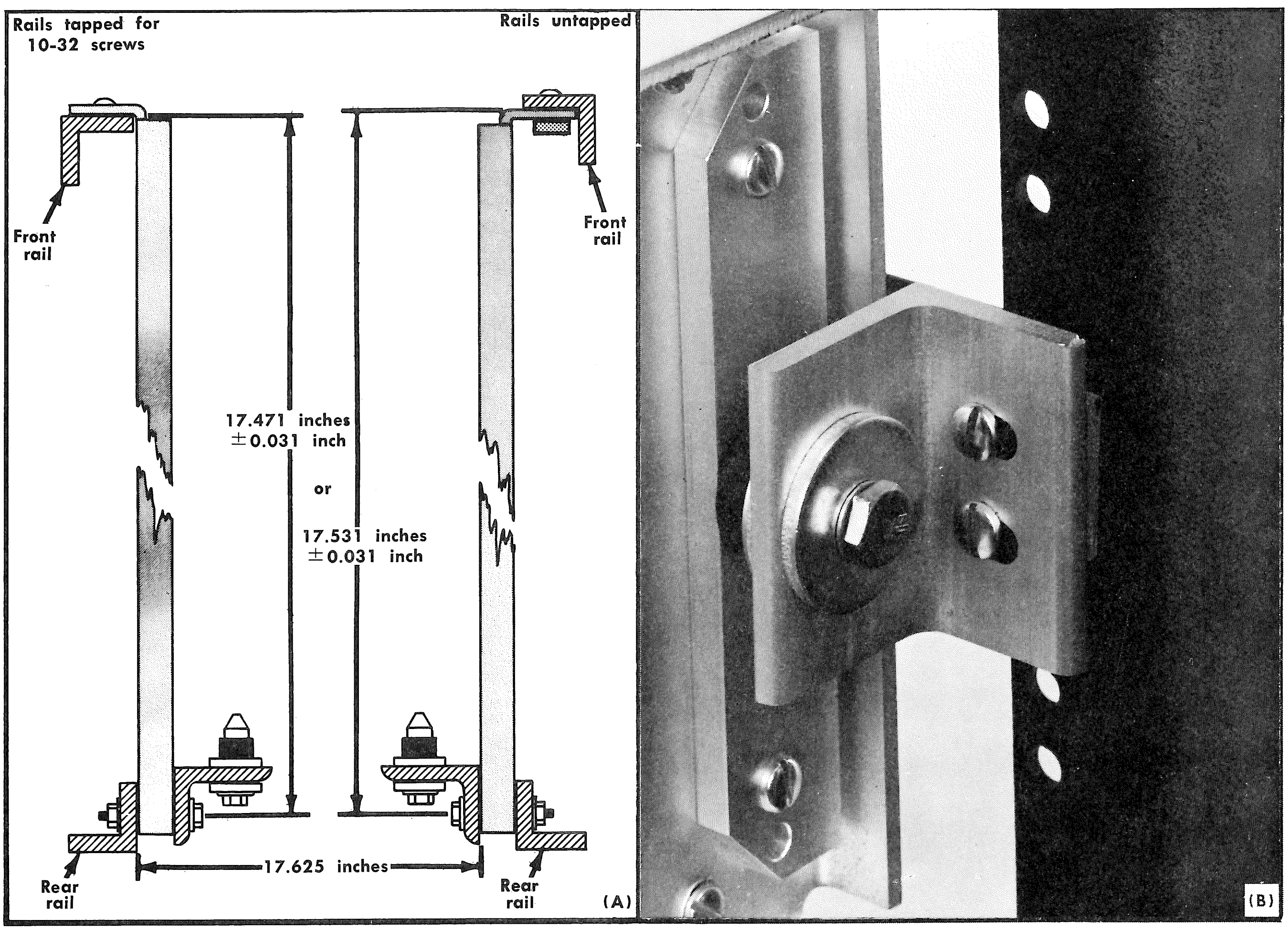


Fig. 7. Supporting the rear of the stationary sections: (A) Dimensions necessary; (B) completed installation.

TO ADJUST ALIGNMENT:

1. Position the instrument with the pivot screws approximately even with the front rails.
2. Loosen the mounting screws at the front of both stationary sections (left side shown).
3. Allow the tracks to seek their normal positions with the instrument centered in the rack.
4. Tighten the mounting screws.
5. Push the instrument all the way into the rack. If tracks do not slide smoothly, check for correct spacing between the rear supports.
6. Check the vertical positioning of the Type R453 front panel with respect to adjacent instruments or panels. If not correct, reposition as necessary.

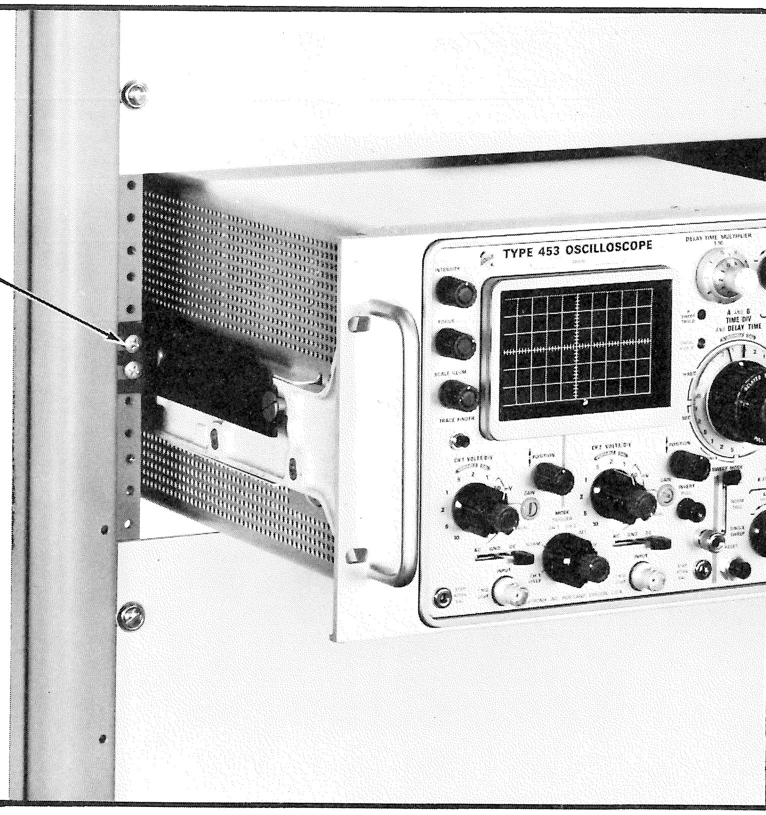


Fig. 8. Locating the mounting holes for the left stationary section. Same dimensions apply to right stationary section.

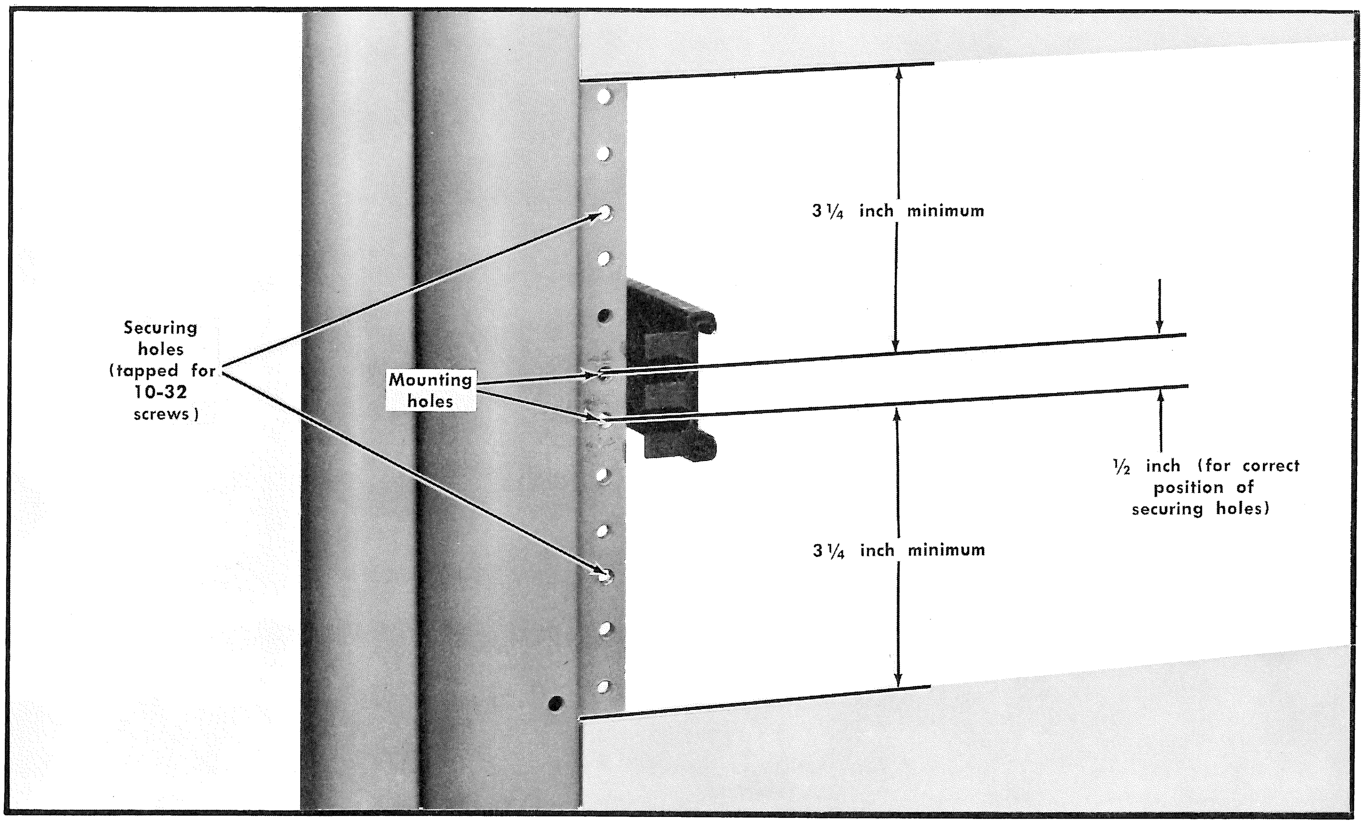


Fig. 9. Alignment adjustments for correct operation.

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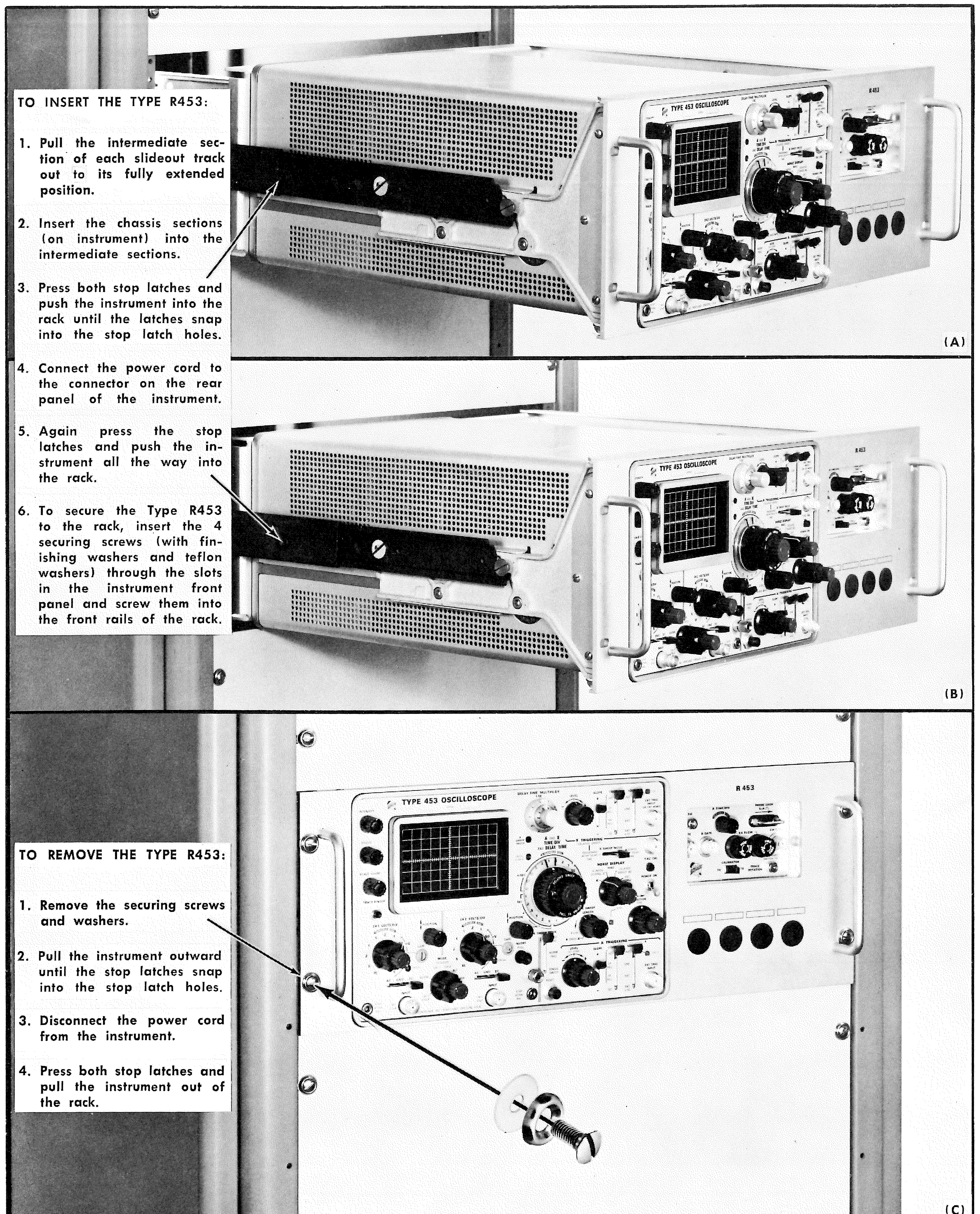

Fig. 10. Procedure for inserting or removing the instrument after the slideout tracks have been installed.

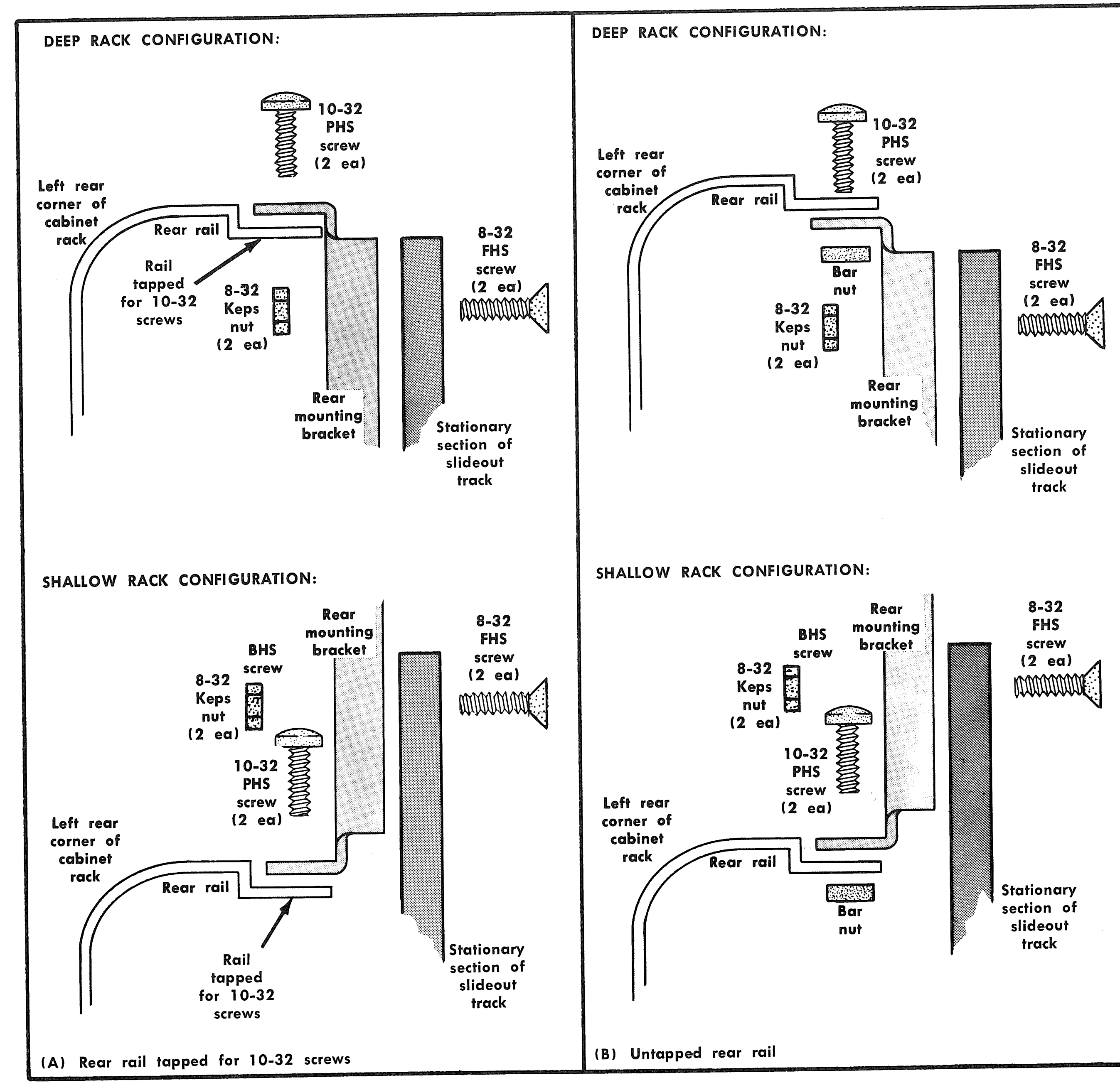

Fig. 11. Alternative method of installing the instrument using rear support brackets.

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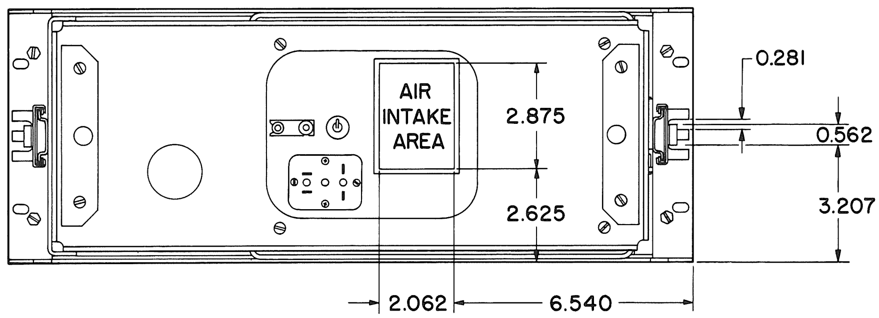
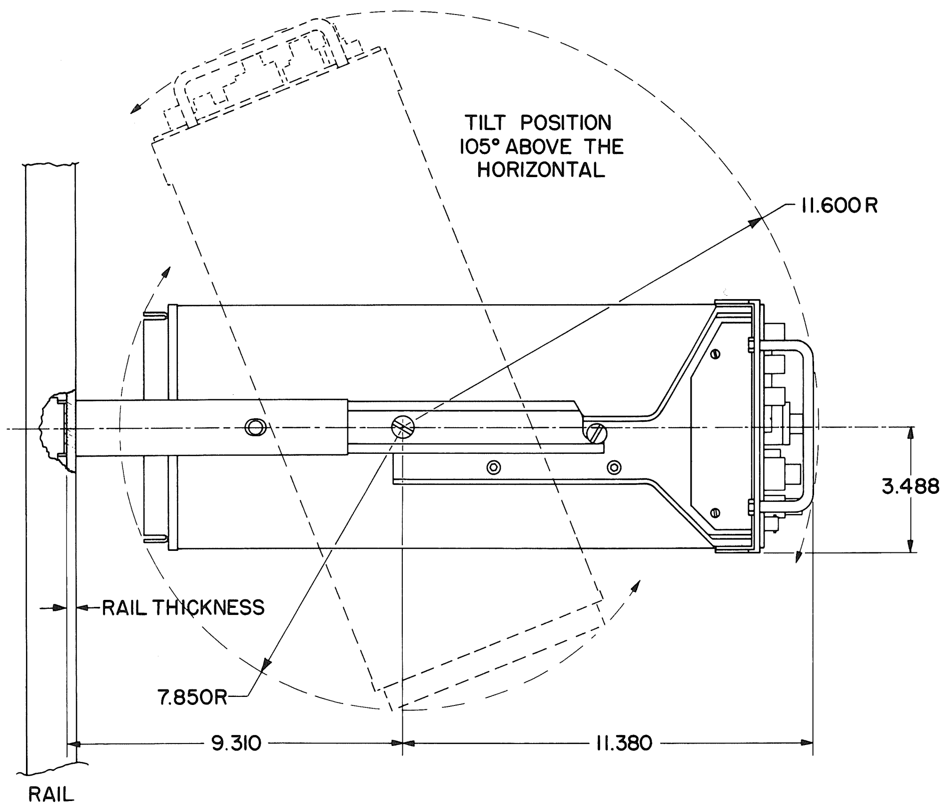
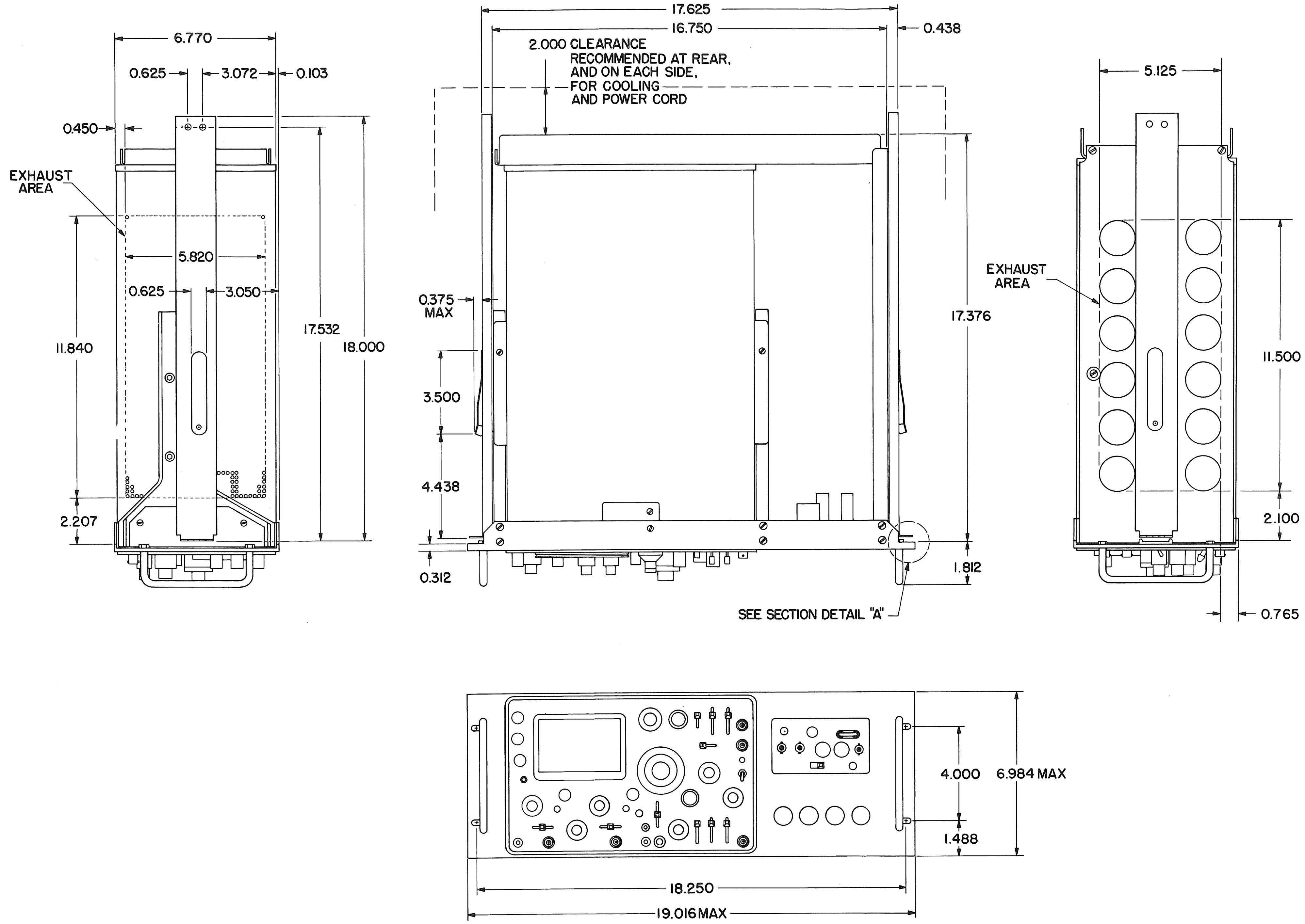
REAR VIEW





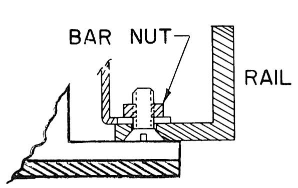
DIMENSIONAL DRAWING 040-0420-00

Type R453



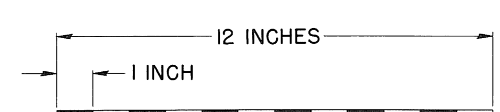
NOTES:
1. ALL DIMENSIONS ARE REFERENCE DIMENSIONS EXCEPT AS NOTED

R453



SECTION DETAIL "A"

RECOMMENDED MOUNTING



A

DIMENSIONAL DRAWING 040-0420-00

FIGURE AND INDEX NUMBERS

Items in this section are referenced by figure and index numbers to the illustrations which appear on the pullout pages immediately following the Diagrams section of this instruction manual.

INDENTATION SYSTEM

This mechanical parts list is indented to indicate item relationships. Following is an example of the indentation system used in the Description column.

Assembly and/or Component
  Detail Part of Assembly and/or Component
  mounting hardware for Detail Part
    Parts of Detail Part
    mounting hardware for Parts of Detail Part
mounting hardware for Assembly and/or Component

Mounting hardware always appears in the same indentation as the item it mounts, while the detail parts are indented to the right. Indented items are part of, and included with, the next higher indentation.

Mounting hardware must be purchased separately, unless otherwise specified.

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial or model number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

ABBREVIATIONS AND SYMBOLS

For an explanation of the abbreviations and symbols used in this section, please refer to the page immediately preceding the Electrical Parts List in this instruction manual.

MECHANICAL PARTS LIST

FIG. 1 EXPLODED VIEW

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description 1 2 3 4 5
1-1	426-0297-00			1	FRAME, front
-2	386-1059-00			1	PLATE, shield
	- - - - - -			-	mounting hardware: (not included with plate)
-3	211-0503-00			3	SCREW, 6-32 x $3/16$ inch, PHS
-4	134-0067-00			4	PLUG, grey plastic
-5	200-0667-00			1	COVER, top
	- - - - - -			-	mounting hardware: (not included with cover)
-6	212-0001-00			2	SCREW, 8-32 x $1/4$ inch, PHS
-7	211-0502-00			1	SCREW, 6-32 x $3/16$ inch, 100° csk, FHS
-8	200-0668-00			1	COVER, bottom
	- - - - - -			-	mounting hardware: (not included with cover)
-9	212-0001-00			2	SCREW, 8-32 x $1/4$ inch, PHS
-10	211-0502-00			1	SCREW, 6-32 x $3/16$ inch, 100° csk, FHS
-11	358-0215-00			1	BUSHING, black plastic
-12	367-0022-00			2	HANDLE
	- - - - - -			-	mounting hardware for each: (not included with handle)
-13	213-0090-00			2	SCREW, 10-32 x $1/2$ inch, HHS
-14	386-1065-00			1	PLATE, rear
-15	386-1063-00			1	PLATE, front frame backing, top
	- - - - - -			-	mounting hardware: (not included with plate)
-16	212-0001-00			1	SCREW, 8-32 x $1/4$ inch, PHS
-17	386-1062-00			1	PLATE, front frame backing, bottom
	- - - - - -			-	mounting hardware: (not included with plate)
-18	212-0001-00			1	SCREW, 8-32 x $1/4$ inch, PHS
-19	386-1061-00			1	PLATE, hinge
	- - - - - -			-	mounting hardware: (not included with plate)
-20	211-0503-00			3	SCREW, 6-32 x $3/16$ inch, PHS
-21	426-0291-02			1	FRAME, support, right
	- - - - - -			-	mounting hardware: (not included with frame)
	212-0040-00			4	SCREW, 8-32 x $3/8$ inch, 100° csk, FHS
-22	426-0291-01			1	FRAME, support, left
	- - - - - -			-	mounting hardware: (not included with frame)
-23	212-0040-00			4	SCREW, 8-32 x $3/8$ inch, 100° csk, FHS
-24	210-0808-00			1	WASHER, centering
-25	211-0507-00			1	SCREW, 6-32 x $5/16$ inch, PHS
-26	210-0457-00			1	NUT, keps, 6-32 x $5/16$ inch
-27	386-1066-00			2	PLATE, pin retaining
	- - - - - -			-	mounting hardware for each: (not included with plate)
-28	212-0008-00			2	SCREW, 8-32 x $1/2$ inch, PHS
	210-0804-00			2	WASHER, flat, 0.170 ID x $3/8$ inch OD

FIG. 1 EXPLODED VIEW *(Cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description 1 2 3 4 5
1-29	386-1064-00			1	PLATE, side
	- - - - - -			-	mounting hardware: (not included with plate)
-30	212-0023-00			1	SCREW, 8-32 x $3/8$ inch, PHS
-31	212-0040-00			1	SCREW, 8-32 x $3/8$ inch, 100° csk, FHS
-32	212-0043-00			4	SCREW, 8-32 x $1/2$ inch, 100° csk, FHS
	210-0458-00			6	NUT, keps, 8-32 x $11/32$ inch
-33	211-0507-00			1	SCREW, 6-32 x $5/16$ inch, PHS
-34	361-0120-00			2	SPACER, stepped
-35	351-0101-00			1 pr	TRACK, slide, stationary & inter-section, w/mounting hardware
-36	213-0129-00			4	SCREW, $1/4$-20 x $3/4$ inch, HSS
-37	214-0502-00			2	PIN, support
-38	210-0984-00			2	WASHER, plastic, 0.484 ID x 0.828 inch OD
-39	210-0985-00			2	WASHER, flat, 0.512 ID x $7/8$ inch OD
-40	210-0866-00			4	WASHER, flat, 0.264 ID x $1\,1/8$ inches OD
-41	210-0011-00			2	LOCKWASHER, internal, $1/4$ ID x $15/32$ inch OD
-42	213-0134-00			2	SCREW, $1/4$-20 x $3/4$ inch, HHS
-43	407-0073-00			2	BRACKET, angle support
-44	212-0520-00			4	SCREW, 10-32 x $1\,1/4$ inch, HHS
-45	210-0805-00			4	WASHER, flat, 0.204 ID x 0.438 inch OD
-46	220-0410-00			4	NUT, keps, 10-32 x $3/8$ inch
-47	361-0119-00			2	SPACER, block
-48	212-0010-00			4	SCREW, 8-32 x $5/8$ inch, PHS
-49	351-0104-00			1 pr	GUIDE, w/mounting hardware
-50	212-0567-00			4	SCREW, 10-32 x $7/8$ inch, OHS
-51	210-0833-00			4	WASHER, finishing, #10
-52	210-0917-00			4	WASHER, plastic, 0.191 ID x $5/8$ inch OD

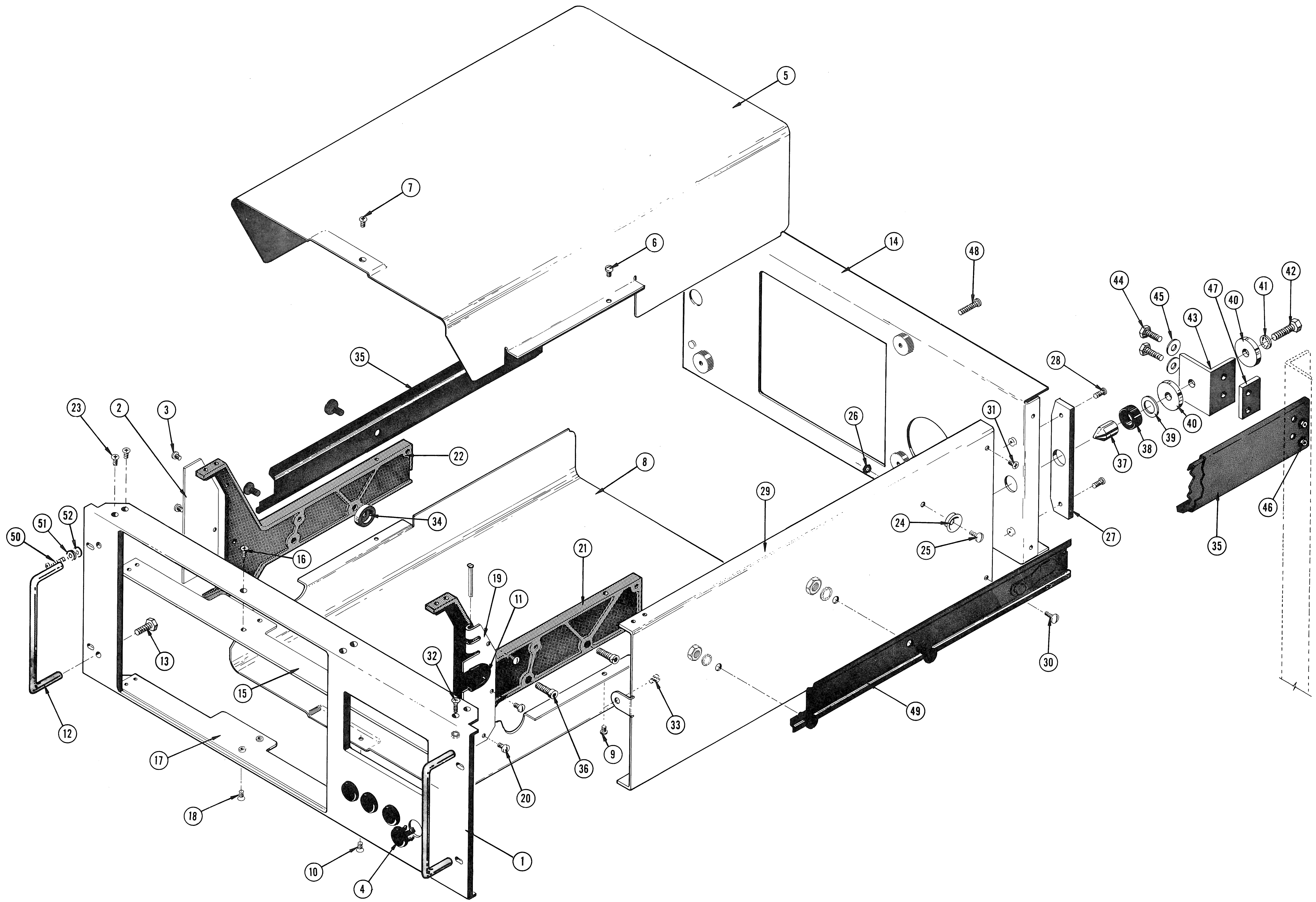


FIG. 1 EXPLODED VIEW 040-0420-00

Ⓐ

MODIFICATION KIT

FUSE HOLDER

For Tektronix Type 453 Oscilloscopes
Serial numbers 100-1800 (approximate)

DESCRIPTION

This modification provides a fuse holder and five spare fuses so that spare fuses may be conveniently contained within the instrument at all times. Some instruments may have a fuse holder, but no fuses.

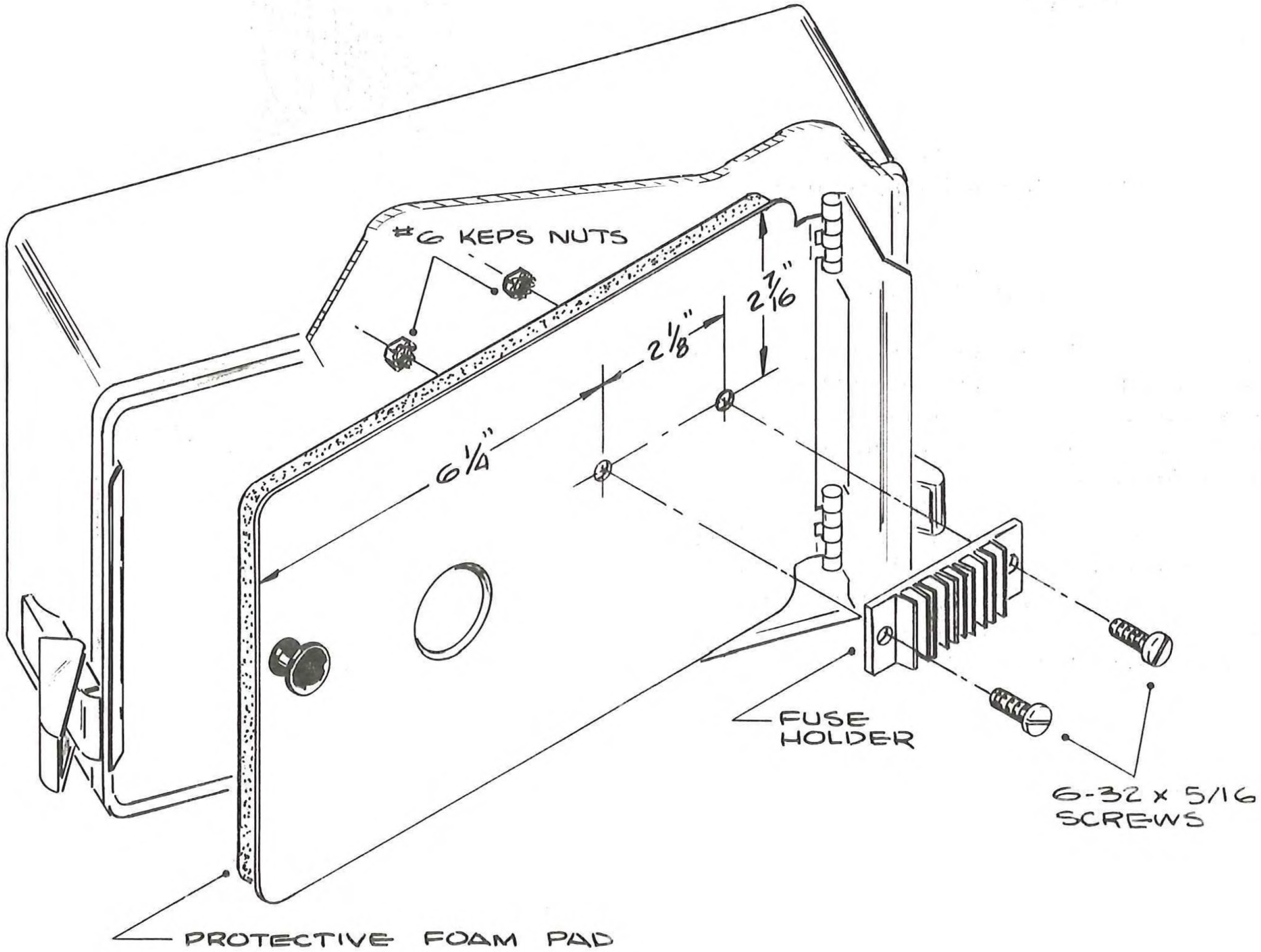
The fuse holder is mounted on the 453 front cover hinge plate, using 6-32 screws and Keps nuts. The modification requires drilling two holes and securing the fuse holder to the hinge plate.

040-0422-00

Publication:
Instructions for 040-0422-00
February 1966

PARTS LIST

Quantity	Description	Part Number
2 ea	Fuse, slo blo, 4/5 amp 3AG	159-0018-00
1 ea	Fuse, slo blo, 2 amp 3AG	159-0023-00
1 ea	Fuse, fast blo, 1/2 amp 3AG	159-0025-00
1 ea	Fuse, fast blo, 1/4 amp 3AG	159-0028-00
2 ea	Nut, Keps, steel, 6-32 x 5/16	210-0457-00
2 ea	Screw, 6-32 x 5/16 PHS	211-0507-00
1 ea	Holder, fuse, storage	352-0093-00



FRONT COVER ASSEMBLY

INSTRUCTIONS

TO INSTALL THE FUSES ONLY:

( ) 1. Remove the front cover assembly from the instrument and install the fuses from the kit into the present fuse holder.

NOTE: If your instrument already has a fuse holder, disregard the following instructions.

TO INSTALL THE FUSE HOLDER AND FUSES:

( ) 2. Open the accessory storage compartment cover and temporarily remove all accessories.

NOTE: To prevent possible drilling damage to the protective foam pad below the hinged plate, locate the new hole positions on the foam side and carefully cut out a 1/2 in. circle of foam where each hole will be.

( ) 3. Locate and drill two 5/32 in. holes in the hinge cover, as shown in the drawing.

( ) 4. Mount the fuse holder (from kit) on the cover, using the 6-32 hardware from the kit.

( ) 5. Install the five spare fuses (from kit) in the fuse holder.

( ) 6. Return the accessories to the accessory storage compartment and secure the front cover assembly on the front of the instrument.

THIS COMPLETES THE INSTALLATION.

( ) Add the new part numbers to your Instrument Manual parts list.

JB:cet

MODIFICATION KIT

HORIZONTAL JITTER REDUCTION

For Tektronix Type 453 Oscilloscopes
Serial numbers 100-2500*

040-0430-00

DESCRIPTION

This modification eliminates excessive horizontal jitter when operating the HORIZ DISPLAY switch in the 10X MAG position.

The horizontal jitter is reduced by supplying an equal noise current in the opposite input of the Horizontal Amplifier. The noise current is provided by adding new electrical components C804, C808, R804, and R808.

The installation consists of:

1) Lifting the 'A' Sweep circuit board.
2) Adding capacitor-resistor combinations, C804-R804 and C808-R808.
3) Reinstalling the 'A' Sweep circuit board.
4) Removing the shield conductor from a three-wire conductor cable.

* The following instruments were factory-modified:

812	960	1483	1988
883	965	1490	2293
889	1146	1761	2347
929	1269	1924	2459

Publication:
Instructions for 040-0430-00
March 1966

PARTS LIST

Qty.	Part Number	Description			
2 ea		Combination, series capacitor-resistor, consisting of:			
1 ea	283-0059-00	Capacitor, cer,	1 μF	25V	
1 ea	315-0822-00	Resistor, comp,	8.2k	1/4W	5%

INSTRUCTIONS

( ) 1. Remove the cabinet panels from the instrument.

( ) 2. Stand instrument on its face. Use some type of padding between instrument and bench to protect the knobs.

( ) 3. Remove the six 4-40 x 5/16 screws with washers that hold the 'A' Sweep circuit board in place.

( ) Lift this board up to gain access to HORIZ DISPLAY switch and HORIZ POSITION potentiometer.

NOTE: Unplug only the wires necessary to allow the board to swing out of the way. Also be sure to note the location of those wires your remove.

( ) 4. Open swinging access panel to gain access to the side of the HORIZ DISPLAY switch.

CAUTION: To prevent damage to wires, it is recommended that a miniature soldering iron be used. Also, careful lead dress of the capacitor-resistor combinations should be observed to prevent short circuit.

( ) 5. Remove the 2-3/4" exposed shield conductor of a three-conductor cable connected to the switch portion of the B TIME/DIV VARIABLE CAL potentiometer located on the swinging access panel.

( ) 6. Install the two series capacitor-resistor combinations (from kit) as shown in drawing.

( ) 7. Close swinging access panel and tighten its retaining screw.

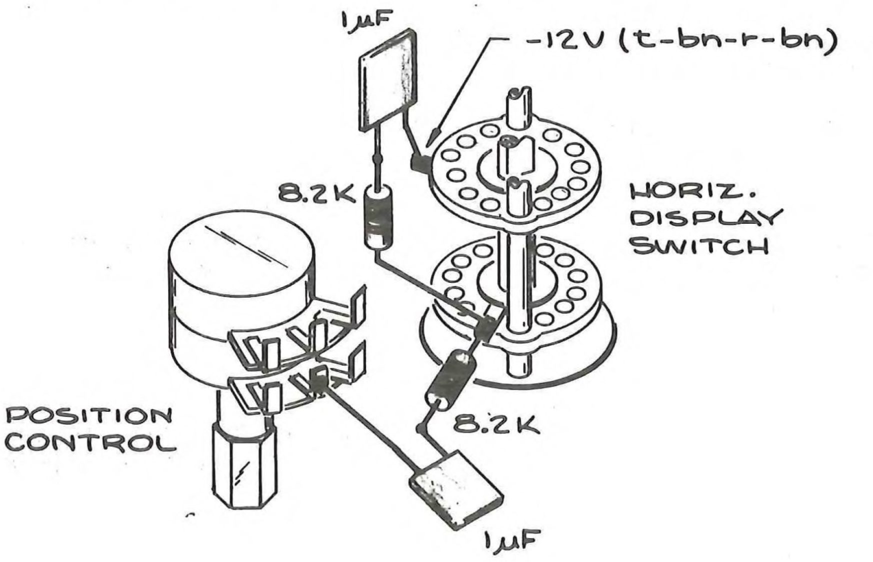
( ) 8. Remount the 'A' Sweep circuit board and reconnect any wires unplugged in step 3.

( ) 9. Replace the instrument cabinet panels.

THIS COMPLETES THE INSTALLATION.

( ) Fasten the Manual insert section in the rear of your Instruction Manual.

JB:cet



HORIZONTAL JITTER REDUCTION

Type 453 -- s/n 100-2500

Installed in Type 453 s/n ______ Date ______

GENERAL INFORMATION

This modification eliminates excessive horizontal jitter when operating the HORIZ DISPLAY switch in the 10X MAG position.

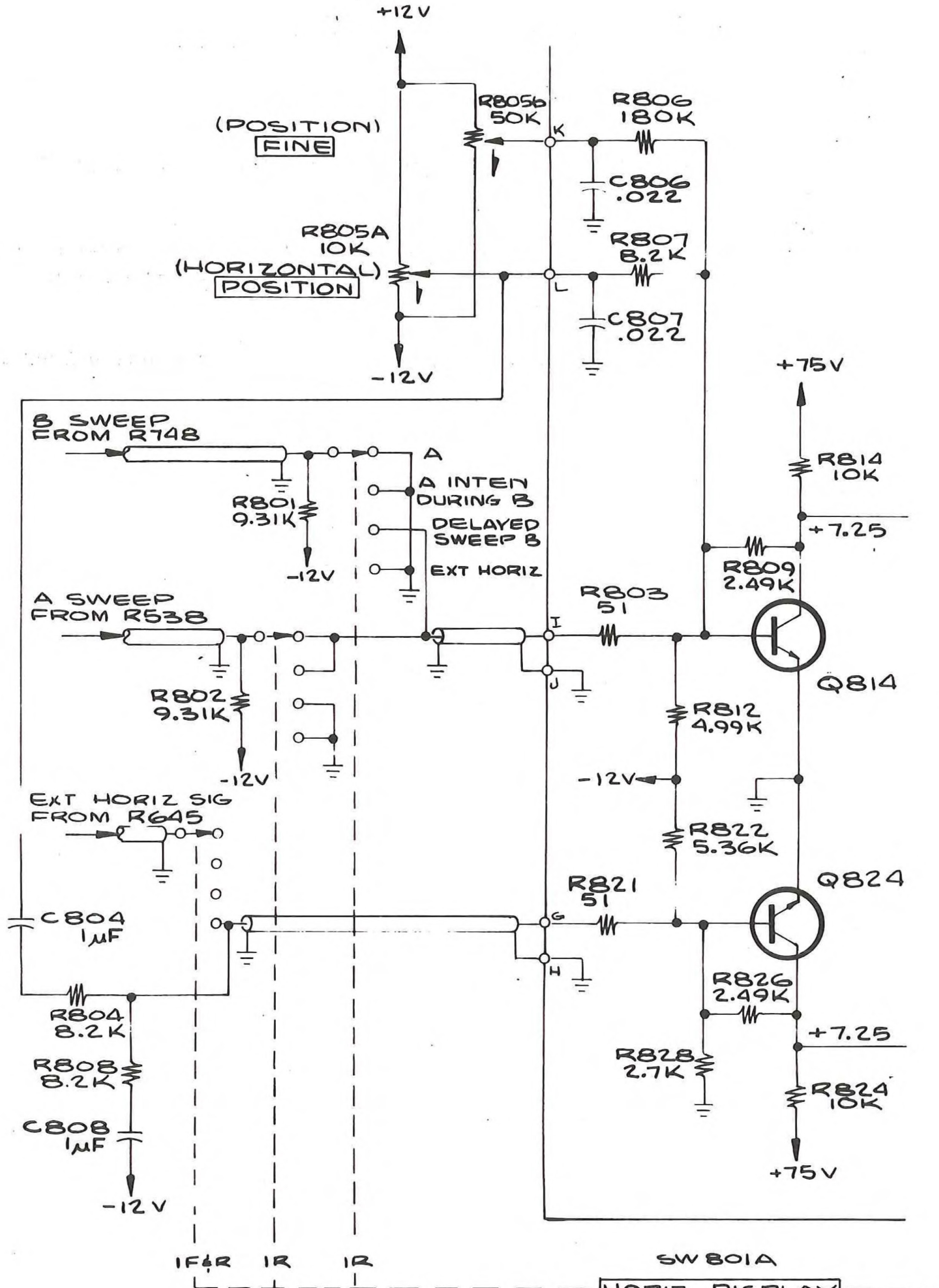
The horizontal jitter is reduced by supplying an equal noise current in the opposite input of the Horizontal Amplifier. The noise current is provided by adding new electrical components C804, C808, R804, and R808.

The information on these pages supersedes the information in your Instruction Manual.

ELECTRICAL PARTS LIST

Values fixed unless marked variable.

Ckt. No.	Part Number	Description			
			CAPACITORS		
C804	283-0059-00	1 µF	25V		
C808	283-0059-00	1 µF	25V		
			RESISTORS		
R804	315-0822-00	8.2k	1/4W	5%	metal film
R808	315-0822-00	8.2k	1/4W	5%	metal film



PARTIAL HORIZ. AMP.
SCHEMATIC

MODIFICATION KIT

PORTABLE TO RACKMOUNT CONVERSION

For the following Tektronix Oscilloscopes:

Type 453 serial numbers 20000-up
Type 454 serial numbers B010100-up

040-0446-01

DESCRIPTION

This modification provides the necessary mechanical components and instructions for constructing a rack-mounting frame around the instrument. The assembled frame permits rack-mounting the Type ## 453 or 454 Oscilloscopes in a standard 19 inch open or closed relay rack or slide-out tracks.

Additional parts are included with this ## kit to provide rear support for the Type 453 or 454 rack-mounted instruments.

The assembly of the frame which surrounds the instrument consists of: 1) removing the ## Type 453/454 from the cabinet, 2) moving the Calibrator Frame chassis to the Front Panel frame for easy access, and 3) assembling the Rack-mount frame and support ## around the Type 453/454 Oscilloscopes.

Publication:
Instructions for 040-0446-01
September 1967

Supersedes:
July 1967

PARTS LIST

Quantity	Part Number	Description
1 ea	016-0096-00	Hardware kit, rack-mounting, rear
1 ea	016-0099-00	Hardware kit, rack-mounting, front
4 ea	134-0067-00	Plug, nylon, gray
4 ea	210-0011-00	Lockwasher, int, 1/4
4 ea	210-0411-00	Nut, hex, 1/4-20 x 7/16
1 ea	210-0457-00	Nut, Keps, 6-32 x 5/16
6 ea	210-0458-00	Nut, Keps, 8-32 x 11/32
1 ea	210-0808-00	Washer, centering, brass
2 ea	211-0502-00	Screw, 6-32 x 3/16 FHS, Pozidriv
2 ea	211-0503-00	Screw, 6-32 x 3/16 PHS, Pozidriv
2 ea	211-0507-00	Screw, 6-32 x 5/16 PHS, Pozidriv
4 ea	212-0001-00	Screw, 8-32 x 1/4 PHS, Pozidriv
2 ea	212-0002-00	Screw, 8-32 x 1/4 FHS, Pozidriv
4 ea	212-0010-00	Screw, 8-32 x 5/8 PHS, Pozidriv
1 ea	212-0023-00	Screw, 8-32 x 3/8 PHS, Pozidriv
9 ea	212-0040-00	Screw, 8-32 x 3/8 FHS, Pozidriv
4 ea	212-0043-00	Screw, 8-32 x 1/2 FHS, Pozidriv
4 ea	213-0090-00	Screw, 10-32 x 1/2, hex
2 ea	213-0129-00	Screw, 1/4-20 x 3/4, socket head
1 ea	214-0881-00	Hinge half
1 ea	334-1120-01	Plate, identification, R454
## 1 ea	334-1120-02	Plate, identification, R453
1 pr	351-0101-00	Track, chassis, left and right
1 pr	351-0104-00	Slide, chassis, tilt type
4 ea	355-0114-00	Stud, shouldered and stepped
2 ea	361-0120-00	Spacer, stepped
2 ea	367-0022-00	Handle
1 ea	386-1062-00	Plate, frame-panel backing, bottom
1 ea	386-1063-00	Plate, frame-panel backing, top
1 ea	386-1064-00	Plate, side, rack instrument
1 ea	386-1261-00	Panel, rear
1 ea	390-0012-00	Cabinet top, oscilloscope
1 ea	390-0013-00	Cabinet bottom, oscilloscope
1 ea	426-0358-01	Support, oscilloscope, right
1 ea	426-0363-01	Support, oscilloscope, left
1 ea	426-0378-01	Frame-panel, rack instrument

INSTRUCTIONS

REFER TO FIG. 1 FOR STEPS 1 THROUGH 5

( ) 1. Remove the front cover assembly from the front of the instrument.

( ) 2. Remove the cabinet top and bottom from the instrument by loosening the left and right cabinet latch screws.

( ) 3. Turn the cabinet latch screws back into the frame rails slightly and remove the "C" retaining rings (if present).

( ) 4. Remove the cabinet latch screws from the frame rails and re-install the "C" retaining rings on the screws so they may be saved for possible future use.

( ) 5. Remove the blue handle covers from the left and right sides of the instrument handle. They may be easily pried off with a standard blade screwdriver.

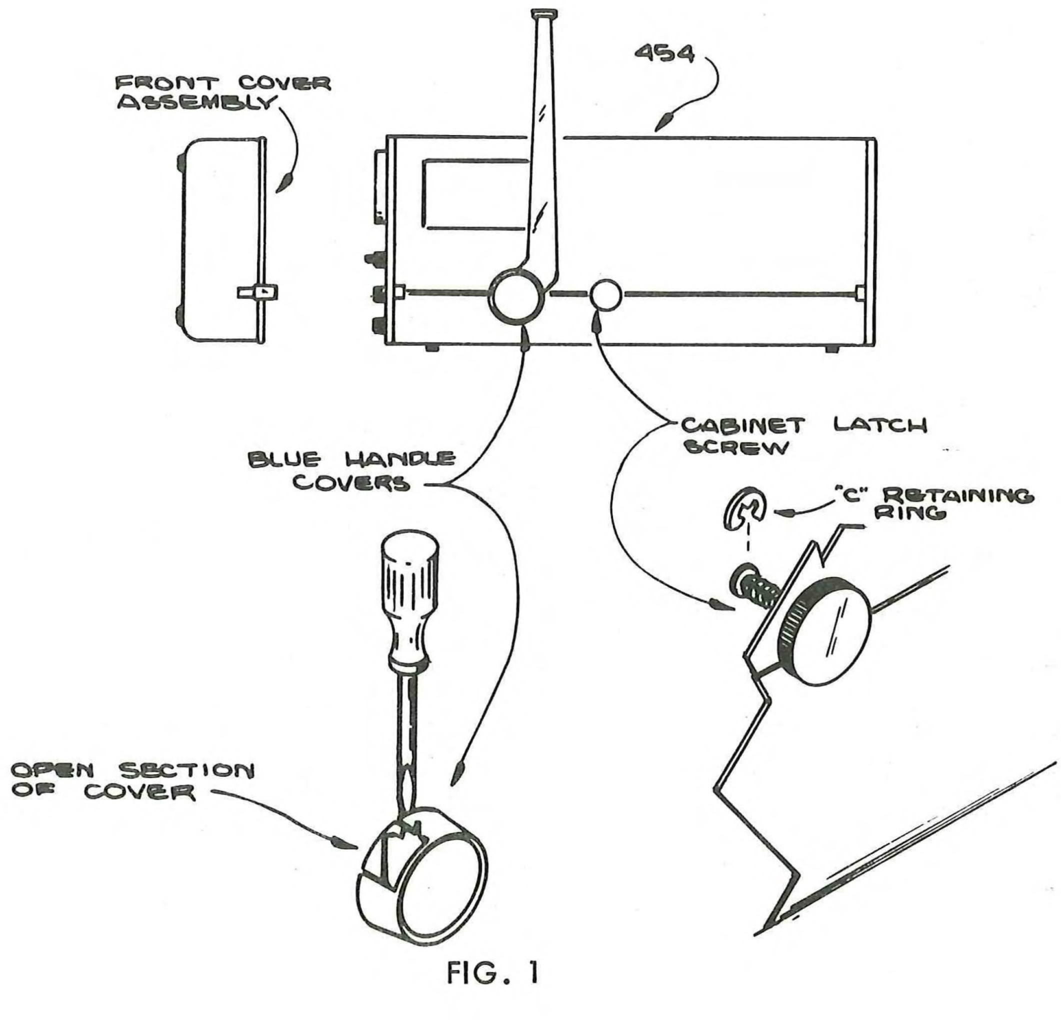


FIG. 1

REFER TO FIG. 2 FOR STEPS 6 THROUGH 10

( ) 6. Remove the two (one per side) socket head Allen screws (SAVE) which secure the handle to the left and right frame rails, and remove the handle from the instrument.

( ) 7. Remove the two 10-32 x 5/16 FHS screws from the front of each frame rail and install the shouldered studs (from kit) in their place. (See Item 10, Fig.5)

( ) 8. Remove the captive screw, nylon washer and "C" retaining ring from the calibrator frame chassis.

( ) 9. Remove the cable clamp which secures the calibrator cable harness to the right frame rail.

( ) 10. Remove the "C" retaining ring and the hinge pin which secure the calibrator frame to the front plate (save hinge pin and retaining ring).

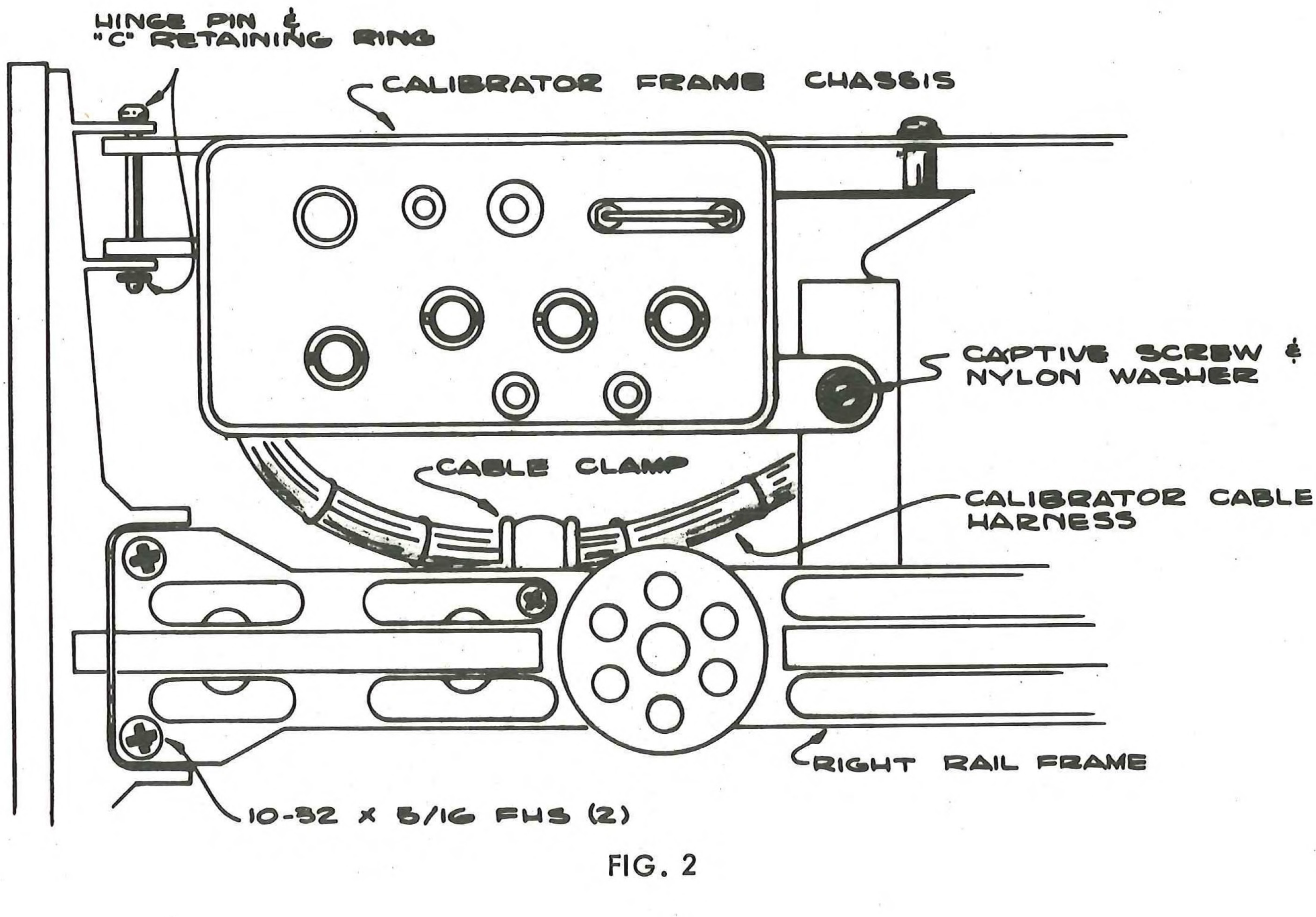


FIG. 2

INSTRUCTIONS (cont)

REFER TO FIG. 3 FOR STEPS 11 THROUGH 14

( ) 11. Position the two calibrator frame ears into the hinge half and fasten together, using the hinge pin and "C" ring removed in step 10.

( ) 12. Install the hinge half (from kit) on the right support casting (from kit), using two 6-32 x 3/16 PHS screws from the kit.

( ) 13. Place a stepped spacer (from kit) between the right rail frame and the right support casting, indented side of the spacer toward the frame, and secure the support casting to the rail frame with the two socket head Allen screws, removed in step 6, and two 1/4 internal lockwashers and two 1/4-20 x 7/16 hex nuts from the kit.

( ) 14. Place a stepped spacer (from kit) between the left rail frame and the left support casting, indented side of the spacer toward the frame, and secure the support casting to the rail frame with two 1/4-20 x 3/4 socket head Allen screws (from kit), and two 1/4 internal lcokwashers and 1/4-20 x 7/16 hex nuts.

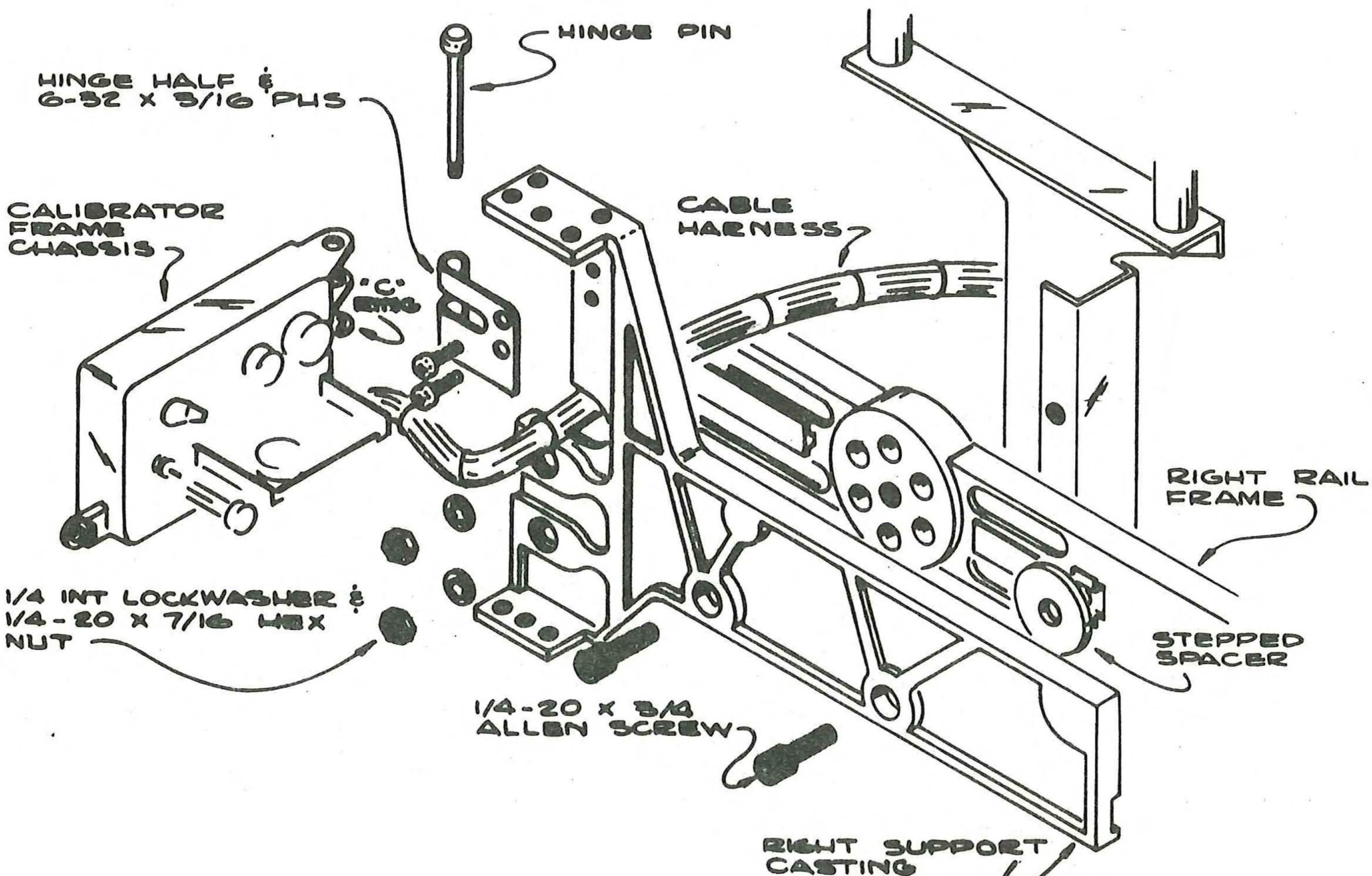


FIG. 3

REFER TO FIG. 4 FOR STEPS 15 THROUGH 31

( ) 15. Position the front rack frame assembly (from kit) over the front panel of the instrument.

( ) 16. Insert the top frame panel backing plate (from kit) between the top of the instrument and the top of the front rack frame.

( ) 17. Fasten the top of the front rack frame to the left and right support castings, using four 8-32 x 3/8 FHS screws from the kit.

( ) 18. Install an 8-32 x 1/4 PHS screw in the front rack frame hole between the left and right support casting holes.

( ) 19. Remove the four rear instrument feet.

( ) 20. Install the rear plate assembly (from kit) to the rear of the instrument, using four 8-32 x 5/8 PHS screws (from kit) through the four rear foot mounting holes.

( ) 21. Position the right side rack plate assembly (from kit) so that its front lip is between the front rack frame and the calibrator frame chassis. Secure the calibrator chassis to the front lip with a 6-32 x 5/16 PHS screw from the kit.

( ) 22. Secure the top of the right side rack plate to the front rack frame, using two 8-32 x 1/2 FHS screws and #8 Keps nuts from the kit.

( ) 23. Secure the rear of the right side rack plate to the rear plate, using the 8-32 x 3/8 PHS and 8-32 x 3/8 FHS screws and two #8 Keps nuts from the kit.

( ) 24. Turn the instrument upside down.

( ) 25. Insert the bottom frame panel backing plate (from kit) between the bottom of the instrument and the bottom of the front rack frame.

( ) 26. Fasten the bottom of the front rack frame to the left and right support castings, using four 8-32 x 3/8 FHS screws from the kit.

( ) 27. Install an 8-32 x 1/4 FHS screw in the front rack frame hole between the left and right support casting holes.

( ) 28. Secure the bottom of the right side rack plate to the front frame rack, using two 8-32 x 1/2 FHS screws and #8 Keps nuts from the kit.

( ) 29. Install the bottom instrument rack cover (from kit) fastening it as follows:

( ) Install a 6-32 x 3/16 FHS screw in the bottom frame panel backing plate.

( ) Install two 8-32 x 1/4 PHS screws into the left and right support castings.

( ) 30. Turn the instrument right side up.

( ) 31. Install the top instrument rack cover (from kit), fastening it as follows:

( ) Install a 6-32 x 3/16 FHS screw in the top frame panel backing plate.

( ) Install two 8-32 x 1/4 PHS screws into the left and right support castings.

( ) 32. Install the proper identification plate in the instrument front panel.

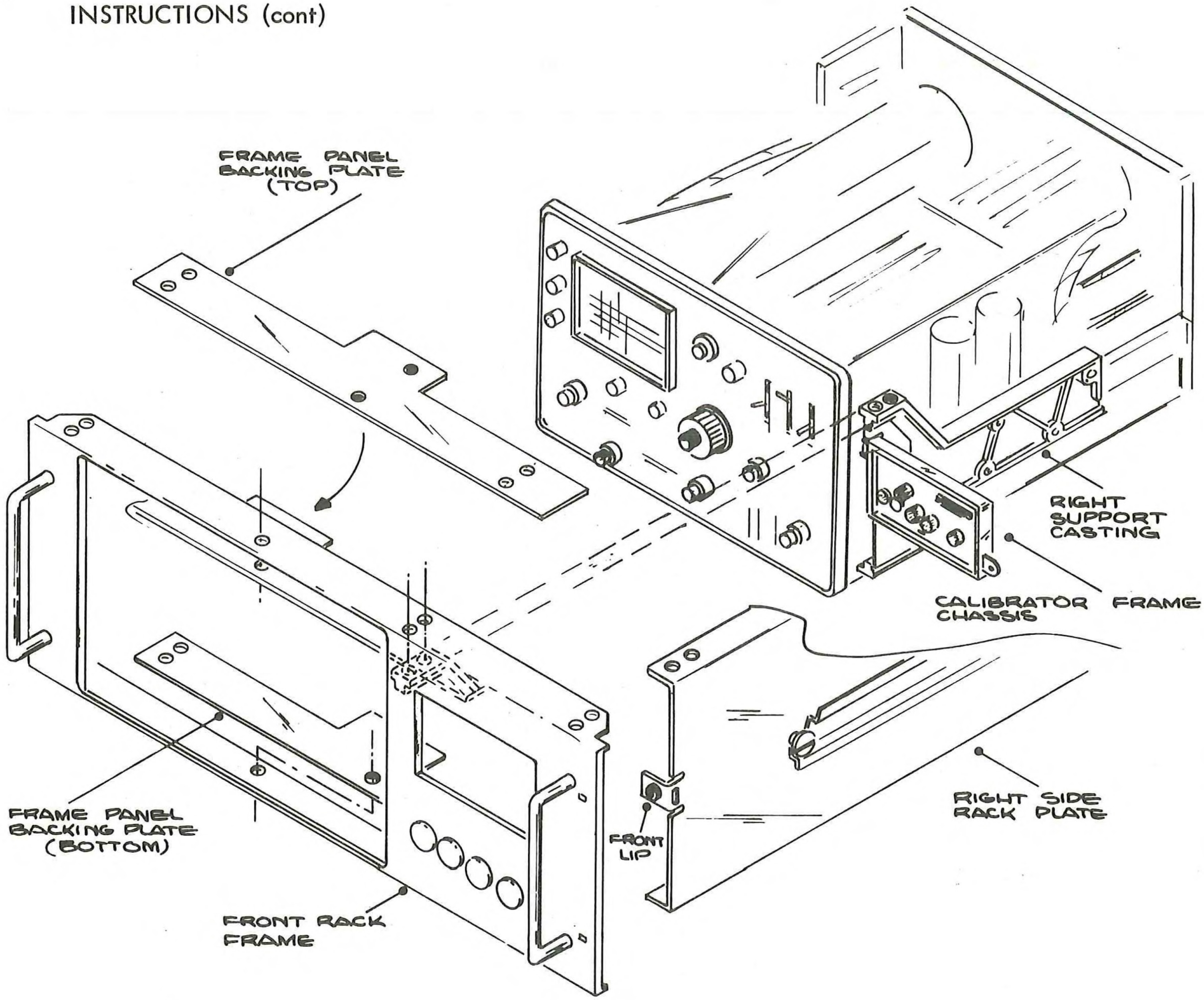


FIG. 4

THIS COMPLETES THE INSTALLATION.

( ) Refer to the Rack-mounting section of your Instrument Instruction Manual for relay rack and rear support installation instructions

BE:ls

ITEM NUMBER PARTS LIST FOR FIG. 5

	Item Number	Description	Part Number
	1	Handle	367-0022-00
	2	Screw, 8-32 x 3/8 FHS	212-0040-00
	3	Plug, nylon, gray	134-0067-00
	4	Screw, 8-32 x 1/4 FHS	212-0002-00
	5	Plate, identification, R454	334-1120-01
##	5A	Plate, identification, R453	334-1120-02
	6	Plate, frame-panel backing, bottom	386-1062-00
	7	Plate, frame-panel backing, top	386-1063-00
	8	Frame-panel, rack instrument	426-0378-01
	9	Screw, 10-32 x 1/2, hex	213-0090-00
	10	Stud, shouldered and stepped	355-0114-00
	11	Lockwasher, internal 1/4	210-0011-00
	12	Nut, hex, 1/4-20 x 7/16	210-0411-00
	13	Screw, 1/4-20 x 3/4 socket head	213-0129-00
	14	Slide, chassis, tilt type	351-0104-00
	15	Spacer, stepped	361-0120-00
	16	Support, oscilloscope, left	426-0363-01
	17	Screw, 6-32 x 3/16 FHS	211-0502-00
	18	Cabinet top, oscilloscope	390-0012-00
	19	Screw, 8-32 x 1/4 PHS	212-0001-00
	20	Screw, 8-32 x 5/8 PHS	212-0010-00
	21	Panel, rear	386-1261-00
	22	Nut, Keps, 8-32 x 11/32	210-0458-00
	23	Screw, 6-32 x 5/16 PHS	211-0507-00
	24	Washer, centering, brass	210-0808-00
	25	Screw, 8-32 x 3/8 PHS	212-0023-00
	26	Nut, Keps, 6-32 x 5/16	210-0457-00
	27	Support, oscilloscope, right	426-0358-01
	28	Screw, 6-32 x 3/16 PHS	211-0503-00
	29	Hinge half	214-0881-00
	30	Plate, side, rack instrument	368-1064-00
	31	Cabinet bottom, oscilloscope	390-0013-00
	32	Screw, 8-32 x 1/2 FHS	212-0043-00

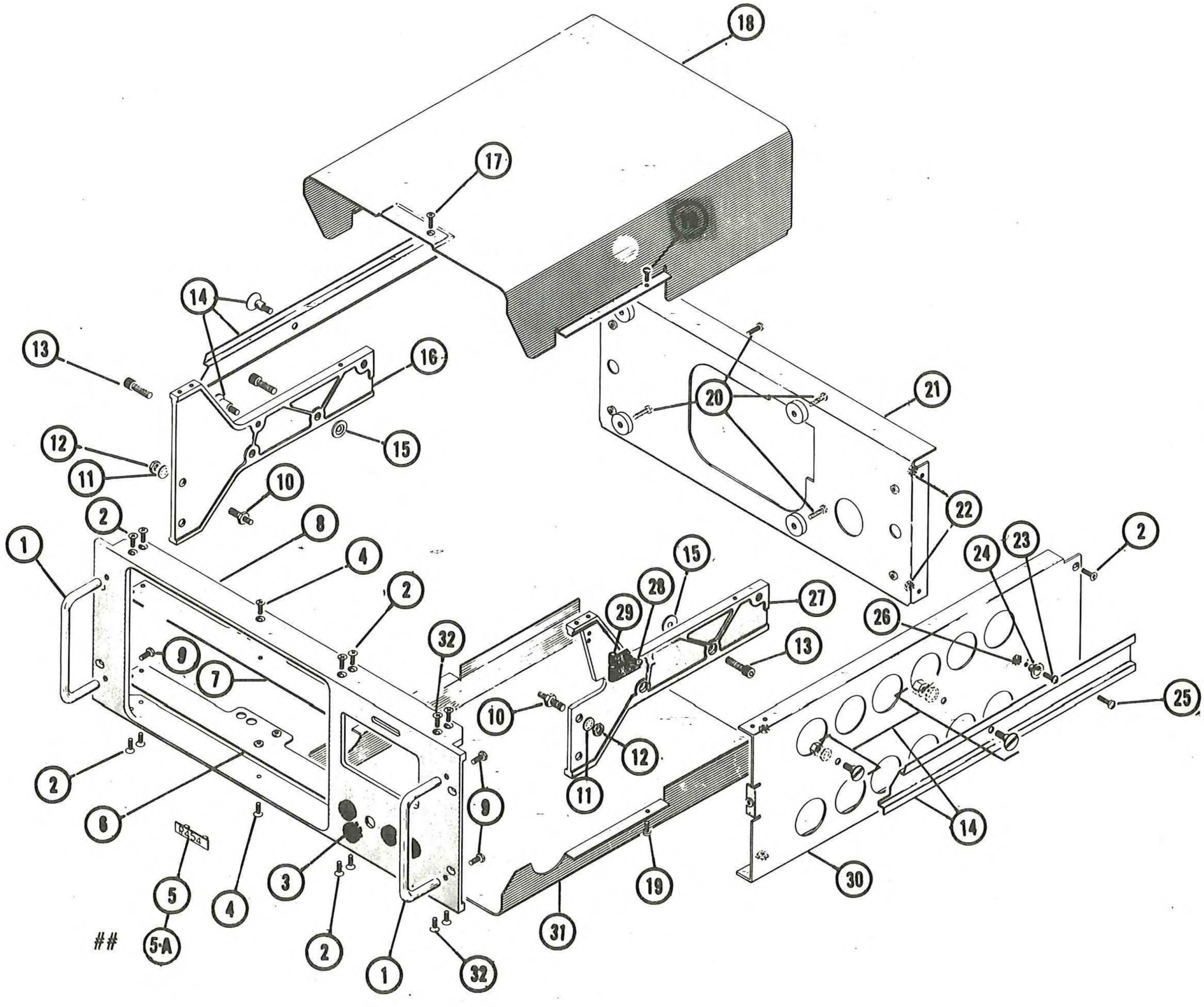

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FIG. 5

MODIFICATION KIT

STANDARD TO WATERTIGHT CABINET (MOD 165M) CONVERSION

For Tektronix Type 453 Oscilloscopes
Serial numbers 20000 - up

040-0473-00

DESCRIPTION

This modification installs a combination transit and operating case capable of being sealed against entry of water. With the front cover in place, the instrument and normal operating accessories are watertight according to the test methods and criteria of MIL - STD - 108. The instrument also meets interference requirements of MIL - I - 6181D and MIL - I - 16910A.

Installation of this modification involves: 1) removing the dust covers, handle, rear overlay, and fan motor; 2) installing two guide rails, a new fan impeller, rear overlay, and power cord; and 3) installing the instrument in its watertight case.

Publication:
Instructions for 040-0473-00
February 1968

PARTS LIST

Quantity	Part Number	Description
1 ea	003-0104-00	Wrench, hex, 5/32
1 ea	161-0039-00	Cord, power, w/Bendix connector
1 ea	161-0042-00	Cord, power, 9 inch
1 ea	200-0809-00	Cover, front, oscilloscope
3 ea	211-0507-00	Screw, 6-32 x 5/16 PHS
4 ea	212-0574-00	Screw, 10-32 x 0.434 FHS
2 ea	213-0134-00	Screw, 1/4-20 x 3/4 HHS
2 ea	213-0138-00	Screw, #4 x 1/4 thread-forming
1 ea	334-1144-00	Plate, identification
1 ea	348-0135-00	Shielding gasket assembly
1 ea	351-0134-00	Guide, slide, right
1 ea	351-0135-00	Guide, slide, left
1 ea	369-0027-00	Impeller assembly, fan, axial
1 ea	386-1308-00	Panel, rear
1 ea	437-0094-00	Cabinet assembly, oscilloscope
1 ea		Tubing, heat-shrink, 162-0546-00, 5/64 in. diam, 1 in.

INSTRUCTIONS

NOTE: It is important that all mechanical components and hardware be saved for future use, especially if the instrument is ever to be re-assembled into its original cabinet.

Refer to Fig. 1 for steps 1 through 6.

( ) 1. Remove the front cover assembly from the front of the instrument.

( ) 2. Remove the blue handle covers from the left and right sides of the instrument handle by prying up on the corners of the open section.

( ) 3. Remove the two socket head Allen screws which secure the handle to the left and right frame rails and remove the handle from the instrument.

( ) 4. Remove the cabinet top and bottom from the instrument by loosening the left and right cabinet latch screws.

( ) 5. Retighten the left and right cabinet latch screws and remove the "C" retaining rings (if present).

( ) 6. Remove the left and right cabinet latch screws from their respective frame rails.

( ) Turn the instrument so the rear is readily accessible.

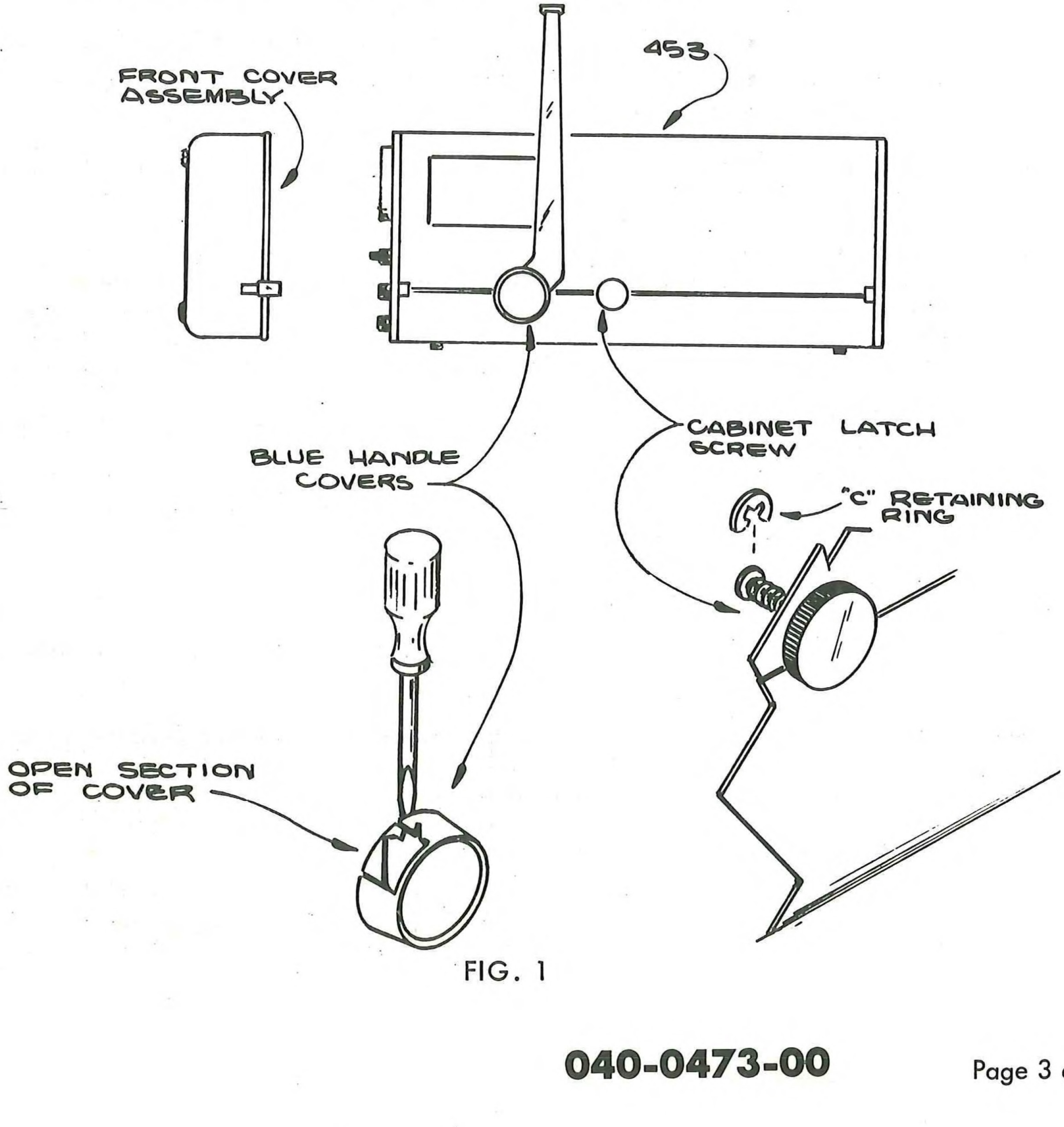


FIG. 1

( ) 7. Remove the four feet from the rear of the instrument.

( ) 8. Remove the shorting strap from the Z Axis input binding and ground binding post. SAVE for later use.

( ) 9. Remove the rear overlay from the instrument. SAVE the hardware for later use.

( ) 10. Remove the 10-32 x 5/16 FHS and the two 8-32 x 5/16 PHS screws from the rear of each frame rail and remove the rear casting. SAVE the screws for later use.

( ) 11. Replace the power cord with a new 9 inch power cord (from kit), wiring in the new cord exactly as the old cord was removed.

( ) 12. Remove the blue plastic air flow housing from the fan.

( ) 13. Remove the white wire between the solder lug on the fan motor bracket and a ceramic strip.

( ) 14. Loosen the 1/16" Allen set screw and remove the impeller from the fan motor shaft.

( ) 15. Remove the fan motor bracket and all its mounting hardware from the rear subpanel.

IMPORTANT: The hardware consists of two flat washers and a nut on each mounting screw. Do not lose them in the instrument.

( ) 16. Remove the fan motor from the fan motor bracket. SAVE the bracket and hardware for later use.

( ) 17. Swap the orange and the black wires coming from the fan motor. To do this, cut the orange wire (coming from the fan motor) to the same length as the black wire, unsolder the black wire from the capacitor and splice it to the other length of orange wire, using the heat-shrinking tubing (from kit) to cover the splice. Solder the orange wire from the fan motor to the capacitor terminal that the black wire was soldered to.

( ) 18. Install the fan motor bracket, removed in step 16, on the new rear overly using the three 6-32 x 5/16 PHS screws supplied.

( ) 19. Reinstall the rear casting. Replace only the top 10-32 x 5/16 FHS and two inner 8-32 x 5/16 PHS screws in the rear of each frame rail.

( ) 20. Install the fan motor on the fan motor bracket using the hardware saved in step 16.

( ) 21. Install the new impeller on the shaft of the fan motor with the portion containing the set screw near the motor.

( ) 22. Install the new rear overlay on the rear casting using the hardware saved in step 9.

( ) 23. Reinstall the shorting strap removed in step 8.

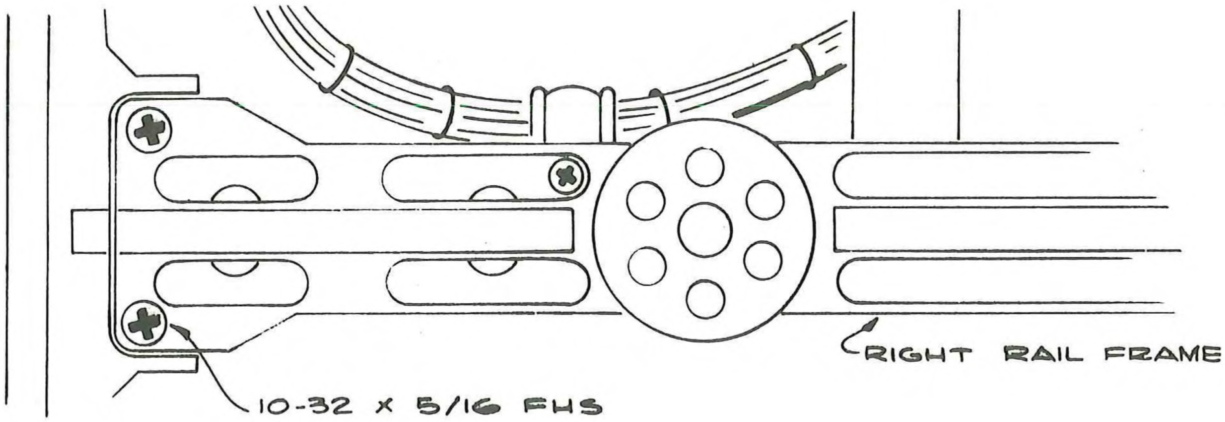


FIG. 2

( ) 24. Remove the 10-32 x 5/16 FHS screws from each frame rail as indicated in Fig. 2.

( ) 25. Install the left and right guide rails on the instrument as shown in Fig. 3 in the Manual insert pages, using two 10-32 x 0.434 FHS and one 1/4-20 x 3/4 HHS screws in each guide rail.

( ) 26. Remove the Allen set screws from the front of the guide rails and install the instrument in the watertight case. The edge of the front casting of the instrument should be approximately flush with the lip of the case. It may be necessary to adjust the hex-head screws on the rear of the guides in the case several times to obtain the correct position.

( ) 27. Install the socket head screws and the spacing washers in the front of the guides and tighten.

( ) 28. Install the electronic shielding gasket around the face of the instrument. It is held in place by turning the latch screws clockwise until snug.

( ) 29. Open the door on the rear of the case and plug the two power cords together.

( ) 30. Close the rear door and install the front cover on the instrument.

THIS COMPLETES THE INSTALLATION.

( ) Place the insert pages in your Instruction Manual.

BE:ls

STANDARD TO WATERTIGHT CABINET (MOD 165M) CONVERSION

Type 453 -- SN 20000 - up

Installed in Type 453 SN__________ Date__________

GENERAL INFORMATION

The Type 453 cabinet is changed to a combination transit and operating case capable of being sealed against entry of water by installation of the front panel cover. With the panel cover in place, the instrument and normal operating accessories are watertight according to the test methods and criteria of MIL-STD-108.

Gasketing and drain plugs are added to the rear and bottom of the instrument for release of internal condensation, in accordance with MIL-STD-108.

The case is provided with a breather valve for the release of excessive pressure differentials which would interfere with panel cover removal after air transit.

Signal inputs, operating controls, power input, and ventilating holes are confined to the front of the instrument and are sealed against moisture entry by installation of the front panel cover.

A sealed rear panel access port is provided for the line voltage range switch, line fuses, and Z AXIS INPUT. A sealed access port is also provided for the side panel controls and connectors.

The instrument meets interference requirements of MIL-I-6181D and MIL-I-16910A, Power line conducted: 150 kHz - 25 MHz. Radiated (with mesh filter installed): 14 kHz - 1000 MHz.

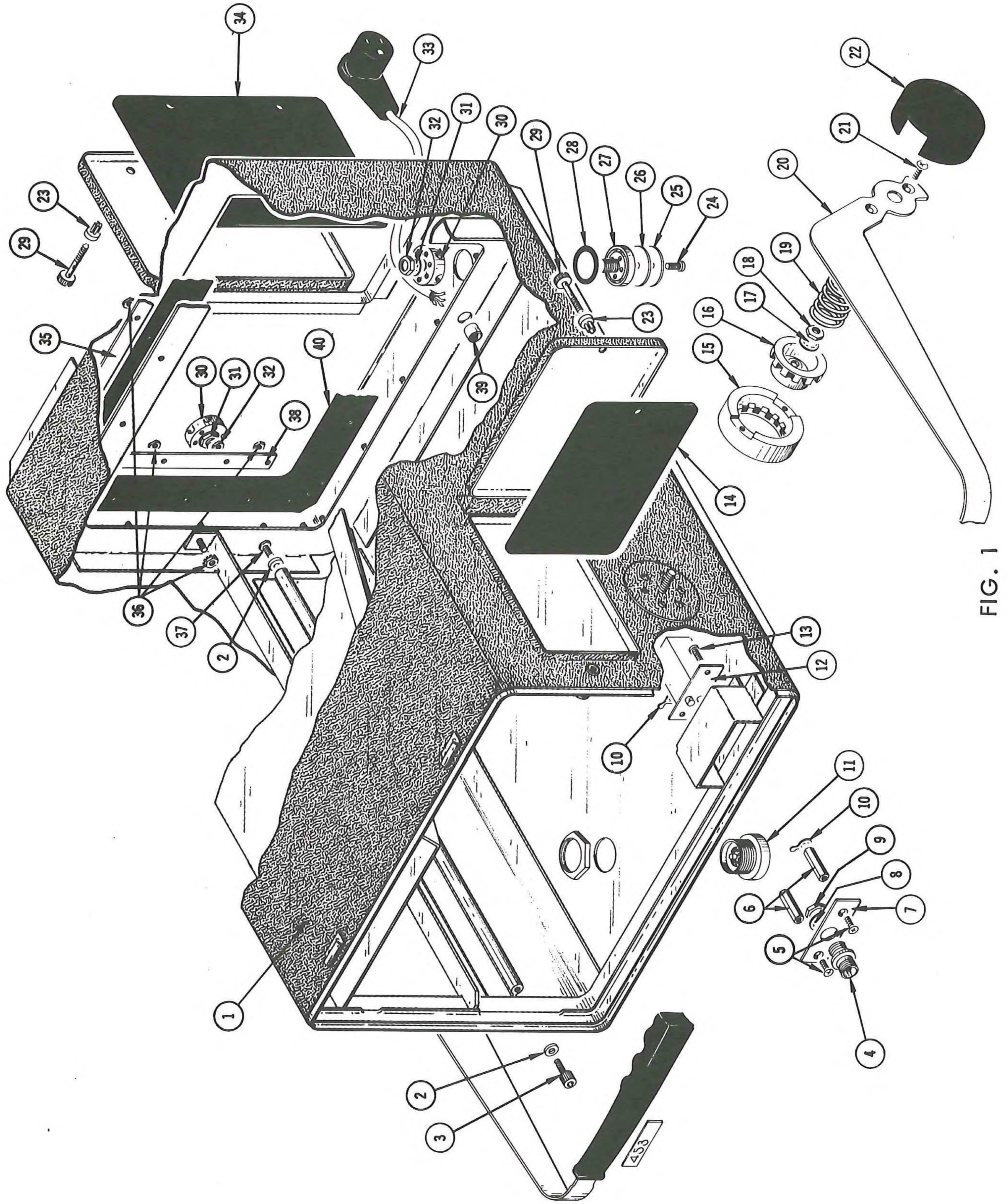
An Allen wrench to fit all case fittings is added to the accessories. A power cord, which mates with the front panel power input connector, is supplied.

NOTE: With the panel cover in place, the modified instrument is watertight, but not necessarily vaportight, and so may tend to accumulate internally condensed moisture unless the drain plugs are left open during extended periods of storage. Where condensation has accumulated, a dryout period with panel cover removed may be required before operation.

CHARACTERISTICS

Dimension

Height:	Cabinet only -- 9-1/8 inches Overall -- 10-3/8 inches (handle in forward position)
Width:	Cabinet only -- 12-15/16 inches including access port Overall -- 14-13/16 inches including handle
Length:	Without panel cover (including knobs) -- 21 inches With panel cover -- 22-1/2 inches With handle in forward position -- 26 inches



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453

FIG. 1

PARTS LIST FOR FIG. 1 -- Oscilloscope cabinet assembly, 437-0094-00, consisting of:

1.	390-0020-00	Cabinet, oscilloscope
2.	210-1049-00	Washer, convex
3.	212-0587-00	Screw, cap, socket head
4.	131-0281-00	Connector, Bendix, 4-pin
5.	211-0538-00	Screw, 6-32 x 5/16 FHS
6.	385-0168-00	Rod, spacer
7.	386-1323-00	Plate, mounting
8.	210-0021-00	Lockwasher, internal
9.	210-0559-00	Nut, hex, 7/16
10.	210-0202-00	Lug, solder, SE-6
11.	214-0976-00	Valve, relief
12.	119-0094-01	Filter, AC line
13.	211-0507-00	Screw, 6-32 x 5/16 PHS
14.	214-0981-00	Gasket (side part)
15.	214-0513-00	Index, handle ring
16.	214-0578-00	Hub, handle index
17.	210-0011-00	Lockwasher, int, 1/4
18.	210-0411-00	Nut, hex, 1/4-20 x 7/16
19.	214-1006-00	Spring, handle index
20.	367-0081-00	Handle, carrying
21.	211-0512-00	Screw, 6-32 x 1/2 FHS
22.	200-0602-00	Cover, handle
23.	358-0255-00	Bushing
24.	212-0008-00	Screw, 8-32 x 1/2 PHS
25.	210-1050-00	Washer, flat
26.	214-0979-00	Gasket
27.	214-0985-00	Plug, vent
28.	354-0317-00	"O" ring
29.	213-0174-00	Screw, thumb
30.	210-1051-00	Washer, drainport
31.	210-0057-00	Lockwasher, split
32.	210-0524-00	Nut, hex, 5/16-24
33.	161-0041-00	Cable, w/right angle female connector
34.	214-0980-00	Gasket
35.	386-1324-00	Plate, retaining, gasket
36.	210-0457-00	Nut, Keps, 6-32 x 5/16
37.	213-0090-00	Screw, 10-32 x 1/2 HHS
38.	386-1325-00	Plate, retaining, gasket
39.	348-0056-00	Grommet, plastic, 3/8
40.	214-0978-00	Gasket, air chamber

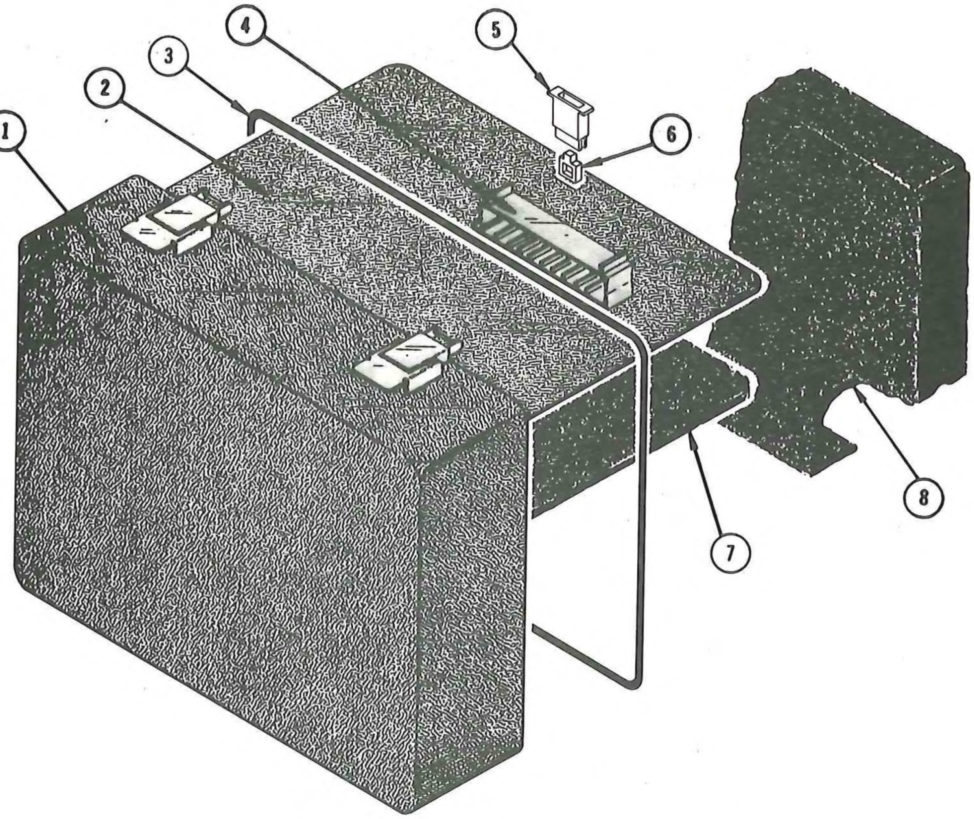


FIG. 2

PARTS LIST FOR FIG. 2 -- Oscilloscope front cover, 200-0809-00, consisting of:

1.	200-0788-00	Cover, oscilloscope cabinet
2.	200-0810-00	Door, accessory storage box
3.	214-0969-00	Gasket
4.	352-0109-00	Holder, fuse and filter
5.	204-0282-00	Body, latch
6.	214-0787-00	Stem, latch
7.	348-0133-00	Pad, cushioning
8.	348-0134-00	Pad, cushioning
Not shown.	214-0756-00	Pin, hinge

PARTS LIST FOR FIG. 3

1.	213-0138-00	Screw, #4 x 1/4, thread-forming
2.	334-1144-00	Plate, identification
3.	348-0135-00	Shielding gasket assembly, electronic
4.	212-0574-00	Screw, 10-32 x 0.434 PHS
5.	213-0134-00	Screw, 1/4-20 x 3/4 HHS
6.	351-0134-00	Rail, guide, right
7.	161-0042-00	Cord, power, 9 inch
8.	211-0507-00	Screw, 6-32 x 5/16 PHS
9.	386-1308-00	Plate, rear overlay
10.	369-0027-00	Impeller, fan, axial
11.	351-0135-00	Rail, guide, left

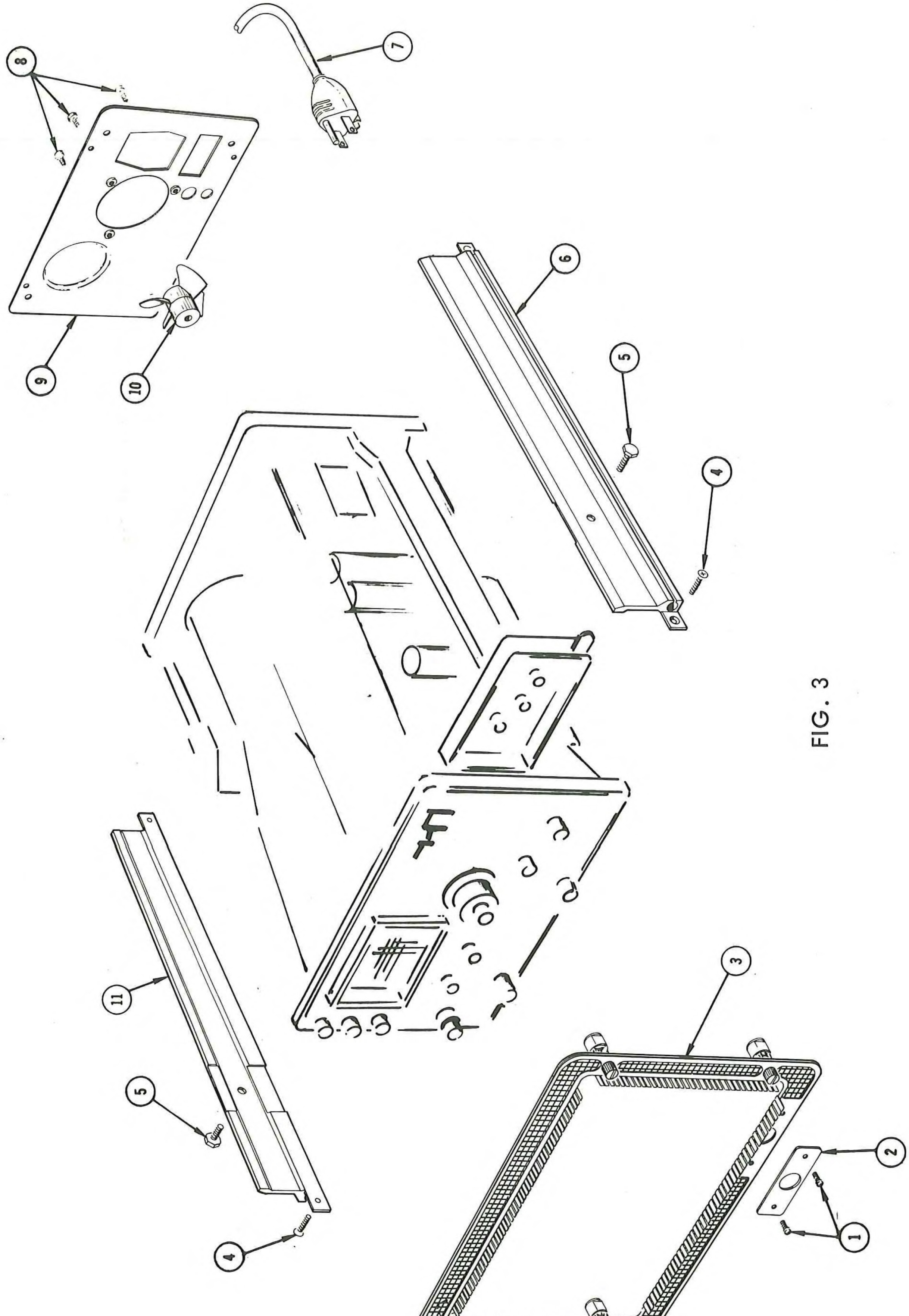


FIG. 3

PARTS REPLACEMENT KIT

HORIZONTAL POSITION POTENTIOMETER

For Tektronix Type 453 Oscilloscopes
Serial numbers 100-1889

DESCRIPTION

Horizontal Position potentiometer 311-0542-01 replaces 311-0542-00 previously used.

The outer shaft of potentiometer 311-0542-00 is not strong enough to withstand the knob set screw tightening torque without collapsing on the inner shaft, which results in shaft binding.

The new potentiometer 311-0542-01 has a 0.265" dia outer shaft and 0.187" dia inner shaft. The old potentiometer has a 0.250" dia outer shaft and a 0.125" dia inner shaft. Electrical characteristics of both potentiometers are the same.

The installation involves lifting the Horizontal Amp circuit board and replacing the Horizontal Position potentiometer with the new one from the kit.

NOTE: If the s/n of your instrument is above those listed or if this kit has already been installed, disregard the instructions as P/N 311-0542-01 is a direct replacement.

050-0270-00

Publication:
Instructions for 050-0270-00
April 1966

PARTS LIST

Quantity	Part Number	Description
1 ea	311-0542-01	Potentiometer, comp, 10k - 50k ±20% 3/8x1x1/2 w/.265 OD x .187 ID shafts
1 ea	358-0029-05	Bushing, potentiometer, standoff
1 ea	366-0138-00	Knob, charcoal
1 ea	366-0319-00	Knob, red

INSTRUCTIONS

( ) 1. Remove the top and bottom instrument covers and turn the instrument upside down.

( ) 2. Remove the red and charcoal knobs from the Horizontal Position potentiometer.

( ) 3. Remove the bushing which secures the Horizontal Position potentiometers to the front panel.

( ) 4. Remove the 6 screws (SAVE) that secure the 'A' SWEEP Generator circuit board and pull the board upward to permit access to the potentiometer terminals.

( ) 5. Replace the Horizontal Position potentiometer with the potentiometer and standoff bushing from the kit. Also use the old potentiometer spacer, washer and lockwasher to mount the new potentiometer.

( ) 6. Reinstall the 'A' SWEEP Generator circuit board with the 6 screws removed in step 4.

( ) 7. Mount and secure the new charcoal and red knobs (from kit) with the white index dots positioned the same as the index dots on the 'A' TRIGGER LEVEL knobs on the instrument.

( ) Check wiring for accuracy.

( ) 8. Reinstall the top and bottom covers removed in step 1.

THIS COMPLETES THE INSTALLATION.

( ) Correct your Manual parts list to agree with the new parts listed in the 050-0270-00 parts list.

JB:ls

PARTS REPLACEMENT KIT

SILICON DIODE

050-0290-00

For the following Tektronix Oscilloscopes:

Type 422	s/n	100-3079
Type 453	s/n	100-2589*
Type 453-210H	s/n	100-2589*
Type 503	s/n	4230-7441*
Type RM503	s/n	2960-5159*

DESCRIPTION

Silicon diode assembly 152-0249-00 replaces 152-0173-00, which is no longer available from the manufacturer. The new assembly consists of two diodes in series, encapsulated in silicone rubber.

Each of the above instruments requires a resistor change to accommodate the new diode.

NOTE: If the serial number of your instrument is above those listed, or if this kit has already been installed, disregard the instructions, as P/N 152-0249-00 is a direct replacement.

*Some instruments within range given may have been factory-modified.

Publication:
Instructions for 050-0290-00
February 1966

PARTS LIST

Quantity	Description				Part Number
1 ea	Diode, silicon, assembly				152-0249-00
1 ea	Spool, w/3 ft. silver-bearing solder				214-0210-00
1 ea	Resistor, comp,	1 k	1/2W	10%	302-0102-00
1 ea	Resistor, comp,	1.6 k	1/4W	5%	315-0162-00
1 ea	Resistor, comp,	430 Ω	1/4W	5%	315-0431-00
1 ea	Resistor, prec,	10.0 k	1/8W	1%	321-0289-00

INSTRUCTIONS

IMPORTANT: When soldering to the ceramic strips, use the silver bearing solder supplied with this kit.

A. TO REPLACE D439 ON TYPE 422:

Replace the following components on the Trigger and Sweep Generator Board (right side of instrument) with parts from the kit (see Fig 1):

( ) R424, 9.53 k 1/8W 1%, with 10.0 k 1/8W 1% resistor.

( ) D439, single diode, with diode assembly.

THIS COMPLETES THE INSTALLATION.

( ) Enter the new parts in your Instruction Manual parts list.

B. TO REPLACE D533 ON TYPE 453 OR 453-210H:

Replace the following components on the 'A' Sweep Board (bottom, towards right side of instrument), with parts from kit (see Fig 2):

( ) R509, 1 k 1/4W 5%, with 430 Ω 1/4W 5% resistor.

( ) R546, 1.5 k 1/4W 5%, with 1.6 k 1/4W 5% resistor.

( ) D533, single diode, with diode assembly.

THIS COMPLETES THE INSTALLATION.

( ) Enter the new parts in your Instruction Manual parts list.

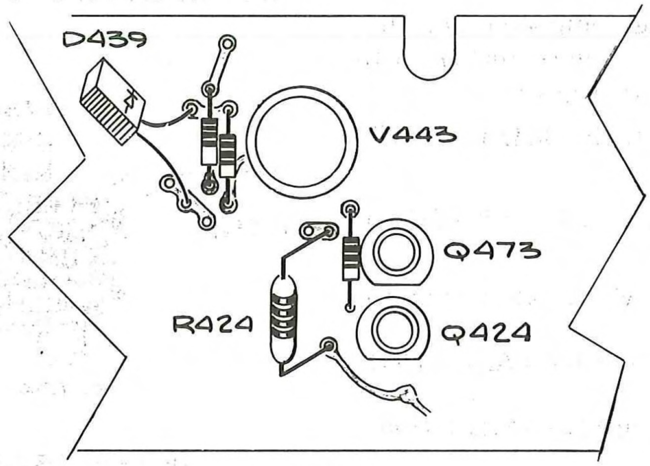

D439
V443
Q473
R424
Q424

Fig 1

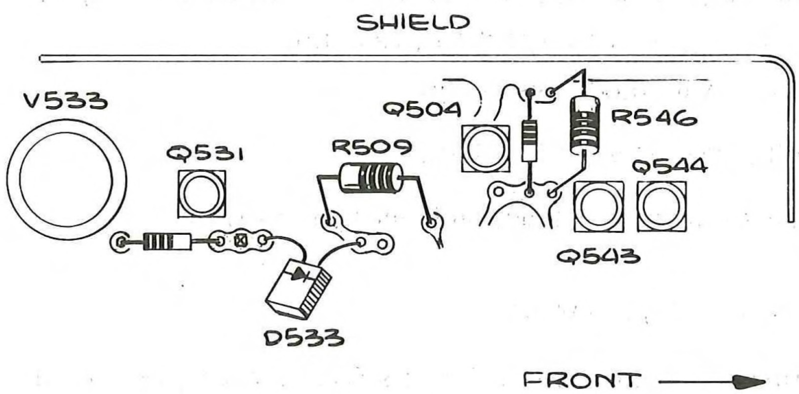

SHIELD
V533
Q504
R546
Q531
R509
Q544
Q543
D533
FRONT

Fig 2

INSTRUCTIONS (cont)

C. TO REPLACE D742 ON TYPE 453 OR 453-210H:

Replace the following components on the 'B' Sweep Board (top of instrument), with parts from the kit (see Fig 3):

( ) R704, 1 k 1/4W 5%, with 430 Ω 1/4W 5% resistor.

( ) R755, 1.5 k 1/4W 5%, with 1.6 k 1/4W 5% resistor.

( ) D742, single diode, with diode assembly.

THIS COMPLETES THE INSTALLATION.

( ) Enter the new parts in your Instruction Manual parts list.

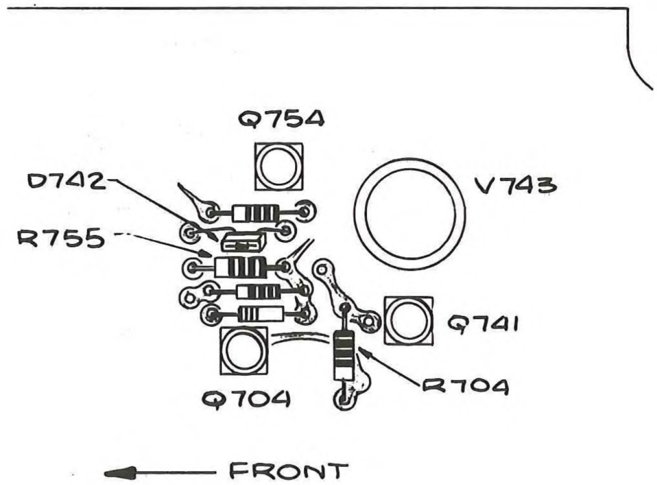


Fig 3

D. TO REPLACE D152 ON TYPE 503:

Replace the following components with parts from the kit (see Fig 4):

( ) R147, 1.5 k 1/2W 10%, with 1 k 1/2W 10% resistor

( ) D152, single diode, with diode assembly.

THIS COMPLETES THE INSTALLATION.

( ) Enter the new parts in your Instruction Manual parts list.

E. TO REPLACE D152 ON TYPE RM503:

Replace the following components with parts from the kit (see Fig 5):

NOTE: Temporarily lift one end of components on ceramic strips above, for access.

( ) R147, 1.5 k 1/2W 10%, with 1 k 1/2W 10% resistor.

( ) D152, single diode, with diode assembly.

THIS COMPLETES THE INSTALLATION.

( ) Enter the new parts in your Instruction Manual parts list.

CH:cet

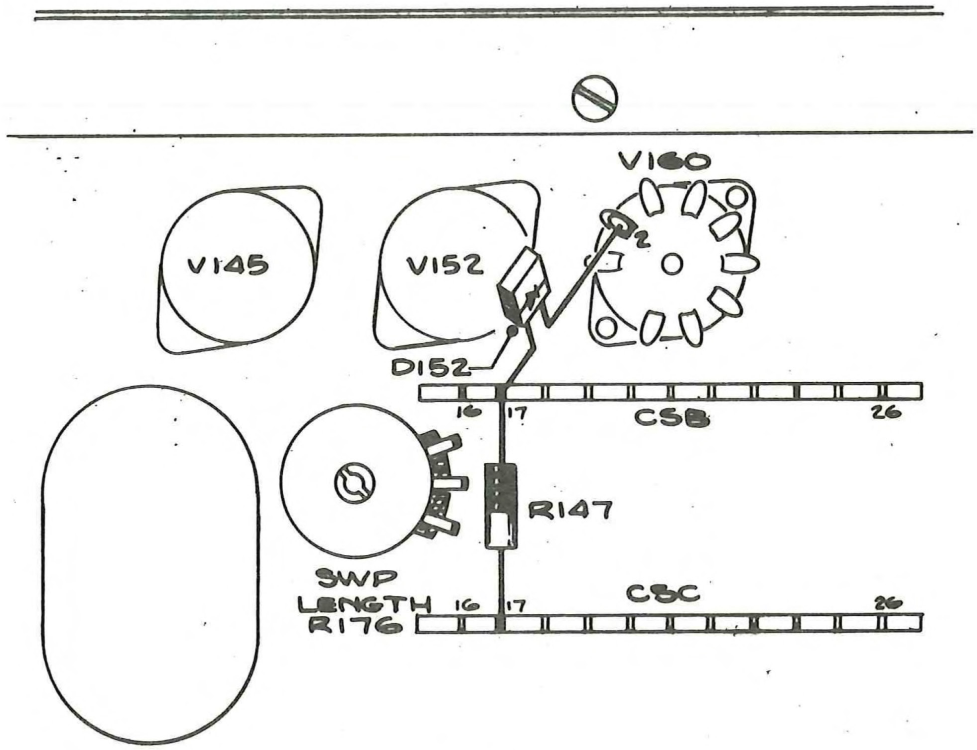

V160
V145
V152
2
D152
16
17
CSB
26
R147
SWP
LENGTH
R176
16
17
CSC
26

Fig 4

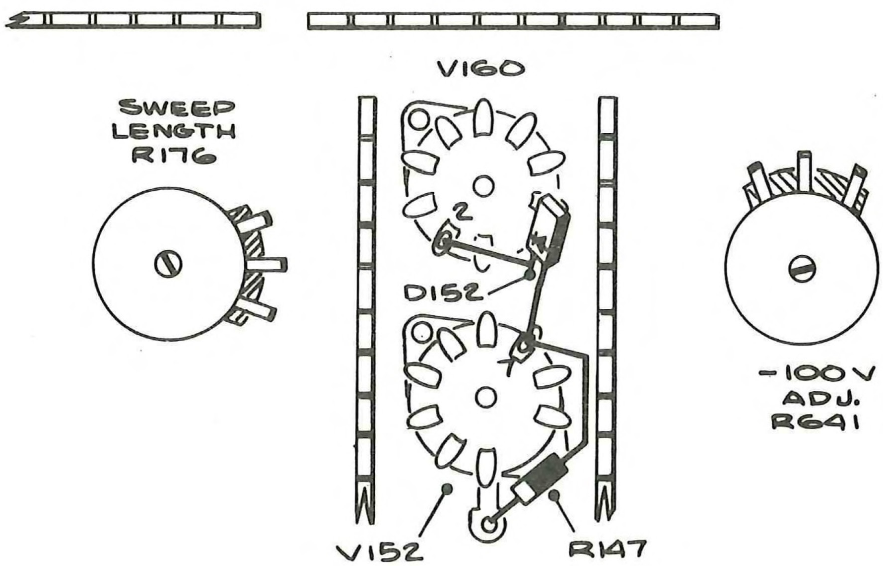

V160
SWEEP
LENGTH
R176
2
D152
-100V
ADJ.
R641
V152
R147

Fig 5

PARTS REPLACEMENT KIT

HORIZONTAL DISPLAY SWITCH

For Tektronix Type 453 Oscilloscopes
Serial numbers 100-2499*

050-0296-00

DESCRIPTION

Horizontal Display switch 262-0725-01 replaces 262-0725-00.

The new switch eliminates excessive horizontal jitter which is apparent when operating in the 10X MAG position.

The new switch is a direct replacement except for the addition of two capacitors C804 and C808, two resistors R804 and R808 and the removal of a grounded conductor shield.

NOTE: If the serial number of your instrument is above those listed, or if this kit has already been installed, disregard the instructions as P/N 262-0725-01 is a direct replacement.

* Some instruments above s/n 811 were factory modified.

Publication:
Instructions for 050-0296-00
March 1966

PARTS LIST

Quantity	Part Number	Description
1 ea	262-0725-01	Switch, wired, HORIZ DISPLAY
1 ea	283-0059-00	Capacitor, cer, 1 µF 25V
1 ea	315-0822-00	Resistor, comp, 8.2k 1/4W 5%

INSTRUCTIONS

The 262-0725-01 switch is a direct replacement for 262-0725-00 except for the following additions:

( ) 1. Add C804, 1 µF 25 V capacitor (from kit), between center terminal of the HORIZONTAL POSITION potentiometer (front section) and the vacant hole in the MAG ON neon holder. Don't solder at the neon holder yet.

( ) 2. Add R804, 8.2k 1/4W 5% resistor, between W1-6R of the HORIZONTAL DISPLAY switch and the vacant hole in the MAG ON neon holder. Solder.

NOTE: The following method is used to identify the HORIZONTAL DISPLAY switch terminals:

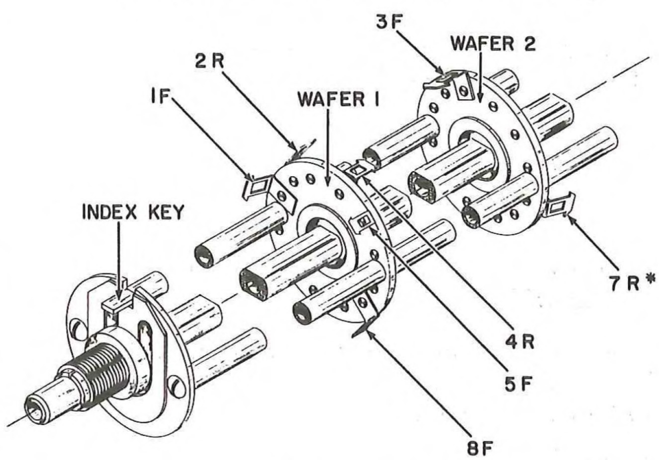
The wafers are numbered from front to rear.

The contact positions are numbered 1 thru 12 relative to the index key, as shown in the drawing.

The contacts have an 'F' or 'R' suffix which denotes that they are on the front or rear of the wafer.

Example: W2-7R (denoted by * on drawing) is contact #7 on rear of wafer 2.

(TYPICAL SWITCH CONFIGURATION)



( ) 3. Cut off the exposed shield from the 3-conductor cable grounded on the 'B' CAL switch SW740Y, located on the swing-out control panel on the right side of the instrument.

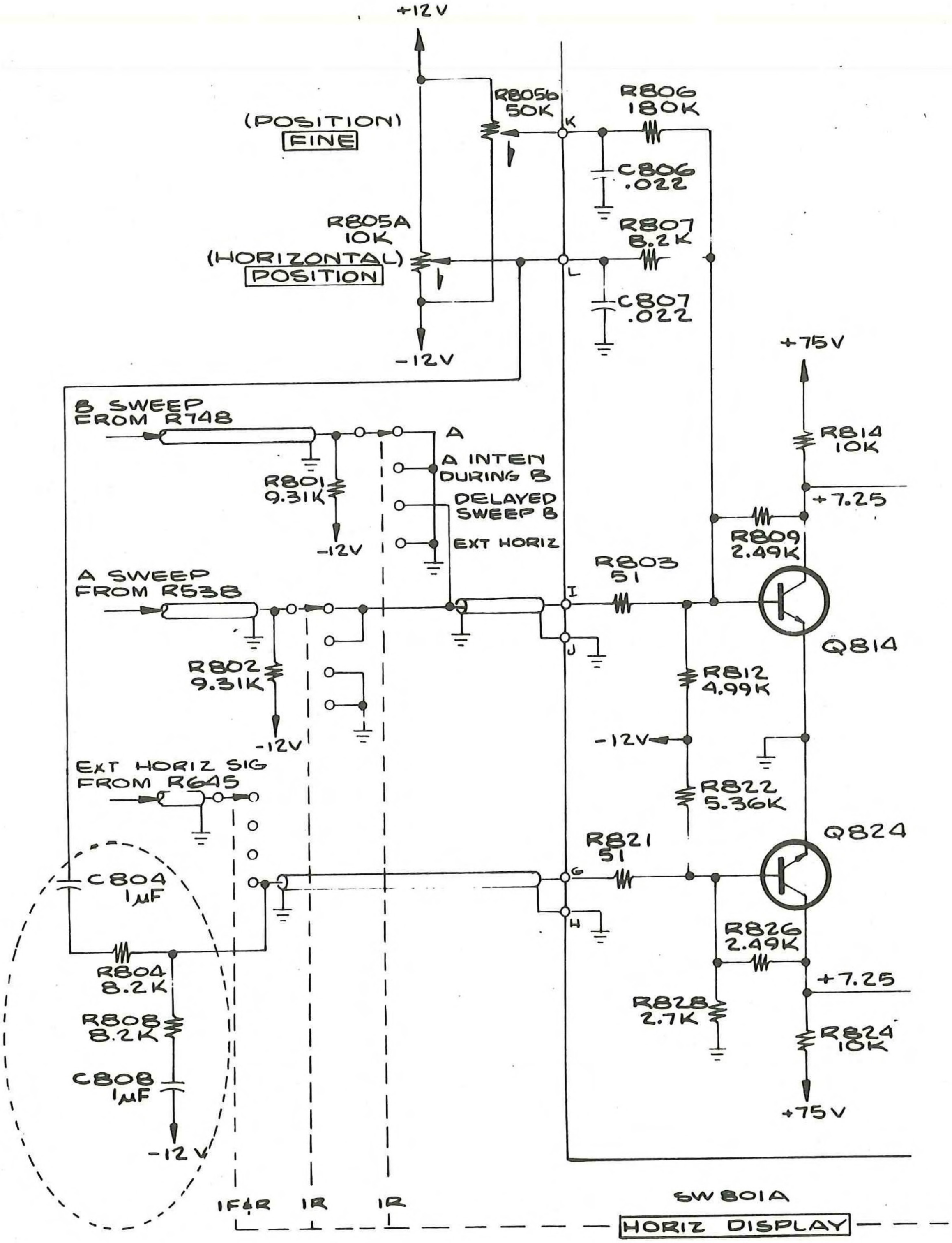
THIS COMPLETES THE INSTALLATION.

( ) Check wiring for accuracy.

( ) Correct the Horizontal Amplifier circuit schematic and parts list in your Manual as indicated below:

Ckt #	Part Number	Description
C804	283-0059-00	1.0 µF 25 V cer
C808	283-0059-00	1.0 µF 25 V cer
R804	315-0822-00	8.2k 1/4W 5%
R808	315-0822-00	8.2k 1/4W 5%
SW801A	262-0725-01	HORIZONTAL DISPLAY/MAG
SW801B	262-0725-01	HORIZONTAL DISPLAY/MAG

DF:ls



PARTIAL HORIZ. AMP.
SCHEMATIC

PARTS REPLACEMENT KIT

Z AXIS/CRT CIRCUIT BOARD, UNWIRED

050-0302-00

For Tektronix Type 453 Oscilloscopes
Serial numbers 100-3440

DESCRIPTION

Z Axis/CRT circuit board, 388-0641-01, replaces 388-0641-00 previously used. Terminals "AC" and "AD" and associated cable wires were removed from the circuit board to reduce cable crosstalk.

The circuit was completed by adding a wire directly from HV transformer terminal #4 to Q930 base.

In addition, the ground circuit for the HV box was changed to reduce vertical trace aberrations from the unblanking pulse.

NOTE: If the serial number of your instrument is above those listed or if this kit has been installed, disregard the instructions as part number 388-0641-01 is a direct replacement.

Publication:
Instructions for 050-0302-00
June 1966

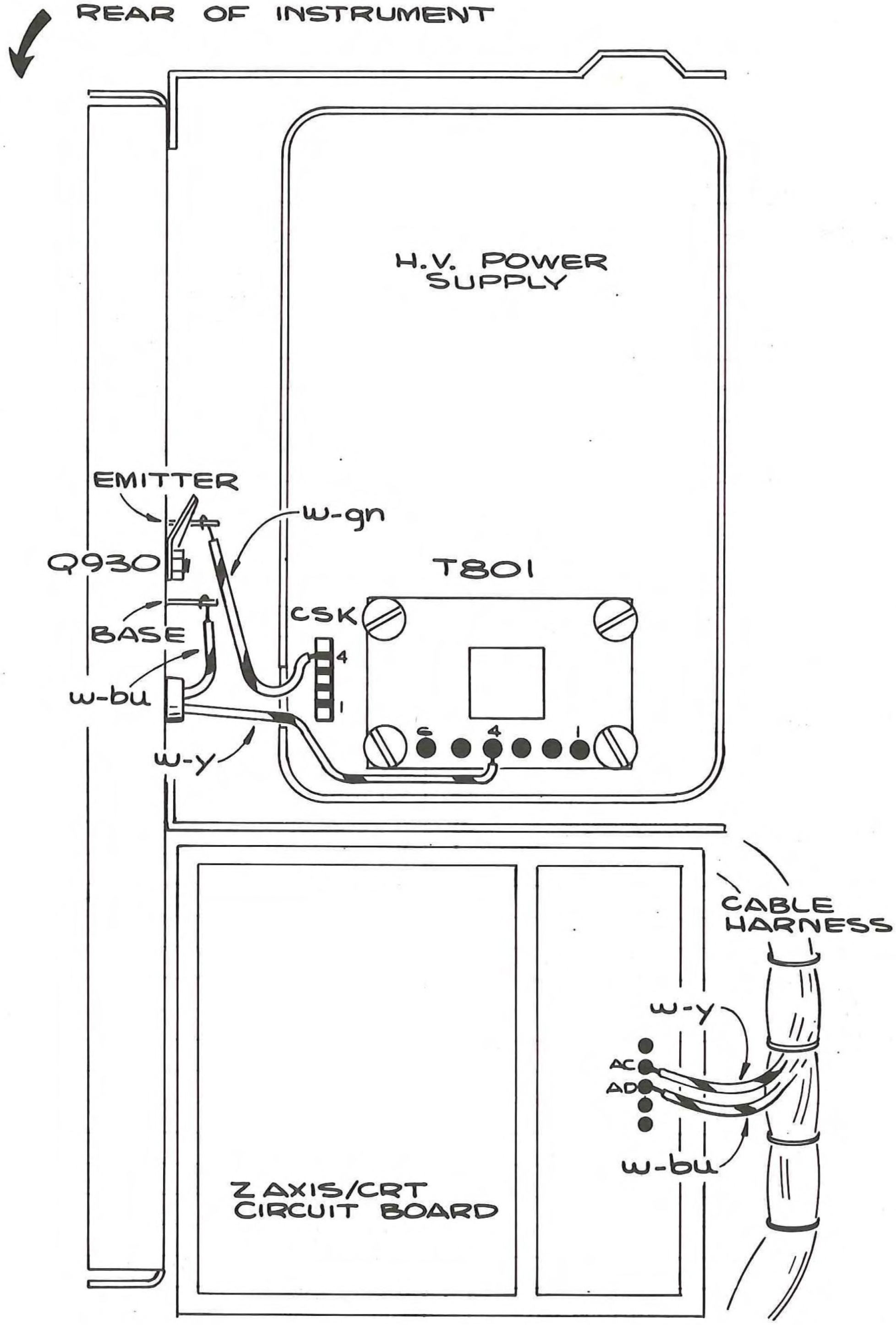

REAR OF INSTRUMENT
H.V. POWER
SUPPLY
EMITTER
w-gn
Q930
T801
BASE
CSK
4
1
w-bu
w-y
6
4
1
CABLE
HARNESS
w-y
AC
AD
w-bu
Z AXIS/CRT
CIRCUIT BOARD

Fig. 1

PARTS LIST

Quantity	Part Number	Description		
1 ea	388-0641-01	Circuit board, Z Axis/CRT		
1 ea	(175-0527-00)	Wire, #22 solid,	2-1/2 in.	white
1 ea	(175-0529-00)	Wire, #26 stranded,	5 in.	white-yellow

INSTRUCTIONS

A. TO REPLACE THE CIRCUIT BOARD:

( ) 1. Remove the top and bottom instrument covers and turn the instrument upside down.

( ) 2. Remove the Z Axis Input ground strap located at the rear of the instrument.

( ) 3. Remove the four securing screws and rear overlay plate.

NOTE: Refer to Fig. 1 while performing steps 4 through 10.

( ) 4. Remove the "DANGER HIGH VOLTAGE" cover.

( ) 5. Remove the plastic cover (200-0620-00) from the HV Power Supply.

( ) 6. Locate the Z AXIS/CRT circuit board terminals "AC" and "AD". Cut the white-yellow and white-blue wires close to the cable harness and remove the pin connectors from terminals "AC" and "AD".

( ) 7. Replace the old Z AXIS/CRT circuit board with the new 388-0641-01 circuit board from the kit.

( ) 8. Unsolder the white-yellow wire connected to the HV transformer terminal #4 and cut the wire close to the cable harness.

( ) 9. Unsolder the white-blue wire connected to the base of Q930 and cut the wire close to the cable harness.

( ) 10. Solder a 5 in. length of #26 white-yellow wire (from kit) between HV transformer terminal #4 and base of Q930.

B. TO CHANGE THE GROUND CIRCUIT:

( ) 1. Remove the 3-1/2 in. length of #26 stranded white-green wire between CSK-4, near T801, and emitter of Q930 (see Fig. 1).

( ) Move the remaining white-green wire from CSK-4 to the emitter of Q930.

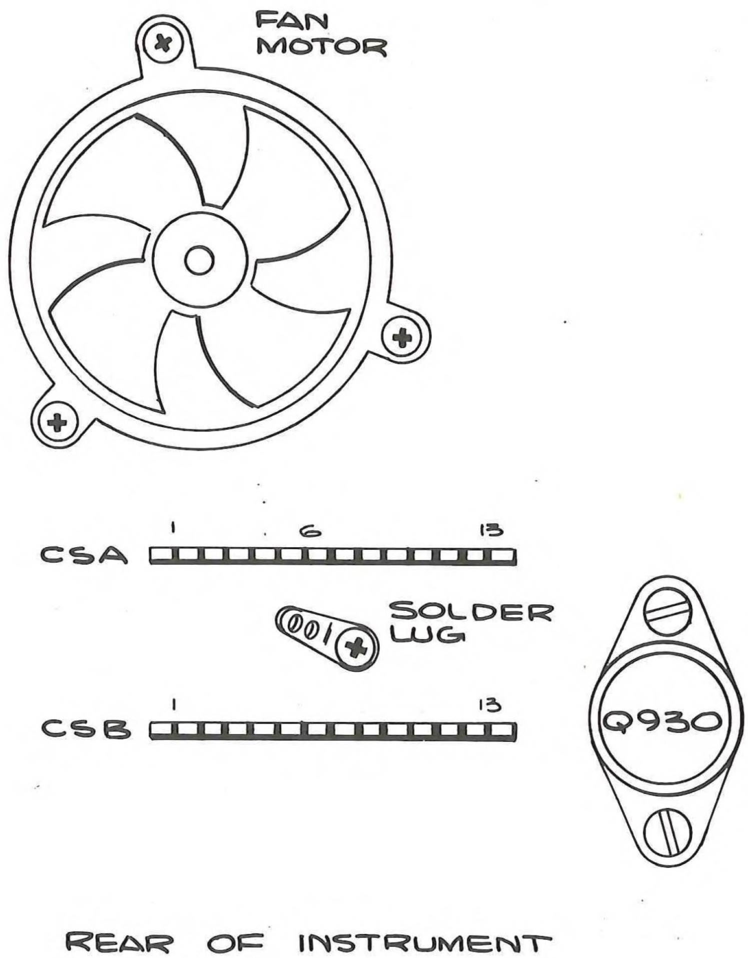

FAN
MOTOR
1
6
13
CSA
SOLDER
LUG
1
13
CSB
Q930
REAR OF INSTRUMENT

Fig. 2

B. (cont)

( ) 2. Solder a 2-1/2 in. length of #22 solid white (from kit) to CSK-4 near T801.

( ) Dress the wire through the plastic grommet in the rear bulkhead plate to the solder lug shown in Fig. 2 (DO NOT solder yet).

( ) 3. Unsolder the #22 white stranded wire from CSA-6 (see Fig. 2) and solder it, along with the wire installed above, to the solder lug shown in Fig. 2.

( ) Reinstall components removed in steps A-5 through A-1 respectively.

THIS COMPLETES THE INSTALLATION.

( ) Check wiring for accuracy.

Change the part numbers in your Manual Parts List as follows:

( ) Z AXIS/CRT circuit board (unwired) from 388-0641-00 to 388-0641-01.

( ) Z AXIS/CRT circuit board (wired assembly w/transistors) from 670-0414-00 to 670-0414-03.

( ) "A" Sweep cable from 179-0995-00 to 179-0995-01.

Change the following point 'A' references, on the Manual "CRT CIRCUIT" schematic as follows:

( ) Change "TO ALL POINTS MARKED 'A'", located near the negative terminal of C937, to read "TO EMITTER Q930."

( ) Below emitter lead of Q930 which reads 'A', change to read "TO C937."

( ) T930 terminal #5 which reads 'A', change to a ground symbol.

( ) C961 which reads 'A', change to a ground symbol.

( ) R963 which reads 'A', change to a ground symbol.

JB:cet

PARTS REPLACEMENT KIT

Z AXIS/CRT WIRED CIRCUIT BOARD WITH TRANSISTORS

For Tektronix Type 453 Oscilloscopes
Serial numbers 100-3440

050-0304-00

DESCRIPTION

Z Axis/CRT wired circuit board with transistors, 670-0414-03, replaces 670-0414-00 previously used.

Terminals "AC" and "AD" and associated cable wires were removed from the circuit board to reduce vertical trace aberrations and cable crosstalk.

The circuit was completed by adding a wire directly from HV transformer terminal #4 to Q930's base.

In addition, the ground circuit for the HV box was changed to reduce vertical trace aberrations from the unblanking pulse.

NOTE: If the serial number of your instrument is above those listed or if this kit has been installed, disregard the instructions as part number 670-0414-03 is a direct replacement.

Publication:
Instructions for 050-0304-00
June 1966

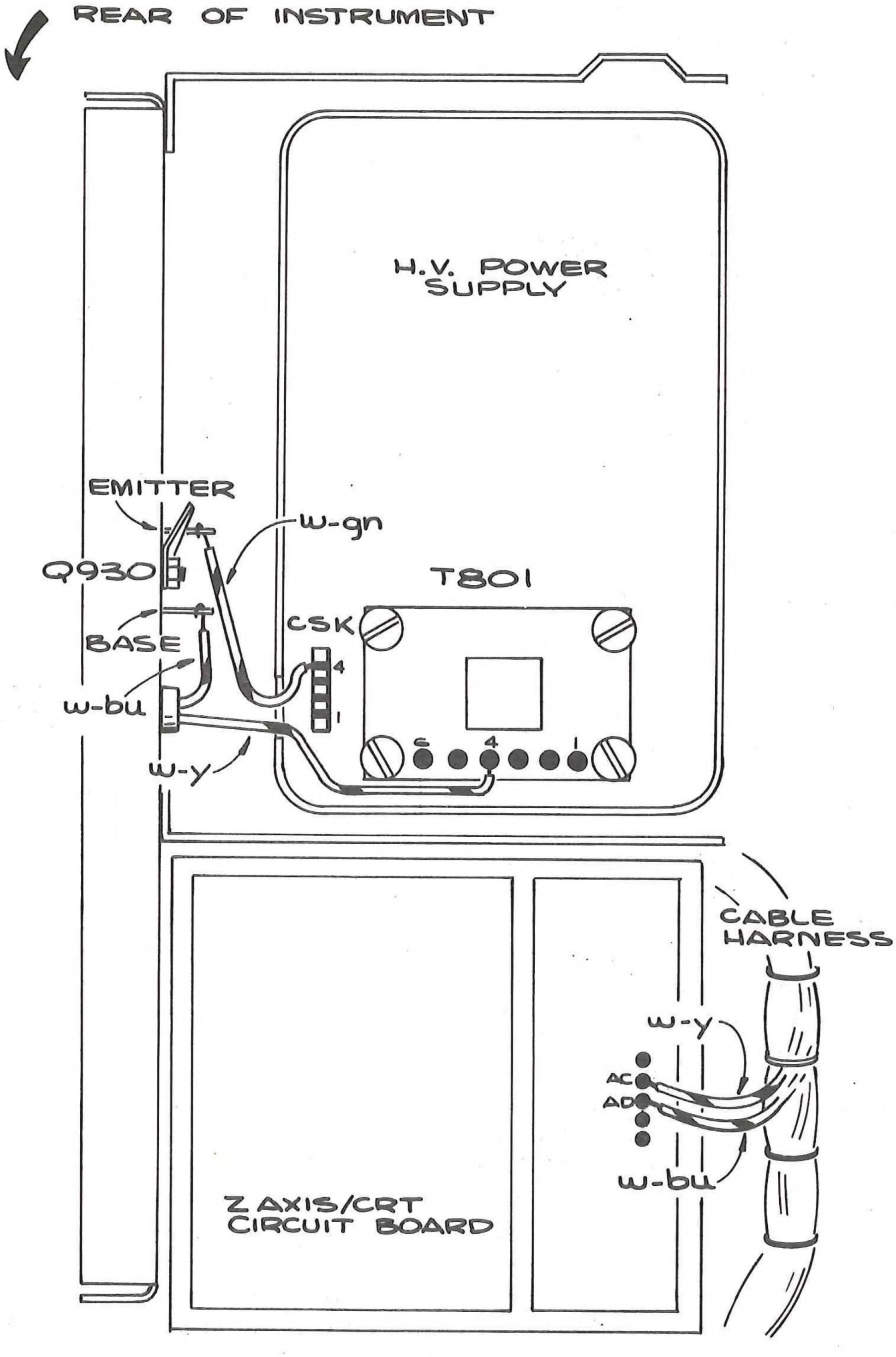

REAR OF INSTRUMENT
H.V. POWER SUPPLY
EMITTER
w-gn
Q930
T801
BASE
CSK
4
1
w-bu
w-y
6
4
1
CABLE HARNESS
w-y
AC
AD
w-bu
Z AXIS/CRT CIRCUIT BOARD

Fig. 1

PARTS LIST

Quantity	Part Number	Description		
1 ea	670-0414-03	Circuit Board, Z Axis/CRT		
1 ea	(175-0527-00)	Wire, #22 solid,	2-1/2 in.	white
1 ea	(175-0529-00)	Wire, #26 stranded	5 in.	white-yellow

INSTRUCTIONS

A. TO REPLACE THE CIRCUIT BOARD:

( ) 1. Remove the top and bottom instrument covers and turn the instrument upside down.

( ) 2. Remove the Z Axis Input ground strap located at the rear of the instrument.

( ) 3. Remove the four securing screws and rear overlay plate.

NOTE: Refer to Fig. 1 while performing steps 4 through 10.

( ) 4. Remove the "DANGER HIGH VOLTAGE" cover.

( ) 5. Remove the plastic cover (200-0620-00) from the HV Power Supply.

( ) 6. Locate the Z AXIS/CRT circuit board terminals "AC" and "AD". Cut the white-yellow and white-blue wires close to the cable harness and remove the pin connectors from terminals "AC" and "AD".

( ) 7. Replace the old Z AXIS/CRT circuit board with the new 670-0414-03 wired circuit board with transistors from the kit.

( ) 8. Unsolder the white-yellow wire connected to the HV transformer terminal #4 and cut the wire close to the cable harness.

( ) 9. Unsolder the white-blue wire connected to the base of Q930 and cut the wire close to the cable harness.

( ) 10. Solder a 5 in. length of #26 white-yellow wire (from kit) between HV transformer terminal #4 and base of Q930.

B. TO CHANGE THE GROUND CIRCUIT:

( ) 1. Remove the 3-1/2 in. length of #26 stranded white-green wire between CSK-4 near T801 and emitter of Q930 (see Fig. 1).

( ) Move the remaining white-green wire from CSK-4 to the emitter of Q930.

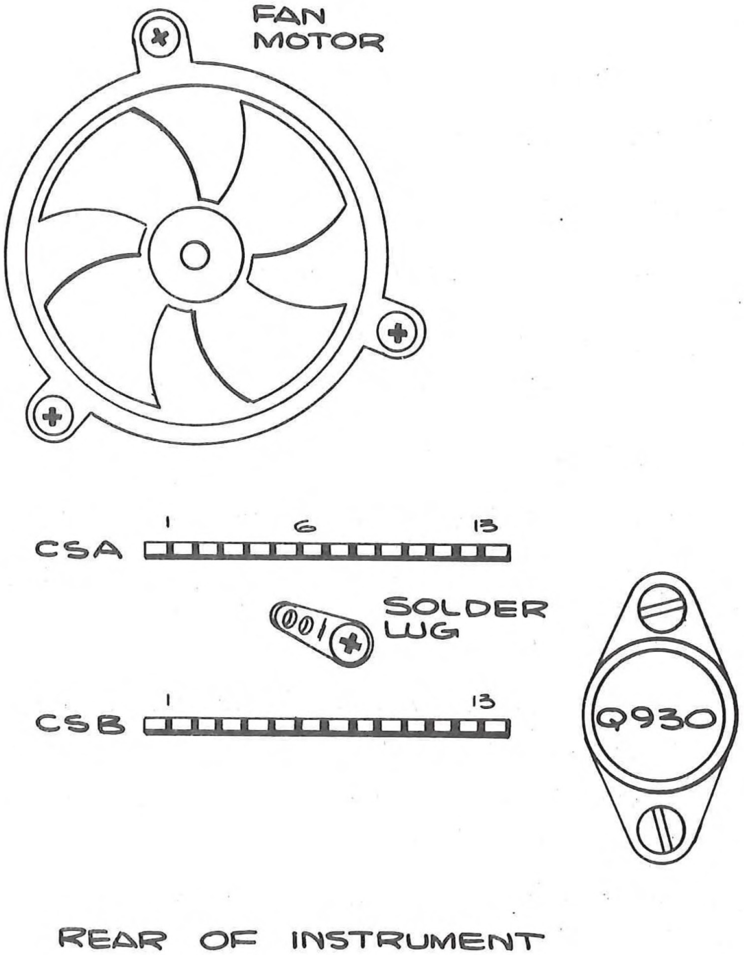

FAN
MOTOR
CSA
1
6
13
SOLDER
LUG
CSB
1
13
Q930
REAR OF INSTRUMENT

Fig. 2

INSTRUCTIONS (cont)

B. (cont)

( ) 2. Solder a 2-1/2 in. length of #22 solid white wire (from kit) to CSK-4 near T801.

( ) Dress the wire through the plastic grommet in the rear bulkhead plate to the solder lug shown in Fig. 2 (DO NOT solder yet).

( ) 3. Unsolder the #22 white stranded wire from CSA-6 (see Fig. 2) and solder it, along with the wire installed above, to the solder lug shown in Fig. 2.

( ) Reinstall components removed in steps A-5 through A-1 respectively.

THIS COMPLETES THE INSTALLATION.

( ) Check wiring for accuracy.

Change the part numbers in your Manual Parts List as follows:

( ) Z AXIS/CRT circuit board (unwired) from 388-0641-00 to 388-0641-01.

( ) Z AXIS/CRT circuit board (wired assembly w/transistors) from 670-0414-00 to 670-0414-03.

( ) "A" Sweep cable from 179-0995-00 to 179-0995-01.

Change the following point 'A' references, on the Manual "CRT CIRCUIT" schematic, as follows:

( ) "TO ALL POINTS MARKED 'A'", located near the negative terminal of C937, to read "TO EMITTER Q930".

( ) Below emitter lead of Q930 which reads 'A', change to read "TO C937".

( ) T930 terminal #5 which reads 'A', change to a ground symbol.

( ) C961 which reads 'A', change to a ground symbol.

( ) R963 which reads 'A', change to a ground symbol.

JB:cet

PARTS REPLACEMENT KIT

POWER SWITCH

For the following Tektronix Oscilloscopes:

Types 453 serial numbers 100-8989
R453 serial numbers 100-8989

050-0346-00

DESCRIPTION

Power switch 260-0716-02 replaces 260-0716-00, offering greater reliability and longer life.

The new switch is a direct replacement mechanically, but not electrically. For changes in wiring see Figs. 1 and 2 on page 2.

NOTE: If the serial number of your instrument is above those listed, or if this kit has been installed, disregard the instructions as PN 260-0716-02 is a direct replacement.

Publication:
Instructions for 050-0346-00
January 1967

PARTS LIST

Quantity	Part Number	Description
1 ea	260-0716-02	Switch, toggle, SPDT

INSTRUCTIONS

( ) 1. Remove the top and bottom dust covers, and SW1101, Power switch.

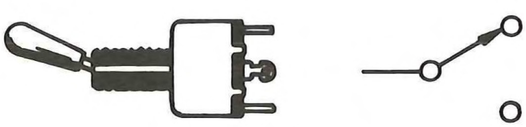
( ) 2. Install the new switch with the index slot down, and wire as follows (see Fig. 2):
( ) yellow-brown-red-brown wire to the center terminal
( ) white wire to the bottom terminal

THIS COMPLETES THE INSTALLATION.

( ) Check Power switch for proper operation.

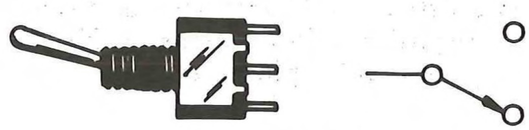
( ) Replace the top and bottom dust covers.

JT:ls



260-0716-00

FIG. 1



260-0716-02

FIG. 2

PARTS REPLACEMENT KIT

POWER CONNECTOR BASE AND GROUND POST

For Tektronix Type 453 Oscilloscopes
Serial numbers 100-488 *

DESCRIPTION

Power Connector Ground Post 129-0078-01 replaces Ground Post 129-0078-00 and Power Base 432-0056-01 replaces Power Base 432-0056-00.

The new Power Base provides a metal surface for mounting the Ground Post. The old Ground Post was mounted on a plastic surface which, because of cold flow, would allow the post to loosen, causing a poor ground connection.

The ground Post was changed from a stud-mounted type to a tapped type, secured with a screw.

The complete Power Connector Assembly, which includes the new post and base was changed from 131-0402-00 to 131-0402-01.

NOTE: If the serial number of your instrument is above those listed, or if this kit has been installed, disregard the instructions as part numbers 129-0078-01 and 432-0056-01 are direct replacements.

* The following instruments were Factory modified:

102	202	227	272
104-5	207	234-9	276
107	209	244	279-389
112-3	215	255	433
157	217	258	435
181	220-1	261-4	463
191	225	266-7	483

050-0368-00

Publication:
Instructions for 050-0368-00
April 1967

PARTS LIST

Quantity	Part Number	Description
1 ea	129-0078-01	Post, ground, 0.250 dia x 0.937 long
1 ea	210-0004-00	Lockwasher, int #4
1 ea	211-0008-00	Screw, 4-40 x 1/4 PH w/phil slot
1 ea	432-0056-01	Base, connector, molded

INSTRUCTIONS

( ) 1. Carefully stand the instrument on its face.

( ) 2. Remove the four screws (two flathead Phillips and two round head) holding the black plastic connector base in place. Save all hardware until completed.

( ) 3. Carefully lift out plastic base by pulling up with the ground post. Be careful not to lose the two spacers indicated in Fig. 1.

( ) 4. Assemble the new connector base as shown in Fig. 2, using the necessary parts from the old assembly.

( ) 5. Install the new base in the instrument, noting the location of the split lockwasher and the flatwasher.

THIS COMPLETES THE INSTALLATION.

( ) Check the operation and alignment of the 5-pin Power connector.

( ) Enter the new part numbers in your Instructions Manual Mechanical Parts List. Be sure to change the Power Connector Assembly number from 131-0402-00 to 131-0402-01.

KH:ls

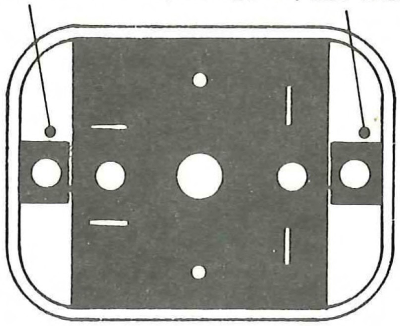

NOTE:
THESE SPACERS ARE LOOSE

FIG. 1

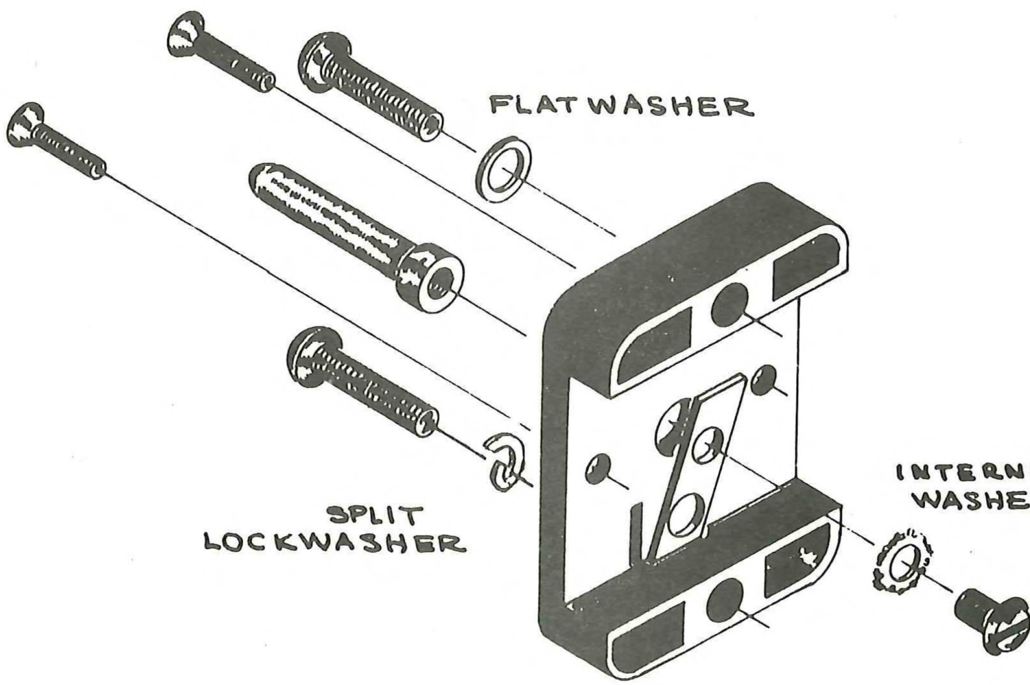

FLAT WASHER
SPLIT
LOCKWASHER
INTERNAL
WASHER

FIG. 2

MOD SUMMARY

MODIFICATION SUMMARY

453

This Modification Summary contains a summary of all production 'Modification Notices' for the Types 453, 453-210H and R453. Unless otherwise indicated, the summarized mod applies to all three instruments.

INDEX

MODIFICATION SUMMARY

VERTICAL AMPLIFIER

Mod No.	Description	Kit/MI No.	Eff SN	Page
M9661	Nuvistor Insulating Plate Removed	Info Only	500	6
M10083	Atten Response Improved	MI - 10083	1130	11
M10095	Discontinued Toroid Core Replaced	Info Only	2260	22
M10179	Atten Bal Range Change	MI - 10179	3150	31
M10416	T357 and T195 Cones Replaced	Info Only	2260	22
M10574	VOLTS/DIV Switch Noise Reduced	Info Only	2776	29
M10609	Oscillation Eliminated	MI - 10609	2500	27
M10618	GAIN Adj Range Extended	MI - 10618	3879	40
M10651	Transient Response Improved	Info Only	none	36.1
M10653-1	Atten Cap Range Centered	Info Only	3660	39
M10653-2	Gain and Bandwidth Improved	Info Only	3660	40
M10670	VOLTS/DIV Pot Coupling Improved	Info Only	4010	41
M10710	400 Hz Modulation Reduced	MI -10710	8950	51
M11050	Atten Cap Range Changed	Info Only	8150	50
M11089-1	Transient Response Improved	Info Only	5672	45
M11360	Oscillations Eliminated	MI - 11360	5670	45
M11475	Extensive Modification to Update Instr	Info Only	20000	68
M11556	Oscillations Eliminated	MI - 11556	8140	49
M11613	Metal Transistors Replaced	Info Only	12680	57
M11701	Atten Resistor Part Number Changed	Info Only	9670	53
M12000	Atten Resistor Part Number Changed	Info Only	11960	56
M12138	Shielding Improved to Reduce Trig Crosstalk	Info Only	20050	69
M12178	Decoupling Capacitors Tolerance Widened	Info Only	15430	67
M12542	C218 Value Optimized to Center CHOP Frequency	Info Only	20645	72
M12998	Variable Volts/Div Replaced	Info Only	23010	77
M13150	Atten Sub Assemblies Changed to Facilitate Assembly	Info Only	22530	73
M13688	UNCAL neons Prevented from random firing	MI-13688	23169	78

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MODIFICATION SUMMARY

TRIGGER A and B

Mod No.	Description	Kit/MI No.	Eff SN	Page
M10104	Coil Protected From Cleaner	Info Only	1490	14.1
M10315	Single Sweep Trig Improved	MI - 10315	1461	13
M11167	Source Switches Made Common to 454 Instr	Info Only	15000	67
M11236	Ext Trig BNC Connectors Changed	Info Only	7290	48
M11430-1	SOURCE & COUPLING Switches Rewired	MI - 11430	11860	55
M11475	Extensive Modifications to Update Instr	Info Only	20000	68
M11613	Metal Transistors Replaced	Info Only	12680	57
M12214-2	Auto Trigger Improved	MI - 12214-2	12680	59
M13009	Components Changed to Increase Sensitivity	Info Only	20225	70

SWEEP GENERATOR A and B

Mod No.	Description	Kit/MI No.	Eff SN	Page
M9661	Nuvistor Insl Plate Removed	Info Only	500	6
M10115	Horizontal Jitter Reduced	MI - 10115	1490	15
M10118-2	Single Sweep Reset Improved	MI - 10118-2	1810	18
M10118-3	Alternate Sweep Operation Improved	MI - 10118-3	1810	19
M10311	Slow Speed Timing Improved	MI - 10311	2590	28
M10416	Sweep Length Knob Replaced	Info Only	2100	22
M10483	Single Sweep Reset Improved	Info Only	3180	33
M10485-1	Cable Changed	Info Only	3440	34
M10592	Timing Resistors Replaced	Info Only	2370	24
M10626	Sweep Switching Improved	Info Only	4080	42
M10655	Capacitor Added to Reduce Jitter	MI - 10655	3450	37
M10813	Holdoff Time Improved	Info Only	5830	46
M11249	Resistor Parts Shortage Eliminated	Info Only	4970	44.1
M11475	Extensive Modification to Update Instr	Info Only	20000	68
M11611	Resistor Change Improve Triggering	Info Only	8934	50
M11613	Metal Transistors Replaced	Info Only	12680	57
M11680-1	Resistor Added to Reduce Jitter	Info Only	10460	54
M11680-2	Circuit Board Layout Changed	Info Only	10460	55
M12437	'A' Sweep Oscillations Eliminated	MI - 12437	12959	60
M12492	'B' Sweep Triggering Improved	MI - 12492	13208	61
M13688	VOLTS/DIV neons Prevented from random Firing	MI - 13688	23169	78

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MODIFICATION SUMMARY

LOW VOLTAGE POWER SUPPLY

HORIZONTAL AMPLIFIER

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MODIFICATION SUMMARY

HIGH VOLTAGE AND CRT

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MODIFICATION SUMMARY

MISCELLANEOUS

M9878	Power Connector Ground Improved	050-0368-00	489	3
M9960	Cover Hinge Noise Reduced	MI - 9960	none	5
M10006	Standard Accessory Added	Info Only	890	7
M10194	Power Cord Ground Improved	040-0424-00	1879	20
M10245	Probe Package Changed	Info Only	none	8
M10266	Standard Accessories Changed	Info Only	1800	17
M10600	Binding Post Assembly Changed	Info Only	5230	44.2
M10676	Current Loop Insulation Improved	MI - 10676	3458	38
M10949	Cabinet Latch Thumb Screws Changed	MI - 10949	13620	64
M11191	Zener Diodes Replaced with 5% Type	Info Only	none	44
M11241	Cover Changed	Info Only	6590	47
M11245	Mod 221T Made Regular Prod	Info Only	7327	49
M11361	Mod 799H Make Production Special	Info Only	6790	48
M11475	Extensive Modification to Update Instr	Info Only	20000	68
M11514	BNC Connectors Changed	Info Only	9780	54
M11786	New High Voltage Box Installed	Info Only	14680	66
M11893	Accessory Compartment Latch Assembly Improved	MI - 11893	14020	65
M12272	Cabinet Feet Changed	Info Only	14860	66
M12386	Common Rack Mounting Kit Prodided for 453 & 454	Info Only	22297	72.1
M12551	Rear Feet Changed to Softer Material	Info Only	22990	76
M13150	Atten Sub Assembly Changed to Facilitate Assembly	Info Only	22530	73
M13768	I. D. Tag Added to Power Cable	Info Only	26280	80

POWER CONNECTOR SUB-BASE AND GROUND POST CHANGED TO IMPROVE GROUND CONNECTION — See SQB — M9878

Effective Prod s/n 489 — Usable in field instruments s/n 100-488

w/exceptions					
102	181	215	234-9	266-7	435
104-5	191	217	244	272	463
107	202	220-1	255	276	483
112-3	207	225	258	279-389	
157	209	227	261-4	433	

FRONT PANEL SYMPTOM: None.

PROBLEM: The ground pin on the power connector was working loose, resulting in intermittent grounding. The post was tightened against the non-metalic sub-base and would loosen because of cold flow.

PRODUCTION CHANGE: The power connector sub-base was changed to provide a metal surface for the ground post to tighten against. The ground post was changed from a stud type with a nut, to tapped secured with a screw(see drawing)

Parts Replacement Kit 050-0368-00 is available to facilitate the replacement of ground post and base in pre-modified instrument.

Parts Removed:

Connector assembly, 5-pin		131-0402-00

Parts Added:

Connector assembly, 5-pin, consisting of:		131-0402-01
* Post, ground, .250 dia x .937 lg		129-0078-01
* Screw, 4-40 x 1/4 PHS phil slot		211-0008-00
* Base		432-0056-01
* Lockwasher, ext #4		210-0004-00
Screw, 4-40 x 7/16 FHS	(2)	211-0114-00
Pin, connecting, .312 x 1.359	(4)	214-0584-00
Actuator, toggle switch		214-0591-00
Switch, toggle, lever, raw		260-0715-00
Strap, ground, connection		346-0041-00
Rod, switch, actuator	(2)	385-0187-00
Bracket, switch		407-0172-00
Base, sub		432-0055-00

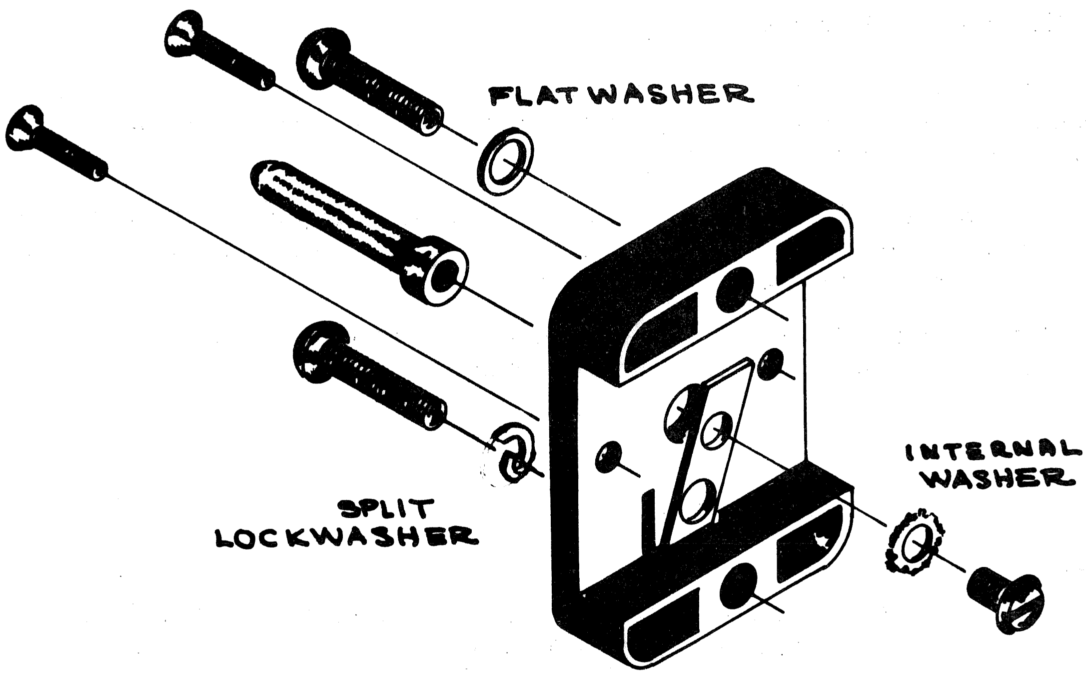
INSTALLATION INSTRUCTIONS:

Parts Required: Parts Replacement Kit 050-0368-00

continued

Installation Procedure:

Refer to kit instructions.



STAINLESS STEEL HINGE PINS REPLACED BY DELRIN TO ELIMINATE SQUEAK IN STORAGE COMPARTMENT DOOR

See SQB

M9960

453, 453-210H ONLY

Effective Prod SN not given

FRONT PANEL SYMPTOM: Noisy hinges on the Accessory Compartment door.

PROBLEM: Stainless steel hinge pins used on front cover Accessory Compartment door cause noise when operated.

PRODUCTION CHANGE: The stainless steel pin hinges were replaced with new Delrin* hinge pins to eliminate noise when door is operated.

Parts Removed:

Pin, hinge, 0.095 dia s.s. rod, 1.220" long	(2)	214-0631-00

Parts Added:

Pin, hinge, 0.092 dia Delrin, 1.735" long	(2)	214-0755-00

INSTALLATION INSTRUCTIONS:

Parts Required: See 'Parts Added'.

Installation Procedure:

a) Remove the stainless steel hinge pins by inserting the point of a curved soldering aid into the outside end of the hinge pin and pushing the hinge pin toward the opposite hinge. Then grasp knurled end of pin with needle nose pliers and remove.

b) Install the two new Delrin hinge pins by inserting the smaller diameter of the pin into the inside end of the hinge. Push pin until its head is flush with the end of the hinge.

A AND B SWEEP AND PREAMPLIFIER NUVISTOR INSULATING PLATE(S) REMOVED BECAUSE OF NO APPARENT NEED — INFORMATION ONLY — M9661

Effective Prod s/n 500 (approx)

FRONT PANEL SYMPTOM: None.

PROBLEM: There was no apparent need for the teflon insulating plate, and flux residue trapped under the plate provided a high resistance path for leakage currents. Sampling instruments are more susceptible to leakage currents than other instruments.

PRODUCTION CHANGE: The teflon insulating plate(s) were deleted from the instrument.

Parts Removed:

Plate, teflon insulating	(6)	387-0603-00

CRT NYLON CUSHION MATERIAL CHANGED TO SILICONE SPONGE TO ELIMINATE POSSIBLE CRT FACE FOGGING — See SQB — M9993

Effective Prod s/n 750 (approx) — Usable in field instruments s/n 100-749

FRONT PANEL SYMPTOM: None.

PROBLEM: Under high temperature conditions the vinyl CRT cushions were causing fogging of the silastic RTV used for banding the light pipe to the CRT face plate.

PRODUCTION CHANGE: The molded vinyl CRT cushions were replaced with die-punched silicone sponge cushions with an adhesive back.

Parts Removed:

Cushion, CRT molded vinyl satinflex, black, .180x.700x2.030	(4)	348-0070-00

Parts Added:

Cushion, CRT silicone sponge, .188x.690x2.030	(4)	348-0070-01

INSTALLATION INSTRUCTIONS:

Parts Required: See 'Parts Added'.

continued

Installation Procedure:

NOTE: Replacement of the CRT cushions requires the removal of the CRT shield.

a) Remove the instrument from the cabinet.

b) Remove the CRT socket and connecting wires.

c) Remove the red and brown wires which connect to the "Y AXIS ALIGNMENT" potentiometer R989.

d) Remove the white and white yellow wires which connect to the Beam Rotator coil.

e) Remove both graticule lamps.

f) Remove the screws and brackets which secure the rear of the CRT shield to the instrument.

g) Remove the CRT shield assembly from the instrument.

h) Loosen the bottom screw, located at the rear of the CRT shield, and remove the CRT.

i) Replace the four vinyl CRT cushions with the silicone sponge cushions.

k) Re-install the wires and components removed in the above steps.

BNC TO BINDER POST ADAPTER ADDED AS A STANDARD ACCESSORY — INFORMATION ONLY — M10006

Effective Prod s/n 890

FRONT PANEL SYMPTOM: None.

PROBLEM: Customer has requested that BNC to Binder Post Adapter be removed from the P6010 Mod 210H Probe package, and 2 adapters be added to the standard accessory list of the 453-210H.

PRODUCTION CHANGE: The BNC to Binder Post Adapter was removed from the probe kit and 2 adapters were added to the standard accessory list of the standard instrument and the Mod 210H.

Parts Removed:

None

Parts Added:

Adapter, BNC to Binder Post	(2)	103-0033-00

CRT FILAMENT VOLTAGE INCREASED TO RAISE CATHODE TEMPERATURE — INFORMATION ONLY — M10183

Effective Prod SN 899

The following instruments were shipped with M10183 installed:

156	459	633	714-20	772	800	839-40
254	462	640-61	722-7	774	806	843
272	464-5	663-78	729-36	779	808-9	860
407	474	680-2	741-50	781	811	866
418	477	684-5	752-3	785-7	814-6	870-1
449	479	687-9	755-9	790	818-22	876
453	593	700	762-4	792	825	879
455	616-9	702-12	766-8	795	830-7	899

FRONT PANEL SYMPTOM: Dim trace.

PROBLEM: The CRT cathode was not being operated at the optimum temperature to provide sufficient electron emission.

PRODUCTION CHANGE: The CRT filament voltage was increased by changing the value of R951 from 9.1Ω to 3.3Ω. See M10256 and M10716, M12245.

Parts Removed:

R951	Resistor, comp, 9.1Ω 1/2 W 5%	307-0063-00

Parts Added:

R951	Resistor, comp, 3.3Ω 1/2 W 5%	307-0053-00

PROBE PACKAGE 010-0186-00 UPDATED AT THE REQUEST OF IBM — INFORMATION ONLY — M10245

Effective Prod SN none given

FRONT PANEL SYMPTOM: None.

PROBLEM: None.

PRODUCTION CHANGE: The probe package 010-0186-00 contents were revised to meet IBM needs per their request.

Parts Removed:

Tube, insul molded blk poly	166-0404-00
Nose, probe assembly for IBM	206-0073-00
Tip, probe (hooked) assembly	206-0114-00

Parts Added:

Manual	070-0495-00
Tip, probe hook assy w/6-32 thread	206-0105-00
Clip, alligator	344-0046-00

CRT FILAMENT RESISTOR CHANGED TO MORE NEARLY OPTIMIZE THE CRT CATHODE OPERATING TEMPERATURE — See SQB — M10256

Effective Prod SN 900 — Usable in field instruments SN 100-899

w/exceptions									
102	260	358	456-8	601	679	728	778	810	842
104-5	262-4	369	461	610	683	737-40	782	812-3	844-5
107	266-7	441	466	623	686	751	786	817	848-59
112-3	276	444	468-70	626	697	754	789	823-4	861-5
207	279	448	475	629	701	760-1	797-8	826-9	867-9
244	337	451-2	555	637	712	765	801	838	872-5
258	345	454	583	662	721	769	803	840	877-99

FRONT PANEL SYMPTOM: Premature CRT failure.

PROBLEM: Life test data combined with a change in vendors for the heater structure has indicated that reliability will be improved by decreasing CRT filament current.

PRODUCTION CHANGE: The value of R951 was changed from 3.3Ω to 9.1Ω. See M10183 and M10716, M12245.

Parts Removed:

R951	Resistor, comp, 3.3Ω 1/2W 5%	307-0053-00

Parts Added:

R951	Resistor, comp 9.1Ω 1/2W 5%	307-0063-00

INSTALLATION INSTRUCTIONS:

Parts Required: See Parts listed below.

R951	Resistor, prec 9.3Ω 1/2W 1%	308-0427-00

NOTE: If R951 is 9.1Ω, it is not necessary to replace it as described by M10256. See M10716.

Installation Procedure:

a) Remove the top and bottom instrument covers.

b) Remove the "DANGER HIGH VOLTAGE" shield.

c) Remove the plastic HV cover.

NOTE: Refer to the drawing for the following component locations:

e) Remove the anode sleeve.

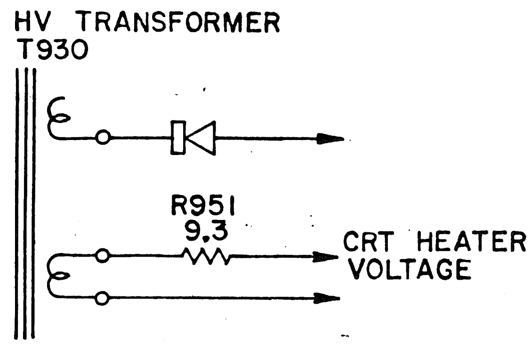
f) Remove the two HV transformer retaining screws.

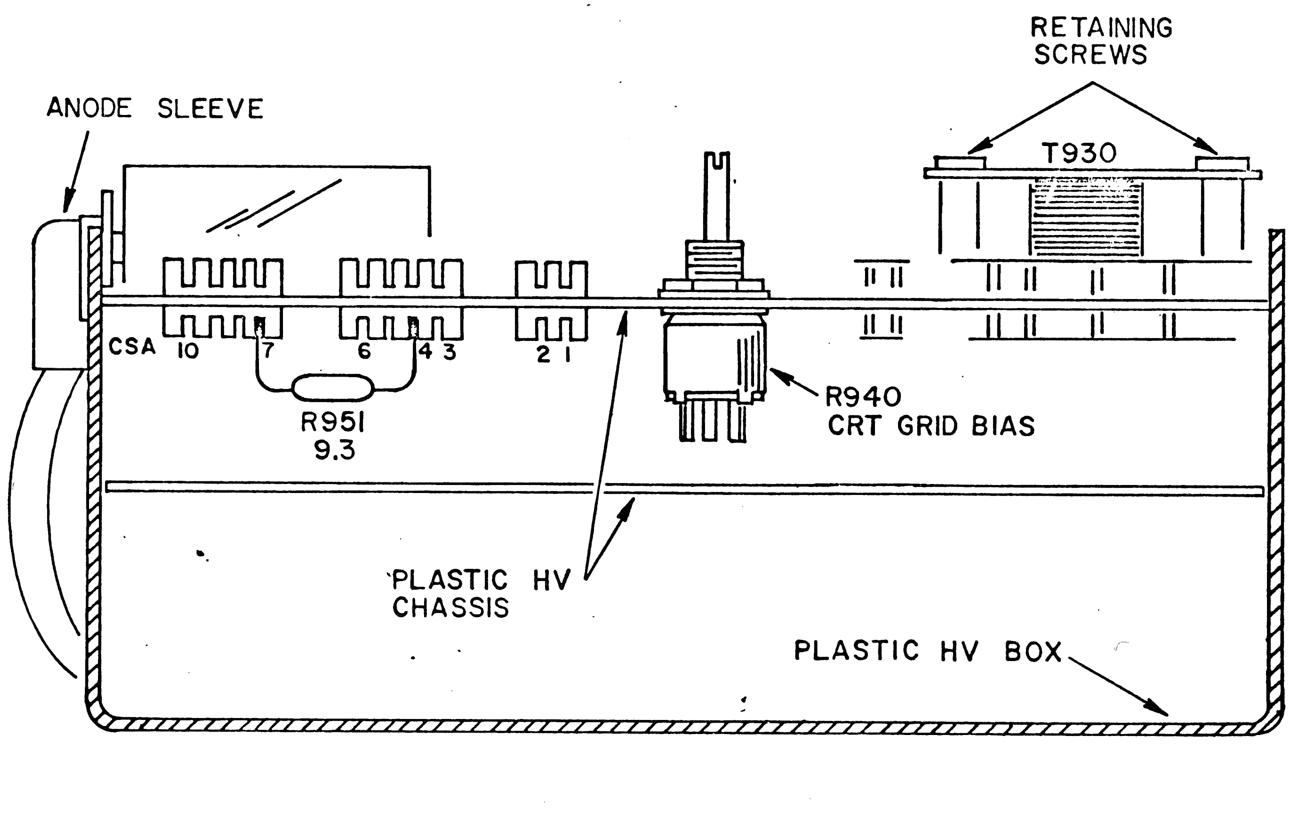
g) Carefully lift up the plastic HV chassis.

continued.

h) Replace R951 (3.3Ω 1/2W 5% resistor) with a 9.3Ω 1/2W 1% resistor between CSL-4 and CSL-7.

i) Reinstall the component parts removed in steps 6 through 1 respectively.





CHANNEL 1 AND 2 ATTENUATOR RESISTOR REPLACED WITH A COIL TO IMPROVE TRANSIENT RESPONSE

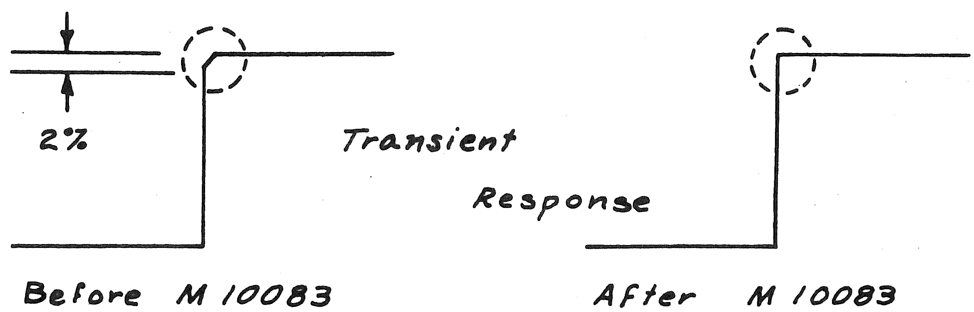
See SQB

M10083

Effective Prod s/n 1130

Usable in field instruments s/n 100-1129

FRONT PANEL SYMPTOM:



PROBLEM: High frequency compensation for 50mV, 0.5V and 5V attenuator positions on Channel 1 and 2 was not optimum.

PRODUCTION CHANGE: R6F (Channel 1) and R106F (Channel 2) were changed from 22Ω resistor to 80nH coils.

Parts Removed:

R6F, R106F	Resistor, comp, 22Ω 1/4W 5%	315-0220-00

Parts Added:

LR6F, LR106F	Coil, fixed, 80nH on form 315-0360-00	108-0365-00

INSTALLATION INSTRUCTIONS:

Parts Required:

See 'Parts Added'.

Installation Procedure: Use the following instructions to remove the Vertical Preamp unit.

a) Remove the screw (mounted with a washer) which holds the MODE-TRIGGER switch (rear of board) to the chassis. The other screw may be left in place.

b) Unsolder the connections on the MODE-TRIGGER switch which do not connect to the Vertical Preamp board.

c) Disconnect all pin connectors which lead off of the Vertical Preamp board.

d) Remove the attenuator shield and remove the nuts (four) located under this shield at each side of the INPUT connectors.

e) Remove the Channel 1 and 2 VOLTS/DIV, VARIABLE, POSITION, AC GND DC, MODE and TRIGGER knobs.

f) Remove the securing nuts on the VOLTS/DIV switches and the STEP ATTEN BAL controls.

g) Remove the three screws at the rear of the board.

continued

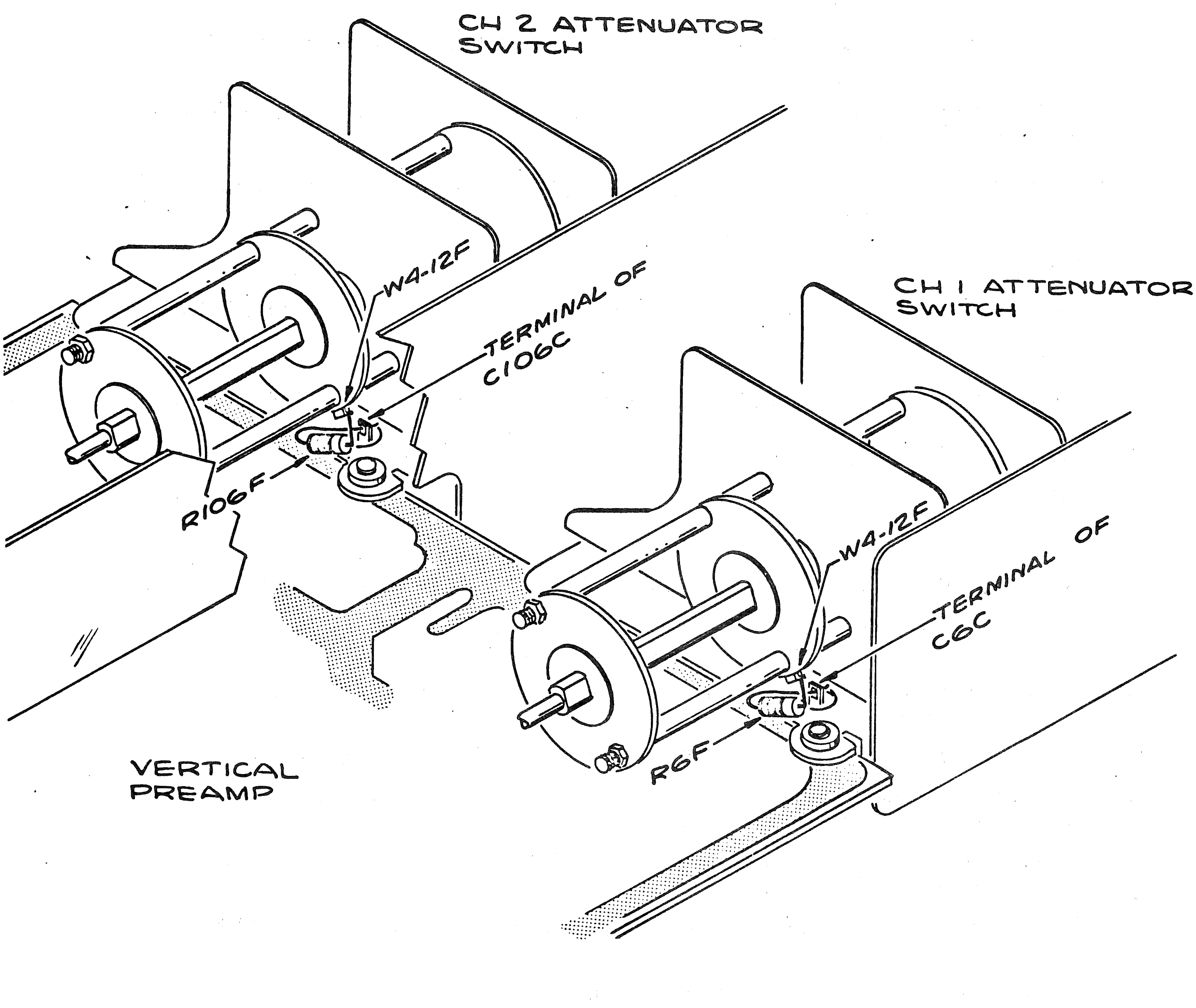
Installation Procedure:

h) Remove the screw and fiber washers located in the center of the circuit board.

i) Lift up on the rear of the assembly and slide it out of the instrument.

k) Replace resistors R6F and R106F, as shown in the drawing, with two 80nH fixed inductors LR6F and LR106F respectively.

m) Re-install the Vertical Preamp unit by performing steps i through a respectively.



'A' AND 'B' TRIGGER SLOPE SWITCH CONTACT GROUNDED TO ASSURE SINGLE SWEEP TRIGGERING — See SQB — M10315

Effective Prod SN 1461 — Usable in field instruments SN 100-1460

w/exceptions	107	555	929	1037	1131	1214	1269-70	1362-3
	207	626	946	1043-5	1133	1220	1272	1365-8
	244	637	958	1050-1	1135-40	1222-3	1278	1370-5
	258	679	960-1	1053-4	1142-51	1225-6	1282	1378
	262-4	713	965-8	1060	1153-7	1228-32	1283	1380-4
	266-7	778	972	1065-6	1159-62	1235-6	1286	1386-7
	276	786-7	978	1070-3	1164	1238-41	1291-4	1389-91
	279	812	981	1076-7	1166	1243-6	1295	1393-1439
	337	817	984	1080	1184-5	1248-50	1297-8	1441-2
	345	823	989	1092	1197	1252-5	1301-3	1444 8
	441	872	993	1104	1199	1256	1305	1450-9
	444	879	1000	1110-1	1202	1257-60	1310-50	
	456-7	883	1005	1117	1209	1262-3	1354-5	
	478	889	1037	1124	1211	1267	1357-60	

also 897, 899 and 908

FRONT PANEL SYMPTOM: Sweep will not trigger on a low rep-rate of a few seconds or longer.

PROBLEM: The collector of Q454 (Q654 in 'B' Trigger) was not returned to ground except through C456 and D456 (C656 and D656 in 'B' Trigger) in the + slope. The same was true of Q464 (Q664 in 'B' Trigger) in the - slope. This allowed the capacitor to charge from leakage current through the diodes. The resultant charge caused tunnel diode D475 (D675 in 'B' Trigger) to be back biased by an amount that could not be overcome by normal circuit action.

PRODUCTION CHANGE: The unused side of the 'A' and 'B' Trigger Slope switches was grounded by adding a #22 wire strap between the long clip at 6A and the detent plate. See Before and After schematics on following page.

Parts Added:

Wire, #22 solid, bare — 176-0122-00

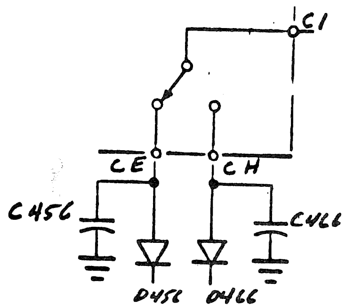
INSTALLATION INSTRUCTIONS:

Parts Required: See 'Parts Added'.

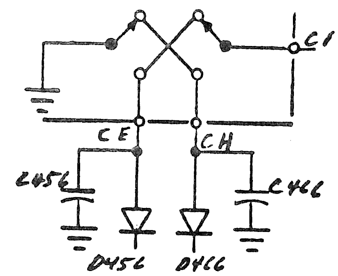
Installation Procedure:

Add a #22 bare wire between the unused contact and the front plate (ground) on the 'A' and 'B' TRIGGER SLOPE switches. (See drawing on following page).

continued

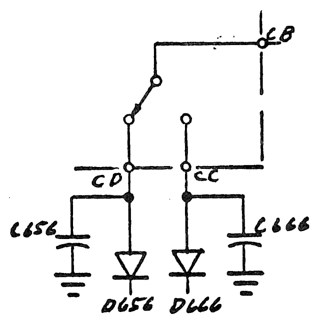


BEFORE

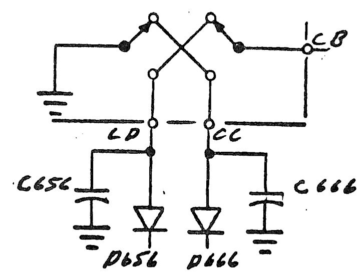


AFTER

PARTIAL 'A' TRIG GEN SLOPE SWITCH SW455

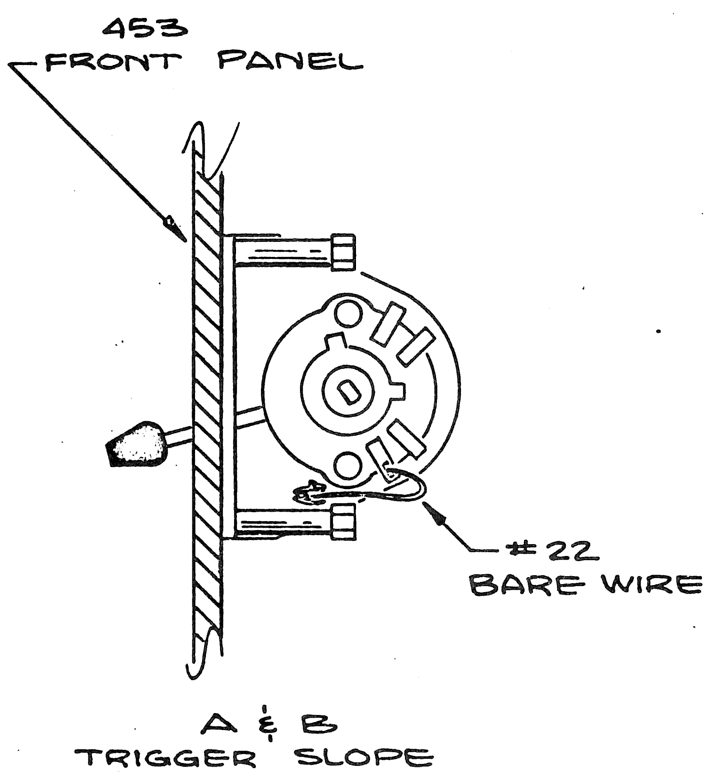


BEFORE



AFTER

PARTIAL 'B' TRIG GEN SLOPE SWITCH SW655



A & B
TRIGGER SLOPE
SWITCH

'A' TRIGGER COIL PROTECTIVE COATING ADDED TO PREVENT DAMAGE FROM CIRCUIT BOARD CLEANER

INFORMATION ONLY

M10104

Effective Prod s/n 1490

FRONT PANEL SYMPTOM: None.

PROBLEM: L469 was being damaged by circuit board cleaner.

PRODUCTION CHANGE: A protective coating of "Lonco 33" was added to L469.

Parts Removed:

L469	Coil, fixed, 0.2 µH	108-0181-00

Parts Added:

L469	Coil, fixed, 0.2 µH, Lonco 33 coating	108-0181-01

"A" OR "B" UNCAL NEON WIRE REPLACED WITH COAX TO ELIMINATE HORIZONTAL JITTER — See SQB — M10115

Effective Prod s/n 1490 — Usable in field instruments s/n 100-1489

FRONT PANEL SYMPTOM: Horizontal jitter (60 Hz).

PROBLEM: The components on the timing switch were picking up 60 Hz radiation from the wire connecting "A" or "B" Uncal neon to the "A" Variable Time/Div control. The 60 Hz was actually getting into this wire via radiation into the wire connecting the "B" Variable Time/Div Cal/Uncal switch to the "A" Variable Time/Div Cal/Uncal switch.

PRODUCTION CHANGE: The wire connecting the "UNCAL A or B" neon to the "A" Variable Time/Div Cal/Uncal switch was changed to a coaxial cable. The shield is grounded only on the end connecting to the "A" Variable Cal/Uncal switch.

Parts Removed:

Wire, insulated, no.26 stranded	175-0529-00

Parts Added:

Cable, coax, 50Ω Imp 30pF per ft. (12-1/2")	175-0284-00

INSTALLATION INSTRUCTIONS:

Parts Required: See 'Parts Added'.

Installation Procedure:

Replace the no.26 white-gray wire connected between the "UNCAL A or B" neon holder and the "A VARIABLE CAL" potentiometer (located on the "A AND B TIME/DIV" switch) with a 12-1/2" length of 50Ω coaxial cable as follows:

a) Prepare cable as shown in Fig. 1.

b) Solder the single center conductor end to the neon holder terminal.

c) Solder the opposite end of the cable to the "A VARIABLE CAL" potentiometer as shown in Fig. 2.

continued

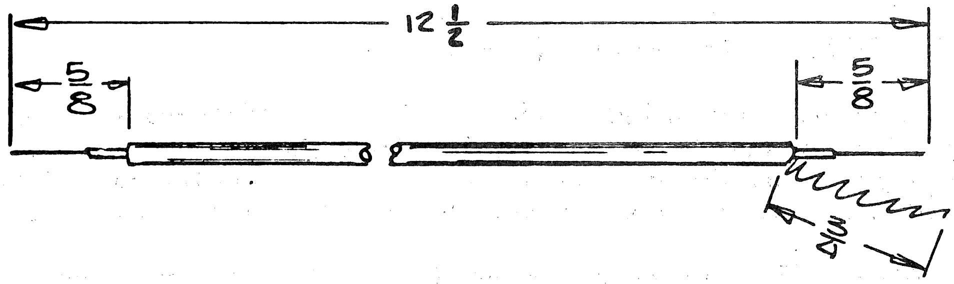


FIG. 1

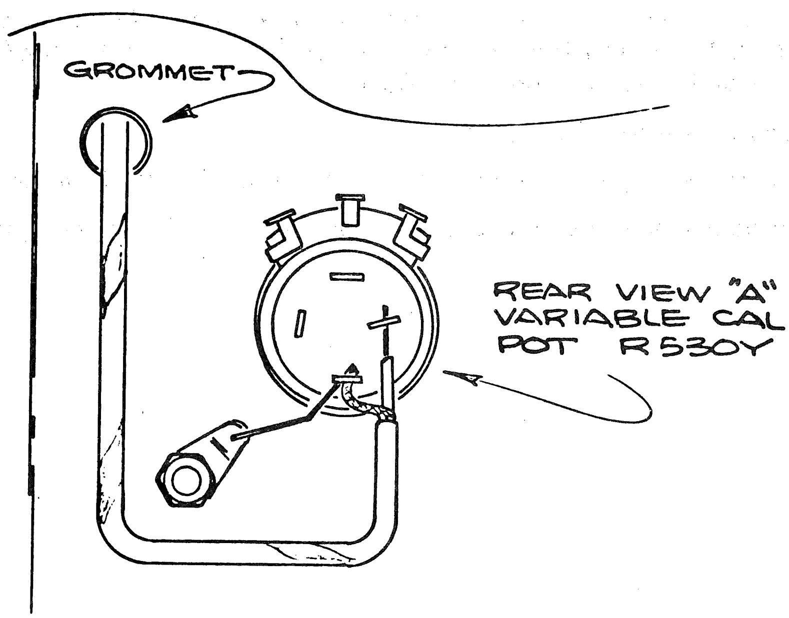


FIG. 2

STANDARD ACCESSORY LIST CHANGED TO INCLUDE SPARE FUSES — See SQB — M10266

Effective Prod s/n 1800 — Usable in field instruments s/n 100-1799

FRONT PANEL SYMPTOM: None.

PROBLEM: Spare fuses were not being shipped with the instrument.

PRODUCTION CHANGE: One complete set of fuses was added as a standard accessory. The fuses will be located in the plastic holder provided on the swing-out panel in the front cover.

Parts Added:

F937	Fuse, slo blo, 2A 2AG	159-0023-00
F1172	Fuse, fast blo, 1/2A 3AG	159-0025-00
F1204	Fuse, fast blo, 1/4A 3AG	159-0028-00
F1101, F1102	Fuse, slo blo, 4/5A 3AG	159-0018-00

INSTALLATION INSTRUCTIONS:

Parts Required:	Modification Kit	040-0422-00
Installation Procedure:	Refer to kit instructions.	

CRT ISOLATION SHIELD VOLTAGE DIVIDER IMPEDANCE LOWERED TO IMPROVE CRT PERFORMANCE — See SQB — M10118-1

Effective Prod s/n 1810 — Usable in field instruments s/n 100-1809

FRONT PANEL SYMPTOM: Edge focus changes with a change in displayed signal.

PROBLEM: Changes in CRT loading were causing the isolation shield voltage to vary, resulting in a change in the focus. This was because the impedance of the R971, R972 divider was too high.

PRODUCTION CHANGE: The isolation shield divider impedance was lowered by changing R971 from 22k, 1/4W, 10% to 3.3k, 1/4W, 5% and R972 from 47k, 1/4W, 10% to 6.8k, 1/2W, 5%. This change made the shield voltage much less susceptible to CRT load variations.

continued

Parts Removed:

R971	Resistor, comp, 22k 1/4W 10%	316-0223-00
R972	Resistor, comp, 47k 1/4W 10%	316-0473-00

Parts Added:

R971	Resistor, comp, 3.3k 1/4W 5%	315-0332-00
R972	Resistor, comp, 6.8k 1/2W 5%	301-0682-00

INSTALLATION INSTRUCTIONS:

Parts Required: See 'Parts Added'.

Installation Procedure:

a) Temporarily remove the metal "Z AXIS INPUT" strap located at the rear of the instrument.

b) Temporarily remove the four PHS screws and rear overlay plate on the rear frame.

c) Replace R971 (22k 1/4W 10%) and R972 (47k 1/4W 10%) located below the rear of the CRT shield and between ceramic strip notches with a 3.3k 1/4W 5% (R971) resistor and a 6.8k 1/4W 5% (R972) resistor. Reinstall parts removed in steps a and b.

"A" SWEEP GENERATOR CAPACITOR VALUE INCREASED TO REDUCE RESET SW BOUNCE EFFECTS IN SINGLE-SWEEP — See SQB — M10118-2

Effective Prod s/n 1810 — Usable in field instruments s/n 100-1809

FRONT PANEL SYMPTOM: With Trigger Level set at or very near zero, the sweep might run when the Reset button was pushed.

PROBLEM: With the Trigger Level set to trigger on very small signals (0.1 mm in amplitude), pushing the Reset button caused enough disturbance on the power supplies to trigger the sweep. There was not a problem with the Trigger Level set for a 2 mm signal.

PRODUCTION CHANGE: C569 was changed from 100 pF to 0.001 µF to reduce the power supply distrubances when activating the Reset button.

Parts Removed:

C569	Capacitor, cer, 100 pF 350 V ±20%	281-0523-00

Parts Added:

C569	Capacitor, cer, 0.001 µF 500 V ±20%	283-0078-00

INSTALLATION INSTRUCTIONS:

Parts Required: See 'Parts Added'.

Installation Procedure:

Replace C569, located between the 'A' SWEEP MODE RESET switch terminals, with a 0.001 µF 500 V capacitor.

"A" SWEEP GENERATOR RESISTOR VALUE CHANGED TO IMPROVE ALTERNATE SWEEP OPERATION

See SQB

M10118-3

Effective Prod s/n 1810

Usable in field instruments s/n 100-1809

FRONT PANEL SYMPTOM: Alternate trace operation fails at fastest sweep speed with sweep length reduced to 5 or 6 cm.

PROBLEM: The alternate trace sync pulse was not large enough at the fastest sweep speeds with the sweep length reduced to 5 or 6 cm (in 25-30% of instruments). All other combinations of sweep speed and sweep length did not produce the problem.

PRODUCTION CHANGE: The value of R526 was changed from 15k to 10k.

Parts Removed:

R526	Resistor, comp, 15k 1/4W 5%	315-0153-00

Parts Added:

R526	Resistor, comp, 10k 1/4W 5%	315-0103-00

INSTALLATION INSTRUCTIONS:

Parts Required: See 'Parts Added'.

Installation Procedure:

Replace R526 located on the "A SWEEP" ec board near terminal "G" with a 10k 1/4W 5% resistor. For additional locational information see instrument manual page 4-12.

POWER CORD GROUND SPRING
ADDED TO ELIMINATE
INTERMITTENT GROUNDING

See SQB

M10194

Effective Prod s/n 1879

Usable in field instruments s/n 100-1878

w/exceptions

244	929	1238	1423-5	1515	1623	1718	1791
258	946	1250	1433	1518	1637	1727	1795-7
262-4	960	1269	1439	1522	1650-63	1730-52	1799
266-7	965	1270	1452	1527	1665-9	1754-9	1802
276	1080	1302	1475	1536	1671-9	1761	1805-6
279	1111	1329	1478	1539	1682	1763-4	1809-39
555	1113	1333	1483	1562	1684-5	1766	1841-59
626	1138	1337	1490	1571	1687-8	1768	1861-77
778	1144	1345	1495	1577-80	1692	1770	
812	1146-7	1349	1498	1582	1699	1773	
817	1160-1	1375	1500	1585-9	1701	1777-8	
883	1214	1404	1502	1591-3	1703-5	1780	
889	1223	1413	1504	1595-6	1708	1782-4	
908	1236	1415	1509-10	1598-9	1712-4	1787-9	

FRONT PANEL SYMPTOM: None.

PROBLEM: The power cord ground contact was intermittent occasionally.

PRODUCTION CHANGE: A power cord ground spring was inserted into the "D" shaped female receptacle to assure a good ground connection.

Parts Removed:

Cord, power, 3-cond, 8 ft. right angle female w/str male plug 115 V	161-0024-00
Cord, power, 3-cond, 8 ft. right angle female w/str male plug 230 V	161-0027-00

Parts Added:

Cord, power, 161-0024-00 w/ground spring 214-0698-00 inserted 115 V	161-0024-01
Cord, power, 161-0027-00 w/ground spring 214-0698-00 inserted 230 V	161-0027-01

INSTALLATION INSTRUCTIONS:

Parts Required: Modification Kit 040-0424-00

Installation Procedure: Refer to kit instructions.

HORIZ POSITION POT REPLACED TO REDUCE BINDING OF POTENTIOMETER SHAFT AFTER TIGHTENING SET SCREW

See SQB

M9914

Effective Prod s/n 1890

Usable in field instruments s/n 100-1889

FRONT PANEL SYMPTOM: None.

PROBLEM: The outer shaft of the Horizontal Position pot (311-0542-00) was not sturdy enough to withstand the knob set screw tightening torque without collapsing on its inner staft, which resulted in binding.

PRODUCTION CHANGE: The Horizontal Position potentiometer was changed to 311-0542-01, which has larger diameter and more sturdy shafts. Outer shaft changed from .250 dia to .265 dia and the inner shaft from .125 dia to .187 dia. The larger shaft sizes required changing the pot standoff bushing and knobs.

Parts Removed:

R805A,B	Potentiometer, comp, 10k-50k ±20% linear, 3/8 x 1 x 1/2	311-0542-00
	Bushing, potentiometer, standoff, plated 358-0029-03	358-0029-01
	Knob assembly, charcoal	366-0175-00
	Knob assembly, red	366-0189-00

Parts Added:

R805A,B	Potentiometer, comp, 10k-50k ±20% linear, 3/8 x 1 x 1/2	311-0542-01
	Bushing, potentiometer, standoff, plated 358-0029-04	358-0029-05
	Knob assembly, charcoal	366-0138-00
	Knob assembly, red	366-0319-00

INSTALLATION INSTRUCTIONS:

Parts Required: Modification Kit 050-0270-00

Installation Procedure: Refer to kit instructions.

'A' SWEEP LENGTH KNOB REPLACED TO IMPROVE READABILITY — INFORMATION ONLY — M10416

Effective Prod s/n 2100

FRONT PANEL SYMPTOM: None.

PROBLEM: It was difficult to read the position of the 'A' Sweep Length knob and the height of the knob was causing interference with adjustment of adjacent knobs.

PRODUCTION CHANGE: The 'A' Sweep Length knob was changed from a 0.585 dia x 0.720 lg knob with 0.700 dia skirt (index on skirt), to a 0.705 dia x 0.545 lg knob (index on the front of knob).

Parts Removed:

Knob assembly, charcoal	366-0220-00

Parts Added:

Knob assembly, charcoal	366-0148-00

TOROID CORE REPLACED WITH SIMILAR TYPE BECAUSE OF DISCONTINUED MANUFACTURE — INFORMATION ONLY — M10095

Effective Prod s/n 2260

FRONT PANEL SYMPTOM: None.

PROBLEM: The vendor has discontinued manufacture of toroid core 276-0512-00 used for T357 and T195.

PRODUCTION CHANGE: Toroid core 276-0512-00 was replaced with 276-0517-00. The parts are directly interchangeable and have no discernable different in appearance.

Parts Removed:

T357, T195	Core, toroid	276-0512-00

Parts Added:

T357, T195	Core, toroid	276-0517-00

CRT COIL FORM CLAMP REDESIGNED TO BETTER FIT CONTOUR OF CRT SHIELD

INFORMATION ONLY

M10521

Effective Prod SN none given

FRONT PANEL SYMPTOM: None.

PROBLEM: Present CRT coil form clamp does not fit the CRT shield, because the clamp mounting surface is round. The copper-beryllium coil form clamp also warps during heat tests.

PRODUCTION CHANGE: The 'Y' AXIS ALIGNMENT coil form clamp 343-0110-00 was replaced with a new 'form-fitting' CRT clamp 343-0131-00.

NOTE: S10624 changed material of 343-0110-00 from copper-beryllium to stainless steel.

Parts Removed:

Clamp, coil form stainless steel	343-0110-00

Parts Added:

Clamp, coil form stainless steel	343-0131-00

'A' AND 'B' SWEEP TIMING RESISTORS CHANGED BECAUSE OF TEMPORARY SHORTAGE OF ORIGINAL PARTS

INFORMATION ONLY

M10592

Effective Prod s/n 2370 w/exceptions: 2300-3, 2335-9, 2340-5, 2368

FRONT PANEL SYMPTOM: None.

PROBLEM: It was necessary to change R530H and R740H because of a temporary shortage of 7.15 M 1/2W 1% resistors (309-0453-00).

PRODUCTION CHANGE: R530H and R740H were each temporarily replaced with a series resistor combination of 7 M 1/2W 1% and 150 k 1/2W 1%.

The following changes were made on the 'A' AND 'B' TIME/DIV switch to accommodate the new resistor combinations:

1. The #22 wire strap from W2-F21 to W3-R22 and R530H, 7.15 M resistor, from W2-F21 to W3R21 were removed. R530H, consisting of a 7 M resistor between W2-F21 and W3-R22 and a 150 k resistor between W2-F-21 and W3-R21, was added.

2. The #22 wire strap from W5-F21 to W6-R22 and R740H, 7.15 M resistor, from W5-F21 to W6-R21 were removed. R740H, consisting of 7 M resistor between W5-F21 and W6-R22 and a 150 k resistor between W5-F21 and W6-R21, was added.

Instruments will revert to original components without further modification notice when sufficient stock exists. Serial numbers will be furnished.

Parts Removed:

R530H	7.15 M 1/2W 1%	309-0453-00
R740H	7.15 M 1/2W 1%	309-0453-00

Parts Added:

R530H	7 M	1/2W	1%	309-0443-00
	150 k	1/2W	1%	309-0049-00
R740H	7 M	1/2W	1%	309-0443-00
	150 k	1/2W	1%	309-0049-00

HORIZONTAL AMPLIFIER COMPONENTS ADDED TO REDUCE HORIZONTAL JITTER WITH X10 MAG "ON"

See SQB

M10484

Effective Prod s/n 2500

Usable in field instruments s/n 100-2499

FRONT PANEL SYMPTOM: A trace width or less of horizontal jitter with the X10 MAG on and sweep at about 1ms/div.

PROBLEM: Power supply noise current was entering the Horizontal Amplifier via R801, R802, R807 and R812.

PRODUCTION CHANGE: Equal noise current was applied to the opposite input of the Horizontal Amplifier by adding two 8.2k 1/4W 5% resistors and two 1 μF 25V ceramic capacitors as shown on the schematic. The Horizontal Display switch was changed by adding dummy terminal lugs at W2-1F and W2-3R. C808 and R808 were added to the switch and are included under the 262-0725-01 part number.

NOTE: Parts Replacement Kit 050-0296-00 is available to facilitate the replacement of the Horiz Display switch 262-0725-00 with 262-0725-01.

Parts Removed:

SW801A, B	Switch, wired, Horiz Display and mag	262-0725-00

Parts Added:

C804	Capacitor, cer,	1 μF 25V	283-0059-00
R804, R808	Resistor, comp,	8.2k 1/4W 5%	315-0822-00
SW801A, B	Switch, wired, Horiz Display		* 262-0725-01
* C808	Capacitor, cer,	1 μF 25V	283-0059-00
	Tubing, #6 polythylene	black 3/4in.	162-0532-00

INSTALLATION INSTRUCTIONS:

Parts Required.

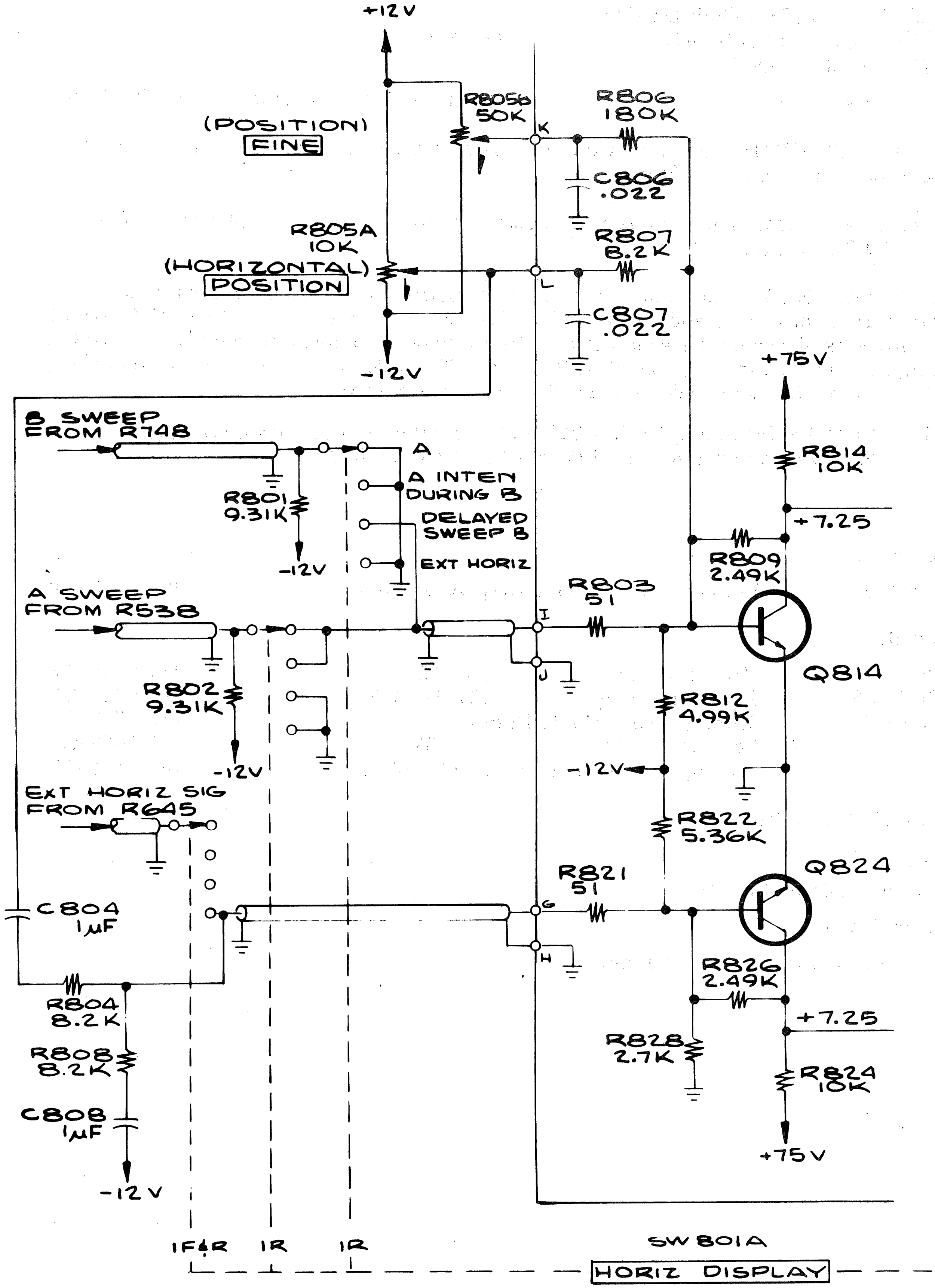
Modification Kit 040-0430-00

Installation Procedure:

Refer to Modification Kit instructions.

continued

M10484
(cont)



PARTIAL HORIZ. AMP.
SCHEMATIC

CH 2 VERTICAL PREAMP AND VERTICAL OUTPUT AMPLIFIER CHANGES ELIMINATE OSCILLATIONS

See SQB

M10609

Effective Prod SN 2500
w/exceptions 1510, 1539, 1918, 2018, 2377, 2417, 2421, 2451, 2453, 2456-7, 2459, 2467, 2469 and 2478

Usable in field instruments SN 100-2499

FRONT PANEL SYMPTOM: The CH2 Vertical Preamp oscillation may appear as an abnormal front corner aberration in the ADD mode with CH2 in NORMAL. The Vertical Output Amplifier oscillation may cause one or more of the following symptoms:

1. An abnormal front corner aberration that changes with a change in VERTICAL POSITION control.
2. Delayed Sweep jitter.
3. A change in DELAY TIME with a change in the SCALE ILLUM.
4. A change in vertical position of the trace with a change in the SCALE ILLUM.
5. Widening of the trace.

PROBLEM: There were two separate oscillations, one in the CH2 Vertical Preamp, and another in the Vertical Output Amplifier. Test was selecting diodes the the Vertical Switching matrix to eliminate the CH2 Vertical Preamp oscillation and transistors were selected to eliminate the Vertical Output Amplifier oscillation.

PRODUCTION CHANGE: The inductance of T195 was increased, by adding another powdered iron core to T195, to eliminate the CH2 Vertical Preamp oscillation. The Vertical Output Amplifier oscillation was eliminated by removing C341.

Parts Removed:

C341	Capacitor, ceramic 0.022 µF 25V	283-0080-00

Parts Added:

T195	Core, powder iron .125 thick x .375 dia w/hole	276-0517-00

INSTALLATION INSTRUCTIONS:

Parts Required: See 'Parts Added'.

Installation Procedure:

a) Add another powdered iron core (276-0517-00) to existing core, T195, which is located on the Vert Preamp circuit board near the Invert switch SW195.

b) Remove C341 (.022 µF 25V ceramic capacitor) located in the corner of the Vert Output Amp circuit board near D344.

'A' AND 'B' SWEEP GENERATOR DIODE CHANGED TO ELIMINATE ERROR AND BECAUSE OF UNAVAILABILITY

See SQB

M10311

Effective Prod s/n 2590
w/exceptions 2530 - 2549

Usable in field instruments s/n 100-2589

FRONT PANEL SYMPTOM: Slow Sweep timing error under high temperature environmental conditions.

PROBLEM: Diode type 152-0173-00 used for D533, D742 caused a slow speed timing error and was also discontinued by the vendor.

PRODUCTION CHANGE: D533 and D742 were changed from 152-0173-00 to a new diode assembly, 152-0249-00. The new assembly consists of two diodes, 152-0245-00 and 152-0246-00 in series, encapsulated in silicone rubber. In order to electrically accommodate the new diode, it was necessary to change R509 and R704 from 1k 1/4W 5% to 430Ω 1/4W 5%; R546 and R755 from 1.5k 1/4W 5% to 1.6k 1/4W 5%.

Parts Removed:

D533, D742	Diode, silicon, Tek spec.	152-0173-00
R509, R704	Resistor, comp, 1k 1/4W 5%	315-0102-00
R546, R755	Resistor, comp, 1.5k 1/4W 5%	315-0152-00

Parts Added:

D533, D742	Diode, silicon, assembly Tek.	152-0249-00
R509, R704	Resistor, comp, 430Ω 1/4W 5%	315-0431-00
R546, R755	Resistor, comp, 1.6k 1/4W 5%	315-0162-00

INSTALLATION INSTRUCTIONS:

Parts Required: See 'Parts Added' or parts below.

Parts Replacement Kit (2) 050-0290-00

Installation Procedure:

Refer to kit instructions.

CHANNEL 1 AND 2 VOLTS/DIV SWITCH MECHANICAL NOISE REDUCED BY NEW VARIABLE VOLTS/DIV POT MOUNTING

INFORMATION ONLY

M10574

Effective Prod SN 2776
w/exceptions 2710-2717, 2770-2774

FRONT PANEL SYMPTOM: Mechanical noise (squeaking) when changing the VOLTS/DIV setting.

PROBLEM: Misalignment of the VOLTS/DIV switch and the VARIABLE pot was contributing to the interferance between the rotor and stator insulators during rotation.

The production test procedure for attempting to eliminate the squeak, involves trimming or re-aligning the attenuator switch. When the switch was trimmed, using the old coupling, excessive bind was placed on VARIABLE pot.

PRODUCTION CHANGE: The VARIABLE pots R75 and R175 were moved back from the pot mounting bracket by adding a washer between the solder lugs and the pot bracket. The one piece couplings were replaced with three piece couplings consisting of two adapters connected together with a braided wire and a wire coupling. The length of the pot shafts was changed from 5.300" to 4.987". See Before and After sketches.

Parts Removed:

Coupling, shaft	5/16 dia x .438 lg.	(2)	376-0039-00
Rod, pot shaft,	5.300" lg.	(2)	384-0368-00

Parts Added:

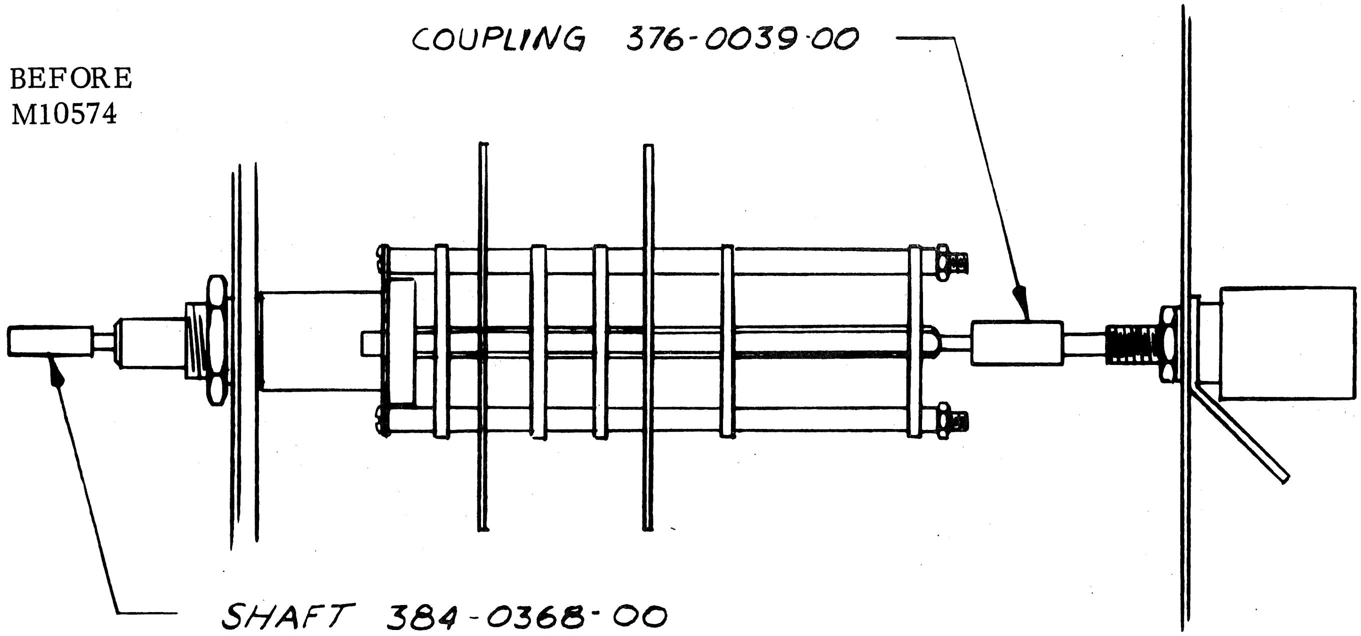
** Coupling assembly	(2)		776-0059-00
Washer, alum	17/64 ID x 1/2 OD x 1/16	(2)	210-0853-00
Rod, pot shaft	4.987 lg.	(2)	384-0410-00
Coupling, pot s.steel wire		(2)	376-0014-00

** The following are sub parts of the coupling assembly:

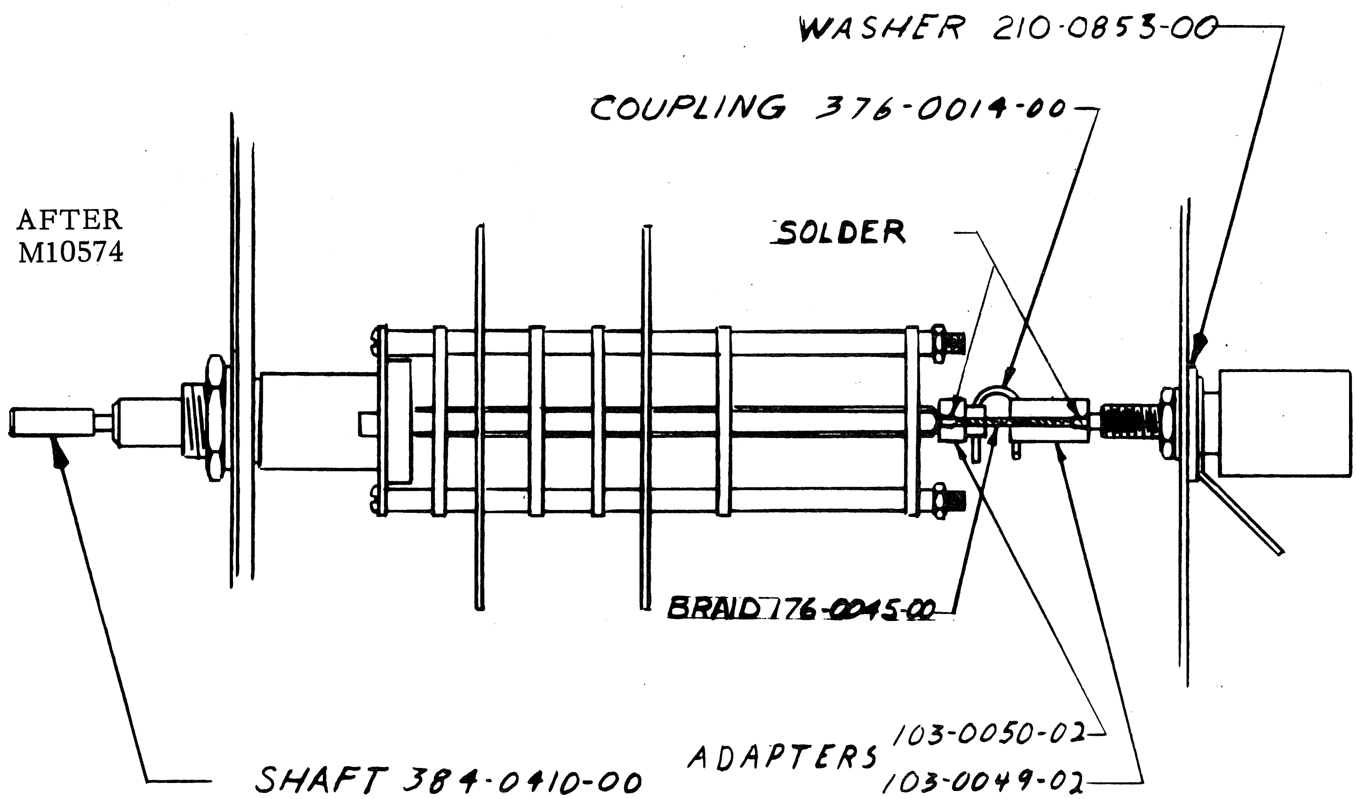
Adapter, shaft coupling, Ni-Albaloy	103-0049-02
Adapter, shaft coupling, Ni-Albaloy	103-0050-02
Wire, braided #24 .083	176-0045-00

continued

BEFORE
M10574



AFTER
M10574



LV POWER SUPPLY CAPACITOR MOUNTING BRACKET WIRING LAYOUT CHANGED TO FACILITATE ASSEMBLY — INFORMATION ONLY — M10394

Effective Prod s/n 2860

FRONT PANEL SYMPTOM: None.

PROBLEM: None.

PRODUCTION CHANGE: The dress of diode leads was changed, wire straps were relocated, and the capacitor mounting cable was changed to facilitate assembly.

Parts Removed:

Lockwasher, int #4		210-0004-00
Screw, 5-32 x 3/16 pan HS, thread-forming		213-0044-00
Tubing, #18 black,	2 in.	162-0503-00

Parts Added:

Wire, #22 solid,	9 in.	white	175-0522-00

CH 1 AND 2 ATTENUATOR BALANCE RANGE CHANGED TO REDUCE INPUT TUBE REJECTS — See SQB — M10179

Effective Prod s/n 3150 — Usable in field instruments s/n 100-3149

FRONT PANEL SYMPTOM: Insufficient attenuator balance range.

PROBLEM: The attenuator balance adjustment range was not sufficient to accommodate the input Nuvistor bias range which resulted in an excessive Nuvistor reject rate (30%).

PRODUCTION CHANGE: The attenuator balance range was increased and centered around the Nuvistor bias range by changing R30/R130 from a 100Ω ±20% potentiometer to a 100Ω ±10% pot, R31/R131 from 825Ω to 649Ω, R32/R132 from 237Ω to 178Ω, and R199 from 649Ω to 562Ω.

Parts Removed:

R30,R130	Potentiometer, comp, 100Ω 1/2W ±20%	311-0169-00
R31,R131	Resistor, prec, 825Ω 1/8W ±1%	321-0185-00
R32,R132	Resistor, prec, 237Ω 1/8W ±1%	321-0133-00
R199	Resistor, prec, 649Ω 1/2W ±1%	323-0175-00
	Nut, pot, 3/8 alum hex, 0.594 lg (2)	220-0437-00

Parts Added:

R30,R130	Potentiometer, comp, 100Ω 1/2W ±10%	311-0258-00
R31,R131	Resistor, prec, 649Ω 1/8W ±1%	321-0175-00
R32,R132	Resistor, prec, 178Ω 1/8W ±1%	321-0121-00
R199	Resistor, prec, 562Ω 1/2W ±1%	323-0169-00
	Nut, pot, alum hex, 13/32 lg (2)	220-0440-00

INSTALLATION INSTRUCTIONS:

Parts Required: See 'Parts Added'.

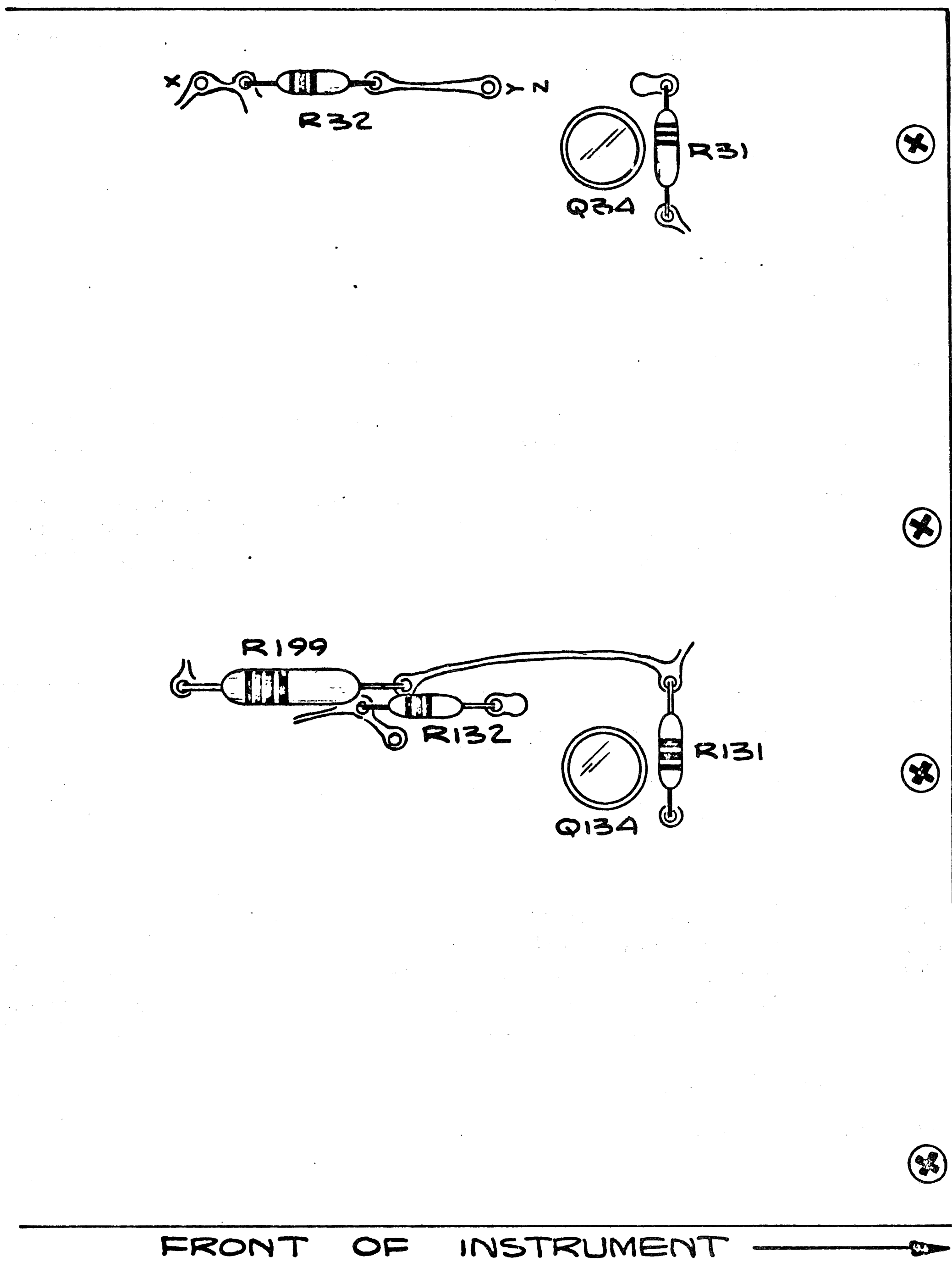
continued

Installation Procedure:

a) Replace the STEP ATTEN BAL pots (R30 and R130), mounted on the front panel, with 100Ω 1/2W ±10% potentiometers. Secure each pot, using a 220-0440-00 aluminum nut.

b) Replace the following components, located on the Ch 1 and 2 Input Preamp circuit board, as indicated on the drawing:

R 31 with a 649Ω 1/8W ±1% resistor
R 32 with a 178Ω 1/8W ±1% resistor
R131 with a 649Ω 1/8W ±1% resistor
R132 with a 178Ω 1/8W ±1% resistor
R199 with a 562Ω 1/2W ±1% resistor



SINGLE SWEEP TRANSISTOR Q564
CHANGED TO INSURE RESET OPERATION

INFORMATION ONLY

M10483

Effective Prod SN 3180

FRONT PANEL SYMPTOM: Single sweep will not reset.

PROBLEM: Transistron transistors (151-0087-00) used at socket Q564 caused the risetime of the reset pulse to be slower than with other types.

The slower output risetime when differentiated to provide the reset pulse, results in a lower amplitude pulse. Worst case condition was simulated in test by shinning a light on neon bulb B568, which slightly reduced the reset pulse amplitude and prevented the single sweep from resetting.

PRODUCTION CHANGE: The transistor (Transitron or Fairchild) at socket Q564 was replaced with a PNP, To-18, 151-0188-01 transistor.

Parts Removed:

Q564	Transistor, Si. PNP To-5	151-0087-00

Parts Added:

Q564	Transistor, Si., PNP, To-18 similar to MM999	151-0188-01

"A" SWEEP GENERATOR CABLE HARNESS CHANGED TO REDUCE CABLE CROSSTALK — INFORMATION ONLY — M10485-1

Effective Prod SN 3440

w/exceptions	1761	1872	1973	2225	2663	2730-1
	2770	2836	2859	2892-4	2920-1	2937
	2939	2980	3031	3034	3073-4	3095
	3270	3294				

FRONT PANEL SYMPTOM: None.

PROBLEM: White-yellow and white-blue wires connected between the HV Transformer, Z Axis circuit board and base of Q930 coupled crosstalk into adjacent cable harness wires.

PRODUCTION CHANGE: The white-yellow and white-blue wires were removed from the cable harness. The square pin connector terminals AC and AD, including shorting jumper, were removed from the circuit board. A 5" piece of #26 stranded white-yellow wire was connected between terminal #4 of HV Transformer T930 and base of Q930 to complete the circuit.

Parts Removed:

Cable, 'A' Sweep	179-0995-00
Circuit board, Z Axis/CRT	388-0641-00

Parts Added:

Cable, 'A' Sweep	179-0995-01
Circuit board, Z Axis/CRT	388-0641-01

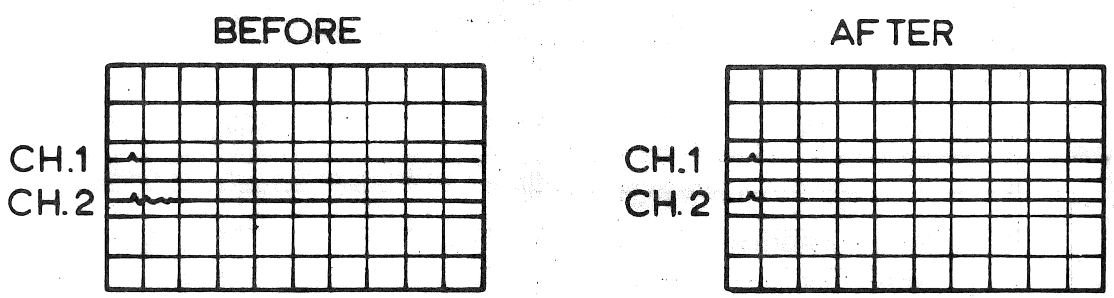
CRT CIRCUIT HV GROUND PATHS
CHANGED TO ELIMINATE CROSSTALK RESULTING IN VERTICAL ABERRATIONS — See SQB — M10485-2

Effective Prod SN 3440 — Usable in field instruments SN 100-3439

w/exceptions

1761	1872	1973	2225	2663	2730-1
2770	2836	2859	2892-4	2920-1	2937
2939	2980	3031	3034	3073-4	3095
3270	3294				

FRONT PANEL SYMPTOM: Vertical aberrations as shown below.



T/DIV = .05µsec
V/DIV = 5mV

PROBLEM: The unblanking amplifier was causing aberrations in the Vertical preamplifier and amplifier systems by way of ground currents through parallel chassis and wire ground paths.

PRODUCTION CHANGE: All connections marked 'A' on the manual CRT CIRCUIT schematic, except emitter of Q930, were connected directly to ground. The emitter of Q930 remains connected to 'A' or through R1159 to ground. Also see M12214-1.

INSTALLATION INSTRUCTIONS:

Parts Required. See part listed below.

Wire, #22 solid white 2-1/2" 175-0527-00

Installation Procedure:

a) Remove the 3-1/2 " length of #26 stranded white-green wire between CSK-4 near T801 and emitter of Q930 (see Fig. 1).

b) Move the remaining white-green wire from CSK-4 to the emitter of Q930.

c) Solder a 2-1/2" length of #22 solid white wire to CSK-4 near T801.

d) Dress the wire through the plastic grommet in the rear bulkhead plate to the solder lug shown in Fig. 2 (DO NOT solder yet).

e) Unsolder the #22 white stranded wire from CSA-6 (see Fig. 2) and solder it, along with the wire installed above, to the solder lug shown in Fig. 2.

continued (See Fig. 1 and 2 on the following page).

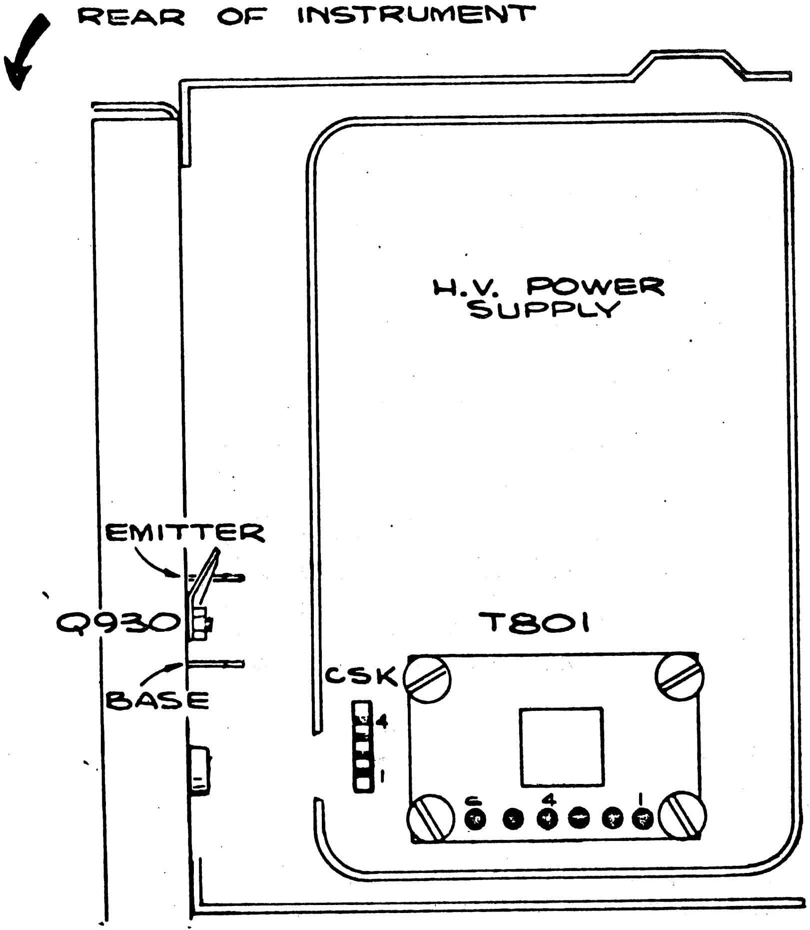

REAR OF INSTRUMENT
H.V. POWER SUPPLY
EMITTER
Q930
BASE
T801
CSK
4
1
6
4
1

Fig. 1

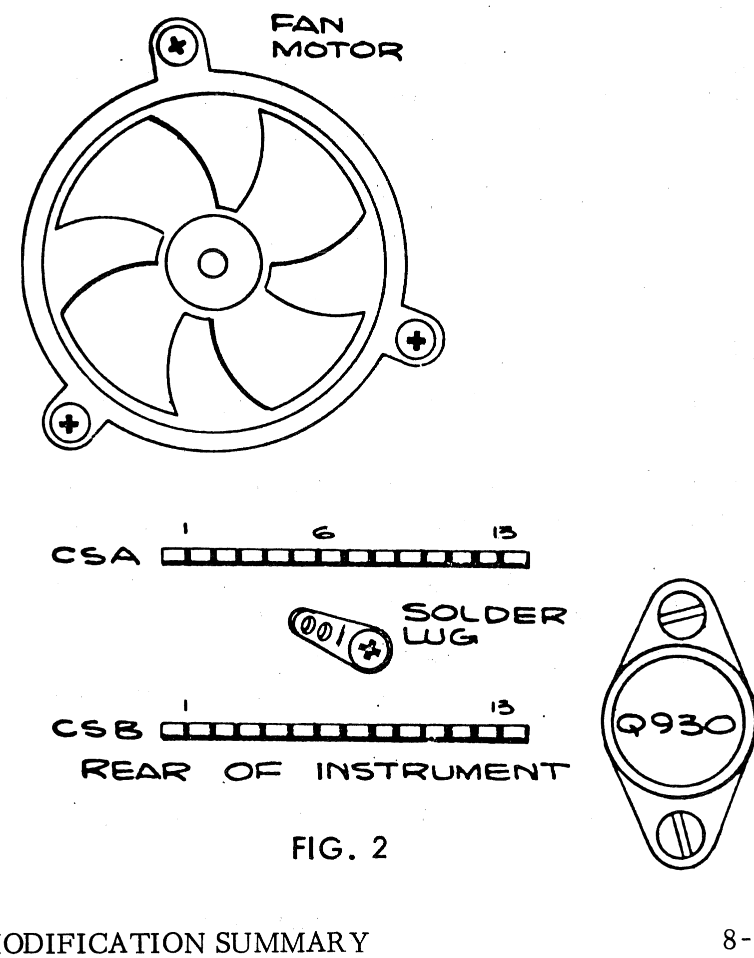

FAN MOTOR
1
6
13
CSA
SOLDER LUG
1
13
CSB
REAR OF INSTRUMENT
Q930

FIG. 2

DELAY LINE SOLDER GROUND LUGS ADDED TO ELIMINATE 'DIP' IN TRANSIENT RESPONSE

INFORMATION ONLY

M10651

Effective Prod SN none given

FRONT PANEL SYMPTOM: See Before and After waveform drawings.

PROBLEM: Delay line winding machine produced delay lines which had an upset in the inductance and capacitance balance of the lines. This caused a 'dip' in the transient response approximately 10 nsec behind the front corner. The 'dip' was over the 2% aberration specification however, all instruments which were shipped were within specifications.

PRODUCTION CHANGE: A #4 lockwasher, mounted on the right hand connector, was replaced with a #4 solder lug. Another solder lug (SE-6) was added under the head of a 6-32 x 1in. delay line mounting screw and a #22 bare wire was connected between both solder lugs.

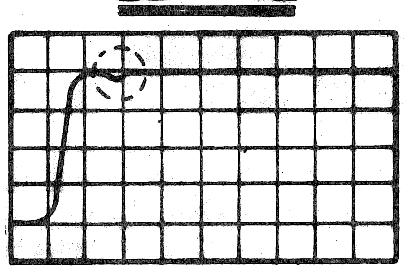
Parts Removed:

Lockwasher, #4 int.	210-0004-00

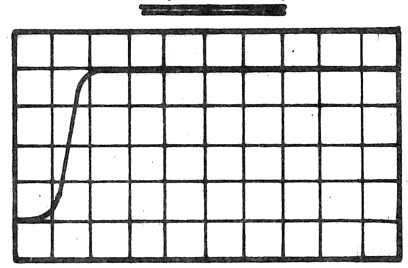
Parts Added:

Solder lug, SE-4	210-0201-00
Solder lug, SE-6	210-0202-00

BEFORE



AFTER



'A' SWEEP GENERATOR FILTER CAPACITOR ADDED ACROSS ZENER DIODE TO FILTER OUT ZENER NOISE CAUSING TRIGGER JITTER — See SQB — M10655

Effective Prod SN 3450 — Usable in field instruments SN 100-3449

FRONT PANEL SYMPTOM: High frequency trigger jitter (within allowable limits).

PROBLEM: Noise from zener diode D559 was causing the holdoff time to change slightly.

PRODUCTION CHANGE: A 0.1 µF 25 V capacitor was added in parallel with D559 across the A SWEEP LENGTH potentiometer.

Parts Added:

C559	Capacitor, cer disc, 0.1 µF 25 V	283-0081-00

INSTALLATION INSTRUCTIONS:

Parts Required:

See 'Parts Added'.

Installation Procedure:

a) Remove the six screws (with lock and flatwashers) that secure the 'A' Sweep circuit board to the instrument. (SAVE)

b) Lift up circuit board and locate the A SWEEP LENGTH switch and potentiometer.

c) Add a 0.1 µF 25 V capacitor across the total resistance of the A SWEEP LENGTH potentiometer in parallel with zener diode D559.

d) Replace the 'A' Sweep circuit board removed in step a.

CRT COLOR FILTERS MADE AVAILABLE TO PROVIDE CORRECT DISPLAY WITH OPTIONAL PHOSPHOR CRT — INFORMATION ONLY — M10658

Effective Prod SN not given

FRONT PANEL SYMPTOM: None.

PROBLEM: Amber, blue and green CRT filters were not available for use with special CRT phosphors.

PRODUCTION CHANGE: Amber, blue and green filters were set up as optional items for use with special CRT phosphors and for customer demand.

Parts Added:

Filter, light amber	0.030 acrylic 3.383 x 2.203	378-0576-01
Filter, light blue	0.030 acrylic 3.383 x 2.203	378-0576-02
Filter, light green	0.030 acrylic 3.383 x 2.203	378-0576-03

CURRENT LOOP CONNECTORS
NEOPRENE INSULATION GLUED TO MTG BRACKET TO PREVENT CONNECTORS FROM SHORTING TO MTG BRACKET

See SQB

M10676

Effective Prod SN 3458 Usable in field instruments SN 100-3457 w/exceptions 2860, 3051, 3053, 3059, 3247, 3249, 3257, 3259, 3340, 3344, 3347, 3351, 3356, 3358, 3359, 3452, 3454-6

FRONT PANEL SYMPTOM: Erratic or no output from current probe loop.

PROBLEM: Solder lugs on the current probe loop may short against the flange on the outer support bracket causing erratic or no output from current probe loop.

PRODUCTION CHANGE: Insulation was provided by adding a 2-1/2" length of Neoprene* extrusion (252-0571-00) along the edge of the top flange of outer support bracket 407-0150-00. The extrusion was secured to the flange with 3M* type EC-2262 cement or equivalent.

Parts Added:

Neoprene extrusion .156 x .234 w/.063 slot 2-1/2"	252-0571-00

INSTALLATION INSTRUCTIONS:

Parts Required: See 'Parts Added'.

Installation Procedure:

a) Cut a 2-1/2" length of 252-0571-00 Neoprene channel extrusion.

b) Open the CALIBRATOR FRAME chassis gate.

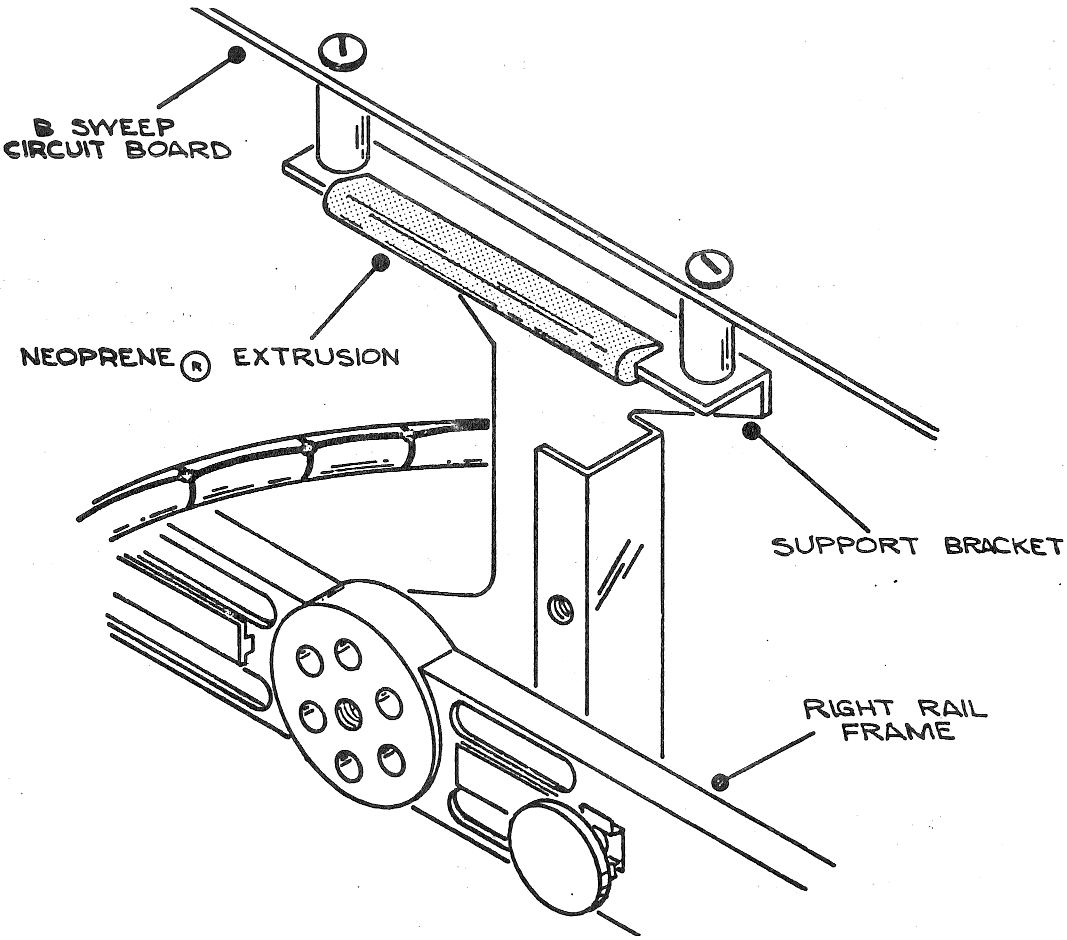
c) Add some EC-2262 cement or equivalent to the edge of the SUPPORT BRACKET. See drawing.

d) Push the 2-1/2" length of extrusion into the SUPPORT BRACKET so that the channel part of the extrusion fits into the SUPPORT BRACKET. See drawing on next page.

e) Close the CALIBRATOR FRAME chassis gate.

continued

* Carboline Co. Registered Trademark
Minnesota Mining and Manufacturing Co. Registered Trademark



VERTICAL ATTENUATOR CAPACITORS CHANGED TO CENTER ADJUSTMENT RANGE OF CAPACITOR TUNING — INFORMATION ONLY — M10653-1

Effective Prod SN 3660

FRONT PANEL SYMPTOM: None.

PROBLEM: Vertical Attenuator capacitors C43A and C143A were typically adjusted near their maximum value.

PRODUCTION CHANGE: C43B and C143B were changed from 14 pF to 18 pF to more nearly center the adjustment range of C43A and C143A.

Parts Removed:

C43B, C143B	Capacitor, cer, 14 pF 500V NPO	281-0577-00

Parts Added:

C43B, C143B	Capacitor, cer, 18 pF 500V NPO	281-0578-00

VERTICAL ATTENUATOR RESISTORS CHANGED TO MEET GAIN AND BANDWIDTH SPECIFICATIONS

INFORMATION ONLY

M10653-2

Effective Prod SN 3660

FRONT PANEL SYMPTOM: None.

PROBLEM: In order to meet the 10mV/div bandpass requirement, it was sometimes necessary to go back and make a rather critical adjustment of the 20mV/div compensation adjustment. Also, tolerances sometimes required a value other than 510Ω for R44C and R144C.

PRODUCTION CHANGE: R44C and R144C were changed from 510Ω to a selected part with nominal installed value of 680Ω. The range for the selected resistor is from 390Ω to 1k.

Parts Removed:

R44C, R144C	Resistor, comp, 510Ω 1/4W 5%	315-0511-00

Parts Added:

R44C, R144C	Resistor, comp, 680Ω 1/4W 5%	315-0681-00

VERTICAL PREAMP RESISTOR VALUES CHANGED TO PREVENT THE NEED OF SELECTING VERTICAL AMPLIFIER RESISTORS AND GAIN ADJ POTS

See SQB

M10618

Effective Prod SN 3879

Usable in field instruments SN 100-3878

w/excepttions 3804-11 3852 3870-72
3813-15 3865

FRONT PANEL SYMPTOM: None.

PROBLEM: The tolerances of the GAIN adjust potentiometer were such that they did not always have sufficient range of adjustment.

PRODUCTION CHANGE: Vertical preamp resistors R92 and R192 were changed from 115Ω to 178Ω.

Parts Removed:

Vertical preamp circuit board kit with plug-in components with the following sub-parts: 670-0419-00

Vertical preamp circuit board kit without plug-in components with the following sub-parts: 670-0419-01

R91, R191	Resistor, prec, 26.1Ω 1/8W 1%	321-0041-00
R92, R192	Resistor, prec, 115Ω 1/8W 1%	321-0103-00

continued

Parts Added:

Vertical preamp circuit board kit with plug-in components with the following sub-parts: 670-0419-03

Vertical preamp circuit board kit without plug-in components with the following sub-parts: 670-0419-02

R91, R191	Resistor, prec, 14.7Ω 1/8 W 1%	321-0017-00
R92, R192	Resistor, prec, 178Ω 1/8 W 1%	321-0121-00

INSTALLATION INSTRUCTIONS:

Parts Required: See 'Parts Added'.

Parts Replacement Kit 050-0307-00 is now available to facilitate the replacement of the Vertical preamp circuit board (with plug-in components).

Installation Procedure:

Use 050-0307-00 kit instructions.

VOLTS/DIV POT SHAFT COUPLING ADAPTERS CHANGED TO PREVENT SET SCREW FROM STRIPPING THREADS — INFORMATION ONLY — M10670

Effective Prod SN 4010

FRONT PANEL SYMPTOM: None.

PROBLEM: Shaft coupling adapter wall thickness is insufficient and allows set screw to strip coupling adapter (103-0049-02) threads. The coupling adapter was originally installed by M10574 at serial number 2776.

PRODUCTION CHANGE: The 103-0049-02 shaft coupling adapter, used on Ch 1 and Ch 2 VARIABLE VOLTS/DIV potentiometers were replaced with the new 103-0049-04 shaft coupling adpaters.

Parts Removed:

Adapter, shaft coupling Ni-albaloy plated (2) — 103-0049-02

Parts Added:

Adapter, shaft coupling Ni-albaloy plated (2) — 103-0049-04

HORIZ SWEEP SWITCH REWORKED AND RESISTOR ADDED TO PREVENT SWEEP LENGTHENING PRIOR TO SWITCHING TO "B" ENDS "A" — INFORMATION ONLY — M10626

Effective Prod SN 4080

FRONT PANEL SYMPTOM: As the "A" SWEEP length is turned ccw, the sweep suddenly lengthens to 10 divisions just prior to the "B" ends "A" detent.

PROBLEM: It was necessary to align the front and rear seating of the "A" SWEEP length switch in order to make the connection from R731 to +12 V before the connection between R555 and D556 was broken.

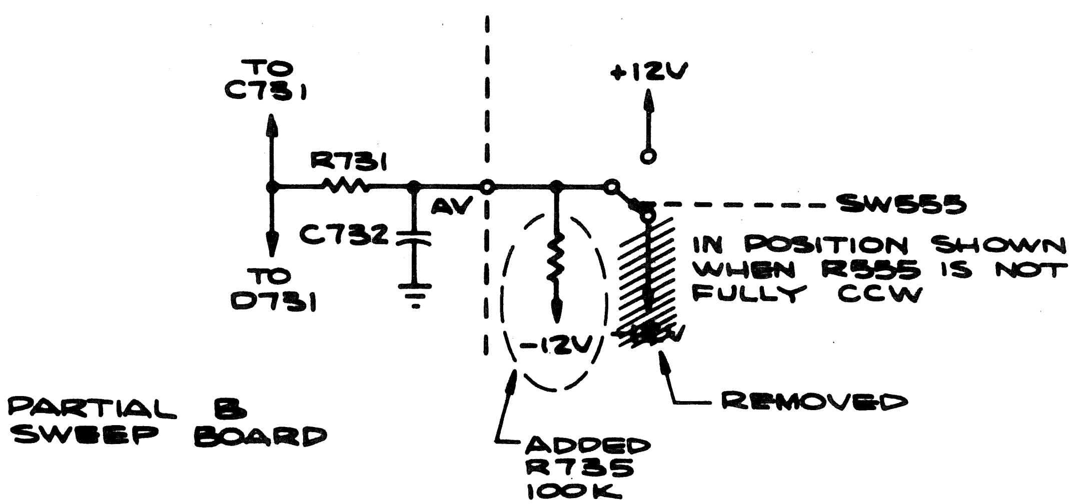
PRODUCTION CHANGE: The -12 V connection to R731 was made through a 100k resistor to allow a make-before-break connection (via the "A" SWEEP length switch) from R731 to +12 V. (Prior to mod, it was not possible to make the +12 V connection before the -12 V connection was broken, because the two supplies would have been shorted together).

Parts Removed:

SW555	Switch, Sweep length	262-0726-00

Parts Added:

SW555	Switch, Sweep length with the following sub-part:	262-0726-01
R735	Resistor, comp, 100k 1/4 W 10%	316-0104-00



+75 V POWER SUPPLY FILTER CAPACITOR C1194 WAS CHANGED TO MEET LEAKAGE SPECIFICATIONS	INFORMATION ONLY	M10809

Effective Prod SN 4080

FRONT PANEL SYMPTOM: None.

PROBLEM: Electrolytic filter capacitor C1194 may have excessive leakage and prevent the +75 V Power Supply from meeting the ±0.75% maximum variation specification.

PRODUCTION CHANGE: Electrolytic capacitor C1194 was replaced with a 3 μF 150 V (290-0305-00) capacitor to prevent excessive leakage.

Parts Removed:

C1194	Capacitor, EMT 4 μF 200 V with insulating sleeve	290-0285-00

Parts Added:

C1194	Capacitor, EMT 3 μF 150 V with insulating sleeve	290-0305-00

Effective Prod SN Not given.

FRONT PANEL SYMPTOM: None.

PROBLEM: Zener diode values are at present widely scattered in both voltage and tolerance. The proposed modifications will standardize all 400 mW, 1 W, 1.5 W and 10 W Zeners now listed as 10 and 20%, to 5% tolerance, and change the majority of non-standard parts to standard JEDEC units. One of these changes is to minimize the number of active part numbers. There will be no increase in cost for the 5% Zeners.

PRODUCTION CHANGE: Voltage tolerance for 10% and 20% Zener diodes was changed to 5% for all uses. At the same time, all 250 mW Zener diodes were changed to 400 mW. Refer to parts removed and added list for details.

Parts Removed:

D1043	Diode, Zener, 1N3024A 15 V ±10%	152-0126-00
D544	Diode, Zener, 1N961 10 V ±10%	152-0064-00
D344, D354	Diode, Zener, 1N4372 3 V ±10%	152-0076-00
D1209	Diode, Zener, 1N3032 33 V ±20%	152-0213-00

Parts Added:

D1043	Diode, Zener, 1N3024B 15 V ±5%	152-0024-00
D544	Diode, Zener, 1N961B 10 V ±5%	152-0149-00
D344, D354	Diode, Zener, 1N4372A 3 V ±5%	152-0278-00
D1209	Diode, Zener, 1N3032B 33 V ±5%	152-0293-00

A & B SWEEP GEN RESISTOR SUBSTITUTION TO OVERCOME TEMPORARY PARTS SHORTAGE

INFORMATION ONLY

M11249

Effective Prod SN 'A' 4970-4979**
'B' 5100-5160**

**NOTE: Instruments will revert back to original component without further modification notice when sufficient stock exists. A block of serial numbers will be furnished to the SN mailing list for history upon termination of this change.

FRONT PANEL SYMPTOM: None.

PROBLEM: Temporary part shortage.

PRODUCTION CHANGE: A temporary shortage of 3.57 M 1/2 W 1% resistors 309-0452-00 necessitates substituting (1 ea) 1.75 M 1/2 W 1% resistor 309-0019-00 and 1.80 M 1/2 W 1% resistor 309-0020-00 in series for R530J and R740J located on the 453 A & B Time/Div switch 262-0724-00.

Parts Removed:

R530J, R740J	3.57 M 1/2 W 1%	309-0452-00

Parts Added:

R530J, R740J	(1.75 M 1/2 W 1%	309-0019-00
	(1.80 M 1/2 W 1%	309-0020-00

CRT FILAMENT SERIES RESISTANCE CHANGED TO PROVIDE OPTIMUM CATHODE OPERATING TEMPERATURE — INFORMATION ONLY — M10716

Effective Prod SN 5225

FRONT PANEL SYMPTOM: None.

PROBLEM: Calculations show that 9.35Ω is the optimum value for maximum CRT life. Premature CRT failure is not expected in instruments with 9.1Ω 5% resistors.

PRODUCTION CHANGE: The CRT filament voltage range design center was changed and the tolerance reduced by changing R951 from 9.1Ω 5% to two 18.7Ω 1% resistors, connected in parallel.

See M10183, M10256 and M12245.

Parts Removed:

R951	Resistor, comp, 9.1Ω 1/2W 5%	307-0063-00

Parts Added:

R950, R951	Resistor, prec, 18.7Ω 1/8W 1%	321-0027-00

BINDING POST STUD AND CAP WERE MADE AVAILABLE AS AN ASSEMBLY TO REDUCE INSTALLATION TIME — INFORMATION ONLY — M10600 453-210 ONLY

Effective Prod SN 5230

FRONT PANEL SYMPTOM: None.

PROBLEM: The bushing post and cap were being installed in two separate operations resulting in an installation time which was longer than that of a preassembled unit.

PRODUCTION CHANGE: The binding post stud 129-0077-00 and binding post cap 200-0103-00 were preassembled into one unit and given a new part number 129-0103-00 to reduce assembly installation time.

Parts Removed:

Post, binding stud	129-0077-01
Cap, binding post	200-0103-00

Parts Added:

Binding post and cap assy' (129-0077-00, 200-0103-00)	129-0103-00

VERTICAL SWITCHING FERRAMIC SUPPRESSORS ADDED TO ELIMINATE VERTICAL PREAMP OSCILLATIONS — See SQB — M11360

Effective Prod SN 5670 — Usable in field instruments SN 100-5669

modified out of sequence

4632	4940-1	5236-7	5249
4788	5087	5239	5381-4
4925	5098	5241-2	5387-9
4928	5231-2	5246	5390 and 5395-9

FRONT PANEL SYMPTOM: Vertical amplifier oscillates at approximately 300 MHz in ADDED mode - non-inverted.

PROBLEM: Channel 1 - Channel 2 crosstalk.

PRODUCTION CHANGE: Ferramic suppressor cores L201, L204, L206 and L209 were added to the anode leads of signal diodes D201, D204, D206, D209 respectively.

Parts Added:

L201, L204, L206, L209	Core, ferramic suppressor (4)	276-0528-00

INSTALLATION INSTRUCTIONS:

Parts Required: See 'Parts Added'.

Installation Procedure:

Install a 276-0528-00 feramic suppressor on the anode leads of D201, D204, D206, and D209.

The diodes are located on the Vertical Preamp circuit board with the cathodes of D201 and D206 connecting to TP284 and D204 and D209 connecting to TP294.

VERTICAL OUTPUT AMPLIFIER CAPACITOR REMOVED TO IMPROVE VERTICAL TRANSIENT RESPONSE — INFORMATION ONLY — M11089-1

Effective Prod SN 5672

FRONT PANEL SYMPTOM: Transient response difficult to adjust because of excessive ringing of waveform.

PROBLEM: Preamp risetime was a little too fast.

PRODUCTION CHANGE: C342 was removed. This increased the high frequency degeneration in the output amplifier.

Parts Removed:

C342	Capacitor, cer 6.8 pF 500 V	281-0572-00

+75 V POWER SUPPLY OSCILLATIONS ELIMINATED BY CHANGING VALUE OF C1184 | See SQB | M11089-2

Effective Prod SN 5672 | Usable in field instruments SN 100-5671

FRONT PANEL SYMPTOM: None.

PROBLEM: +75 V Power Supply oscillates at 70 kHz - 100 kHz.

PRODUCTION CHANGE: C1184 was changed from a 0.001 μF 500 V discap capacitor to a 0.01 μF 250 V discap capacitor.

Parts Removed:

C1184	Capacitor, cer 0.001 μF 500 V discap	283-0078-00

Parts Added:

C1184	Capacitor, cer 0.01 μF 250 V discap	283-0079-00

INSTALLATION INSTRUCTIONS:

Parts Required: See 'Parts Added'.

Installation Procedure:

Replace C1184 with an 0.01 μF 250 V discap capacitor 283-0079-00.

"A" SWEEP GENERATOR VALUE OF HOLDOFF CAP WAS CHANGED TO MEET TEST SPECIFICATIONS | INFORMATION ONLY | M10813

Effective Prod SN 5830

FRONT PANEL SYMPTOM: None.

PROBLEM: Holdoff time on the 10 μsec, 20 μsec and 50 μsec ranges was limited to no more than 10% of the sweep length. Test was selecting parts to meet this requirement in some instruments.

PRODUCTION CHANGE: Holdoff capacitor, C550C, was changed from 470 pF to 390 pF.

Parts Removed:

C550C	Capacitor, cer, 470 pF 500 V 10% X5U	281-0525-00

Parts Added:

C550C	Capacitor, cer, 390 pF 500 V 10% X5U	281-0551-00

POWER SUPPLY LEADS REROUTED TO ELIMINATE 400Hz RIPPLE ON CRT DISPLAY — INFORMATION ONLY — M11199

Effective Prod SN 5860

FRONT PANEL SYMPTOM: None.

PROBLEM: Excessive Power Supply ripple on the display when operated on 400Hz line. This is caused by insufficient shielding of the Power Supply cables, cable routing, and insufficient isolation of the low voltage regulator circuit.

PRODUCTION CHANGE: The regulated supply voltage wires were run by a more direct route and in a shielded cable. The ground reference of the regulator board was run to the distribution point on the rear bulkhead plate through the cable shield and the low voltage regulator board was insulated from its standoffs.

These changes necessitated new cable assembly part numbers as indicated in the Remove-Add list. Also see M10710.

Parts Removed:	Cable, low voltage regulator	179-0987-00
	Cable, anode	179-0997-00
	Screw, 4-40x5/16 PHB assembly (3)	211-0116-00
Parts Added:	Cable, low voltage regulator	179-0987-01
	Cable, anode	179-0997-01
	Screw, 4-40x1/4 BH nylon (3)	211-0040-00
	Insulators, circuit board mounting (3)	214-0781-00

INSTRUMENT COVER MODIFIED TO BE COMPATIBLE WITH THE TYPES 454 AND 491 — INFORMATION ONLY — M11241

Effective Prod SN 6590 — 453, 453-210H ONLY

w/exception	4086	4637	6022	6025	6219-20	6222	6224	62226-27
	6229	6392	6395 thru 6411		6413	6415-17	6419	

FRONT PANEL SYMPTOM: None.

PROBLEM: None.

PRODUCTION CHANGE: The Type 453 instrument cover was changed from 016-0074-00 to 016-0074-01. The new cover differs from the old as follows: three dot fasteners added to the top and bottom of the open end (instrument back) of cover, 1.300 inches from end, one on cover lid and one 2.400 inches on each side of cover lid. A 6 x 9 inch cover strap 214-0810-00 with three dot fasteners on each end added to the open end of cover to hold power cord. Marking on cover "TYPE 453 OSCILLOSCOPE COVER' replaced by "INSTRUMENT COVER".

Parts Removed:

Cover, instrument, blue vinyl — 016-0074-00

Parts Added:

Cover, instrument, blue vinyl — 016-0074-01

TYPE 453 MOD 799H SET UP AS PRODUCTION SPECIAL — INFORMATION ONLY — M11361

Effective Prod SN 6790

FRONT PANEL SYMPTOM: None.

PROBLEM: There was a large demand for the Type 453 Mod 799H.

PRODUCTION CHANGE: A new Production Special final kit was et up to supply Mod 799H as a Production Special instead of a Custom Instrument.

Parts Removed:	None.	
Parts Added:	Special Mod 799H final kit	602-0646-00

A & B EXT TRIG CALIB BNC CONNECTORS CHANGED TO UTILIZE EXISTING STOCK — INFORMATION ONLY — M11236

Effective Prod SN 7290

FRONT PANEL SYMPTOM: None.

PROBLEM: To utilize existing stock of parts.

PRODUCTION CHANGE: Change BNC connectors (A Ext Trig Input, B Ext Trig Input and 1 kC Cal) located on the 453 front subpanel from 131-0106-00 to 131-0462-00. The new connector has a .125 inch thick collar as compared to an .046 inch thick collar on the old connector, resulting in a slightly greater over all height.

Parts Removed:			
	Connector, receptacle, BNC chassis mt female contact	(3)	131-0106-00
Parts Added:			
	Connector, receptacle, BNC D hole, bulkhead mt female contact	(3)	131-0462-00

PRODUCTION SPECIAL KIT SET UP TO CONVERT 453 TO MOD 221T BECAUSE OF LARGE DEMAND — INFORMATION ONLY — M11245

Effective Prod SN 7327

FRONT PANEL SYMPTOM: None.

PROBLEM: There is a large demand for the 453 Mod 221T.

PRODUCTION CHANGE: A Production Special Kit was set up to convert the regular 453 to a Mod 221T because of the large demand for the custom Mod 221T.

Parts Added:

Special Mod 221T Final Kit, consisting of:	602-0643-00
Probe package 9' P6010 (2)	010-0201-00
Cable/probe tip 5" (2)	175-0383-00
P6019 package and passive term 9'	015-0065-01

VERTICAL OUTPUT AMPLIFIER Q324 AND Q334 CHANGED TO ELIMINATE OSCILLATIONS — See SQB — M11556

Effective Prod SN 8140 — Usable in field instruments SN 100-8139

FRONT PANEL SYMPTOM: Ringing on the front corner of a fast rise waveform.

PROBLEM: Q324 and Q334 were oscillating. The problem showed up as a ringing on the front corner of a fast rise waveform. This ringing could be as much as 4% of waveform amplitude.

PRODUCTION CHANGE: Q324 and Q334 were changed from 151-0120-00 to 151-0120-01.

Parts Removed:

Q324, Q334	Transistor, Si NPN TO-18	151-0120-00

Parts Added:

Q324, Q334	Transistor, Si NPN TO-18	151-0120-01

INSTALLATION INSTRUCTIONS:

Parts Required: See 'Parts Added'.

Installation Procedure:

Replace Q324 and Q334 with 151-0120-01 transistors.

INPUT ATTENUATORS CAPACITOR VALUES CHANGED TO PROVIDE SUFFICIENT COMPENSATION RANGE — INFORMATION ONLY — M11050

Effective Prod SN 8150

FRONT PANEL SYMPTOM: Unable to compnsate attenuators in the .2 V/div through 10 V/div positions.

PROBLEM: Insufficient capacitance range in the ÷10 and ÷100 attenuators to always compensate for component tolerance.

PRODUCTION CHANGE: C9B and C109B were increased in value to 1.4-7.3 pF and C8D, C108D, C9D and C109D were made test selected values as follows:

C8D and C108: 4.7 pF, 5.6 pF, or 6.8 pF. Assembly installed value is 5.6 pF.

C9D and C109D: 3.3 pF, 3.9 pF, or 4.7 pF. Assembly installed value is 3.9 pF.

Parts Removed:

C9B, C109B	Capacitor, variable, ceramic 1.3-5.4 pF	281-0099-00

Parts Added:

C9B, C109B	Capacitor, variable, ceramic 1.4-7.3 pF	281-0100-00

'A' SWEEP GENERATOR RESISTOR VALUES CHANGED TO INSURE ADEQUATE TRIGGERING CAPABILITIES AT LOW TEMPERATURES — INFORMATION ONLY — M11611

Effective Prod SN 8934

FRONT PANEL SYMPTOM: No 'A' sweep in Auto Mode.

PROBLEM: The proper amount of bias current for D505 in some instances could not be maintained at low operating temperatures. As a result, 'A' sweep in some instruments would not free run in the Auto Mode.

PRODUCTION CHANGE: R496 was changed from a 2.7k to a 2.2k resistor and R592 and R593 were changed from 6.2k to 5.1k resistors.

Parts Removed:

R496	Resistor, comp 2.7k 1/4 W 5%	315-0272-00
R592, R593	Resistor, comp 6.2k 1/4 W 5%	315-0622-00

Parts Added:

R496	Resistor, comp 2.2k 1/4 W 5%	315-0222-00
R592, R593	Resistor, comp 5.1k 1/4 W 5%	315-0512-00

VERTICAL PREAMPS NUVISTOR PLATE DECOUPLING CAPACITORS INCREASED IN VALUE TO REDUCE 400 Hz VERTICAL MODULATION

See SQB

M10710

Effective Prod SN 8950

Usable in field instruments SN 100-8949

FRONT PANEL SYMPTOM: 400 Hz vertical modulation of the display.

PROBLEM: Insufficient plate decoupling of the input cathode follower stages allows vertical modulation of the display when operated on 400 Hz.

PRODUCTION CHANGE: C23 and R123 were increased in value from 0.03 μF to 0.56 μF.

Parts Removed:

C23, C123	Capacitor, cer 0.03 μF 200 V	283-0092-00

Parts Added:

C23, C123	Capacitor, EMC 0.56 μF 100 V tantalum ±10%	290-0311-00

INSTALLATION INSTRUCTIONS:

Parts Required: See 'Parts Added'.

Installation Procedure:

Replace C23 and C123 with 0.56 μF tantalum capacitors (290-0311-00) with the + leads going to the plates of V23 and V123.

AC POWER SWITCH CHANGED
TO MORE RELIABLE TYPE — See SQB — M11619

Effective Prod SN 8990 — Usable in field instruments SN 100-8989

FRONT PANEL SYMPTOM: None.

PROBLEM: An inductive voltage 'kick' occurs, when the AC Power switch is operated, which results in failure of the power switch.

PRODUCTION CHANGE: The Torbal Power switch, SW1101, was replaced with a higher current capacity type C & K switch. The Torbal switch requires a wiring change. See drawing.

Parts Removed:

SW1101	Switch, toggle SPDT	260-0716-00

Parts Added:

SW1101	Switch, toggle SPDT	260-0716-02

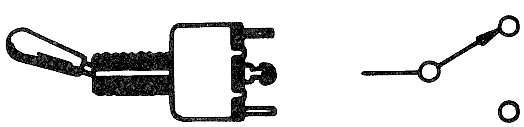
INSTALLATION INSTRUCTIONS:

Parts Required: See Part Listed below

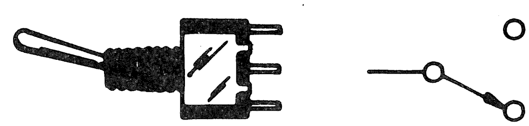
Parts Replacement Kit 050-0346-00

Installation Procedure:

Refer to kit instructions.



260-0716-00



260-0716-02

+12 V, -12 V, +75 V AND HV POWER SUPPLY TRANSISTOR MOUNTING HARDWARE CHANGED TO ELIMINATE POSSIBLE SHORT — INFORMATION ONLY — M10723

Effective Prod SN 9670

FRONT PANEL SYMPTOM: None.

PROBLEM: Possibility exists that Q1137, Q1167, Q1197 and Q930 transistor in the +12 V, -12 V, +75 V and HV Power Supply could be shorted to the chassis if the mounting screw breaks the anodized coating of the aluminum insulating washers used to mount the transistors.

PRODUCTION CHANGE: The mounting washers of Q1137, Q1167, Q1197 and Q930 were changed from anodized aluminum washers to shouldered fiber washers.

Parts Removed:	Washer, shouldered alum .312 dia x .020 thick w/#6 hole black anodized	210-0983-00
Parts Added:	Washer, fiber #6 shouldered	210-0811-00

ATTENUATOR RESISTOR PART NUMBER CHANGED TO ELIMINATE DUPLICATE PART NUMBER — INFORMATION ONLY — M11701

Effective Prod SN 9670

FRONT PANEL SYMPTOM: None.

PROBLEM: There are two part numbers for a single 990k 1/4 W 1/2% precision resistor.

PRODUCTION CHANGE: Attenuator resistor R9C/R109C, a 990k 1/4 W 1/2% precision resistor part number was changed from 322-0659-00 to 322-0624-01.

Parts Removed:

R9C/R109C	Resistor, 1/4 W prec 990k ±1/2%	322-0659-00

Parts Added:

R9C/R109C	Resistor, 1/4 W prec 990k ±1/2%	322-0624-01

FRONT PANEL BNC CONNECTORS CHANGED TO PROVIDE A COST SAVINGS BY ELIMINATING ONE OF TWO SIMILAR PARTS

INFORMATION ONLY

M11514

Effective Prod SN 9780

FRONT PANEL SYMPTOM: None.

PROBLEM: Two similar front panel BNC connectors are being stocked when one is capable of suppling all of the demand. The connectors are used at A EXT Trig Input, B EXT Trig Input and 1 kHz Cal locations.

PRODUCTION CHANGE: BNC connector 131-0462-00 was eliminated from stock and replaced by 131-0352-01. The connectors are the same except for shank length which is 0.425" on 131-0462-00 and 0.450" on 131-0352-01.

Parts Removed:

Connector, receptacle, BNC, D hole	(3)	131-0462-00

Parts Added:

Connector, receptacle, BNC, D hole	(3)	131-0352-01

A & B SWEEP GENERATORS RESISTORS ADDED TO ELIMINATE SPURIOUS OSCILLATIONS CAUSING SWEEP JITTER

INFORMATION ONLY

M11680-1

Effective Prod SN 10460

FRONT PANEL SYMPTOM: Erratic delay jitter of about 1 part in 100 at certain TIME/DIV settings.

PROBLEM: Spurious oscillation of approximately 200-250 MHz at Q543 and Q753. Jitter is affected by lead dress to TIME/DIV switch, TIME/CM setting and transistors Q543 and Q743.

PRODUCTION CHANGE: The circuits were damped by adding a 47 Ω 1/10 W 5% resistor in series with the base of Q543 and a 100 Ω 1/10 W 5% resistor in series with the base of Q753. The leads of R752 were insulated by 5/64" *Thermofit tubing.

Parts Added:

R543	Resistor, comp, 47 Ω 1/8 W 5%	317-0470-00
R752	Resistor, comp, 100 Ω 1/10 W 5%	317-0101-00
	Tubing, 5/64" Thermofit (.072')	

*Raychem Corp. Registered Trademark

A & B SWEEP GENERATORS CIRCUIT BOARD LAYOUTS CHANGED TO MOUNT R543 & R752 ADDED IN M11680-1 | INFORMATION ONLY | M11680-2

Effective Prod SN 10460

FRONT PANEL SYMPTOM: None.

PROBLEM: No permanent mounting for R543 and R752.

PRODUCTION CHANGE: The conductive strips between the base of Q753 and R749 on the 'B' sweep board and the base of Q543 and Q538 on the 'A' sweep board were removed and R752 and R543 installed in their place. The part numbers now become 388-0644-01 ('A' sweep) and 388-0645-01 ('B' sweep).

Parts Removed:

Circuit board, 'A' Sweep	388-0644-00
Circuit board, 'B' Sweep	388-0645-00

Parts Added:

Circuit board, 'A' Sweep	388-0644-01
Circuit board, 'B' Sweep	388-0645-01

TRIGGERING SOURCE AND COUPLING SWITCHES REWIRED TO ELIMINATE 'B' TRIGGER AND EXT HORIZONTAL PROBLEMS | See SQB | M11430-1

Effective Prod SN 11860 | Usable in field instruments SN 100-11859

FRONT PANEL SYMPTOM: 'B' Trigger will trigger on 'A' GATE.

PROBLEM: The close proximity of 'B' TRIGGERING SOURCE switch and the 'A' GATE jack allows 'B' Trigger to trigger on the 'A' GATE signal.

PRODUCTION CHANGE: The leads of C615 (0.01 μF) and C616 (100 pF) connected to contact R4 of the 'B' TRIGGERING SOURCE switch were moved to contact F-2 of 'B' TRIGGERING COUPLING switch. The #22 bare wire to contact F-4 of the TRIGGERING SOURCE switch was extended to run through contact R-4 also.

Parts Removed: None.

Parts Added: None.

INSTALLATION INSTRUCTIONS:

Parts Required: None.

Installation Procedure:

Refer to MI - 11430 instructions.

WIRING AND COLOR CODING CHANGED TO FACILITATE WIRING AND ELIMINATE SHOCK HAZARD	INFORMATION ONLY	M11430-2

Effective Prod SN 11860

FRONT PANEL SYMPTOM: None.

PROBLEM: A shock hazard exists on the power switch with the present color coding. Also, difficulty in wiring the lower high voltage chassis exists.

PRODUCTION CHANGE: The #22 stranded white wire in the regulator cable between thermal cutout TK1101 and Power Switch SW 1101 was changed to yellow-brown-brown-brown.

A #22 bare wire was added between CSF-1 and CSF-2 on the lower high voltage chassis and the #22 white-red wire and one lead of R903 (3M) was moved from CSF-1 to CSF-2.

Parts Removed:	Wire, insulated #22 stranded (white) 1.833'	175-0527-00
Parts Added:	Wire, insulated #22 stranded (yellow-brown-brown-brown) 1.833'	175-0524-00

ATTENUATOR PRECISION RESISTOR PART NUMBERS CONSOLIDATED	INFORMATION ONLY	M12000

Effective Prod SN 11960

FRONT PANEL SYMPTOM: None.

PROBLEM: Two part numbers exist for the same value precision resistor.

PRODUCTION CHANGE: Part number 322-0658-00 was deleted and its usage changed to 322-0621-01.

Parts Removed:		
	Resistor, prec, 900k 1/4W ±1/2%	322-0658-00
Parts Added:		
	Resistor, prec, 900k 1/4W ±1/2%	322-0621-01

METAL TRANSISTORS OF THE PLUG-IN TYPE REPLACED WITH THE LOWER COST 'MOLDED' TRANSISTORS — INFORMATION ONLY — M11613

Effective Prod SN 12680

FRONT PANEL SYMPTOM: None.

PROBLEM: None. Material cost reduction.

PRODUCTION CHANGE: Replace all the metal cased transistors with the 'molded' type transistors. To accommodate the change of Q54 and Q154, the capacitors C49 and C149, located on the vertical preamp circuit board adjacent to TP34 and TP134 respectively, were changed from 2.2pF to 3.3pF capacitors. See M12437.

Parts Removed:

C49, C149	Capacitor, 2.2pF	281-0604-00
Q304, Q314, Q514, Q524, Q714, Q724, Q734, Q769, Q1014	Transistor, 2N2501	151-0108-00
Q494	Transistor, 2N1132	151-0087-00
Q814, Q824	Transistor, 2N2369	151-0127-00
Q473, Q684	Transistor, 2N964	151-0131-00
Q575, Q585, Q834, Q913, Q844, Q863, Q873	Transistor, MM999	151-0133-00
Q564	Transistor, 2N3251 metal case	151-0188-01
Q1129, Q1159	Transistor, 2N3053	151-0136-00
Q1114, Q1124, Q1154, Q1184	Transistor, 2N929	151-0151-00
Q54, Q84, Q94, Q154, Q184, Q194	Transistor, XF737	151-0167-00

Parts Added:

C49, C149	Capacitor, 3.3pF	281-0534-00
Q494, Q564, Q575, Q585, Q834, Q844, Q863, Q873, Q913	Transistor, 2N4122	151-0220-00
Q54, Q84, Q94, Q154, Q184, Q194, Q473, Q684	Transistor, 2N964	151-0221-00
Q304, Q314, Q514, Q524, Q714, Q724, Q734, Q814, Q824, Q1014	Transistor, 2N4275	151-0223-00
Q769, Q1129, Q1159, Q1114, Q1124, Q1154, Q1184	Transistor, 2N3692	151-0224-00

+12 V POWER SUPPLY DIODES REMOVED
TO PREVENT DAMAGE WHEN 115 VOLT INSTRUMENT IS PLUGGED INTO 230 V LINE

See SQB

M12214-1

Effective Prod SN 12680

Usable in field instruments SN 3440-12679**

**This mod is usable below SN 3440 if M10485-2 has been installed.

FRONT PANEL SYMPTOM: None.

PROBLEM: In instruments with M10485-2 installed, extensive damage could result if an attempt was made to operate it on 230 V line while connected for 115 V operation. Damage could also result if D1167 were to become shorted.

PRODUCTION CHANGE: D1159 and D1167 were removed. When D1167 is removed, it leaves an unnecessary #22 solid white-yellow wire in the cable which is removed in-plant. The cable number then becomes 179-0991-01.

Parts Removed:

D1159	Diode, 6185	152-0185-00
D1167	Diode, Zener 1N972	152-0142-00
	Cable, reg bracket	179-0991-00

Parts Added:	Cable, reg bracket	179-0991-01

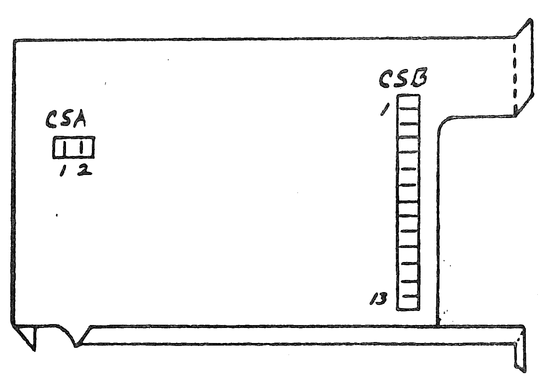
INSTALLATION INSTRUCTIONS:

Parts Required: None.

Installation Procedure:

a) Remove D1159 (152-0185-00) located on the Low Voltage Regulator circuit board near Q1159.

b) Lift the Low Voltage Regulator circuit board and remove D1167, connected between CSB-12 and the emitter of Q1137. Leave the remaining #22 solid white-yellow wire soldered to CSB-12. Refer to strip layout.



'A' TRIGGER GENERATOR 'AUTO TRIGGERING' IMPROVED BY ADDITION OF A DIODE | See SQB | M12214-2

Effective Prod SN 12680 | Usable in field instruments SN 100-12679

FRONT PANEL SYMPTOM: Unstable triggering with a flickering bright baseline on the display.

PROBLEM: The reset of D475 by a narrow width pulse will sometimes reset the AUTO multivibrator, Q485-Q495 if Q485 has not yet reached saturation.

PRODUCTION CHANGE: The negative going excursion of the collector of Q484 is limited by the addition of a diode in parallel with L484 with the anode hooked to ground.

Parts Added:

D483	Diode, 6185	152-0185-00

INSTALLATION INSTRUCTIONS:

Parts Required: See 'Parts Added'.

Installation Procedure:

Install D483 (152-0185-00) in parallel with L484 making sure the anode lead goes to ground. L484 is located on the 'A' Sweep circuit board near Q484.

'A' SWEEP GENERATOR DIODE RELOCATED TO ELIMINATE OSCILLATIONS AT THE END OF THE SWEEP

See SQB

M12437

Effective Prod 12959

Usable in field instruments SN 12680-12958**

** Also usable below SN 12680 if M11613 is installed.
modified out of sequence

6244	9573-4	11370-1	12573	12739	12827
6276	9712	11373	12577	12748-9	12832
6458	9717	11376-8	12582	12755	12842-3
7772	9902	11381	12589	12761	12846
7781	9917	11383	12630	12763	12849-59
7783	10123	11385	12633-5	12765	12861
7795-8	10310	11387-9	12637-9	12770	12867-9
7811	10314	11689	12650-79	12774-6	12873-909
7814-6	10316	11762-4	12692	12783	12911
7818	10318	11767-72	12694	12786	12914
7820-1	11182-3	11774-9	12701-2	12805-6	12919
7825	11185	12065	12710-1	12808	12922
7827	11189	12345	12718-9	12810-2	12926
8587	11192	12350	12721	12814-5	12928-46
9383	11194-5	12378	12727	12818-9	12948-9
9550	1198-9	12392	12734-5	12822	12951-7

FRONT PANEL SYMPTOM: Oscillations near the end of the sweep with minimum sweep length. Unable to arm sweep in single sweep mode of operation.

PROBLEM: Some 151-0220-00 epoxy case transistors installed in M11613 caused erratic sweep gating multivibrator switching.

PRODUCTION CHANGE: The anode lead of diode D575 was moved from the common emitters of Q575 and Q585 to the base of Q575.

Parts Removed: None.

Parts Added: None.

INSTALLATION INSTRUCTIONS:

Parts Required: D575 Diode, 6185 152-0185-00

Installation Procedure:

See MI - 12437

'B' SWEEP GENERATOR RESISTOR VALUE CHANGED TO PREVENT SWEEP FREE-RUNNING IN 'B' TRIGGERABLE AFTER DELAY-TIME MODE

See SQB

M12492

Effective Prod SN 13208
modified out of sequence

Usable in field instruments SN 100-13207

6244	9550	11194-5	12585	12851	12965-7	13035
6276	9573-4	11198-9	12589	12854-5	12969	13039-46
7458	9712	11370-1	12630	12859	12972	13048-51
7772	9717	11373	12633-9	12879	12980-2	13053-71
7781	9902	11376-8	12650-79	12885	12984-5	13073-110
7783	9917	11381	12694	12897	12987	13112-3
7795-8	10123	11383	12702	12902	12991	13115-29
7811	10310	11385	12710	12905-6	12998-9	13131
7814-6	10314	11387-9	12719	12932	13001	13133-42
7818	10316	11689	12739	12934-6	13003	13144-6
7820-1	10318	11762-4	12763	12938-40	13005	13148-83
7825	11182-3	11767-72	12776	12944	13007-8	13186
7827	11185	11775-9	12806	12946	13024	13189
8587	11189	12378	12822	12952	13026	13191-206
9383	11192	12582	12827	12956	13032	

FRONT PANEL SYMPTOM: 'B' Sweep free-runs when in 'B' TRIGGERABLE AFTER DELAY-TIME Mode. Problem is especially bad at fast sweep rates and with large amplitudes of 50 MHz signals and with 'B' TRIGGER LEVEL fully ccw.

PROBLEM: When Q774 is switched on, it has too large of a collector voltage transition causing Q785 to be driven into V_{BE} breakdown by Q775. This results in too high of a negative transient at D705, thus turning on the sweep.

PRODUCTION CHANGE: R774 was changed from 680 Ω to 1 k. This reduced the voltage transition of Q774.

Parts Removed:

R774	Resistor, comp 680 Ω 1/4 W 10%	316-0681-00

Parts Added:

R774	Resistor, comp 1 k 1/4 W 5%	315-0102-00

INSTALLATION INSTRUCTIONS:

See MI - 12492

CRT CIRCUIT COIL ADDED AND CAPACITOR CHANGED TO REDUCE HIGH LINE DELAY JITTER — INFORMATION ONLY — M11383

Effective Prod SN 13430

FRONT PANEL SYMPTOM: Excessive delay jitter at high line voltage.

PROBLEM: Current pulses in power supply ground reference.

PRODUCTION CHANGE: C937 was changed from 50 μF to 47 μF and L937 (80 μH) was added between F937 and C937. This reduced the peak current in the high voltage oscillator. This wiring change requires the #22 stranded white-red wire connected to the outboard terminal of F937 be moved to CSD-1.

Parts Removed:

C937	Capacitor, 50 μF 25 V -10% +75%	290-0209-00

Parts Added:

L937	Coil, fixed 80 μH on form 276-0120-00	108-0422-00
C937	Capacitor, 47 μF 35 V ±20%	290-0316-00

The following instruments received all of M11383 except for the moving of the #22 stranded white-red wire:

13430-3	13473-6	13502	13533	13580
13435	13478-9	13506-7	13535	13585
13437-45	13483	13515	13537	13607-8
13447-9	13487	13519-22	13539	13637
13453	13489-94	13524-7	13570-4	13646
13459-60	13497-500	13529-31	13578	13657
13462-8				

L V POWER SUPPLY CAPACITOR MOUNTING BRACKET CIRCUIT NUMBERS FOR RECTIFIER DIODES CHANGED TO AGREE WITH SCHEMATIC

INFORMATION ONLY

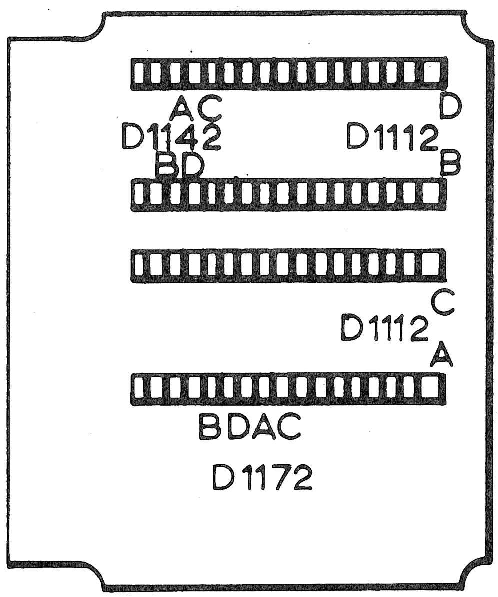
M11564

Effective Prod SN 13430

FRONT PANEL SYMPTOM: None.

PROBLEM: The circuit numbers marked on the mounting bracket do not agree with the Type 453 Power Supply schematic.

PRODUCTION CHANGE: Rectifier diode circuit number silkscreening on the bracket was corrected.



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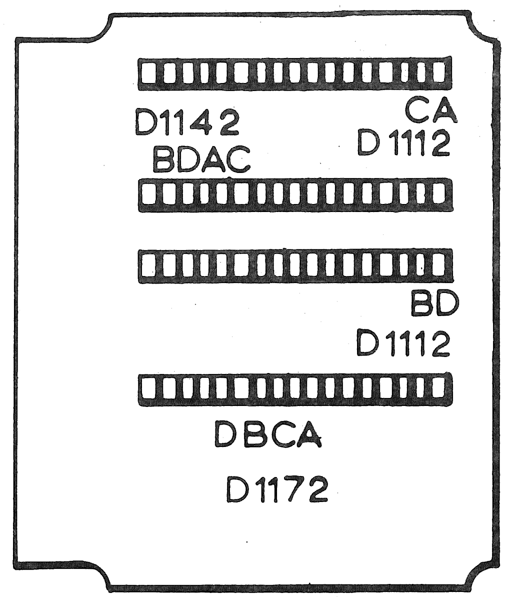


AFTER

CABINET LATCH THUMB SCREWS MODIFIED TO PREVENT LOSS OF SCREW RETAINING RING — See SQB — M10949

Effective Prod SN 13620 — Usable in field instruments SN 100-13619

FRONT PANEL SYMPTOM: None.

PROBLEM: When cabinet latch thumb screws are loosened too far, the retaining rings are forced off the end and drop into the instrument.

PRODUCTION CHANGE: The thumb screws were replaced with thumb screws having a thread relief of .183 dia x .343 long at the end of the threaded portion.

Parts Removed:	Thumb screws, cabinet latch (2)	214-0598-01
Parts Added:	Thumb screws, cabinet latch (2)	214-0910-01

INSTALLATION INSTRUCTIONS:
See MI - 10949

CRT CIRCUIT SLO-BLO FUSE F937 CHANGED TO ELIMINATE PREMATURE OPENING — See SQB — M12245-1

Effective Prod SN 13820 — Usable in field instruments SN 100-13819

FRONT PANEL SYMPTOM: None.

PROBLEM: Random fuse failure occurs with no circuit malfunction. The slo-blo fuse value was de-rating when the ambient temperature became elevated to approximately +55° C.

PRODUCTION CHANGE: The slo-blo fuse previously used as F937 was replaced by a fast-blo fuse of the same current rating. The fast-blo fuse provided more dependable operation and better circuit protection.

Parts Removed:

F937	Fuse, 2A 3AG slo-blo	159-0023-00

Parts Added:

F937	Fuse, 2A 3AG fast-blo	159-0021-00

INSTALLATION INSTRUCTIONS:

See MI - 12245-1

CRT CIRCUIT METAL FILM RESISTOR REPLACED BY WIRE WOUND RESISTOR FOR IMPROVED RELIABILITY — INFORMATION ONLY — M12245-2

Effective Prod SN 13820

FRONT PANEL SYMPTOM: None.

PROBLEM: Metal film resistors in this application are considered to be unreliable. Also, the optimum value wire wound resistor is not available.

PRODUCTION CHANGE: The two metal film resistors used in parallel as R950 and R951 are replaced by one R951, a 9.3Ω 1/2W 1% wire wound resistor.

Parts Removed:

R950, R951	Resistor, prec 18.7 Ω 1/8W 1% metal film	321-0027-00

Parts Added:

R951	Resistor, prec 9.3Ω 1/2W 1% WW	308-0427-00

FRONT COVER CHANGED TO INSTALL IMPROVED LATCH ASSEMBLY ON ACCESSORY COMPARTMENT LID — See SQB — M11893

Effective Prod SN 14020 — Usable in field instruments SN 100-14019

FRONT PANEL SYMPTOM: None.

PROBLEM: The previously used latch assembly was difficult to engage and frequently broke.

PRODUCTION CHANGE: The front cover assembly 200-0633-01 on the Type 453 was replaced by the Type 454 front cover assembly 200-0633-02. The new cover assembly has an improved latch assembly on the accessories storage door.

Parts Removed:	Cover, front assembly	200-0633-01
Parts Added:	Cover, front assembly	200-0633-02

INSTALLATION INSTRUCTIONS:

See MI - 11893

HIGH VOLTAGE ASSEMBLY BOX MODIFIED TO PROVIDE ROOM FOR MOUNTING NEW FAN ASSEMBLY | INFORMATION ONLY | M11786

Effective Prod SN 14680

FRONT PANEL SYMPTOM: None.

PROBLEM: A new fan assembly to be installed at a later date interferes with the high voltage box. Also there is insufficient clearance at the rear of the CRT shield for lateral adjustment because the shield hits the fan motor capacitor.

PRODUCTION CHANGE: New box has an additional clearance dimple and a relocated pem nut. Pem studs in the bottom of the new box for mounting C1102 are relocated. To insure clearance,bend the capacitor mounting terminals down toward the high voltage box at approximately a 45° angle.

Parts Removed:	Box, high voltage	202-0142-00
Parts Added:	Box, high voltage	202-0142-01

CABINET FOOT CHANGED TO BE COMMON TO TYPE 453, 454, & 491 | INFORMATION ONLY | M12272

Effective Prod SN 14860

FRONT PANEL SYMPTOM: None.

PROBLEM: None.

PRODUCTION CHANGE: The cabinet foot for use on the Type 453 was changed from 348-0080-00 to 348-0080-01. This provides a common foot for use on the 453, 454 and 491.

Parts Removed	Foot, plastic, molded polyurethane	348-0080-00
Parts Added:	Foot, plastic, molded polyurethane	348-0080-01

A & B TRIGGER MODIFIED SOURCE SWITCH TO MAKE TYPE 453 SOURCE SWITCH USABLE IN THE TYPE 454 — INFORMATION ONLY — M11167

Effective Prod SN 15000

FRONT PANEL SYMPTOM: None.

PROBLEM: To make the Type 453 Source switch usable in the Type 454.

PRODUCTION CHANGE: The Type 453 "A" and "B" Source switches SW430 and SW610 were changed from 260-0698-00 to 260-0698-01. Changes made are as follows: Dummy terminal lugs added at positions F6A, F7A and F8A.

Parts Removed:

SW430, SW610	Switch, raw lever, Source 1s 4 pos	260-0698-00

Parts Added:

SW430, SW610	Switch, raw lever, Source 1 s 4 pos	260-0698-01

CH 1 AND CH 2 VERT PREAMP BY-PASS CAPACITORS C23 AND C123 REPLACED WITH WIDER TOLERANCE CAPACITOR FOR BETTER COMPONENT AVAILABILITY — INFORMATION ONLY — M12178

Effective Prod SN 15430

FRONT PANEL SYMPTOM: None.

PROBLEM: Component availability

PRODUCTION CHANGE: Replaced C23 and C123, 0.56 μF 100 V ±10% capacitors, with 0.56 μF 100 V ±20% capacitors.

NOTE: Due to a parts shortage, a special purchased 0.47 μF 100 V ±10% capacitor was randomly installed, without regards to serial numbers, prior to the availability of the 0.56 μF 100 V ±20% capacitor, part number 290-0327-00.

Parts Removed:

C23, C123	Capacitor, EMC 0.56 μF 100 V ±10% DC tantalum w/insulating sleeve axial lead	290-0311-00

Parts Added:

C23, C123	Capacitor, EMC 0.56 μF 100 V ±20% DC tantalum w/insulating sleeve, axial lead	290-0327-00

COMPLETE INSTRUMENT EXTENSIVELY MODIFIED TO INCORPORATE NEW AND IMPROVED ELECTRICAL & MECHANICAL FEATURES — INFORMATION ONLY — M11475

Effective Prod SN 20000

FRONT PANEL SYMPTOM: None.

PROBLEM: None.

PRODUCTION CHANGE: Involved redesign is made in most areas of the instrument. A major portion of circuit boards, sheet metal, cast parts, switches, and cable harnesses are replaced. Basic sections of change are as follows:

1. Redesign of Vertical Amplifier and Trigger circuitry to replace nuvistors with field effect transistors. Modification of other circuitry, where possible, to allow replacing standard transistors with more economical epoxy case versions.
2. Replacement of silicone and Delrin* VOLTS/DIV switches with new types using diallylphthalate which do not bind or squeak.
3. Addition of a mu-metal shield on the rear section of the existing CRT shield, reducing electrical interference with CRT gun operation.
4. Addition of a Line Voltage Selector assembly, providing low, medium, and high voltage range operation on both 115 and 230 Volts.
5. Addition of a rubber shockmounting arrangement to the fan motor which decreases audio noise.

Refer to your instrument Instruction Manual for any questions concerning the extensive parts changes involved in this modification.

* Du Pont registered trademark

VERTICAL AMPLIFIER METAL SHIELD REPLACED TO IMPROVE CIRCUIT SHIELDING AND BE COMPATIBLE WITH THE TYPE 454

INFORMATION ONLY

M12138

Effective Prod SN 20050

FRONT PANEL SYMPTOM: Unstable triggering when triggering on CH 1 only on low amplitude signals in the chopped mode.

PROBLEM: Cross-talk between the Vertical Amplifier and the Trigger circuit.

PRODUCTION CHANGE: Center support plate 386-0203-00 was replaced by center support chassis 386-1268-00. The new chassis design provides additional shielding by eliminating openings in the vicinity of "A" SWEEP MODE switch and between "A" Sweep and Vertical Preamp circuit boards.

The new design also changes the method of securing the delay line bracket to the chassis from a hex head screw to a Keps nut.

Parts Removed:

Screw, 6-32 x 5/16 HHS	213-0049-00
Plate, center support	386-0203-00

Parts Added:

Nut, Keps 6-32 x 5/16	210-0457-00
Chassis, center support	386-1268-00

A AND B TRIGGER GENERATORS
COMPONENTS CHANGED TO INCREASE SENSITIVITY

INFORMATION ONLY

M13009

Effective Prod SN 20225

modified out of sequence

20040	20070-3	20090-1	20105	20116	20176-7
20058	20080-2	20093	20107-8	20150-67	20179-80
20063	20084	20100	20110-2	20169-70	20182-9
20068	20086-8	20102	20114	20173	20191-204 and 20206-23

FRONT PANEL SYMPTOM: Difficulty in meeting 50 mV internal trigger specifications in the AC, AC LF REJECT, and HF REJECT modes.

PROBLEM: Circuit sensitivity was not high enough to provide reliable triggering at approximately 30 Hz in AC, and AC HF REJECT modes and 30 kHz in the AC LF REJECT mode.

PRODUCTION CHANGE: Sensitivity of the trigger circuits was increased by making several component changes, removals, and additions as shown in the "Remove-Add" lists and the attached schematics.

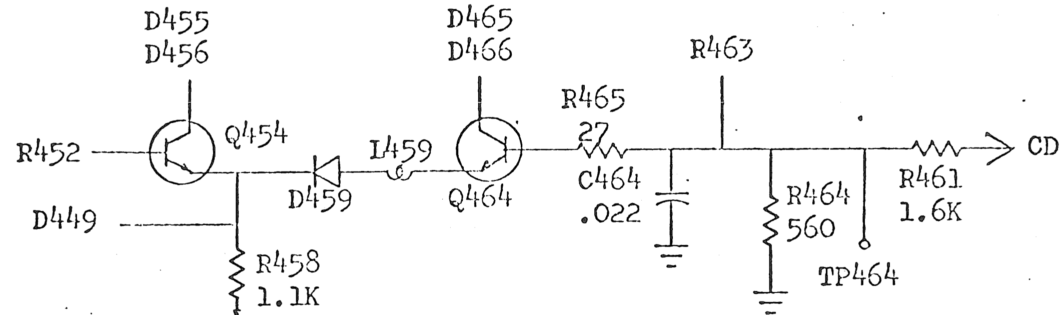
Parts Removed:

D459, D653	Diode, 6185	152-0185-00
L459	Core, ferramic suppressor	276-0528-00
R461, R661	Resistor, comp, 1.6k 1/4W 5%	315-0162-00
R664	Resistor, comp, 560Ω 1/4W 5%	315-0561-00

Parts Added:

LR459, LR653	Coil, fixed, 0.27μH ±10%	108-0487-00
D459, D653	Diode (152-0185-00 w/D035 case)	152-0185-01
D460, D654	Diode, zener, 1N4372A	152-0278-00
R461, R661	Resistor, comp, 1.5k 1/4W 5%	315-0152-00
R466	Resistor, comp, 6.8k 1/4W 5%	315-0682-00
R666	Resistor, comp, 3.3k 1/4W 5%	315-0332-00
R664	Resistor, comp, 620Ω 1/4W 5%	315-0621-00

continued



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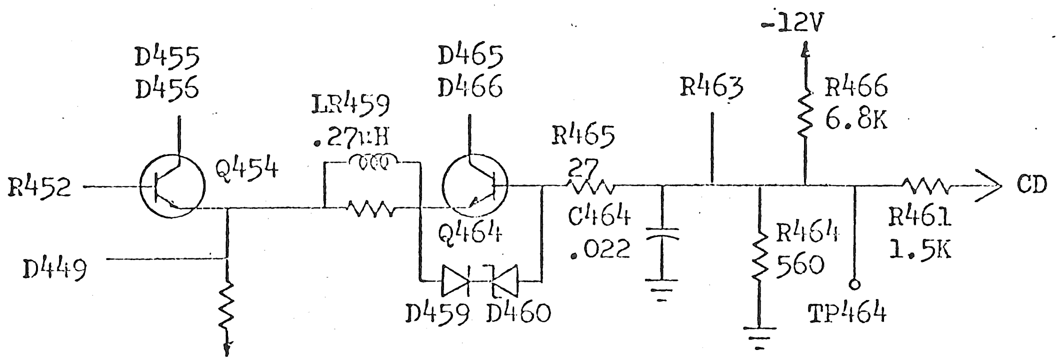
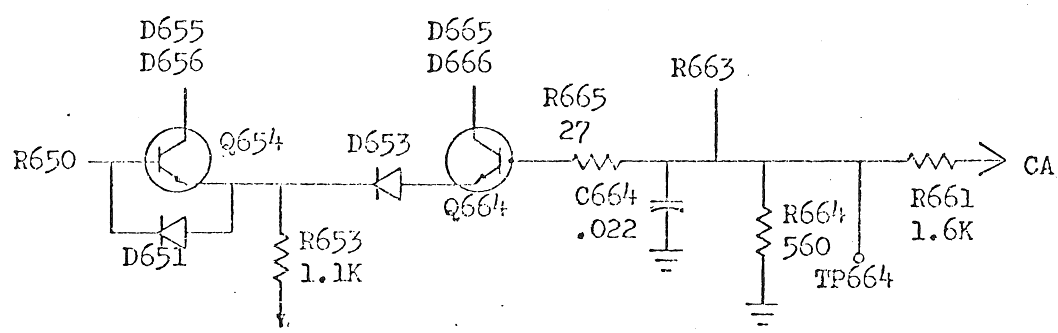


AFTER

"A" Trigger Generator
(Partial Diagram)



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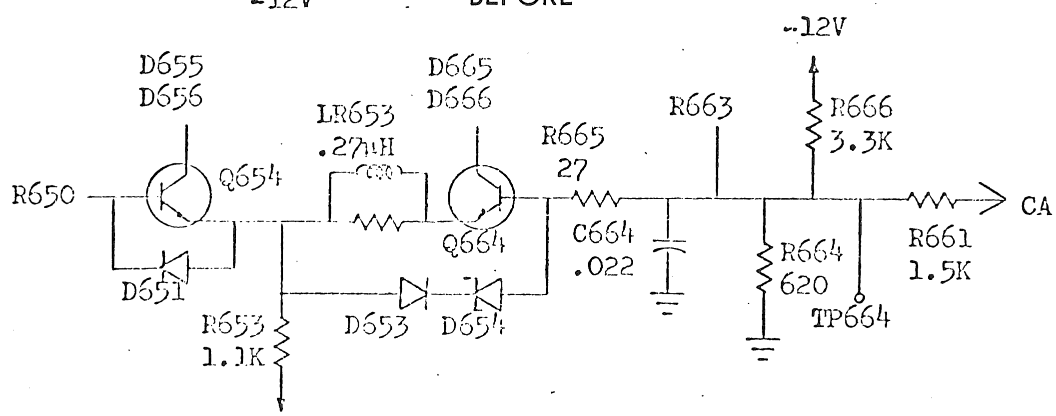


AFTER

"B" Trigger Generator
(Partial Diagram)

VERTICAL SWITCHING C218 VALUE CHANGED TO MORE NEARLY CENTER "CHOP" FREQUENCY

INFORMATION ONLY

M12542

Effective Prod SN 20645

modified out of sequence

20051	20161-2	20267	20350	20435-7	20521
20053-4	20164-6	20269-71	20352-4	20539-40	20523
20056	20179	20280-3	20356-7	20442	20525
20058-63	20183	20291	20360	20444	20527
20066	20185	20295	20362	20446-7	20530-4
20068-73	20187	20299-300	20364-5	20449	20536
20077	20195	20302-4	20367	20453-4	20538-43
20080-2	20197	20310	20370-1	20458	20546-8
20086	20200	20314	20375	20461-4	20550
20088	20204	20316	20380-1	20469	20552
20090	20206-7	20318	20383	20471-9	20554-5
20094-5	20212-4	20322	20385-8	20481	20559-70
20097	20219-21	20326	20398	20483	20573-602
20105	20223	20328	20400-1	20485-7	20605-26
20111	20228	20331	20404-5	20489	20628-31
20116	20235	20335	20407-14	20491	20633-7
20150	20239-40	20337	20416	20493-5	20639-43
20154	20242-3	20339-40	20418-21	20497-8	
20156	20255-6	20346	20423-9	20500	
20159	20262	20348	20431-3	20502-13	

FRONT PANEL SYMPTOM: None.

PROBLEM: Test was sometimes selecting C218 to meet CHOP frequency specifications. The 0.0082 μF value of C218 was not optimum.

PRODUCTION CHANGE: C218 was changed in value from 0.0082 μF ±5% to 0.01 μF ±5%.

Parts Removed:

C218	Capacitor, PTM, 0.0082 μF 100 V 5%	285-0698-00

Parts Added:

C218	Capacitor, PTM, 0.01 μF 100 V 5%	285-0598-00

Effective Prod SN 22297 (R453 only)

FRONT PANEL SYMPTOM: None.

PROBLEM: None.

PRODUCTION CHANGE: The 453 conversion kit 016-0080-00 was replaced with the 454 conversion kit 016-0108-00. The new kit has front panel identification tag inserts for both the R453 and R454 instruments. The tag that is not used will be discarded.

Parts Removed:	Conversion kit, 453 to R453	016-0080-00
Parts Added:	Conversion kit, 453 to R453 or 454 to R454	016-0108-00

ASSEMBLY KITS CHANGED TO FACILITATE INSTRUMENT SCHEDULING AND ASSEMBLY

INFORMATION ONLY

M13150

Effective Prod SN 22530

FRONT PANEL SYMPTOM: None

PROBLEM: None

PRODUCTION CHANGE: Several sub-assembly part numbers were changed to reflect part deletions or additions to facilitate instrument scheduling and assembly. No real change was made to individual component parts so far as the assembled instrument is concerned.

The Channel I and Channel II VOLTS/DIV switch 262-0728-01 is replaced by 262-0728-02. The molded rear mounting plate 386-1284-00 and the components attached to it are transferred to the Attenuator and Preamp Assembly 644-0413-01.

The Attenuator Front Plate Assembly 631-0416-00 is deleted and all parts are transferred to the Attenuator and Preamp Assembly 644-0413-01.

Attenuator switch and chassis assembly 644-0412-01 is deleted and all parts including VOLTS/DIV switch 262-0728-02 are transferred to the Attenuator and Preamp Assembly 644-0413-01.

Attenuator shield 337-0769-00 (2 ea.) is transferred from the Preamp Combo Assembly 644-0413-01 to Attenuator Chassis 610-0473-01.

Fan Motor Assembly 635-0433-00 is deleted and all parts are transferred to the Rear Bulkhead Assembly 631-0418-01.

continued

REMOVE:

CKT. NO.	QUANT.	DESCRIPTION	PART NO.
	1	Attenuator front plate assembly	631-0416-00
	2	Attenuator preamp combo assembly	644-0412-01
	1	Fan Motor assembly	635-0433-00
	2	Shield, Attenuator chassis, plated	337-0769-00

ADD:

	2	Shield, Attenuator chassis, plated	337-0769-00
	1	Motor, 1 MC, 10 CFM w/shaft	147-0027-00
	3	Lockwasher, steel #4 split cad plate	210-0054-00
	3	Screw 4-40 x 1/4 PHS cad plate	211-0008-00
	1	Fan, Impeller, axial	369-0025-00
	1	Bracket, Fan Motor, painted blue	407-0308-01
	2	Connector, terminal, teflon	131-0157-00
	.334	Wire, braided #24 beldon (two .167" lengths)	176-0045-00
	2	Lockwasher, steel, internal	210-0046-00
	4	" " #2 split cad plate	210-0053-00
	4	Lug, solder, 1/4" hole lockround	210-0223-00
	4	Nut, hex, brass, 2-56 x 3/16 cad plate	210-0405-00
	4	Nut, hex, brass, 4-40 x 3/16 cad plate	210-0406-00
	2	Nut, hex, brass 1/4-32 x 5/16 cad plate	210-0583-00
	2	" " " " " "	210-0583-00
	2	Screw, 4-40 x 7/8 FHS 100° cad plate	211-0109-00
SW5/SW105	2	Switch, rotary, wired, Ch. I, Ch. II VOLTS/DIV.	*262-0728-02
C73,C173	2	Cap., cer., 3.3 pF	281-0534-00
R90,R190	2	Pot, comp., 100Ω 1/2W linear 20%	311-0169-00
R75,R175	2	" " 250Ω " " 10%	311-0385-00
R40,R140	2	" " 10K linear 20%	311-0546-00
R73,R173	2	Res., comp, 1K, 1/4W, 5%	315-0102-00
R74,R174	2	" " 10K, 1/4W, 10%	316-0103-00
	2	Holder, single, NE-1 molded nylon	352-0067-00
	2	Filter, lens, neon molded plexiglass	378-0541-00
	1	Plate, Attenuator	386-0225-00
	2	Plate, Mtg., molded acetal	386-1284-00
	2	Chassis, Attenuator	610-0473-01

New Attenuator switch assembly *262-0728-02 is the same as 262-0728-01 except for the following:

REMOVE:

	1	Connector, terminal, teflon	131-0157-00
	.167	Wire, braided, #24 Beldon	176-0045-00
	**2	Lockwasher, steel, internal 1/4	210-0046-00
	2	" " #2 split cad plate	210-0053-00
	2	Lug, solder, 1/4" hole lockround	210-0223-00
	2	Nut, hex, brass, 2-56 x 3/16 cad plate	210-0405-00
	**2	Nut, hex 5/16 brass 1/4-32 cad plate	210-0583-00
	2	Spring, switch, shaft, plated	214-0599-00
SW5/SW105	1	Switch, raw, rotary, CH I/CH II VOLTS/DIV.	260-0720-01
C73/C173	1	Cap., cer. 3.3 pF	281-0534-00
R90/R190	1	Pot, comp., 100Ω 1/2W linear 20%	311-0169-00
R75/R175	1	Pot, comp, 250Ω 1/2W linear 10%	311-0385-00
R73/R173	1	Res. comp. 1K, 1/4W, 5%	315-0102-00
R74/R174	1	Res. comp., 10K, 1/4W, 10%	316-0103-00
	1	Plate, mtg. mold acetal	386-1284-00

ADD:

SW5/SW105	1	Switch, raw, rotary, CH. I/CH.II VOLTS/DIV.	260-0720-01
	2	Spring, switch, shaft, plated	214-0599-00

REAR CASTING INSTRUMENT FEET REPLACED TO REDUCE POSSIBILITY OF CRT SHOCK DAMAGE

INFORMATION ONLY

M12551

Effective Prod SN 22990

FRONT PANEL SYMPTOM: None.

PROBLEM: Instrument feet made of polycarbonate were hard and wouldn't absorb shock. This created possibility of damaging CRT when setting the instrument down.

PRODUCTION CHANGE: The material used to make the feet was changed from polycarbonate to a softer polyurethane.

Parts Removed:	Screw, 8-32 x 1-1/4 PHS Pozidriv (4)	212-0082-00
	Foot, body and cord holder (4)	348-0078-00
	Foot, cap(4)	348-0079-00
Parts Added:	Post, metallic (4)	129-0146-00
	Screw, 8-32 x 1/4 PHS Pozidriv (4)	212-0021-00
	Foot, body and cord holder (4)	348-0078-01
	Foot, cap (4)	348-0079-01

VARIABLE VOLTS/DIV CONTROLS REPLACED TO IMPROVE UNCAL NEON SWITCH RELIABILITY — INFORMATION ONLY — M12998

Effective Prod SN 23010

FRONT PANEL SYMPTOM: UNCAL neons do not turn off.

PROBLEM: The basic design of the switch and the way it is attached to VARIABLE VOLTS/DIV controls does not provide reliable switch operation.

PRODUCTION CHANGE: The VARIABLE VOLTS/DIV switch/potentiometer combinations were changed to a more dependable part as shown in the Remove-Add list. To provide clearance between the new potentiometer and the mounting plate, a lockwasher is added between the potentiometer solder lug and the mounting plate.

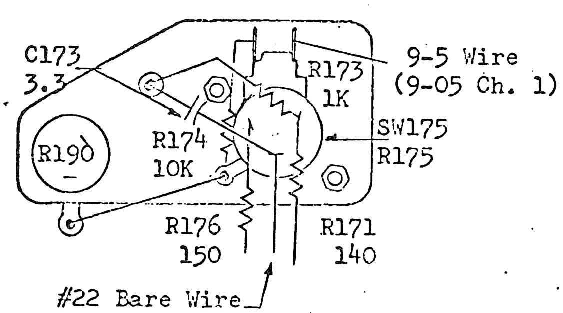
Parts Removed:

R75/SW75, R175/SW175	Resistor, variable, comp., 250 Ω ±10% 1/2 W linear w/SPST sw	311-0385-00

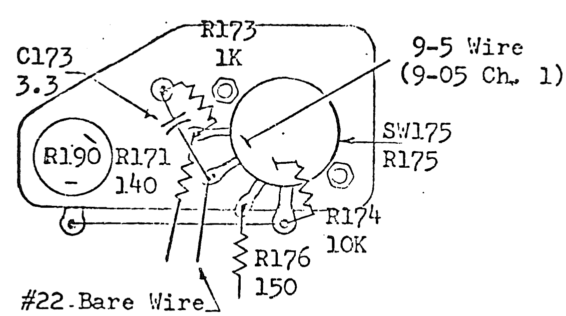
Parts Added:

R75/SW75, R175/SW175	Resistor, variable, comp., 250 Ω ±10% 1/2 W linear w/SPST sw	311-0385-01
	Lockwasher, internal, potentiometer	210-0046-00

Before



After



Note: Ch. 2 circuit numbers are shown. Ch. 1 circuit numbers utilize the last two digits of Ch. 2 except as indicated.

A AND B TIMING SWITCH AND CH 1 AND CH 2 VERTICAL PREAMP SWEEP UNCAL AND VOLTS/DIV NEONS SHUNTED BY RESISTORS TO PREVENT RANDOM FIRING DUE TO SWITCH LEAKAGE	See SQB	M13688

Effective Prod SN 23169

Usable in field instruments SN 100-23168

modified out of sequence

20000-08	20523	21537	22475	22790-91	22973-74
20012-39	20550	21614	22477	22793	22978
20041-49	20560-64	21649	22487	22798	22986-87
20053	20588	21652	22494-95	22801	22990-93
20059	20592	21670	22549	22804-05	22996-99
20061	20641	21703	22613	22807	23001-03
20070	20646	21731	22654-55	22834	23005
20072-73	20756	21751-52	22658	22852	23008-10
20080-82	20779	21843	22866-67	22854	23012-17
20086	20789	21858	22670	22857	23021-25
20088	20854	21882	22672	22859	23028-80
20094	20874	21902	22675	22870	23084-88
20154	20894	21908	22677	22876	23092-99
20187	20904	21960	22680	22879	23100
20221	20924	21994	22683	22892	23102-08
20235	20974	22005	22689-90	22896-97	23110-14
20242-43	21031	22008	22692	22902	23116-18
20282	21056	22018-19	22696-98	22904	23120
20346	21107	22099	22710	22927	23122
20354	21134	22100	22715	22934	23125-30
20371	21330	22109	22737	22936	23134
20375	21341	22177	22748	22938-39	23138
20392	21357	22197-98	22764	22944	23140-67
20404	21368	22330	22774	22946	
20412	21402	22347	22783	22952-55	
20491	21406	22366	22786	22962	
20497	21529	22420	22688	22964-65	

FRONT PANEL SYMPTOM: Random spikes on vertical display.

PROBLEM: Switch leakage is causing the Sweep UNCAL and VOLTS/DIV neons to randomly fire when the dark current is low.

PRODUCTION CHANGE: A 10 Meg resistor was installed across the Sweep UNCAL neon and across both VOLTS/DIV neons.

Parts Removed: None

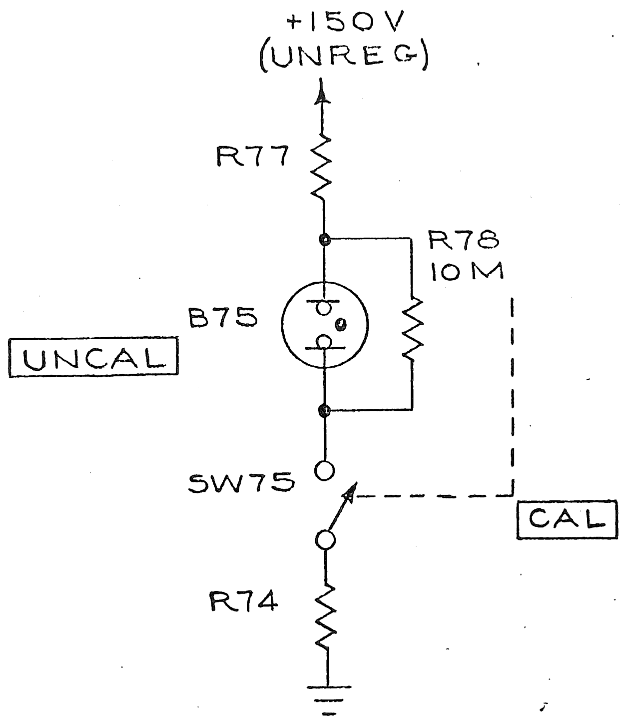
Parts Added:

R528 R78, R178	Resistor, comp., 10 M, 1/4 W, 10%	316-0106-00

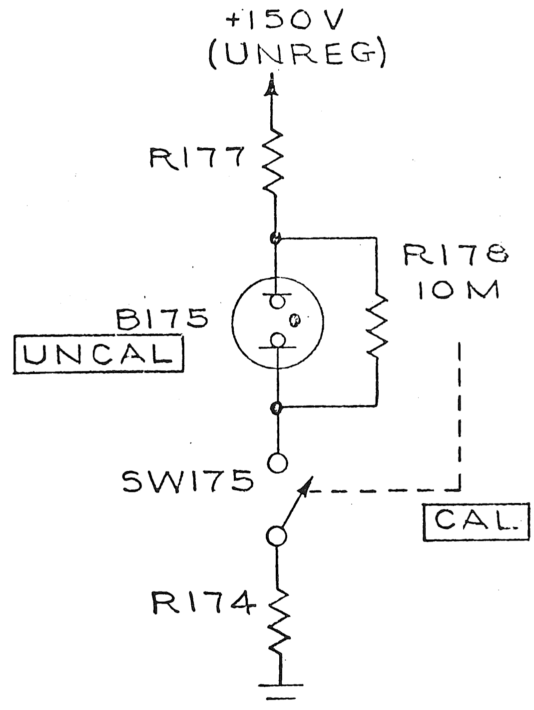
INSTALLATION INSTRUCTIONS:

See MI-13688.

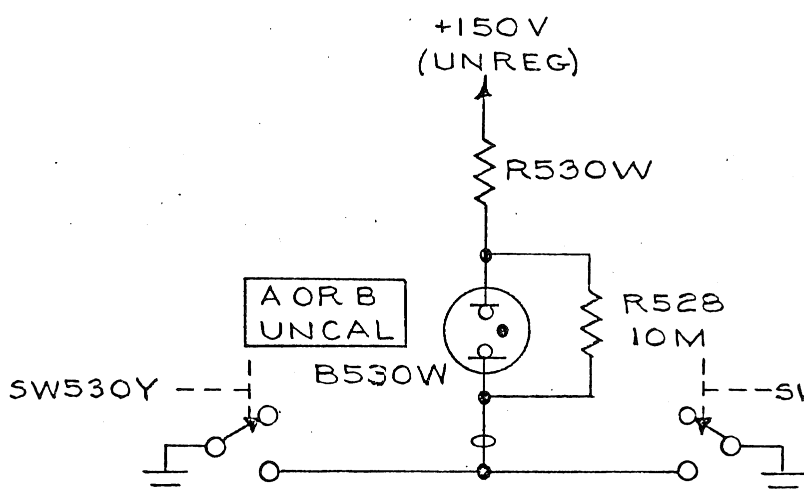
continued



PARTIAL
CHANNEL 1 VERTICAL PREAMP



PARTIAL
CHANNEL 2 VERTICAL PREAMP



PARTIAL
A AND B TIMING SWITCH

CRT FILTER SUPPORT SPRING REPLACED WITH IMPROVED PART — INFORMATION ONLY — M12971

Effective Prod SN 25630

FRONT PANEL SYMPTOM: None.

PROBLEM: Lack of support in the center of the plastic protector frame allows the frame and CRT protector plate to separate when applying pressure during removal.

PRODUCTION CHANGE: A new support spring was installed to provide the support needed during protector removal.

Parts Removed:	Spring, filter	214-0654-00
Parts Added:	Spring, grounding, CRT mesh filter	214-0996-00

POWER CORD INDENTIFICATION TAG ADDED — INFORMATION ONLY — M13768

Effective Prod SN 26280

FRONT PANEL SYMPTOM: None.

PROBLEM: Foreign customers may change the power plug and wiring color code may not agree with the United States wiring code.

PRODUCTION CHANGE: A heat shrinkable sleeve was added to the power cord to identify the function of the individual wires.

Parts Removed:	None.	
Parts Added:	Identification sleeve	334-1205-00

BD

MODIFICATION INSTRUCTIONS

MI - 9960

Instr Type	Serial numbers
422	none given
453	100 - 500 (approx)

ACCESSORY COMPARTMENT DOOR HINGE PINS REPLACED TO REDUCE NOISE

This modification reduces the noise, caused from operating the Accessory Compartment door, by replacing the steel hinge pins with Delrin* pins.

PARTS REQUIRED

Quantity	Tektronix Part Number	Description
2 ea	214-0755-00	Pin, hinge, Delrin, 0.292 dia x 1.735

INSTALLATION

Replace steel pins with the Delrin pins.

* DuPont Registered Trademark

MODIFICATION INSTRUCTIONS

MI - 9993

Instr Type	Serial numbers
422	100-1039
453	100- 750 (approximately)

CRT CUSHIONS REPLACED TO PREVENT POSSIBLE "FOGGING" OF CRT FACE

This modification replaces the molded vinyl black CRT cushions in the CRT shield with silicone sponge red cushions to prevent a possible discoloration of the bonding material between the Graticule Light Pipe and the CRT faceplate. The discoloration appears as white clouding near the graticule lamps.

The installation involves removing the CRT and shield, and replacing the cushions in the shield.

PARTS REQUIRED

Quantity	Tektronix Part Number	Description
4 ea	348-0070-01	Cushion, CRT, silicone sponge, 0.188 x 0.690 x 2.030

INSTALLATION

1) Remove the top and rear covers from the instrument.
2) Remove the CRT socket, HV Anode lead, and the Horizontal and Vertical neck pin connections.
3) Unsolder the brown (ground lug) and red wires from the "Y AXIS ALIGNMENT" potentiometer R989 located on the rear bulkhead next to the CRT socket.
4) Unsolder the white (upper) and white-yellow wires from the Beam Rotator coil terminals located on the side of the CRT shield just behind the HV Anode connection.
5) Remove the cable clamp just above the Beam Rotator coil terminals.
6) Remove the two front shield mounting nuts and graticule light holders.
7) Remove the two screws which secure the rear of the CRT shield to the two rear support brackets and, loosen the bracket mounting screw of the bracket nearest the side of the instrument.
8) Slide the CRT and shield toward the rear and then tilt front upward and remove from the instrument. This will require that the graticule light leads be pulled over the front of the CRT face.
9) Loosen the bottom screw on the rear CRT support bracket, located on the inside of the CRT shield. Do not loosen or remove the two side screws.
10) Remove the CRT from the shield by gently pushing on the CRT from the rear.
11) Replace the four vinyl CRT cushions with the silicone rubber cushions. Remove the paper to expose the adhesive back.
12) Re-install the CRT and shield in the reverse order as described above.

BE:ls

2-10-68

MODIFICATION INSTRUCTIONS

COIL ADDED TO IMPROVE TRANSIENT RESPONSE

The front corner high frequency transient response in the 50 mV, 0.5 V and 5 V VOLTS/DIV can be improved by replacing the 22 Ω resistors R6F (CH 1) and R106F (CH 2), with an 80 nH coil. An approximate 2% front corner high frequency rolloff is sometimes present in these three positions.

The installation involves removing the CRT and shield to gain access to the Channel 1 and 2 VOLTS/DIV switches, and replacing the two components which are located on the switches.

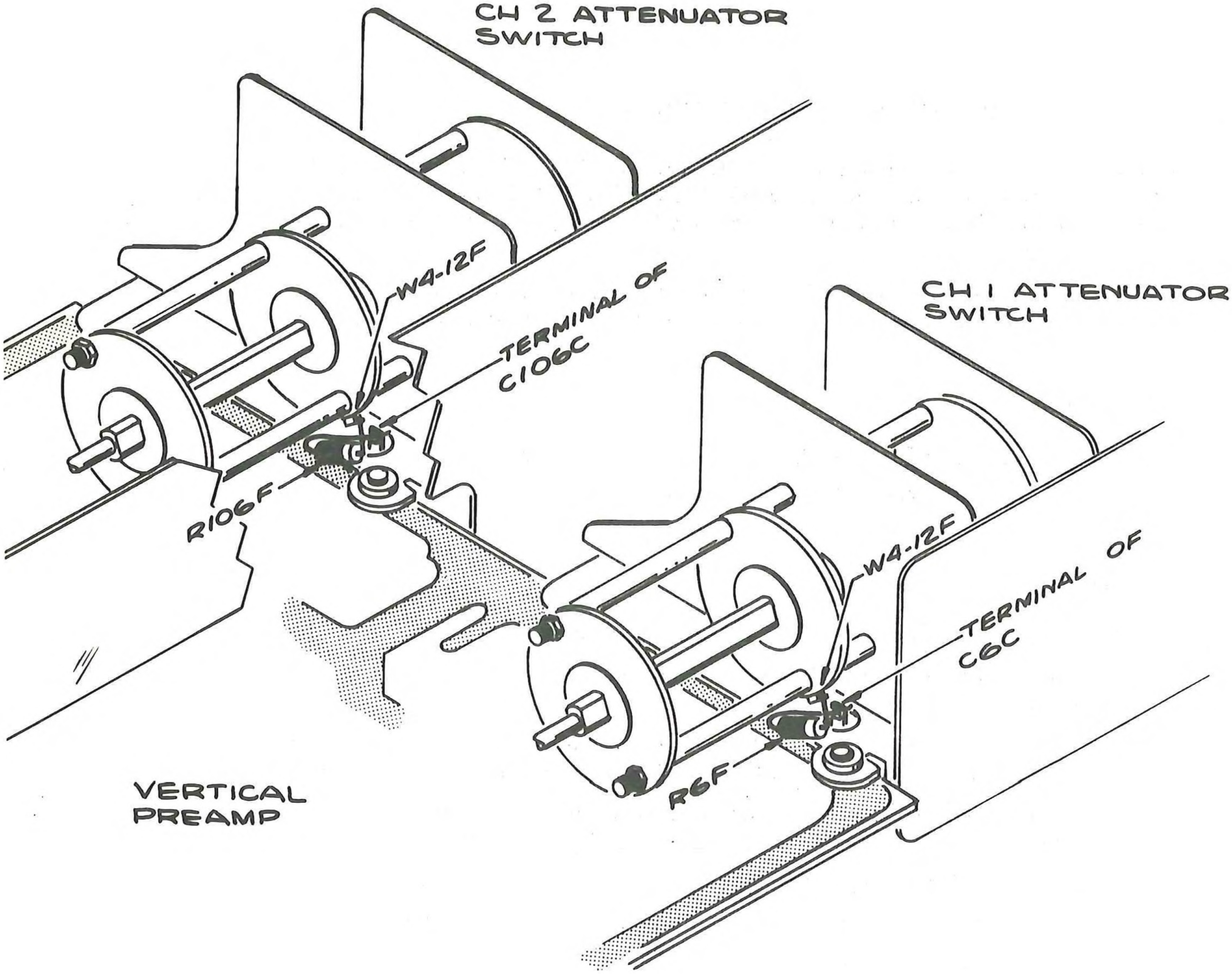
PARTS REQUIRED

Quantity	Tektronix Part Number	Description
2 ea	108-0365-00	Coil, fixed, 80 nH

INSTALLATION

1) Remove the top and rear covers from the instrument.
2) Remove the CRT socket, HV Anode lead, and the Horizontal and Vertical neck pin connections.
3) Unsolder the brown (ground lug) and red wires from the "Y AXIS ALIGNMENT" potentiometer R989 located on the rear bulkhead next to the CRT socket.
4) Unsolder the white (upper) and white-yellow wires from the Beam Rotator coil terminals located on the side of the CRT shield just behind the HV Anode connection.
5) Remove the cable clamp just above the Beam Rotator coil terminals.
6) Remove the two front shield mounting nuts and graticule light holders.
7) Remove the two screws which secure the rear of the CRT shield to the two rear support brackets and, loosen the bracket mounting screw of the bracket nearest the side of the instrument.
8) Slide the CRT and shield toward the rear and then tilt front upward and remove from the instrument. This will require that the graticule light leads be pulled over the front of the CRT face.
9) Replace R6F and R106F with the 80 nH coils. See drawing.
10) Re-install the CRT in the reverse order as described above.

continued


CH 2 ATTENUATOR SWITCH
W4-12F
TERMINAL OF C106C
R106F
CH 1 ATTENUATOR SWITCH
W4-12F
TERMINAL OF C6C
R6F
VERTICAL PREAMP

MODIFICATION INSTRUCTIONS

MI - 10115

Type 453 Oscilloscope

Serial numbers 100-1489

"UNCAL A OR B" NEON WIRE REPLACED WITH COAX TO ELIMINATE 60 Hz HORIZONTAL JITTER

The wire connecting the "UNCAL A or B" neon to the 'A' VARIABLE TIME/DIV CAL switch is replaced with a coax cable to prevent it from radiating 60 Hz into the sweep circuits causing horizontal jitter in the display.

PARTS REQUIRED

Quantity	Tektronix Part Number	Description
12-1/2"	175-0284-00	Cable, coax, 50Ω and 30 pF/ft.

INSTALLATION

Replace the #26 white-gray wire connected between the "UNCAL A or B" neon holder and the "A VARIABLE CAL" potentiometer (located on the "A AND B TIME/DIV" switch) with a 12-1/2" length of 50Ω coaxial cable as follows:

a) Prepare cable as shown in Fig. 1.

b) Solder the single center conductor end to the neon holder terminal.

c) Solder the opposite end of the cable to the "A VARIABLE CAL" potentiometer, as shown in Fig. 2.

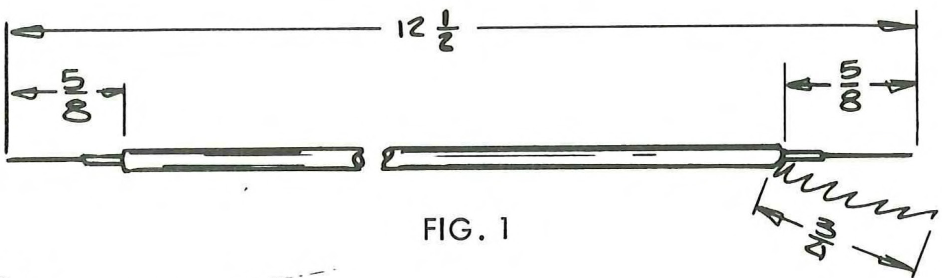


FIG. 1

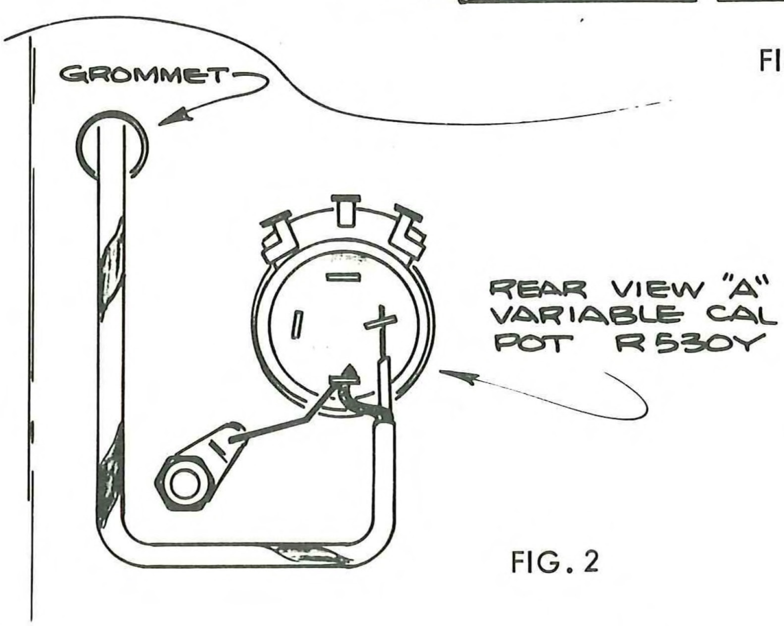


FIG. 2

MODIFICATION INSTRUCTIONS

MI - 10118-1

Type 453 Oscilloscope

Serial numbers 100-1809

CRT EDGE FOCUS IMPROVED

Changing CRT displays would cause the Isolation Shield voltage to vary because of the varying load currents. This would cause the edge focus of the displays to change. By lowering the impedance of the Isolation Shield source voltage this problem is eliminated.

This is accomplished by decreasing the value of divider Resistors R971 and R972.

PARTS REQUIRED

Quantity	Tektronix Part Number	Description
1 ea	315-0332-00	Resistor, composition, 3.3k 1/4W 5%
1 ea	301-0682-00	Resistor, composition, 6.8k 1/2W 5%

INSTALLATION

1) Remove the instrument rear overlay plate by removing the four corner screws and Z AXIS INPUT strap.

2) Replace the 22k 1/4W 10% resistor (R971), mounted between the ceramic strips just below the CRT, with a 3.3k 1/4W 5% resistor.

3) Replace the 47k 1/4W 10% resistor (R972), same location, with a 6.8k 1/2W 5% resistor.

4) Re-install parts removed in step 1.

MODIFICATION INSTRUCTIONS

MI - 10118-2

Type 453 Oscilloscope

Serial numbers 100-1809

PREVENTS UNWANTED FIRING OF SWEEP WHEN RESET BUTTON PUSHED

With the TRIGGERING LEVEL set to trigger on very small amplitude signals on the order of 0.1 mm, it is sometimes possible to cause the sweep to run when operating in the SINGLE SWEEP mode and the RESET button is pushed to re-arm the sweep.

By increasing the capacitance of the capacitor (C569) shunting the RESET switch, this problem can be reduced.

PARTS REQUIRED

Quantity	Tektronix Part Number	Description
1 ea	283-0078-00	Capacitor, ceramic, 0.001 µF 500 V ±20%

INSTALLATION

Replace C569, mounted across the terminals of the RESET switch, with the 0.001 µF capacitor.

MODIFICATION INSTRUCTIONS

MI - 10118-3

Type 453 Oscilloscope

Serial numbers 100-1809

ALTERNATE SWEEP OPERATION AT FAST SWEEP SPEEDS IMPROVED

On the fastest sweep speeds with the sweep length reduced to 5 or 6 cm, the alternate trace sync pulse was not large enough to always cause the vertical amplifier to switch channels.

By changing the value of R526 in the 'A' Sweep Generator this problem can be eliminated.

PARTS REQUIRED

Quantity	Tektronix Part Number	Description
1 ea	315-0103-00	Resistor, composition, 10k 1/4W 5%

INSTALLATION

Replace R526 (15k 1/4W 5% resistor), located on the 'A' Sweep circuit card near terminal 'G' (outside edge of card), with a 10k 1/4W 5% resistor.

MODIFICATION INSTRUCTIONS

MI - 10179

Type 453 Oscilloscope

Serial numbers 100-3149

"STEP ATTEN BAL" RANGE CHANGED TO IMPROVE INPUT NUVISTOR SELECTION

This modification extends the adjustment range of the CH 1 and CH 2 "STEP ATTEN BAL" potentiometers. The added adjustment range will reduce the number of replacement input nuvsitors that have to be rejected because their bias range is outside the adjustment range of the "STEP ATTEN BAL" control.

Installation consists of replacing the "STEP ATTEN BAL" potentiometer and five associated resistors located on the Preamplifier circuit board.

PARTS REQUIRED

Quantity	Tektronix Part Number	Description
2 ea	311-0169-00	Potentiometer, composition, 100Ω 1/2W ±10%
2 ea	321-0175-00	Resistor, precision, 649Ω 1/8W ± 1%
2 ea	321-0121-00	Resistor, precision, 178Ω 1/8W ± 1%
1 ea	323-0169-00	Resistor, precision, 562Ω 1/2W ± 1%
2 ea	220-0440-00	Nut, potentiometer, alum hex, 13/32" lg

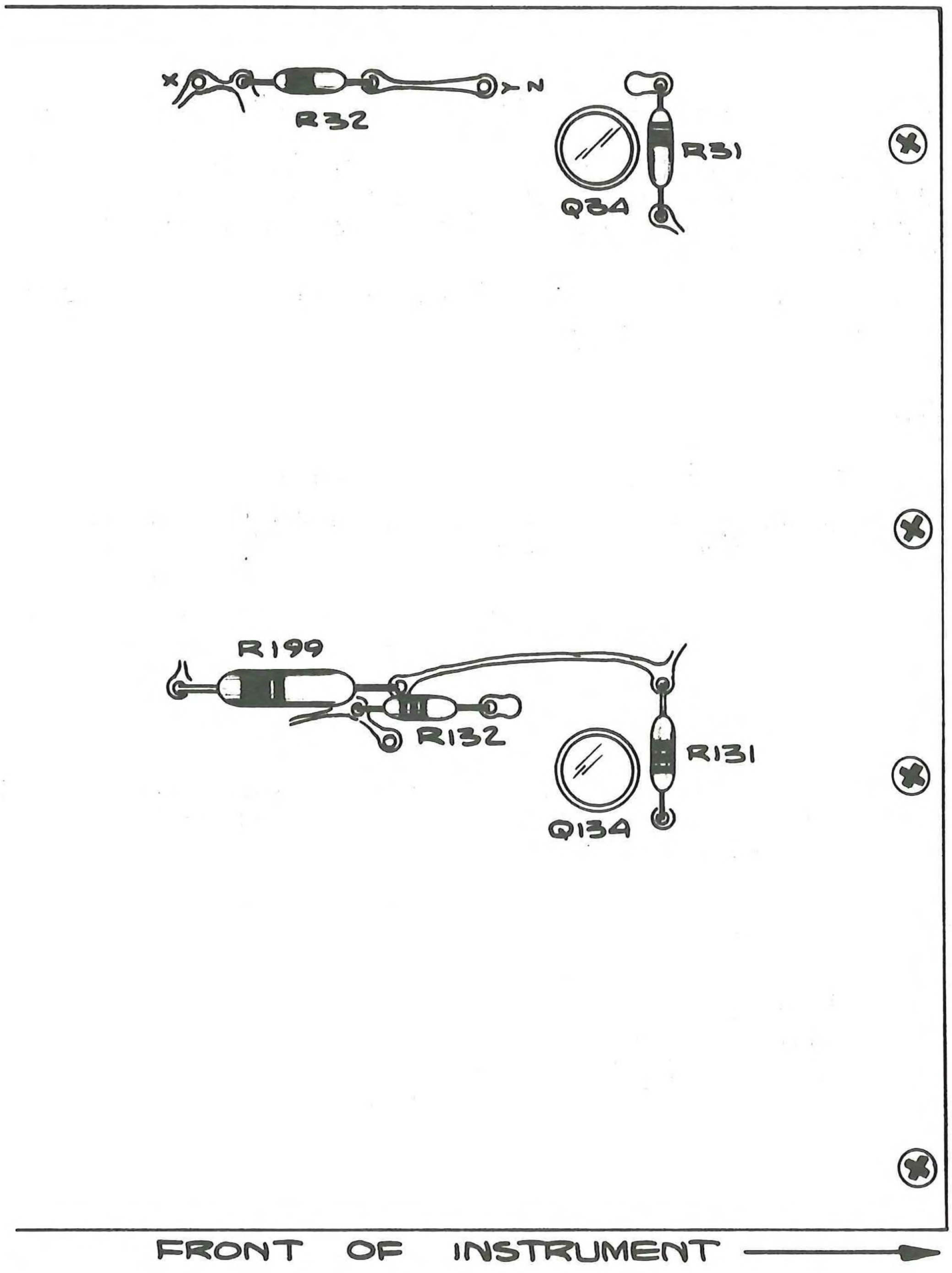
INSTALLATION

1) Replace the STEP ATTEN BAL potentiometers (R30 and R130), mounted on the front panel, with 100Ω 1/2W ±10% potentiometers. Secure each potentiometer, using a 220-0440-00 aluminum nut.

2) Replace the following components, located on the CH 1 and CH 2 Input Preamplifier circuit board, as indicated on the drawing:

R 31 with a 649Ω 1/8W ±1% resistor
R 32 with a 178Ω 1/8W ±1% resistor
R131 with a 649Ω 1/8W ±1% resistor
R132 with a 178Ω 1/8W ±1% resistor
R199 with a 562Ω 1/2W ±1% resistor

continued


X
Y-N
R32
R31
Q34
R199
R132
R131
Q134
FRONT OF INSTRUMENT

MODIFICATION INSTRUCTIONS

MI - 10256

Type 453 Oscilloscope

Serial numbers (see below)*

CRT FILAMENT RESISTOR CHANGED TO OPTIMIZE FILAMENT VOLTAGE

This modification changes the CRT filament series resistor from 3.3 Ω to 9.3 Ω to optimize the CRT cathode operating temperature for brightness and operating life.

* Many instruments between serial numbers 100-899 were modified at the factory to incorporate a 9.1 Ω resistor in place of the 3.3 Ω. The 9.1 Ω resistor in these instruments does not need to be replaced with the 9.3 Ω resistor.

PARTS REQUIRED

Quantity	Tektronix Part Number	Description
1 ea	308-0427-00	Resistor, precision, 9.3 Ω 1/2 W 1%

INSTALLATION

1) Remove the top and bottom instrument covers.

2) Remove the "DANGER HIGH VOLTAGE" shield.

3) Remove the plastic HV cover.

   NOTE: Refer to the drawing for the following component locations.

4) Remove the anode sleeve and unsolder the anode lead from the HV assembly.

5) Remove the two HV transformer retaining screws.

6) Carefully lift up the plastic HV chassis and lay it back over the rear of the instrument.

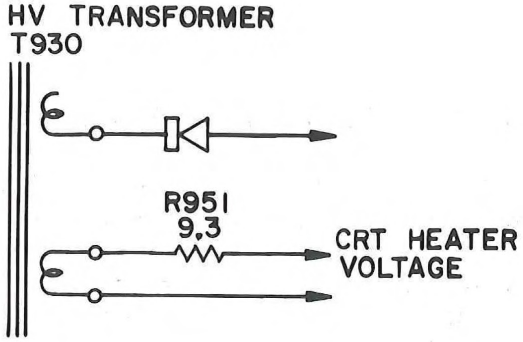
7) Replace R951 (3.3 Ω 1/2 W 5% resistor) with a 9.3 Ω 1/2 W 1% resistor between CSL-4 and CSL-7.

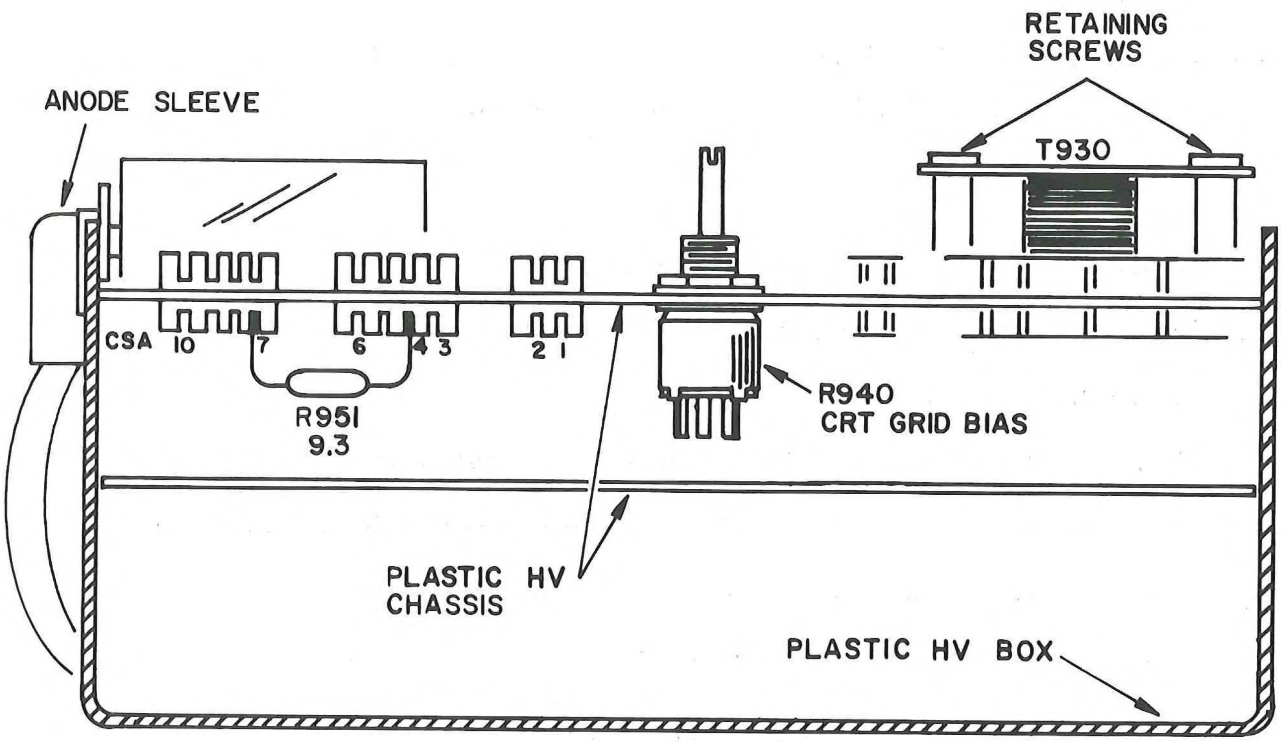
8) Re-install the components parts removed in steps 6 through 1 respectively.

continued

MI - 10256 is usable in the following instruments:

156	455	593	687-9	752-3	781	808-9	843
254	459	616-9	700	755-9	785-7	811	860
272	462	633	702-12	762-4	790	814-6	866
407	464-5	640-61	714-20	766-8	792	818-22	870-1
418	474	663-78	722-7	772	795	825	876
449	477	680-2	729-36	774	800	830-7	879
453	479	684-5	741-50	779	806	839-40	899


HV TRANSFORMER
T930
R951
9.3
CRT HEATER
VOLTAGE


RETAINING
SCREWS
ANODE SLEEVE
T930
CSA
10
7
6
4
3
2
1
R951
9.3
R940
CRT GRID BIAS
PLASTIC HV
CHASSIS
PLASTIC HV BOX

MODIFICATION INSTRUCTIONS

MI - 10315

Type 453 Oscilloscope

Serial numbers 100-1460 *

TRIGGER SLOPE SWITCH CONTACT GROUNDED TO IMPROVE LOW REP-RATE TRIGGERING

An unused contact on the 'A' and 'B' TRIGGERING SLOPE switches is grounded to the switch frame to improve low rep-rate (few seconds or longer) triggering.

This ground position will prevent a back bias from being impressed across tunnel diode D475 (D675 in 'B' Trigger), due to a negative charge being built up across capacitors C456 and C466 (C656 and C666 in 'B' Trigger) from diode leakage current. This back bias was large enough to prevent the tunnel diode from being triggered into the high state. See the BEFORE and AFTER schematics.

* The following instruments were modified at the factory:

107	555	897	1000	1117	1209	1269-70	1370-5
207	626	899	1005	1124	1211	1272	1387
244	637	908	1037	1131	1214	1278	1380-4
258	679	929	1043-5	1133	1220	1282-3	1386-7
262-4	713	946	1050-1	1135-40	1222-3	1286	1389-91
266-7	778	958	1053-4	1142-51	1225-6	1291-5	1393-1439
276	786-7	960-1	1060	1153-7	1228-32	1297-8	1441-2
279	812	965-8	1065-6	1159-62	1235-6	1301-3	1444-8
337	817	972	1070-3	1164	1238-41	1305	1450-9
345	823	978	1076-7	1166	1243-6	1310-40	
441	872	981	1080	1184-5	1248-50	1354-6	
444	879	984	1092	1197	1252-60	1357-60	
456-7	883	989	1104	1199	1262-3	1362-3	
478	889	993	1110-1	1202	1267	1365-8	

PARTS REQUIRED

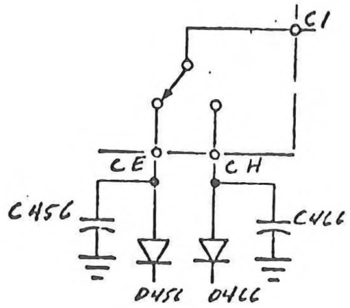
Quantity	Tektronix Part Number	Description
		Wire, #22 solid, bare

INSTALLATION

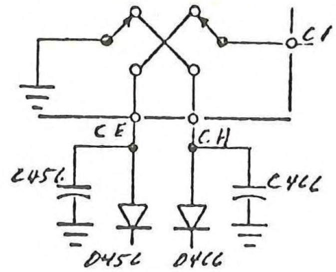
Solder a #22 bare wire between the unused contact on the 'A' and 'B' TRIGGERING SLOPE switches and the switch frame. See drawing.

Access to the 'B' TRIGGERING SLOPE switch is best obtained from the side by swinging out the side access plate. Be extremely careful not to burn the wire insulation with the soldering iron.

continued

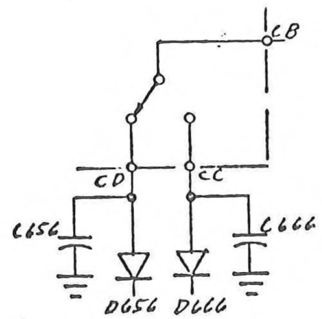


BEFORE

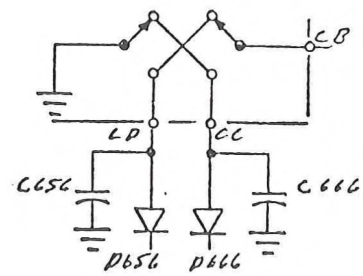


AFTER

PARTIAL 'A' TRIG GEN SLOPE SWITCH SW455

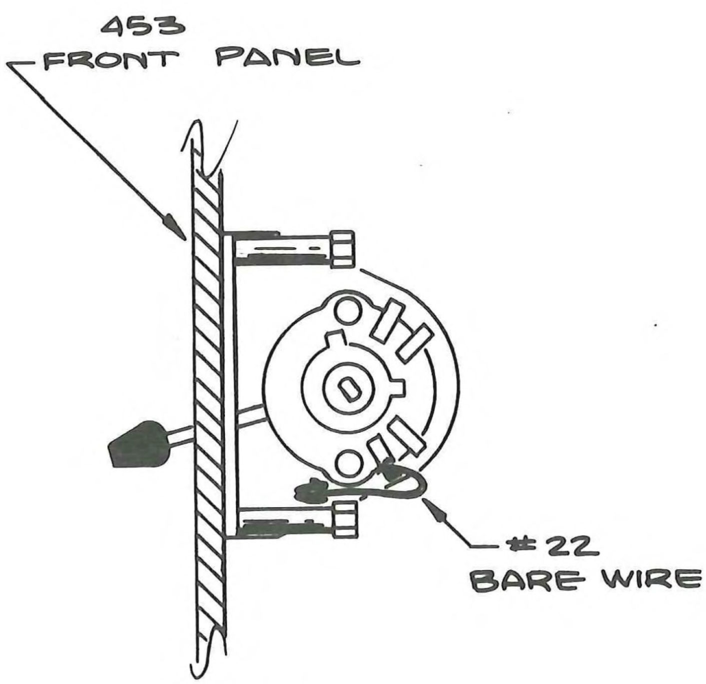


BEFORE



AFTER

PARTIAL 'B' TRIG GEN SLOPE SWITCH SW655



A & B
TRIGGER SLOPE
SWITCH

HIGH VOLTAGE GROUND POINT CHANGED TO REDUCE VERTICAL ABERRATION AND DIODES REMOVED TO PREVENT POWER SUPPLY DAMAGE

The small trace 'wrinkle' (or vertical aberration) present on the first two centimeters of the CH 2 trace (T/DIV = 0.05 μs; V/DIV = 5 mV) can be reduced by changing the connection point of terminal 5 of the HV transformer and anode of V952 from an elevated ground to a chassis ground, and relocating the ground point for the Z AXIS circuit board.

Damage to the +12 V power supply regulator circuit, caused by plugging an instrument wired for 115 V line into a 230 V source, can be prevented by removing D1167. Diode D1159, in the same circuit, should also be removed.

Diodes D1167 and D1159 were needed in instruments prior to this change to protect the +12 V supply in the event of a short or arcing in the high voltage supply. Changing the location of the high voltage ground connection eliminates the need for the diodes.

The installation involves removing two diodes from the +12 V regulator circuit and relocating a few wires in the high voltage circuit.

PARTS REQUIRED

Quantity	Tektronix Part Number	Description
2-1/2"		Wire, #22 solid, insulated, white

continued

* The following serial numbered instruments were modified at the factory to include the HV ground relocation. The diodes were not removed at this time. See Tektronix Modification Instructions MI 12214-1.

1761	1973	2663	2770	2859	2920-1	2939	3031	3073-4	3270
1872	2225	2730-1	2836	2892-4	2937	2980	3034	3095	3294

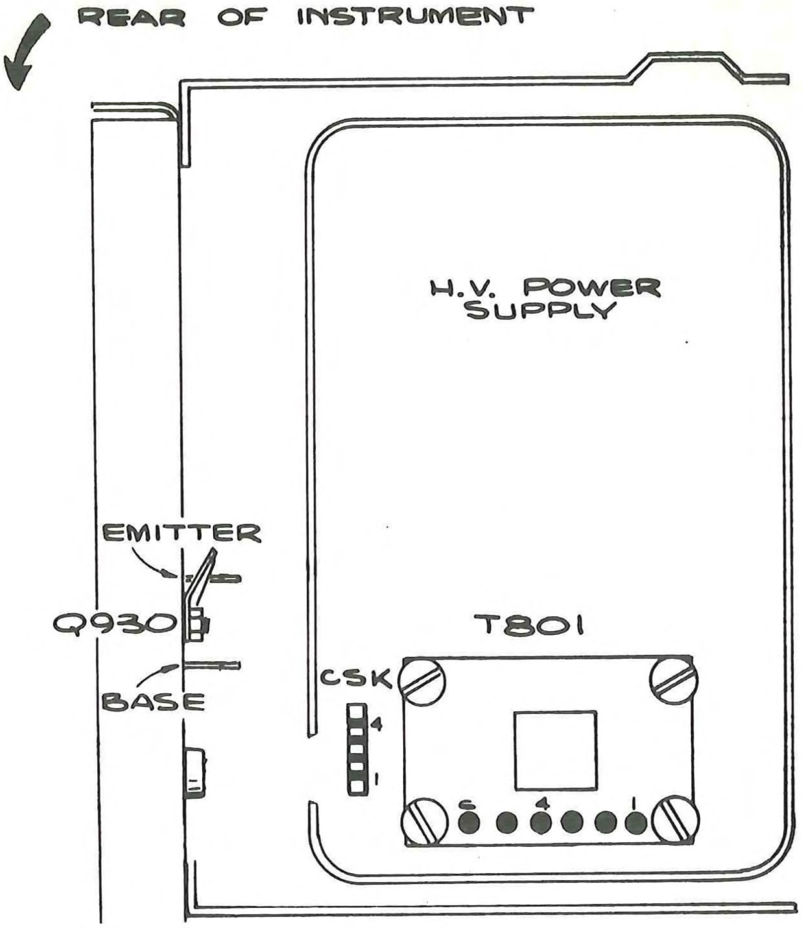

REAR OF INSTRUMENT
H.V. POWER SUPPLY
EMITTER
Q930
BASE
T801
CSK
4
1
6
4
1

FIG. 1

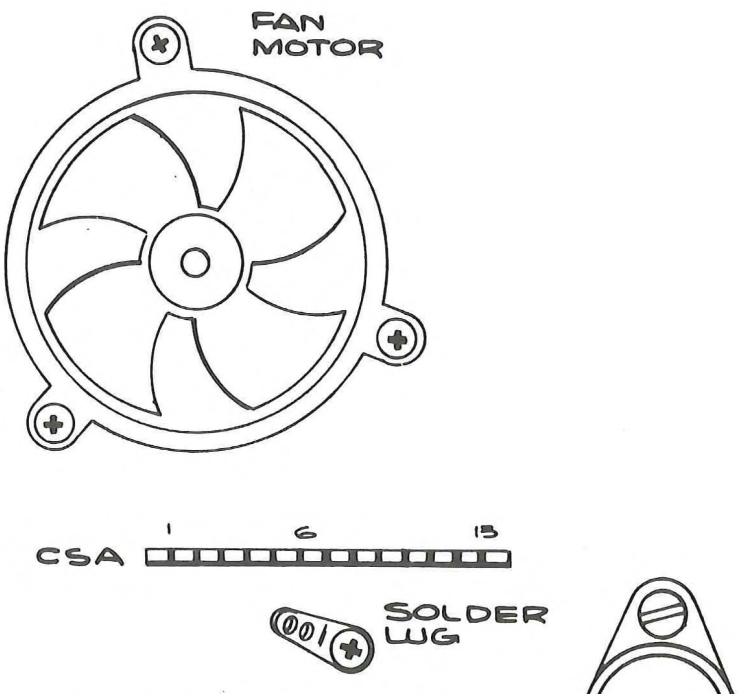

FAN MOTOR
CSA
1
6
13
SOLDER LUG
CSB
1
13
Q930
REAR OF INSTRUMENT

FIG. 2

INSTALLATION

TO RELOCATE THE HV GROUND POINT:

1) Remove the 3-1/2" length of #26 stranded white-green wire between CSD-4 near T801 and emitter of Q930 (see Fig. 1).
2) Move the remaining white-green wire at CSK-4 to the emitter of Q930.
3) Solder a 2-1/2" length of #22 solid white wire to CSK-4.
4) Dress the wire through the plastic grommet in the rear bulkhead plate to the solder lug shown in Fig. 2. (DO NOT solder yet.)
5) Unsolder the #22 white stranded wire from CSA-6 (see Fig. 2) and solder it, along with the wire installed above, to the solder lug shown in Fig. 2. (This is the ground wire from the Z AXIS circuit board.)

TO REMOVE DIODES D1167 AND D1159:

1) Remove D1159 from the Low Voltage Regulator circuit board located on the top side of the instrument just above the power transformer (see Fig. 3).
2) Remove the three Low Voltage Regulator circuit board mounting screws and swing the board back out of the way.
3) Remove D1167 from the Low Voltage Regulator chassis just below the circuit board. See Fig. 4 for location.

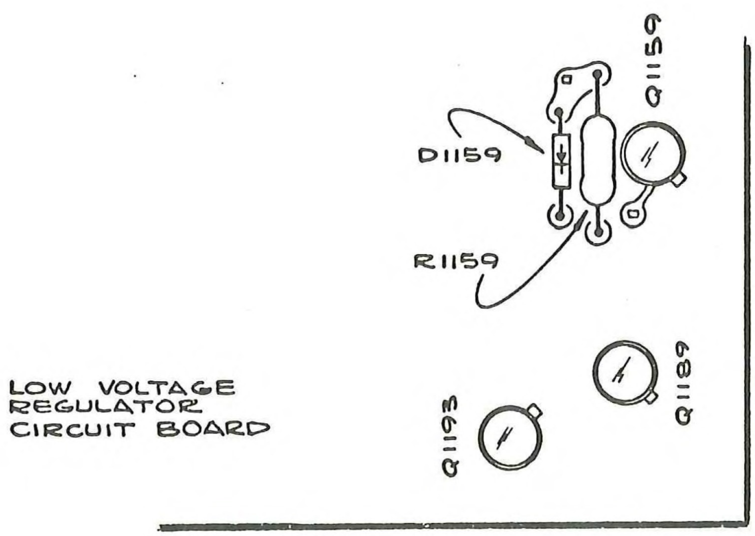


FIG. 1

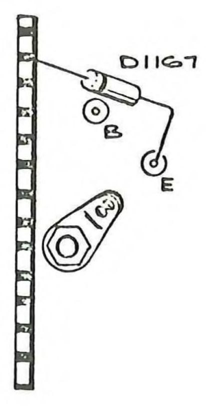


FIG. 2

MODIFICATION INSTRUCTIONS

MI - 10609

Type 453 Oscilloscope

Serial numbers 100-2499

OUTPUT AMPLIFIER AND CHANNEL 2 PREAMPLIFIER VERTICAL OSCILLATIONS ELIMINATED

Oscillations in the CH 2 preamplifier, which show up as an abnormal front corner aberration when operating in the ADD mode with CH 2 in NORMAL, can be prevent by increasing the inductance of T195. This accomplished by adding another powered iron core to T195.

Oscillations in the Vertical Output Amplifier, which show up in one or more of the ways listed below, can be prevented by removing C341.

1) Abnormal front corner aberration that changes with VERTICAL POSITION.
2) Delayed sweep jitter.
3) Change in DELAY TIME with a change in the SCALE ILLUM.
4) Change in vertical position of the trace with change in the SCALE ILLUM.
5) Widening of the trace.

PARTS REQUIRED

Quantity	Tektronix Part Number	Description
1 ea	276-0517-00	Core, powdered iron, 0.125" thick x 0.375" dia w/hole

INSTALLATION

1) Add another powdered iron core adjacent to existing core, T195. T195 is the core on the leads connecting the "INVERT PULL" switch to the circuit card.

2) Remove C341 (0.022 µF 25 V ceramic capacitor) located in the upper right corner of the Output Amplifier circuit card (left side of instrument).

MODIFICATION INSTRUCTIONS

MI - 10618

Type 453 Oscilloscope

Serial numbers 100-3878 *

RANGE OF GAIN ADJUST POTENTIOMETER EXTENDED

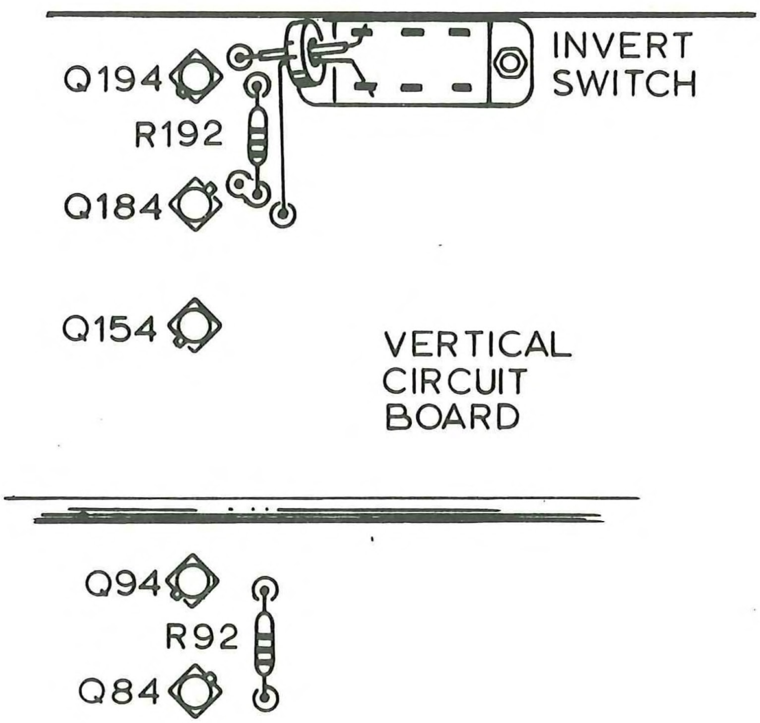
Occasionally, after replacing tubes or components in the Vertical Amplifier, the GAIN adjust potentiometer will be at, or near, the end of its range. By replacing resistors R92 and R192 in the emitter circuit of the Vertical Preamplifier output stage, the GAIN adjust potentiometer can be brought back to nearer the center of its range.

PARTS REQUIRED

Quantity	Tektronix Part Number	Description
2 ea	321-0121-00	Resistor, precision, 178Ω 1/8W 1%

INSTALLATION

Replace R92 and R192 (115Ω 1/8W 1% resistors) with 178Ω 1/8W 1% resistors. See drawing for location.



* The following serial numbered instruments were modified at the factory.

3804-11 3813-5 3852 3865 3870-2

MODIFICATION INSTRUCTIONS

MI - 10655

Type 453 Oscilloscope

Serial numbers 100-3449

HIGH FREQUENCY TRIGGERING IMPROVED BY ADDITION OF CAPACITOR

Adding a 0.1 μF capacitor across the 'A' SWEEP LENGTH potentiometer and zener diode D559 reduces the high frequency trigger jitter. Noise from the zener diode caused the sweep holdoff time to vary, which produced the jitter.

PARTS REQUIRED

Quantity	Tektronix Part Number	Description
1 ea	283-0081-00	Capacitor, ceramic disc, 0.1 μF 25 V

INSTALLATION

1) Remove the six screws (with lock and flat washers) that secure the 'A' Sweep circuit board to the instrument. (SAVE)

2) Lift up circuit board and locate the 'A' SWEEP LENGTH switch and potentiometer.

3) Add a 0.1 μF 25 V capacitor across the total resistance of the 'A' SWEEP LENGTH potentiometer in parallel with zener diode D559.

4) Replace the 'A' Sweep circuit board removed in step 1.

MODIFICATION INSTRUCTIONS

MI - 10676

Type 453 Oscilloscope

Serial numbers 100-3458 *

INSULATION ADDED TO PREVENT SHORTING OF CURRENT PROBE LOOP

It is possible for the solder lugs on the 5 mA current PROBE LOOP to short against the flange on the outer support bracket if the lugs are twisted slightly or the access panel is misaligned. This will produce either erratic or no output from the current loop.

To prevent this from occurring, a 2-1/2" length of Neoprene* extrusion is added along the edge of the top flange of the outer support bracket. See drawing.

PARTS REQUIRED

Quantity	Tektronix Part Number	Description
2-1/2"	252-0571-00	Neoprene Extrusion, .156 x .234 w/.063 slot

INSTALLATION

1) Open the CALIBRATOR FRAME chassis gate.

2) Add some 3M* type EC-2262 cement or equivalent to the edge of the SUPPORT BRACKET. See drawing.

3) Push a 2-1/2" length of extrusion onto the SUPPORT BRACKET as shown.

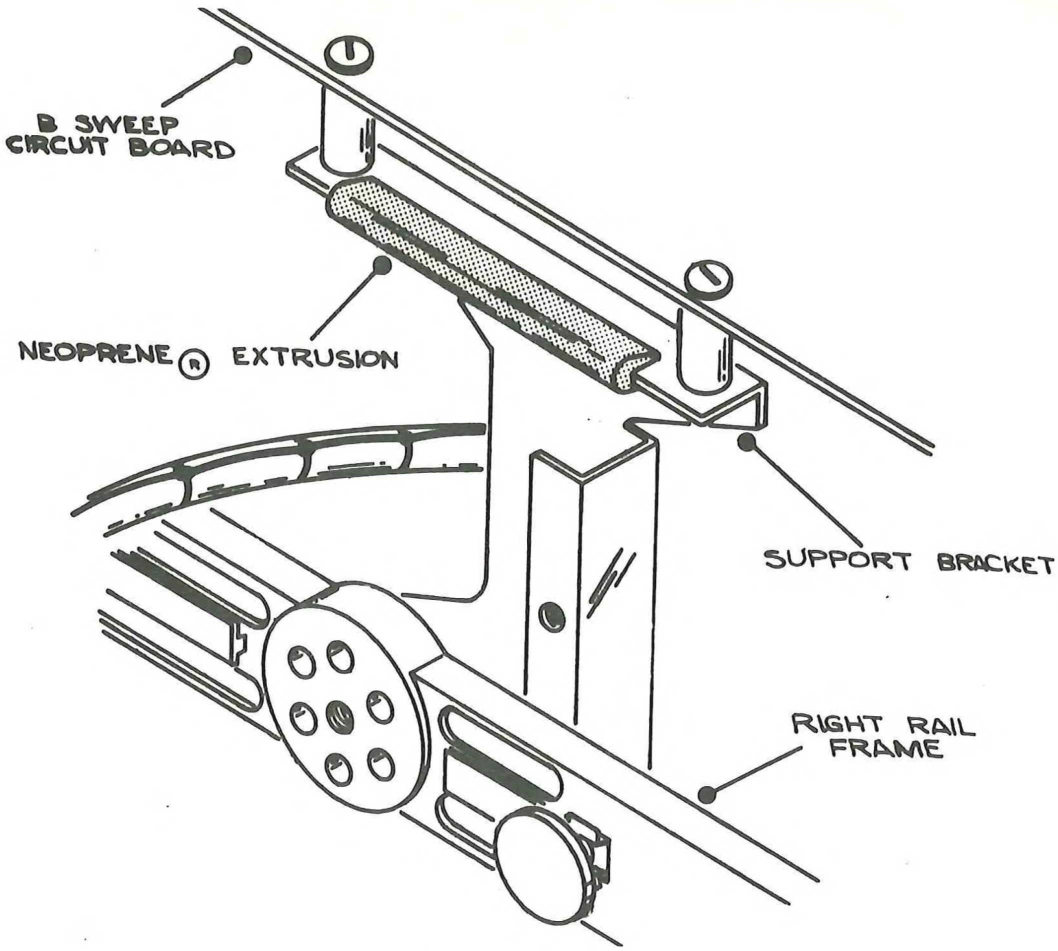
* The following serial numbered instruments were modified at the factory:

2860	3054	3247	3257	3340	3347	3356	3452
3051	3059	3249	3259	3344	3351	3348-9	3454-6

continued

* Carboline Co. Registered Trademark

* Minnesota Mining and Manufacturing Co. Registered Trademark


B SWEEP
CIRCUIT BOARD
NEOPRENE® EXTRUSION
SUPPORT BRACKET
RIGHT RAIL
FRAME

MODIFICATION INSTRUCTIONS

MI - 10710

Type 453 Oscilloscope

Serial numbers 100-8950

400 Hz LINE FREQUENCY MODULATION OF VERTICAL DISPLAY REDUCED

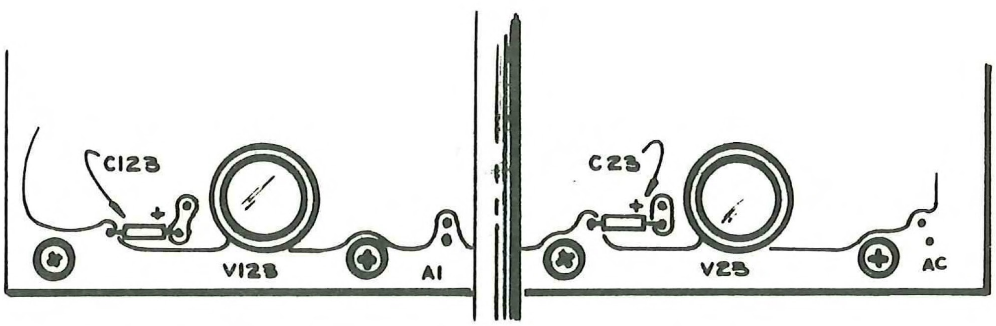
When operating the instrument from a 400 Hz line source, vertical modulation of the display at a 400 Hz rate would sometimes occur. This possibility is eliminated by increasing the size of Vertical Preamplifier Input Cathode Follower plate decoupling capacitor, C23 (CH 1) and C123 (CH 2).

PARTS REQUIRED

Quantity	Tektronix Part Number	Description
2 ea	290-0311-00	Capacitor, EMC, 0.56 µF 100 V ±10% Tantalum

INSTALLATION

Replace C23 and C123, 0.03 µF 200 V ceramic discap capacitors, with 0.56 µF EMC Tantalum capacitors. See drawing for location.



VERTICAL CIRCUIT BOARD

MODIFICATION INSTRUCTIONS

MI - 10949

Type 453 Oscilloscope

Serial numbers 100-13619

CABINET LATCH THUMB SCREWS REPLACED WITH IMPROVED TYPE

This modification replaces the cabinet latch thumb screws with improved screws having a thread relief at the end. This thread relief prevents turning the screws out too far and forcing the retaining ring off of the screw and into the instrument.

PARTS REQUIRED

Quantity	Tektronix Part Number	Description
2 ea	214-0910-01	Thumb screw, cabinet latch

INSTALLATION

1) Loosen the two (one on each side) cabinet latch thumb screws and remove the cabinet top.

2) Turn the thumb screws back into the frame rails and remove the retaining rings. Save the retaining rings for re-use.

3) Replace the thumb screws with the improved screw and re-install the retaining rings on the end of the thumb screws.

4) Replace the cabinet top.

MODIFICATION INSTRUCTIONS

MI - 11089-2

Type 453 Oscilloscope

Serial numbers 100-5671

OSCILLATIONS IN +75V SUPPLY PREVENTED

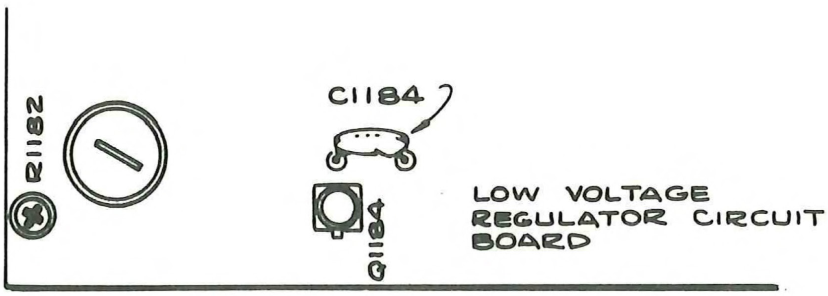
Under certain conditions the +75V Power Supply will oscillate at a frequency of from 70kHz to 100kHz. Changing the value of capacitor C1184, in the +75V regulator circuit, will eliminate this possibility.

PARTS REQUIRED

Quantity	Tektronix Part Number	Description
1 ea	283-0079-00	Capacitor, cer, 0.01 µF 250V discap

INSTALLATION

Replace C1184, 0.001 µF 500V discap, with a 0.01 µF 250V ceramic discap capacitor. See drawing for location.



MI - 11360

Type 453 Oscilloscope

Serial numbers 100-5669 *

POSSIBILITY OF VERTICAL AMPLIFIER OSCILLATIONS IN ADDED MODE REDUCED

Under certain conditions the Vertical Amplifier oscillates when operated in the "ADD" Mode, non-inverted. The oscillation occurs at a frequency of about 300 MHz and appears as a broadening of the trace.

By adding ferramic suppressor cores to the anode lead of the Channel switching diodes, D201, D204, D206 and D209 this oscillation can be prevented.

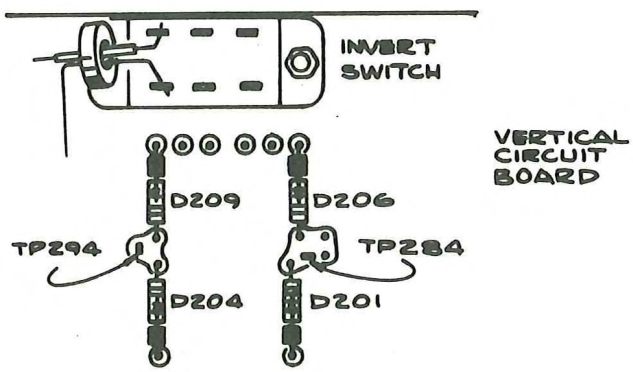
PARTS REQUIRED

Quantity	Tektronix Part Number	Description
4 ea	276-0528-00	Core, ferramic suppressor

INSTALLATION

Install the ferramic cores on the anode leads of diodes D201, D204, D206 and D209. See drawing for location.

NOTE: To gain sufficient diode lead length to install the cores, it may be necessary to completely remove the diodes and reposition them on the circuit board.



* The following serial numbered instruments were modified at the factory:

4632	4925	4940-1	5098	5236-7	5241-2	5249	5387-90
4788	4925	5087	5231-2	5239	5246	5381-4	5395-9

modification instructions

MI - 11430

Type 453

STABILITY OF 'B' TRIGGER AND SWEEP IMPROVED

Tektronix Type 453 Oscilloscope
Serial Numbers 100-11860

Because of the close proximity of the "B TRIGGERING SOURCE" switch to the 'A' GATE jack, it is possible that the 'B' Trigger will occasionally trigger on the 'A' Sweep Gate when the 'B' Trigger is operated in the External X1 mode. To prevent this from occurring, the leads of C615 (0.01 µF) and C616 (100 pF) were relocated on the "B TRIGGERING SOURCE" switch.

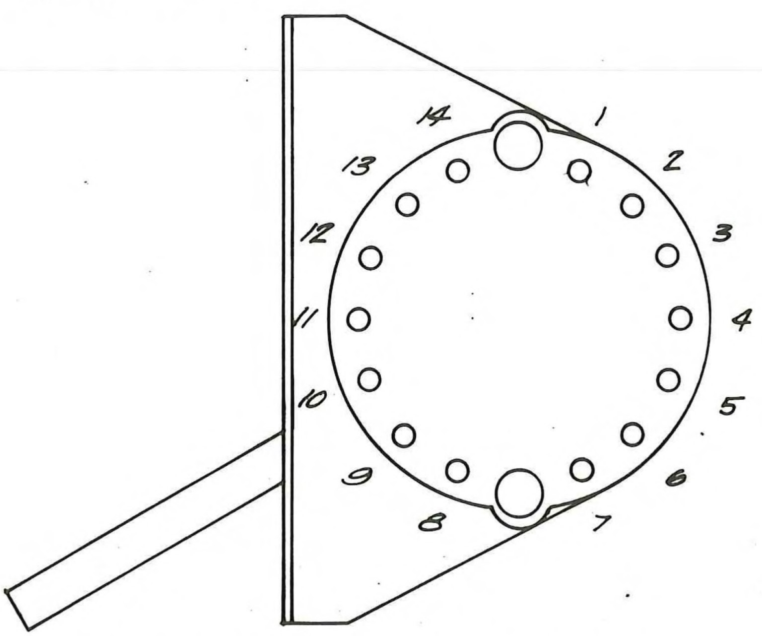
PARTS REQUIRED

None

INSTALLATION

1) Unsolder the leads of C615 (0.01 µF discap) and C616 (100 pF ceramic capacitor) from contact 7 of the "B TRIGGERING SOURCE" switch. See drawing.

2) Resolder the leads to contact 3 on the "B TRIGGERING COUPLING" switch. This is the same contact that the jumper wire, front contact 7 on the "B TRIGGERING SOURCE' switch, is soldered to.



BD:ls

TYPICAL SWITCH CONFIGURATION

9-10-68

MODIFICATION INSTRUCTIONS

MI - 11556

Type 453 Oscilloscope

Serial numbers 100-8139

RINGING ON FRONT CORNER OF FAST RISE INPUT PULSES REDUCED

Occasionally Vertical Output transistors, Q324 and Q334, would oscillate. The oscillation would appear as excessive ringing, of up to 4%, on the front corner of fast rise input pulses. By replacing these transistors with the same type RCA transistors, the oscillations can be eliminated.

PARTS REQUIRED

Quantity	Tektronix Part Number	Description
2 ea	151-0120-01	Transistor, Si NPN, TO-18, RCA

INSTALLATION

Replace Q324 and Q334, located on the Vertical Output Amplifier circuit board, with the 151-0120-01 transistors.

MODIFICATION INSTRUCTIONS

MI - 11893

Type 453 Oscilloscope

Serial numbers 100-14019

ACCESSORY COMPARTMENT LATCH ASSEMBLY REPLACED WITH IMPROVED ASSEMBLY

The latch assembly on the accessory compartment lid is replaced by a new improved latch assembly. The previously used latch assembly was difficult to engage and occassionally broke when an attempt was made to close the lid with the latch in the locked position. A set of two special chassis punches, Tektronix Part Number 003-0506-00, are required to install the new latch.

PARTS REQUIRED

Quantity	Tektronix Part Number	Description
1 ea	204-0282-00	Body, latch
1 ea	214-0787-00	Stem, latch

INSTALLATION

1) Remove the front cover assembly from the instrument.

2) Open the accessory compartment and remove the latch assembly from the lid.

3) Using the smallerchassis punch marked "LID", assemble the punch on the lid as shown in Fig. 1 and punch a rectangular hole keeping the hole as parallel to the lid edge as possible.

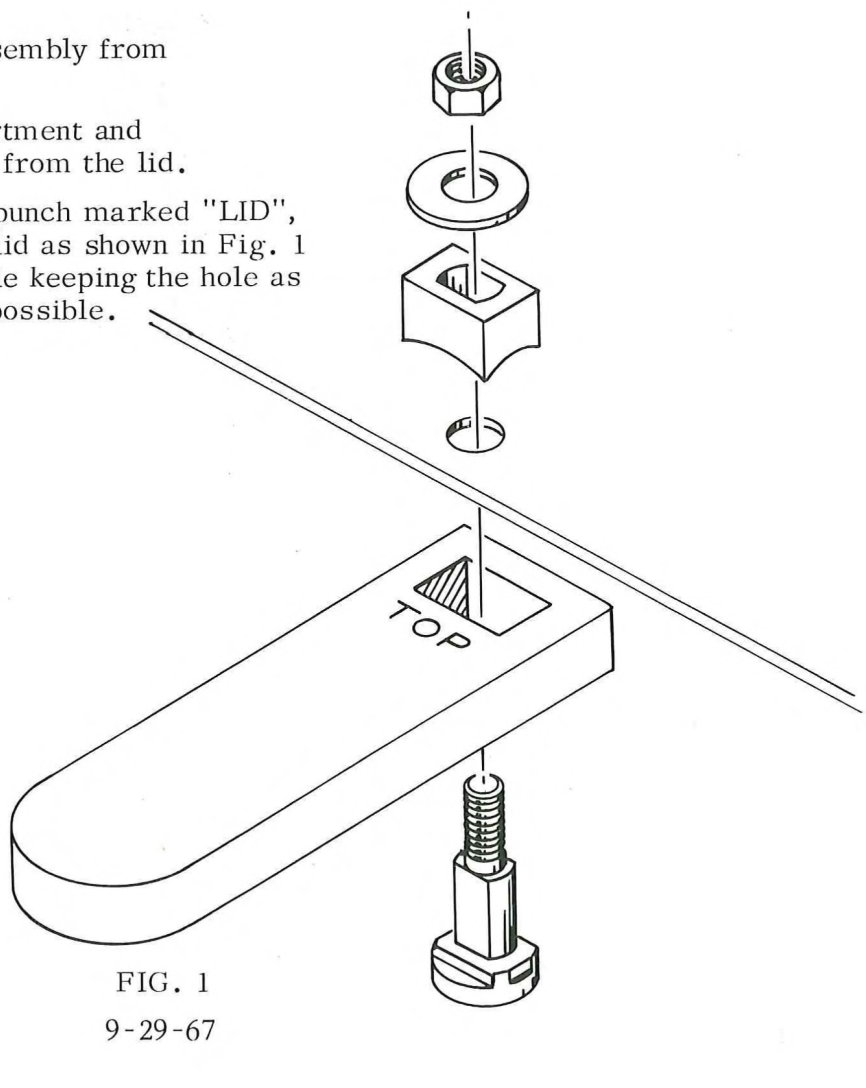


FIG. 1

continued

9-29-67

INSTALLATION (continued)

4) Using the larger chassis punch marked "LIP", assemble the punch in the same order as used in step 3 substituting the latch lip for the accessory compartment lid. Again, keep the hole as parallel as possible to the lip edge.

5) Insert the latch stem into the latch body as shown in Fig. 2 making certain the latch stem is inserted completely by squeezing the flexible wings together.

6) Install the latch assembly in the accessory compartment lid. Make certain the latch body is inserted through the hole in the lid far enough to allow the lid to seat in the recessed groove of the latch body.

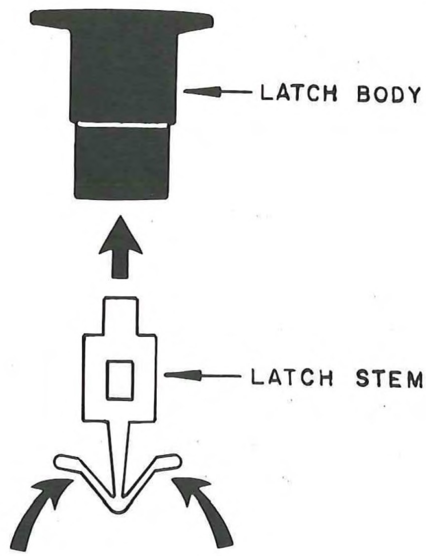


FIG. 2

MODIFICATION INSTRUCTIONS

MI - 12214-1

Type 453 Oscilloscope

Serial numbesr 3440-12679 *

PREVENTS EXCESSIVE POWER SUPPLY DAMAGE WHEN 115V INSTRUMENT IS PLUGGED INTO 230V LINE

Damage to the +12V power supply regulator circuit can occur in instruments that contain D1167, if the instrument is accidentally plugged into a 230V line source, when connected for 115V operation. By removing diode D1167 this problem is eliminated. Another diode, D1159, that is no longer needed is also removed.

* Diodes D1167 and D1159 were needed in instruments prior to serial number 3440 to protect the +12V supply in the event of a short or arcing in the high voltage supply. At serial number 3440 the high voltage ground reference point was changed, eliminating the need for the diodes.

Instructions for removing the diodes and changing the high voltage reference point in instruments serial numbers 100-3439 are outlined in Tektronix Modification Instructions MI 10485-2.

INSTALLATION

1) Remove D1159 from the Low Voltage Regulator Circuit board located on the top side of the instrument just above the power transformer. See Fig. 1.

2) Remove the three Low Voltage Regulator Circuit board mounting screws and swing the board back out of the way.

3) Remove D1167 from the Low Voltage Regulator chassis located just below the circuit board. See Fig. 2 for location.

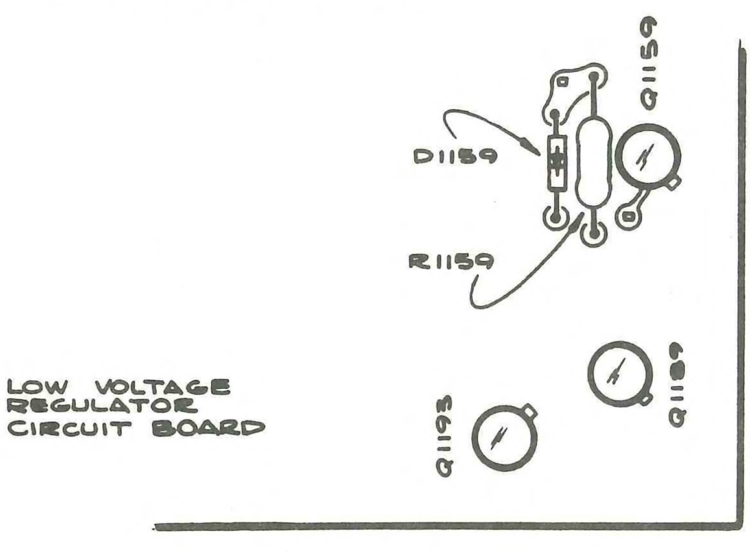


FIG. 1

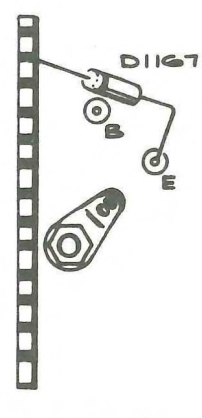


FIG. 2

MODIFICATION INSTRUCTIONS

MI - 12214-2

Type 453 Oscilloscope

Serial numbers 100-12679

AUTO TRIGGERING STABILITY IMPROVED BY ADDITION OF DIODE

When triggering on narrow (50ns or less) pulses in the AUTO TRIG Mode, the triggering would sometimes operate irratically. The irratic triggering would appear as unstable triggering and a flickering base line.

The negative excursion of the input pulse to the Auto Multivibrator would occur soon enough to reset the Auto Multi before Q485 had time to reach saturation. By adding a diode across the input coil (L474) to the Multi, to clip the negative going input pulse, the problem was eliminated.

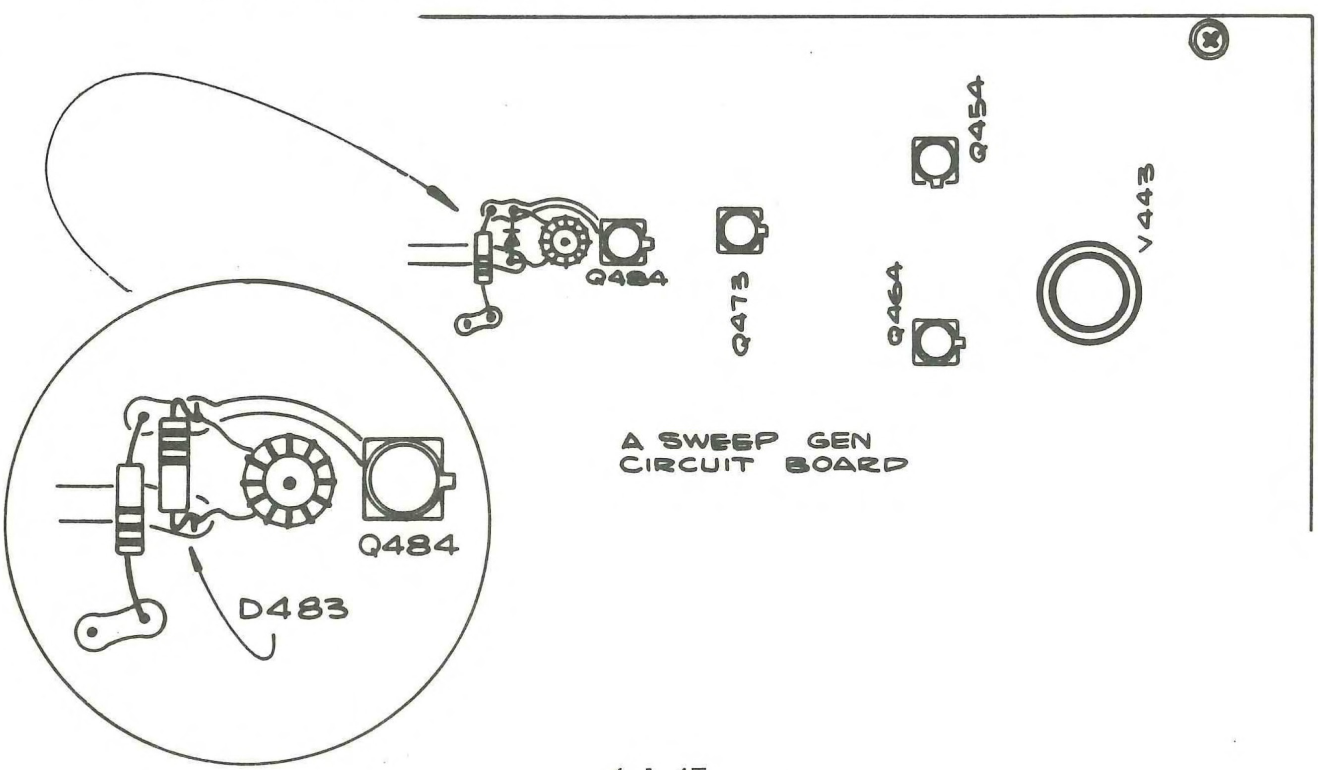
PARTS REQUIRED

Quantity	Tektronix Part Number	Description
1 ea	152-0185-00	Diode, 6185

INSTALLATION

Add diode D483 in parallel with L484, making sure the anode lead goes to ground.

See drawing for location.



6-1-67

MODIFICATION INSTRUCTIONS

MI - 12245-1
Type 453 Oscilloscope
Serial numbers 100-13819

SLO-BLO FUSE IN CRT CIRCUIT REPLACED TO ELIMINATE PREMATURE OPENING

Random failure of fuse F937 in the CRT circuit was occuring with no apparent circuit malfunction. The slo-blo fuse used as F937 was de-rating in value as the ambient operating temperature became elevated to approximately +55° C.

The slo-blo fuse previously used is replaced by a fast-blo fuse of the same current rating providing more dependable operation and better circuit protection.

PARTS REQUIRED

Quantity	Tektronix Part Number	Description
1 ea	159-0021-00	Fuse, 2A 3AG fast-blo

INSTALLATION

Replace fuse F937 with a 2A 3AG fast-blo fuse. Fuse F937 is located in a snap-in receptacle on the back side of the rear bulkhead plate directly below the CRT shield opening.

BE:fb

9-12-67

MODIFICATION INSTRUCTIONS

MI - 12437

Type 453 Oscilloscope

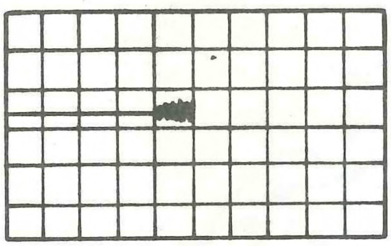
Serial numbers 12680-12959 *

DIODE CONNECTION CHANGED TO PREVENT OSCILLATIONS

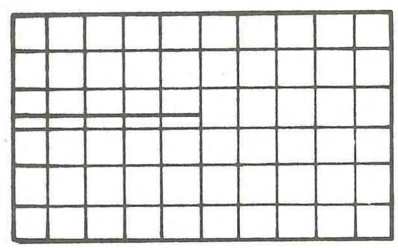
This modification changes the connection of the anode lead of D575 to prevent oscillations from occurring near the end of the sweep, when the sweep length is set to minimum. It also assures that the sweep will be armed when operating in the single sweep mode.

The oscillation appears as vertical aberration on the end of the sweep. See drawing.

BEFORE



AFTER



PARTS REQUIRED

Quantity	Tektronix Part Number	Description
1 ea	152-0185-00	Diode, 6185

continued

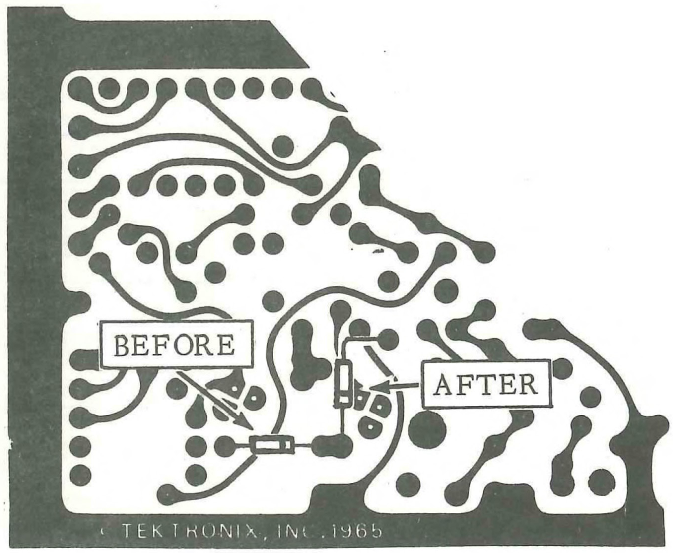
* The following serial numbered instruments were modified at the factory:

6244	9573-4	11370-1	12573	12739	12827
6276	9712	11373	12577	12748-9	12832
6458	9717	11376-8	12582	12755	12842-3
7772	9902	11381	12589	12761	12846
7781	9917	11383	12630	12763	12849-59
7783	10123	11385	12633-5	12765	12861
7795-8	10310	11387-9	12637-9	12770	12867-9
7811	10314	11689	12650-79	12774-6	12873-909
7814-6	10316	11762-4	12692	12783	12911
7818	10318	11767-72	12694	12786	12914
7820-1	11182-3	11774-9	12701-2	12805-6	12919
7825	11185	12065	12710-1	12808	12922
7827	11189	12345	12718-9	12810-2	12926
8587	11192	12350	12721	12814-5	12928-46
9383	11194-5	12378	12727	12818-9	12948-9
9550	11198-9	12392	12734-5	12822	12951-7

INSTALLATION

1) Remove D575 from the 'A' Sweep Generator board. D575 is located near Q585 and Q575. See drawing.

2) Install a new 152-0185-00 diodes, as indicated in the drawing, with the anode connected to C561 and the cathode connected to the same point it originally was.



MODIFICATION INSTRUCTIONS

MI - 12492

Type 453 Oscilloscope

Serial numbers 100-13208*

TRIGGERING IN "B TRIGGERABLE AFTER DELAY TIME" MODE IMPROVED

Occasionally the 'B' sweep will free run when in the "B TRIGGERABLE AFTER DELAY TIME" Mode. This problem is most apparent at fast sweep speeds when triggering on large 50MHz signals and with the "B TRIGGER LEVEL" fully ccw.

This modification corrects this problem by changing the value of the Delay Pickoff Amplifier collector load resistor, R773. This reduces the voltage transition at the collector of Q774. Previously this transition was large enough to cause Q785 to be driven into V_{BE} breakdown which in turn resulted in too high of a negative transient at D705, thus turning on the sweep.

PARTS REQUIRED

Quantity	Tektronix Part Number	Description
1 ea	315-0102-00	Resistor, composition, 1k 1/4W 5%

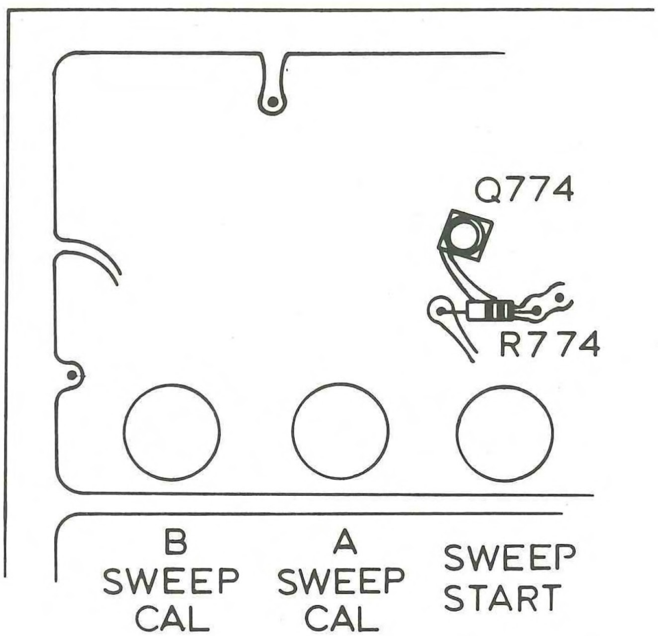
INSTALLATION

Replace R774, located on the B Sweep Generator circuit board, with a 1k 1/4W 5% composition resistor.

continued

* The following serial numbered instruments were modified at the factory:

6244	9550	11194-5	12585	12851	12965-7	13035
6276	9573-4	11198-9	12589	12854-5	12969	13039-46
7458	9712	11370-1	12630	12859	12972	13048-51
7772	9717	11373	12633-9	12879	12980-2	13053-71
7781	9902	11376-8	12650-79	12885	12984-5	13073-110
7783	9917	11381	12694	12897	12987	13112-3
7795-8	10123	11383	12702	12902	12991	13115-29
7811	10310	11385	12710	12905-6	12998-9	13131
7814-6	10314	11387-9	12719	12932	13001	13133-42
7818	10316	11689	12739	12934-6	13003	13144-6
7820-1	10318	11762-4	12763	12938-40	13005	13148-83
7825	11182-3	11767-72	12776	12944	13007-8	13186
7827	11185	11775-9	12806	12946	13024	13189
8587	11189	12378	12822	12952	13026	13191-206
9383	11192	12582	12827	12956	13032	


Q774
R774
B
SWEEP
CAL
A
SWEEP
CAL
SWEEP
START

TEKTRONIX	**modification instructions**	MI - 13688 Type 453

NEON MISFIRING PREVENTED

Tektronix Type 453 Oscilloscopes
Serial Numbers 100-23168*

By adding 10M resistors in parallel with the VOLTS/DIV neons and the A or B SWP UNCAL neon, neon misfiring caused by switch leakage can be prevented. The misfiring, if present, shows up as random spikes on the Vertical display.

The modification consists of shunting the VOLTS/DIV and A or B SWP UNCAL neons with 10M resistors.

PARTS REQUIRED

Quantity	Tektronix Part Number	Description
3 ea	316-0106-00	Resistor, comp, 10M 1/4W 10%

* The following serial numbered instruments were modified at the factory:

20000-8	20404	21134	22005	22675	22852	22990-3
20012-39	20412	21330	22008	22677	22854	22996-9
20041-9	20491	21341	22018-9	22680	22857	23001-3
20053	20497	21357	22099	22683	22859	23005
20059	20523	21368	22100	22689-90	22870	23008-10
20061	20550	21402	22109	22692	22876	23012-7
20070	20560-4	21406	22177	22696-8	22879	23021-5
20072-3	20588	21529	22197-8	22710	22892	23028-80
20080-2	20592	21537	22330	22715	22896-7	23084-8
20086	20641	21614	22347	22737	22902	23092-9
20088	20646	21649	22366	22748	22904	23100
20094	20756	21652	22420	22764	22927	23102-8
20154	20779	21670	22475	22774	22934	23110-4
20187	20789	21703	22477	22783	22936	23116-8
20221	20854	21731	22487	22786	22938-9	23120
20235	20874	21751-2	22494-5	22688	22944	23122
20242-3	20894	21843	22549	22790-1	22946	23125-30
20282	20904	21858	22613	22793	22952-5	23134
20346	20924	21882	22654-5	22798	22962	23138
20354	20974	21902	22658	22801	22964-5	23140-67
20371	21031	21908	22866-7	22804-5	22973-4	
20375	21056	21960	22670	22807	22978	
20392	21107	21994	22672	22834	22986-7	

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INSTALLATION

1) Remove the top and rear covers from the instrument.

2) Remove the CRT socket, HV Anode lead, and the Horizontal and Vertical neck pin connections.

3) Unsolder the brown (ground lug) and red wires from the "Y AXIS ALIGNMENT" potentiometer R989, located on the rear bulkhead next to the CRT socket.

4) Unsolder the white (upper) and white-yellow wires from the Beam Rotator coil terminals located on the side of the CRT shield just behind the HV Anode connection.

5) Remove the cable clamp just above the Beam Rotator coil terminals.

6) Remove the two front shield mounting nuts and graticule light holders.

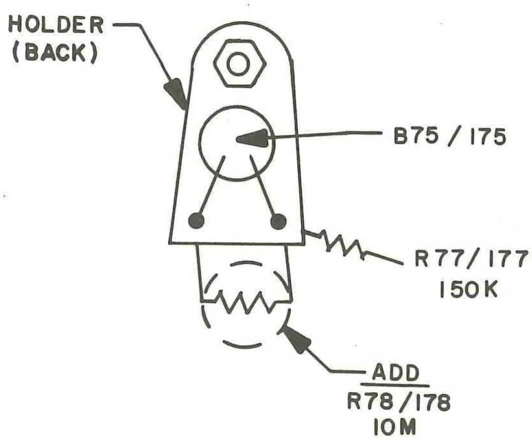
7) Remove the two screws which secure the rear of the CRT shield to the two rear support brackets and loosen the bracket mounting screw of the bracket nearest the side of the instrument.

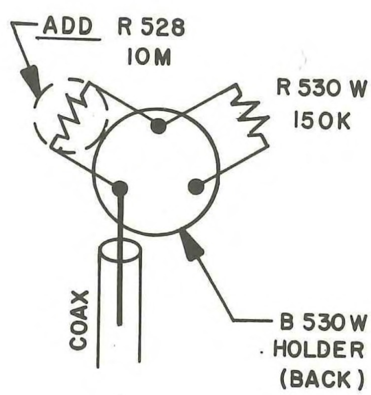
8) Slide the CRT and shield toward the rear and then tilt front upward and remove from the instrument. This will require that the graticule light leads be pulled over the front of the CRT face.

9) Loosen the bottom screw on the rear CRT support bracket, located on the inside of the CRT shield. Do not loosen or remove the two side screws.

10) Install R528, R78 and R178 (see drawing).

11) Reinstall the CRT and shield in the reverse order, as described above.

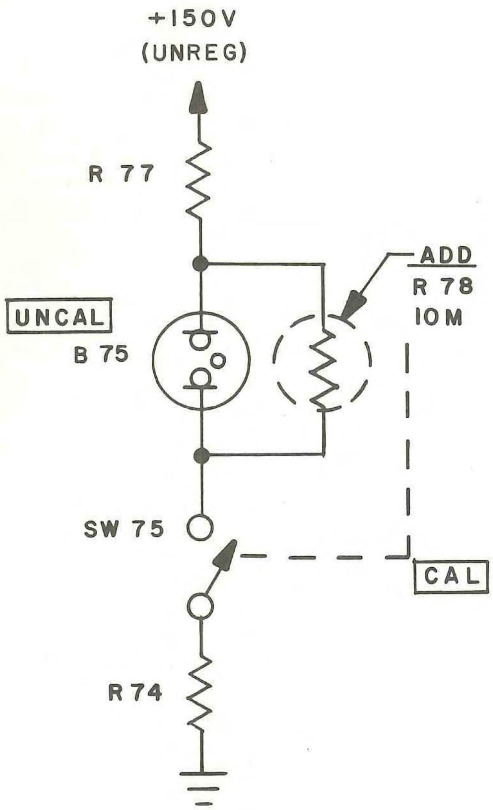


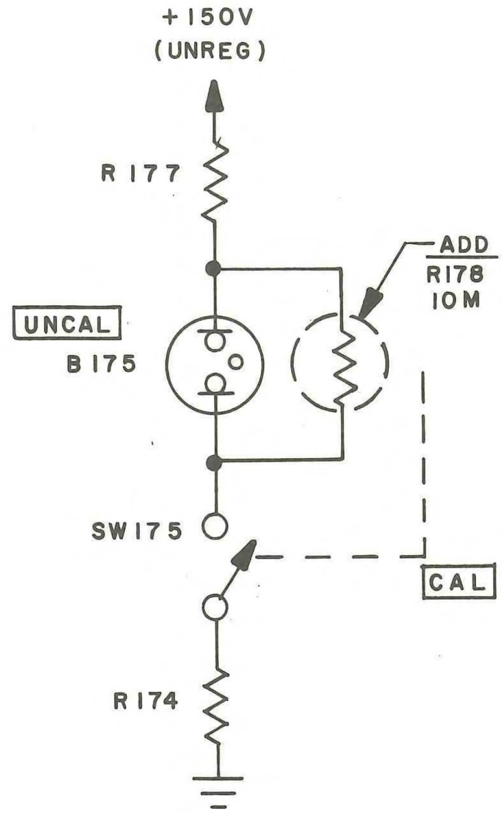


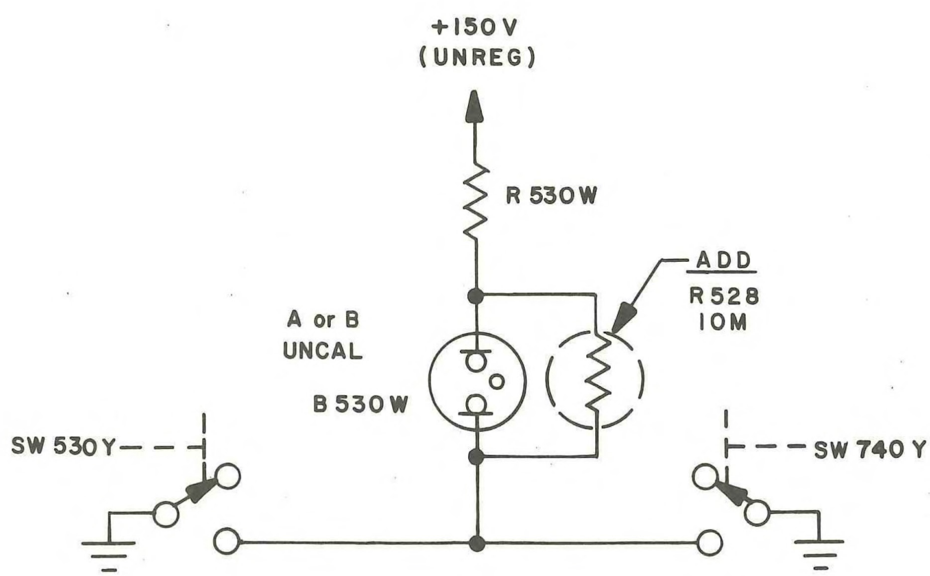
THIS COMPLETES THE INSTALLATION.

Correct the A and B TIMING SWITCH, and CH 1 and CH 2 Vertical Preamp schematics, and the Electrical Parts List in your Instruction Manual.

BD:ls


+150V
(UNREG)
R 77
ADD
R 78
10M
UNCAL
B 75
SW 75
CAL
R74


+150V
(UNREG)
R 177
ADD
R178
10M
UNCAL
B 175
SW175
CAL
R 174


+150V
(UNREG)
R 530W
ADD
R528
10M
A or B
UNCAL
B 530W
SW 530Y
SW 740 Y