

PRODUCT REFERENCE BOOK

for the Tektronix Type

422

oscilloscopes

For all serial numbers

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file 422 PRB
date 3-30-66

U.S. MARKETING SALES RELEASE



453/R453 and 422/R422 - QUANTITY DISCOUNT

A close look at the manufacturing processes for the 422 and the 453 have led us to permit summation of both cabinet and rackmount instruments for quantity discount purposes on these products.

One purchase order for both 453's and R453's which meets all requirements for quantity discount will be treated as follows:

If there are ten or more 453's, R453's or sum of the two on one purchase order, there would be a quantity discount. Where there is to be a discount on a combination of standard and rackmount instruments with one shipment the higher priced instrument - R453 in this case - will be placed in the most favored position from the discount standpoint. That is - they will be on the high discount end.

Where multiple shipments of combinations of rackmounts and cabinet 453's are involved, the discount applying to each instrument will be established by the shipping schedule. The first through ninth will be at catalog price whether they are cabinet or rackmount, etc. In case the discount break occurs within one shipment, the previous paragraph applies - the higher priced items get biggest discount within the shipment where the break occurs.

In the case of the 422, the same ground rules apply. 422 MOD 150B merits additional explanation. Since 422 MOD 150B is a dual configuration, it should be considered two instruments in computation of quantity discounts. Of course 453's and 422's cannot be combined.

The basis upon which we are handling these two instruments in this manner is that the cabinet and corresponding rackmount are produced simultaneously on the same production line with identical processes up to cabinetizing which, of course, is at the very end of the process. The ease with which the instrument can be completed as either a cabinet or rackmount and the ability to retrofit with relative ease by a cabinet change accounts for our position. There is no basis to take such an approach with other instruments presently in the product line because earlier instruments are dissimilar and cannot be produced simultaneously by identical processes up to the final stages of manufacturing.

file 422 RB
date 12-14-66



U.S. MARKETING SALES RELEASE

P6012 BECOMES STANDARD ACCESSORY

FOR R317, 317, 310A, 321A, 422

The accessory change to provide two P6012 probe packages in place of two P6006 probe packages as standard accessories for the above instruments is being implemented. This change provides the purchaser of these products with added value at no increase in the price of these instruments.

The change will be made as follows:

<u>PRODUCT</u>	<u>SERIAL NUMBER</u>
R317	880
317	4870
310A	21740
321A	3130
422	6990

Shipments of products with the new probe package will start by December 27, 1966.

PERFORMANCE

422 CRT's

Tony Bryan, 1-10-66

TYPE	PHOSPHOR	TEK NUMBER
T4220-1-1	P1	154-0466-01
T4220-2-1	P2	154-0466-02
T4220-7-1	P7	154-0466-03
T4220-11-1	P11	154-0466-04
T4220-31-1	P31 (std)	154-0466-00

422 CRT LIGHT FILTERS

Tony Bryan, 1-10-66

Filter,Light	Smoky Grey (std acc)	378-0549-00
"	" Green	378-0557-00
"	" Blue	378-0558-00
"	" Amber	378-0559-00

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.

400-SERIES CRT's - PREMATURE FAILURES - continued

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.

Progress is necessarily slow in correcting life expectancy problems since many weeks of life 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.

EMI TEST REPORTS

The attached 422-1 and 422-2 Test Reports are for your information and are not necessarily for customers, since this is a report on one (1) instrument. It is intended to be typical and of one instrument the same as you might expect to get if one instrument were measured for drift and some other similar characteristic. The report does not become a part of the specification.

The catalog characteristic is that the instruments meet the Mil-I-6181D RFI spec to 1 GHz. However, we are not prepared to supply free supporting documentation on an individual instrument or group of instruments (which is called "type certification").

In order for such documentation to be supplied, it would be necessary for us to test the specific instruments to be shipped. This would mean a goodly number of man hours. If such documentation were required by a customer, then we would have to negotiate with him for the extra delay in delivery and for the expense of the extra work from our normal manufacturing processes.

For certification by Serial Number, every instrument would require testing, with the test records to support the certification.

To certify by instrument type, enough sampling would need to be done to ensure that, statistically, a group of instruments conform to the specification so as to certify the group.

The catalog language is intended to call out the characteristic performances of the instrument, not to imply that certification is available simply by asking. Additional copies of this report may be had by writing Product Technical Information, if it can be useful in negotiating on "catalog" purchases with EMI conscious customers.



Report No.: 759018

Date: 6 August 1965

Preproduction Engineering

TEKTRONIX, INC.
Beaverton, Oregon


EMI TEST REPORT

of

TEKTRONIX, INC.

TYPE 422 (AC Model) OSCILLOSCOPE

Prepared by:



Keith W. Sessions
RFI Engineer
Environmental Test Dept.

Approved by:



Jack Luscher
Manager
Environmental Test Dept.

Approved by:



Jess Gard
Manager
Reliability Engineering

GENERAL: The Tektronix Type 422 is a high-performance, dual-trace oscilloscope featuring light weight, small size, large CRT viewing area, and the ability to survive severe environments. Two models are available. One operates on AC; the other on AC or DC, with an optional battery pack for completely portable operation.

The tests herein described were performed on the AC model.

PURPOSE OF TEST: This test was performed to determine the electro-magnetic interference characteristics of Tektronix Oscilloscope Type 422 (AC Model).

UNIT TESTED: Type 422 oscilloscope, serial number 515, with AC Power Supply, serial number 515. CRT mesh filter (Tektronix, Inc., part number 378-0571-00) was installed on this instrument. Manufacturer: Tektronix, Inc., Box 500, Beaverton, Oregon.

DATE OF TEST: 13 July 1965

APPLICABLE SPECIFICATION: MIL-I-6181D

TEST SITE: All tests were conducted in a double wall, solid shielded room located in the Tektronix Environmental Test laboratory. The shielded room is 12 x 20 x 8 feet and was manufactured by Topatron, Incorporated. The ground plane is 3 x 20 feet x 0.064 inch copper, and is bonded to the room walls in compliance with MIL-I-6181D.

TEST EQUIPMENT: Empire Devices Model NF-105 Noise and Field Intensity Meter, with tuning units and associated antennas.

NF-105 S/N 3040

T-A/NF-105 S/N 3040

T-1/NF-105 S/N 3040

Calibration due 11/18/65

T-2/NF-105 S/N 3040

T-3/NF-105 S/N 3040

Line Impedance Stabilization Networks built in accordance with MIL-I-6181D requirements.

TEST PROCEDURE: The Type 422 (AC Model) was operated normally. Modes of operation were selected which were expected to produce maximum RF generation in each frequency band.

Each frequency band was scanned, with the measuring instrument in "peak" function, and frequencies noted where RF emanations could be detected. At each frequency so selected, front panel controls of the test specimen were varied to produce the worst case condition. Determination of the interference type, broadband or narrowband, was accomplished, and the level measured and recorded.

In bands where no interference could be produced, representative frequencies were selected, and ambient noise levels were recorded.

Frequency ranges measured are as follows:

Radiated	0.150 to 1000 MHz
Power-line Conducted	0.150 to 25 MHz

Figure 3 is a typical radiated interference test configuration.

TEST RESULTS: Radiated interference levels, both narrowband and broadband, were below the limits of MIL-I-6181D, as shown on data sheets 3 and 4. No graphical presentation of radiated interference is included because measurable radiated interference occurred at only one frequency. A radiated interference level of 11.0 db above $1\mu\text{v}$ (narrowband) was measured at 0.385 MHz. That level is 12 db below the MIL-I-6181D limit of 23.0 db above $1\mu\text{v}$. It should be noted that the radiated interference data presented is valid only with the CRT mesh filter in position over the CRT face.

Power-line conducted interference levels, both narrowband and broadband, were below the limits specified in MIL-I-6181D, as shown on data sheets 1 and 2. Figures 1 and 2 present graphically the conducted interference levels.

CONCLUSIONS: The Type 422 (AC Model) with CRT mesh filter installed meets the requirements of MIL-I-6181D for radiated interference from 150 kHz to 1000 MHz and power-line conducted interference from 150 kHz to 25 MHz.

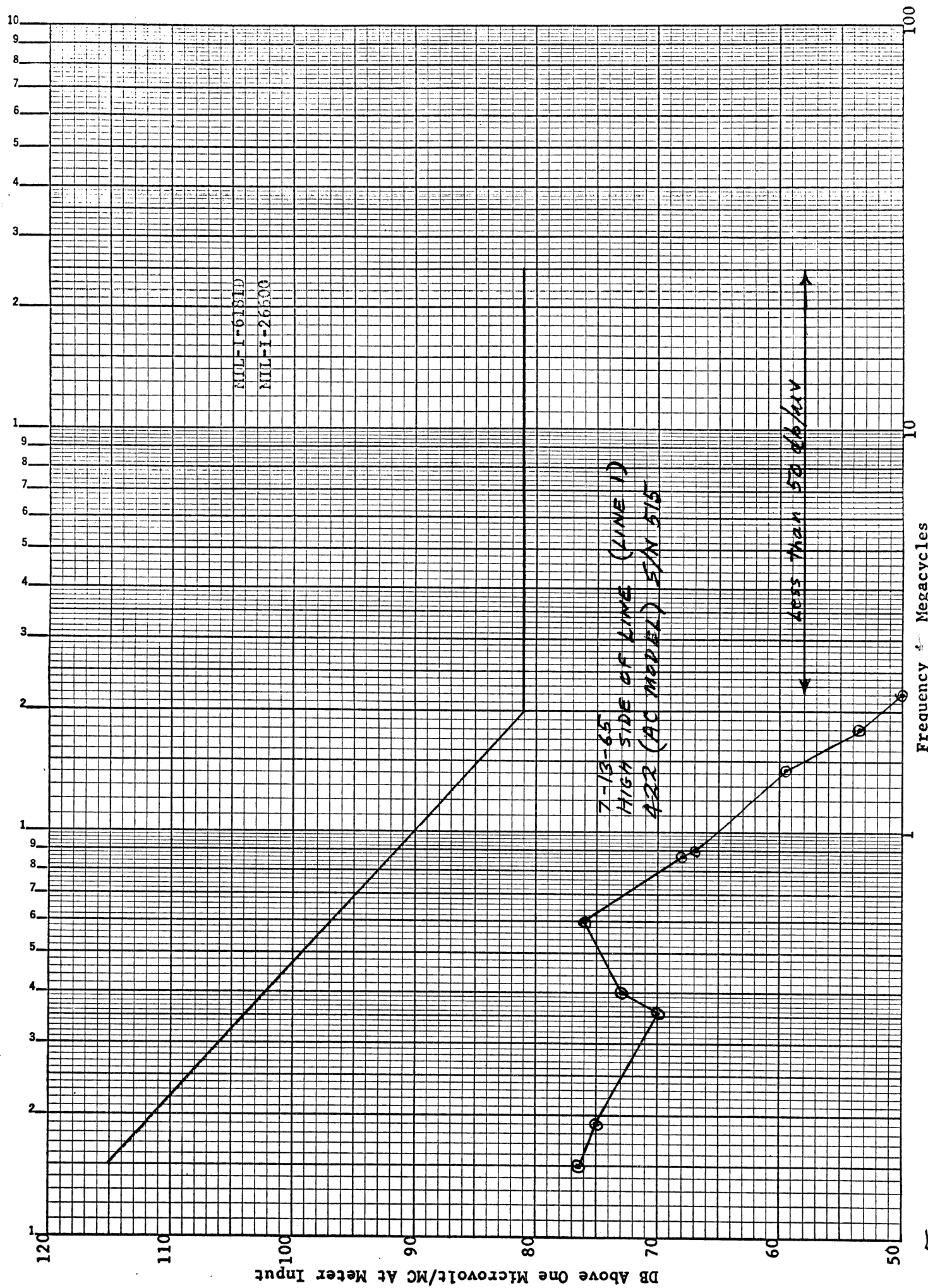


FIGURE
 BROADBAND AND PULSED CW CONDUCTED INTERFERENCE LIMITS USING STABILIZATION NETWORK

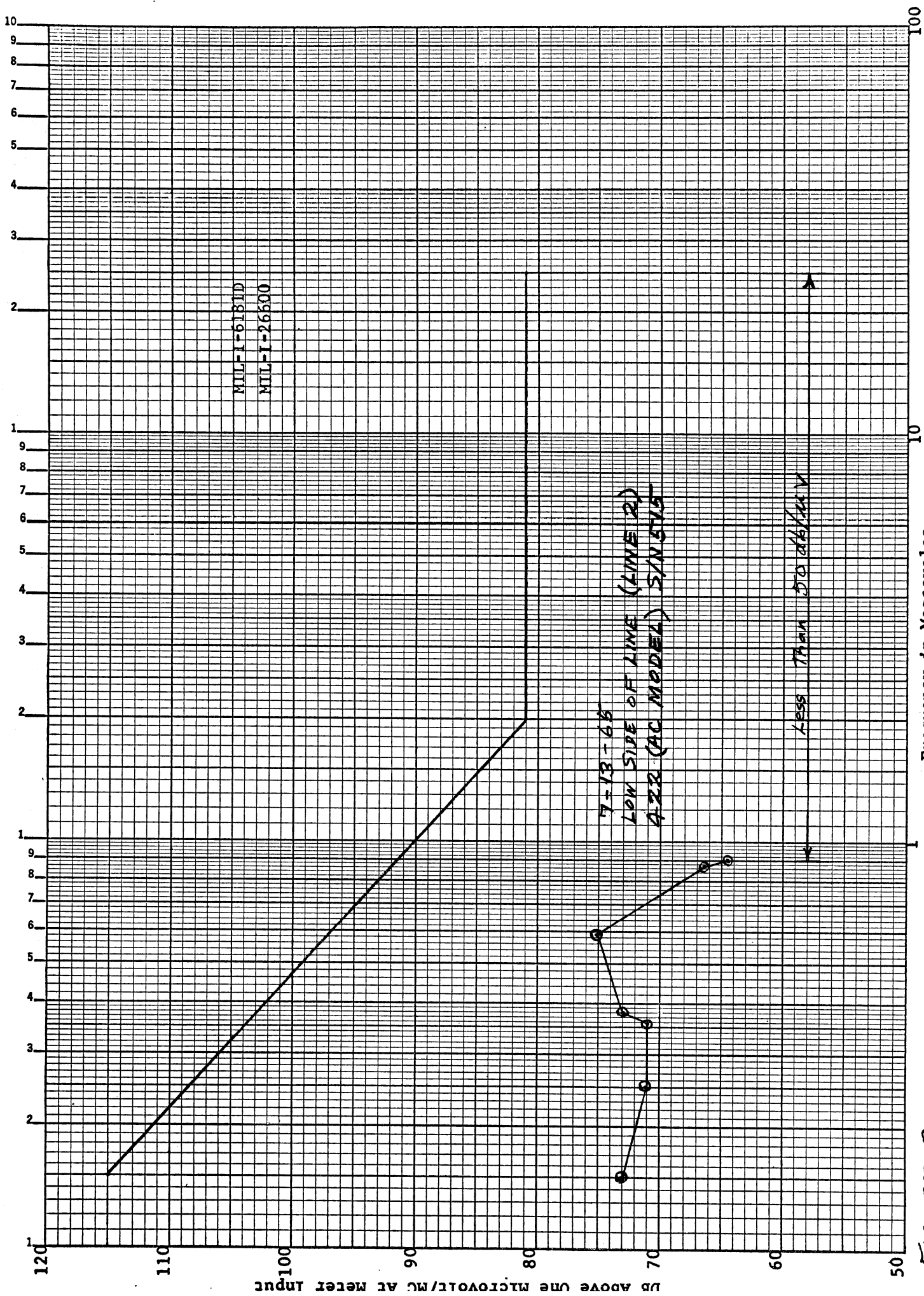
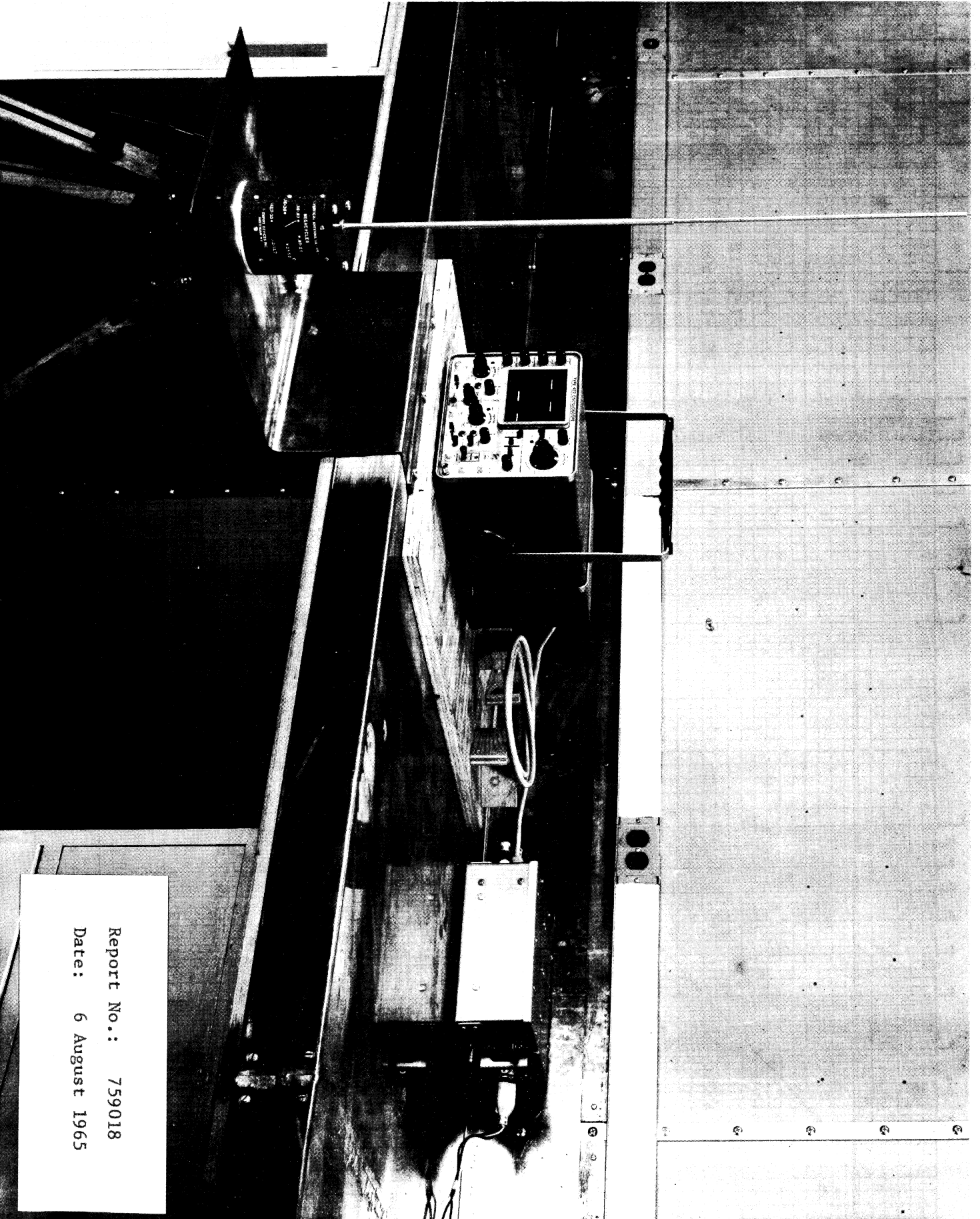


FIGURE 2 BROADBAND AND PULSED CW CONDUCTED INTERFERENCE LIMITS USING STABILIZATION NETWORK

FIGURE 3



Report No.: 759018
Date: 6 August 1965

Report No.: 751098

Date: 14 October 1965

Preproduction Engineering

TEKTRONIX, INC.
Beaverton, Oregon

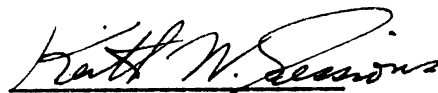
EMI TEST REPORT

of

TEKTRONIX, INC.

TYPE 422 (AC/DC MODEL) OSCILLOSCOPE

Prepared by:



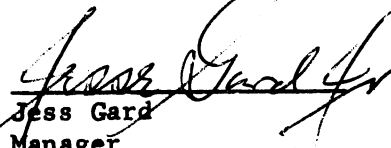
Keith W. Sessions
RFI Engineer
Environmental Test Dept.

Approved by:



Jack Luscher
Manager
Environmental Test Dept.

Approved by:



Jess Gard
Manager
Reliability Engineering

GENERAL: The Tektronix Type 422 is a high-performance, dual-trace oscilloscope featuring light weight, small size, large CRT viewing area, and the ability to survive severe environments. Two models are available. One operates on AC; the other on AC or DC, with an optional battery pack for completely portable operation.

The tests herein described were performed on the AC/DC Model, including the optional battery pack.

PURPOSE OF TEST: This test was performed to determine the electromagnetic interference characteristics of Tektronix Oscilloscope Type 422 (AC/DC Model).

UNIT TESTED: Type 422 oscilloscope, serial number 762, with AC/DC power supply, serial number 762. CRT mesh filter (Tektronix, Inc., part number 378-0571-00) was installed on this instrument. Manufacturer: Tektronix, Inc., Box 500, Beaverton, Oregon.

DATE OF TEST: 28 September 1965

APPLICABLE SPECIFICATION: MIL-I-6181D

TEST SITE: All tests were conducted in a double wall, solid shielded room located in the Tektronix Environmental Test laboratory. The shielded room is 12 x 20 x 8 feet and was manufactured by Topatron, Incorporated. The ground plane is 3 x 20 feet x 0.064 inch copper, and is bonded to the room walls in compliance with MIL-I-6181D.

TEST EQUIPMENT: Empire Devices Model NF-105 Noise and Field Intensity Meter, with tuning units and associated antennas.

NF-105 S/N 3040

T-A/NF-105 S/N 3040

T-1/NF-105 S/N 3040

T-2/NF-105 S/N 3040

T-3/NF-105 S/N 3040

Calibration due 11/18/65

Line Impedance Stabilization Networks built in accordance with MIL-I-6181D requirements.

TEST PROCEDURE: Separate tests were performed with the 422 (AC/DC Model) operating normally from each of the following power sources:

1. 120 VAC 1Ø 60Hz
2. 25 VDC (external source)
3. self-contained battery pack

Modes of operation were selected which were expected to cause maximum RF generation within each frequency band. Each band was scanned, with the measuring instrument in "Peak" function, and frequencies noted where RF emanations could be detected. At each frequency so selected, front panel controls of the test specimen were varied to produce the worst case condition. Determination of the interference type, broadband or narrowband, was then accomplished, and the level recorded. In bands where no RF emanations could be produced, representative frequencies were selected and ambient noise levels were recorded.

Frequency ranges measured are as follows:

Radiated	0.150	to	1000MHz
Power-line Conducted	0.150	to	25MHz

Figure 8 depicts a typical radiated interference test configuration.

TEST RESULTS: Radiated interference levels, both narrowband and broadband, were below the limits of MIL-I-6181D over the frequency range of 150 kHz to 1000 MHz, as shown on data sheets 3, 4, 7, 8, 9, and 10. Figures 1, 2, and 3 present graphically the radiated interference levels with respect to MIL-I-6181D limits. It should be noted that the radiated interference data presented is valid only with the CRT mesh filter in position over the CRT face.

Power-line conducted interference levels, both narrowband and broadband, were below the limits of MIL-I-6181D over the frequency range of 150 kHz to 25 MHz. Data is presented on data sheets 1, 2, 5, and 6. Figures 4, 5, 6, and 7 present graphically the power-line conducted interference levels with respect to MIL-I-6181D limits.

CONCLUSIONS: The Type 422 (AC/DC Model) with CRT mesh filter installed meets the requirements of MIL-I-6181D for radiated interference from 150 kHz to 1000 MHz and power-line conducted interference from 150 kHz to 25 MHz.

REPORT NO. : 751098
 DATE : 10/14/65
 TEST SPECIMEN : 422 (AD/DC MODEL)
 S/N 762/762
 INPUT POWER : 120VAC 1Ø 60Hz
 TYPE OF TEST : RADIATED
 SPECIFICATION : MIL-I-6181D

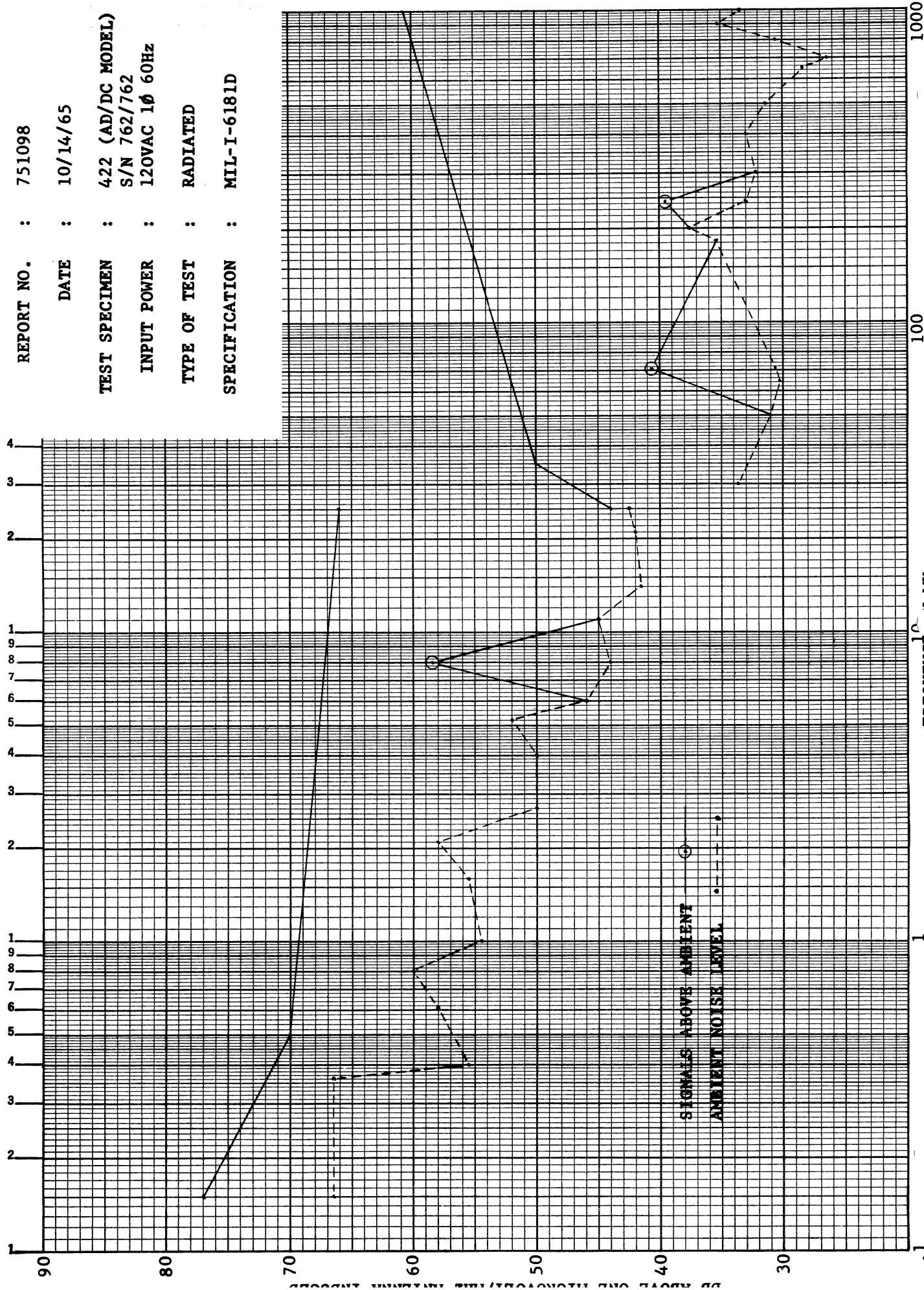


FIGURE 1
 BROADBAND AND PULSED CW RADIATED INTERFERENCE LIMITS

REPORT NO. : 751098
 DATE : 10/14/65
 TEST SPECIMEN : 422 (AC/DC MODEL)
 S/N 762/762
 INPUT POWER : 25V DC (EXTERNAL SOURCE)
 TYPE OF TEST : RADIATED
 SPECIFICATION : MIL-I-6181D

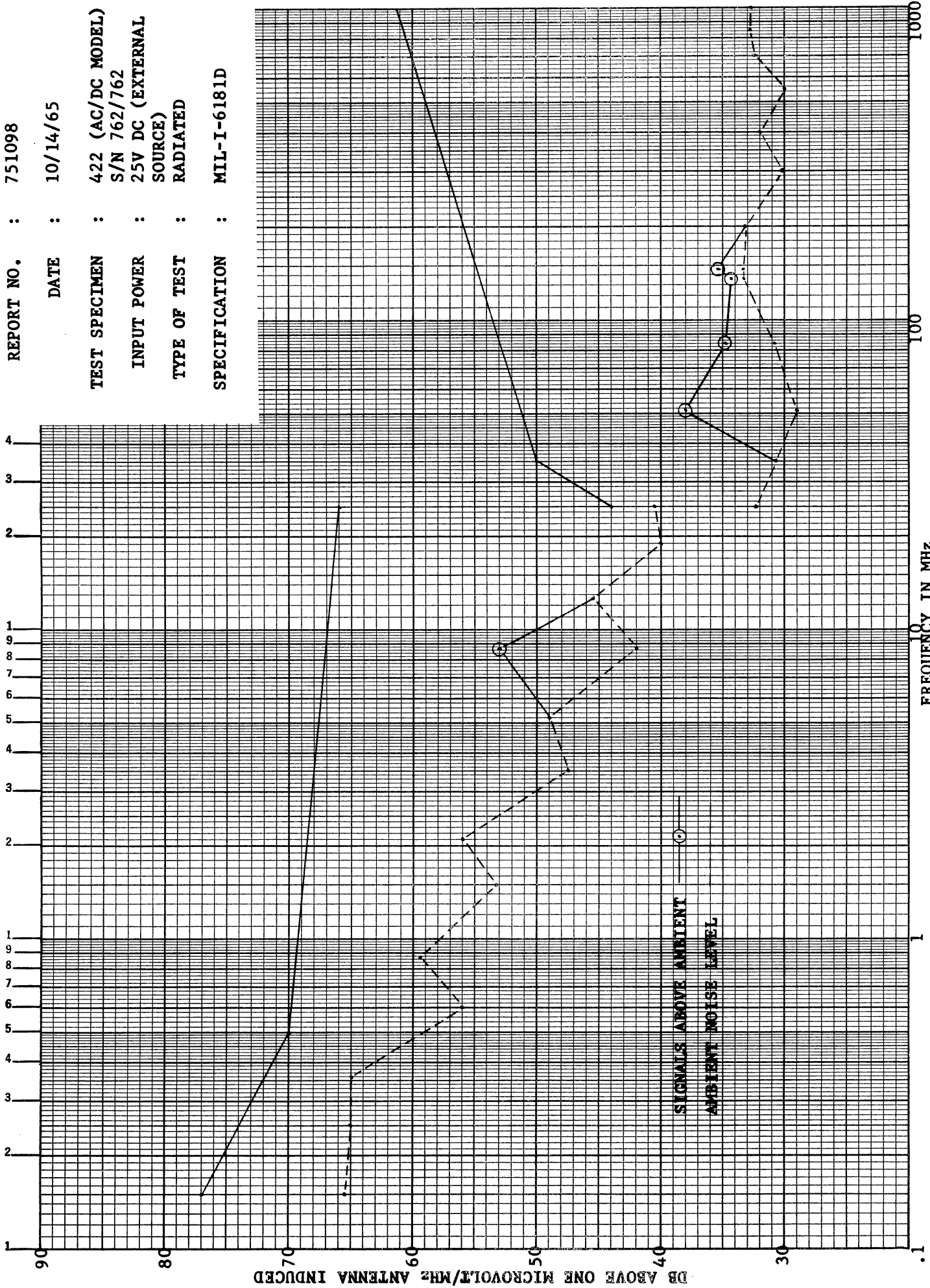


FIGURE 2 BROADBAND AND PULSED CW RADIATED INTERFERENCE LIMITS

REPORT NO. : 751098
 DATE : 10/14/65
 TEST SPECIMEN : 422 (AC/DC MODEL)
 S/N 762/762
 INPUT POWER : 24VDC (SELF-CONTAINED
 BATTERY PACK)
 TYPE OF TEST : RADIATED
 SPECIFICATION : MIL-I-6181D

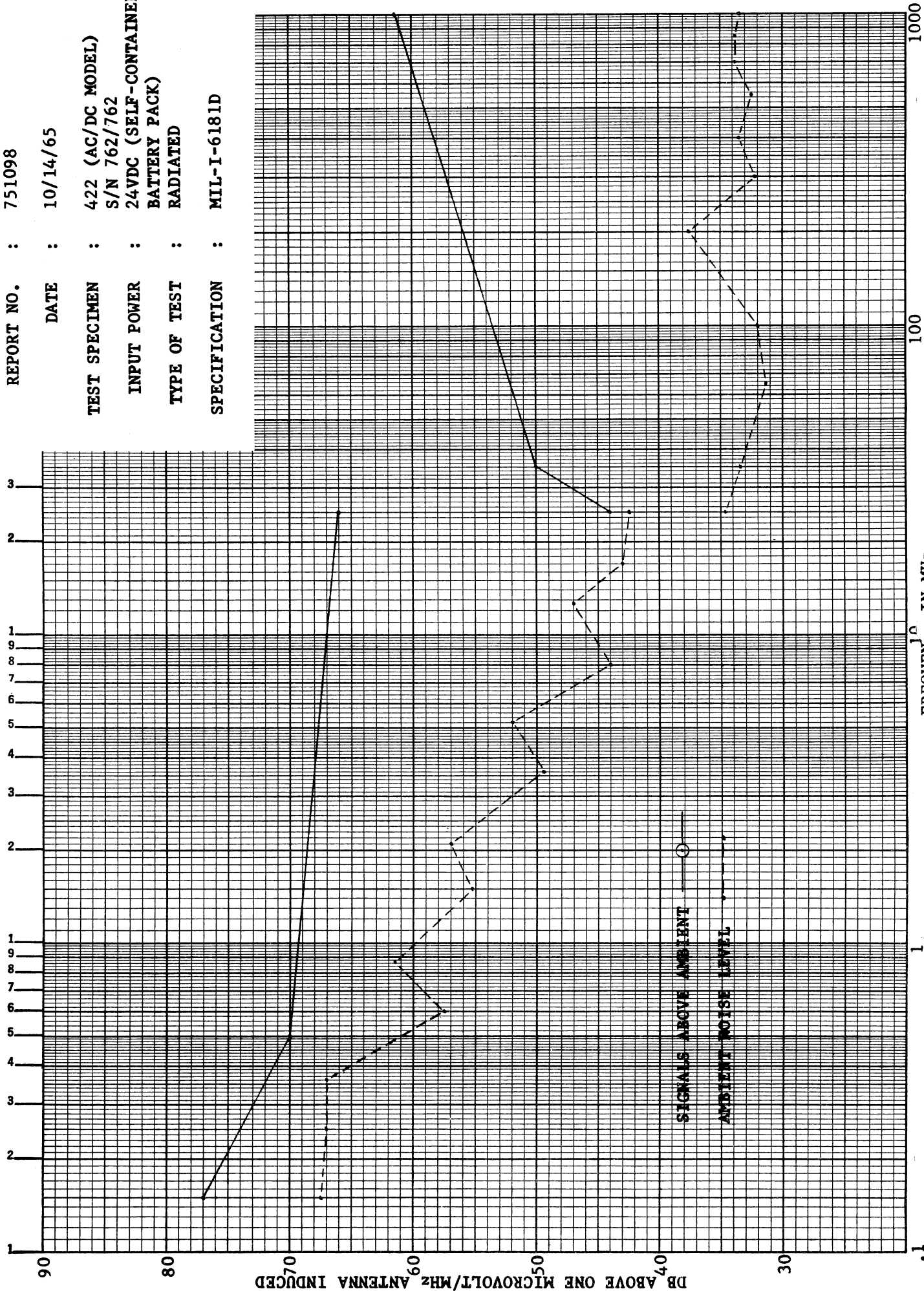


FIGURE 3 BROADBAND AND PULSED CW RADIATED INTERFERENCE LIMITS

REPORT NO. : 751098
 DATE : 10/14/65
 TEST SPECIMEN : 422 (AC/DC MODEL)
 S/N 762/762
 INPUT POWER : 120VAC 1Ø 60Hz
 TYPE OF TEST : POWER-LINE CONDUCTED
 LINE 1 (HIGH SIDE OF
 LINE)
 SPECIFICATION : MIL-I-6181D

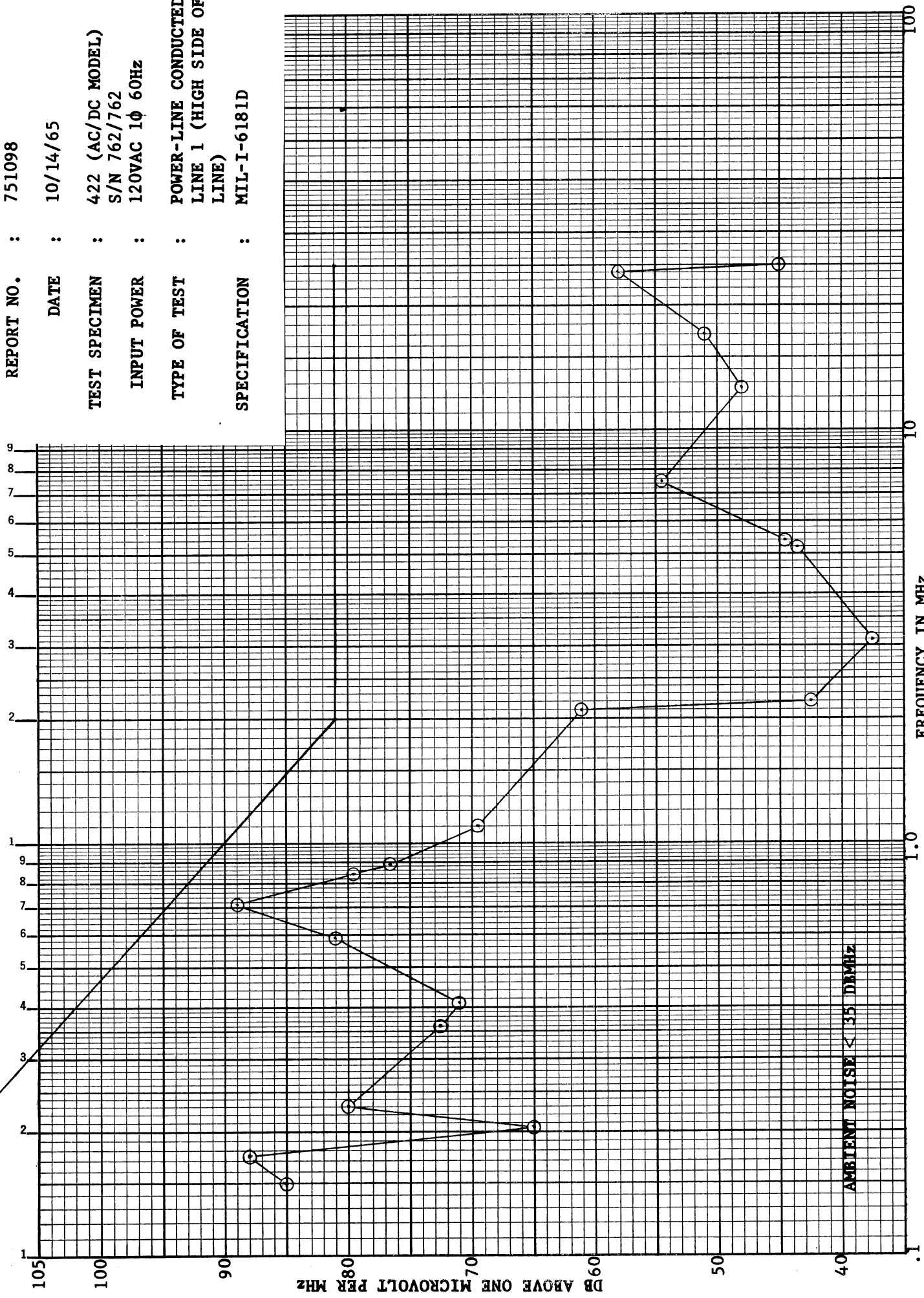


FIGURE 4 BROADBAND AND PULSED CW CONDUCTED INTERFERENCE LIMITS USING STABILIZATION NETWORK

REPORT NO. : 751098
 DATE : 10/14/65
 TEST SPECIMEN : 422 (AC/DC MODEL)
 S/N 762/762
 INPUT POWER : 120VAC 1 ϕ 60Hz
 TYPE OF TEST : POWER-LINE CONDUCTED
 LINE 2 (LOW SIDE OF
 LINE)
 SPECIFICATION : MIL-I-6181D

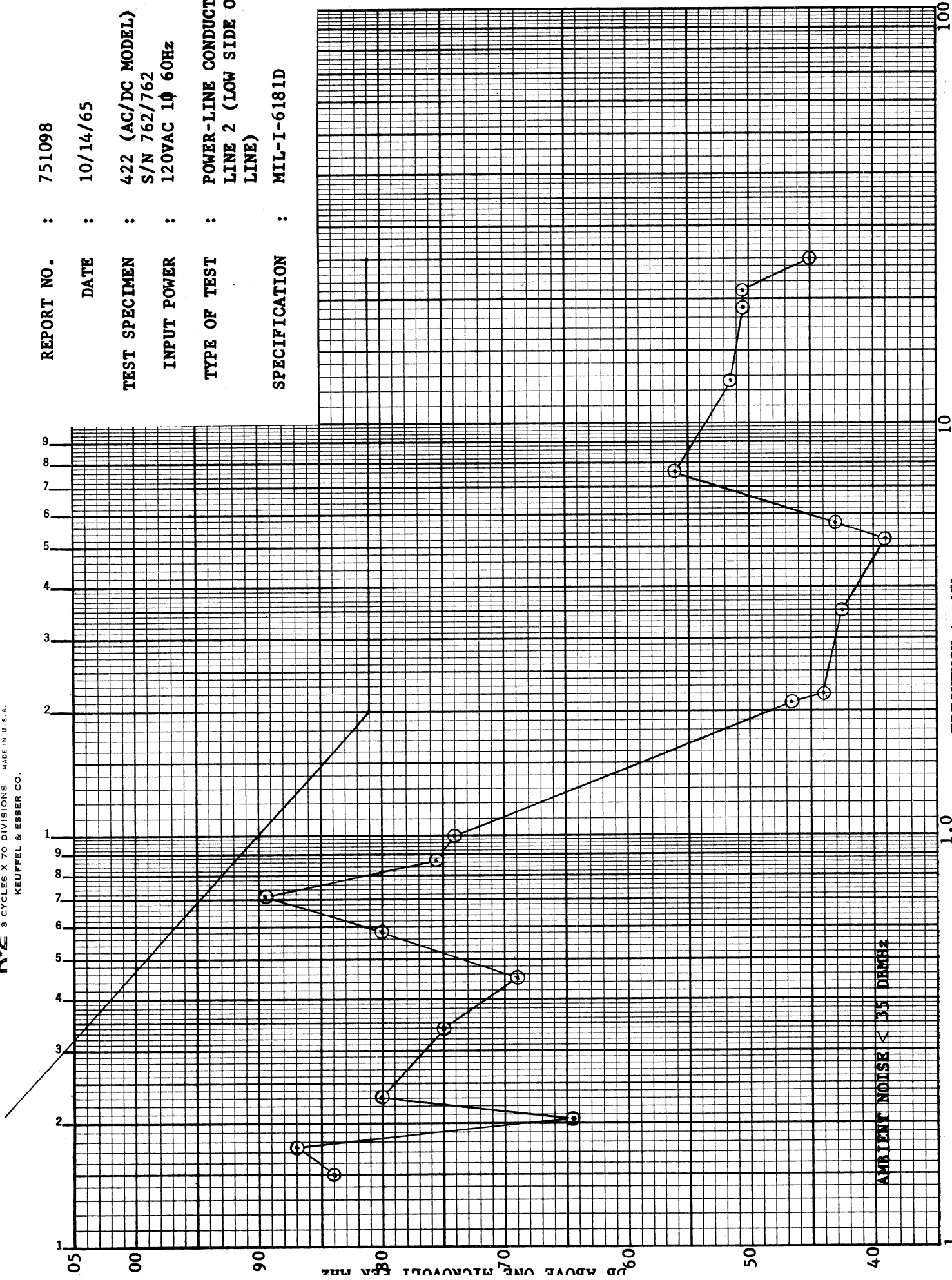


FIGURE 5 BROADBAND AND PULSED CW CONDUCTED INTERFERENCE LIMITS USING STABILIZATION NETWORK

REPORT NO. : 751098
 DATE : 10/14/65
 TEST SPECIMEN : 422 (AC/DC MODEL)
 S/N 762/762
 INPUT POWER : 25VDC (EXTERNAL SOURCE)
 TYPE OF TEST : POWER-LINE CONDUCTED
 LINE 1 (+)
 SPECIFICATION : MIL-I-6181D

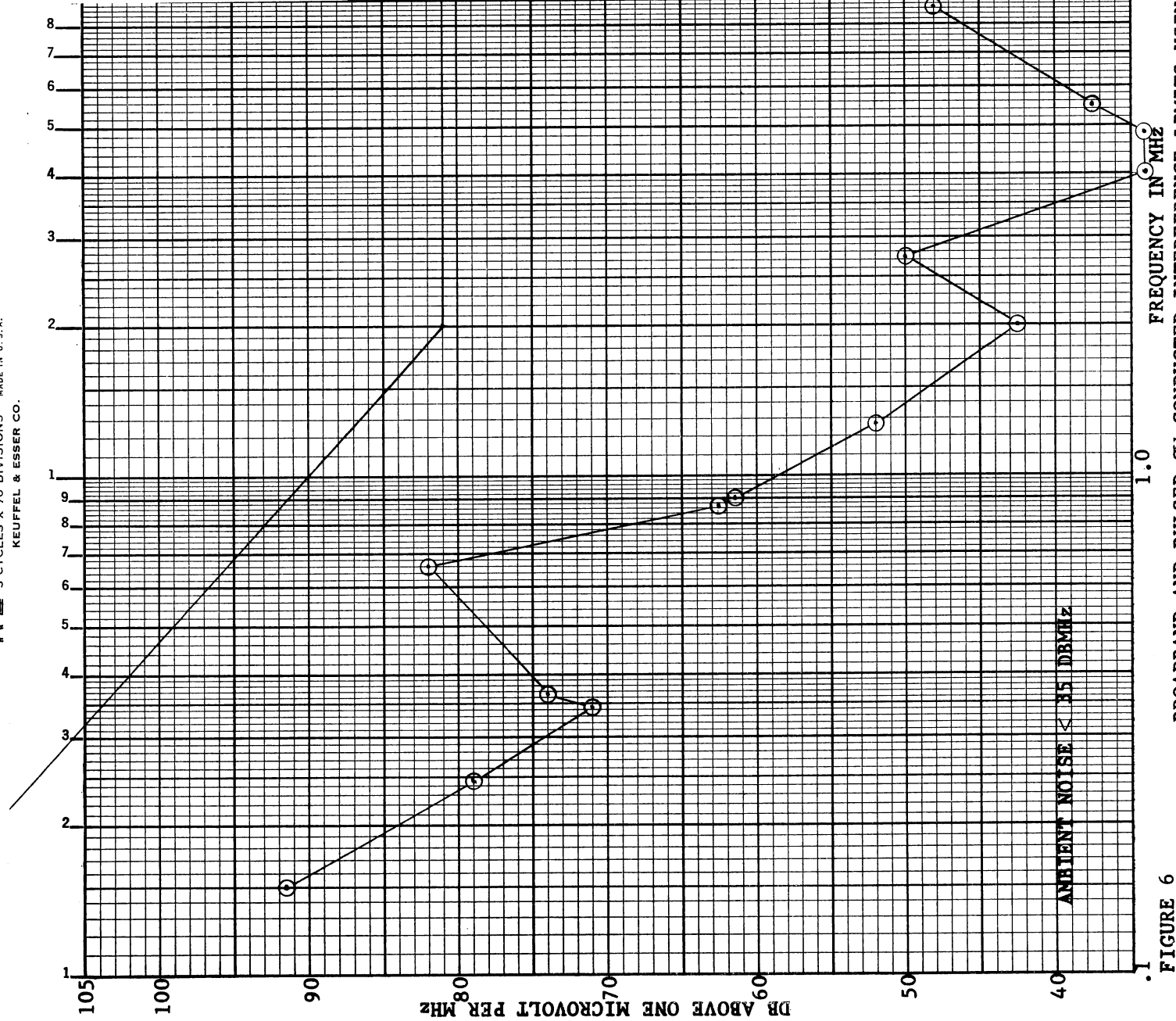


FIGURE 6
 BROADBAND AND PULSED CW CONDUCTED INTERFERENCE LIMITS USING STABILIZATION NETWORK

REPORT NO. : 751098
 DATE : 10/14/65
 TEST SPECIMEN : 422 (AC/DC MODEL)
 S/N 762/762
 INPUT POWER : 25VDC (EXTERNAL SOURCE)
 TYPE OF TEST : POWER-LINE CONDUCTED
 LINE 2 (-)
 SPECIFICATION : MIL-I-6181D

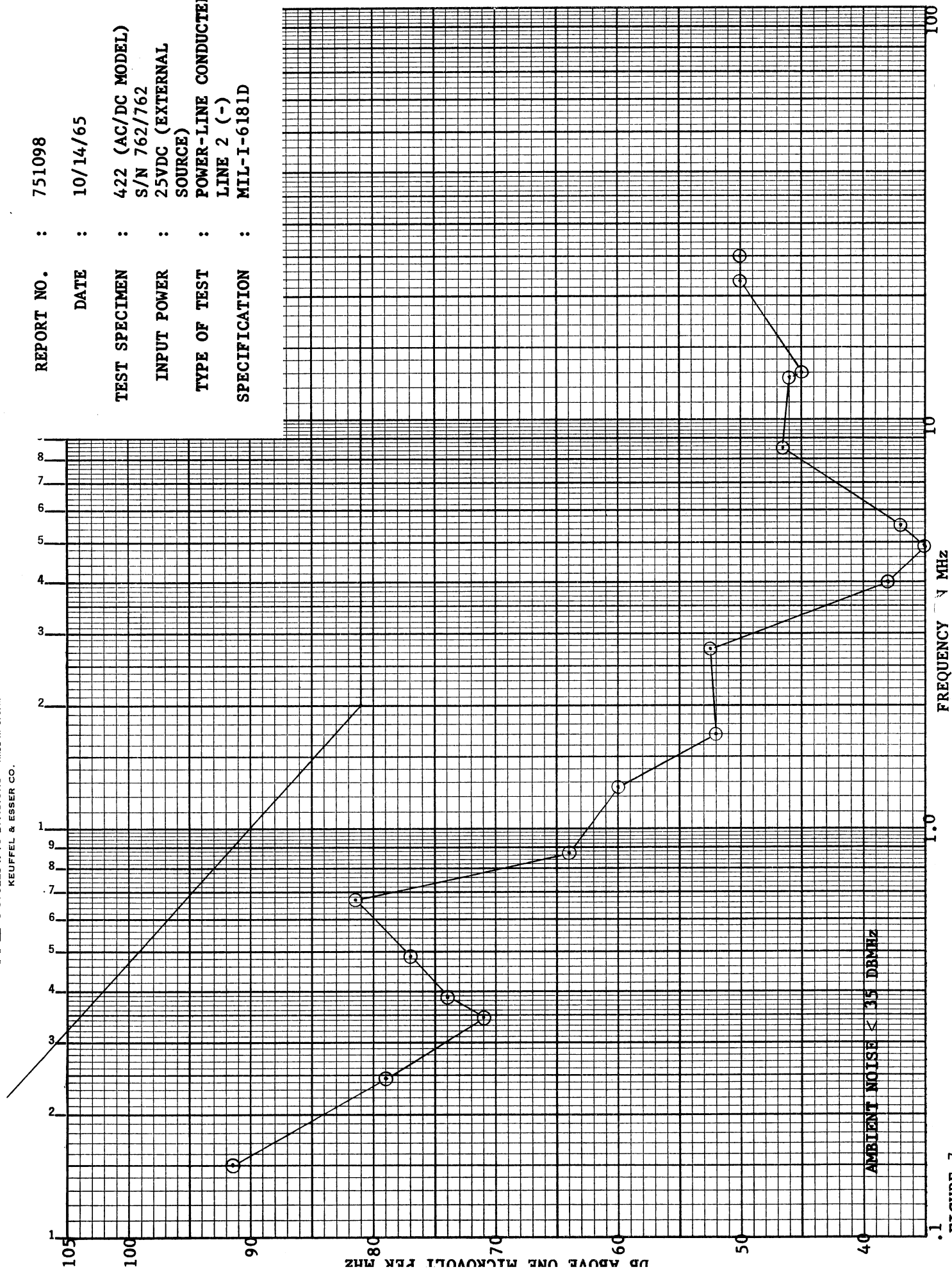
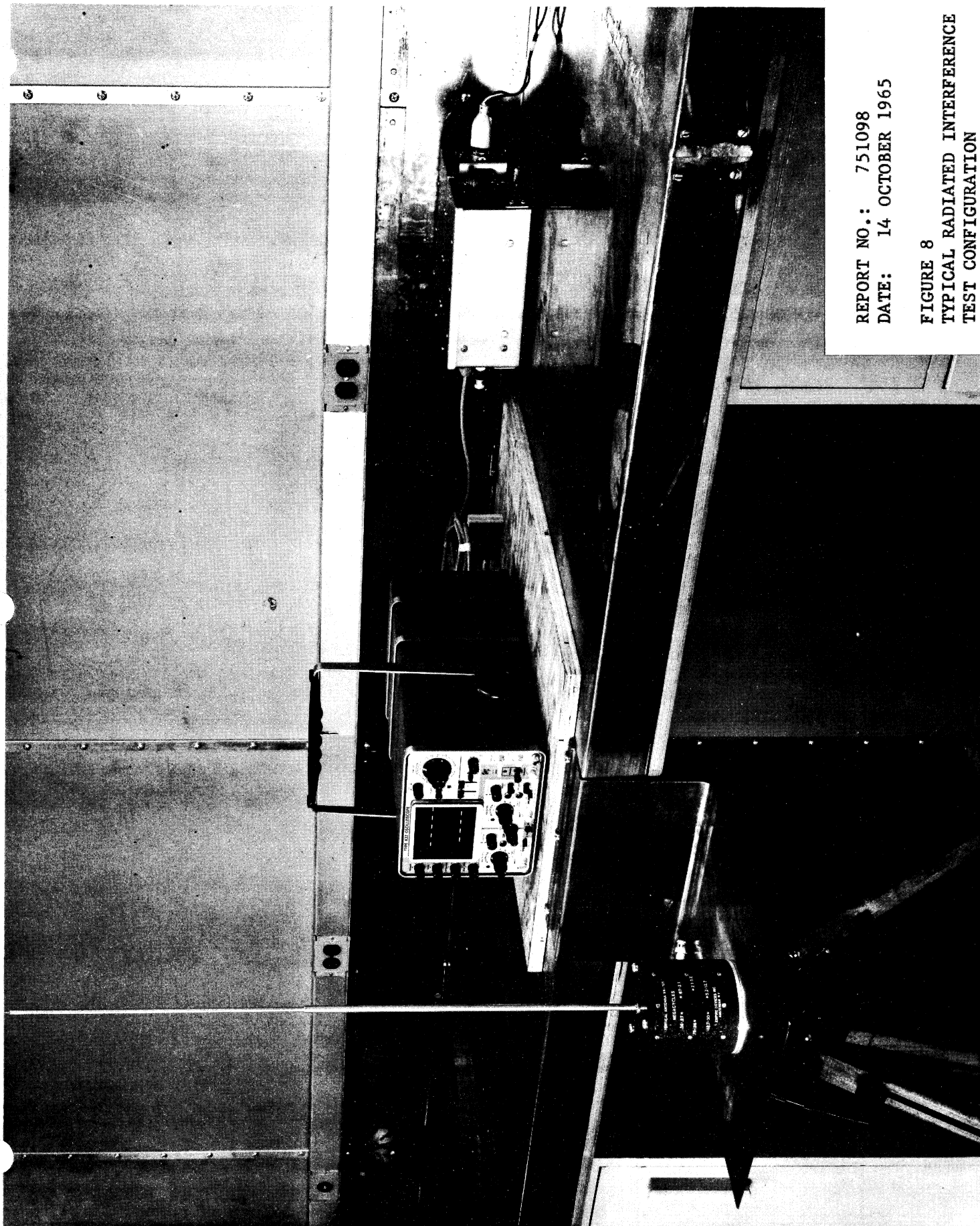


FIGURE 7 BROADBAND AND PULSED CW CONDUCTED INTERFERENCE LIMITS USING STABILIZATION NETWORK



REPORT NO.: 751098

DATE: 14 OCTOBER 1965

FIGURE 8

TYPICAL RADIATED INTERFERENCE
TEST CONFIGURATION

IMPORTANT INFORMATION ABOUT THE USE OF NICKEL-CADMIUM BATTERIES

The Nickel-Cadmium cells supplied for use in Tektronix oscilloscopes using battery power (321, 321A, and 422 AC/DC) have been selected as a result of exhaustive engineering evaluation. Each cell has been rigidly inspected, has received an ampere hour test, and has met or exceeded the minimum ampere hour storage requirement.

These cells should provide a useful operating life extending over several hundred charge and discharge cycles, providing the precautions listed below are observed:

PRECAUTIONS

The life of hermetically sealed Nickel-Cadmium cells may be shortened if abused in one or more of the following ways:

1. If recommended charge rate is exceeded.
2. If installed incorrectly and charged in reverse (321 or 321A).
3. If charger is operated incorrectly (see 422 AC/DC or 321A Manuals).
4. If discharged to a point where one or more cells are reverse polarized.

The following information concerning Nickel-Cadmium cells should prove helpful in avoiding the pitfalls mentioned above.

CHARGING PROCESS

During charging, sealed Nickel-Cadmium cells normally contain an internal pressure, because gas evolution and chemical recombination is taking place. As charging current is increased, gas evolution and internal pressure also increases so charging at rates in excess of those recommended should be avoided. Cell cases and seals will withstand these excess pressures, but the pressure relief vent may be punctured, which may result in shorter overall battery life.

Periodic inspection of batteries and battery compartments is recommended for signs of battery out-gassing due to venting. Any such signs should be cause for a closer inspection of the cells. Any residue should be cleaned immediately with a solution of baking soda and water. After cleaning, the affected compartment or power supply should be dried thoroughly at approximately 140°F for 12 hours to make sure that all water has been evaporated before the instrument is put into use.

321/321A CHARGING RATES

TEKTRONIX Part Number 146-0005-00 may be charged at the highest rate provided by the Type 321 or 321A oscilloscope, which is 400 milliamperes. These cells should be charged for the full time recommended on the cell jacket, before operating the instrument on them for any length of time. Leaving the cells on full charge for periods longer than specified on the cell jackets may not cause damage, but it is not recommended.

Cells procured from sources other than TEKTRONIX should be charged at the 200 milliampere rate provided

by the Type 321 or 321A, unless it is clearly indicated on the cell that they will stand the 400 milliampere charging rate. It would be unwise to assume that 3.5 AH cells other than those supplied by TEKTRONIX can be charged at 400 milliamperes by reasoning that the TEKTRONIX P/N 146-0005-00 is rated at 3.5 AH and is charged at 400 milliamperes. When a Type 321 or 321A oscilloscope is operated from an external power source, a trickle charge of approximately 30 milliamperes is applied to the batteries. Type 321 instruments having serial numbers above 3259 may be set to trickle charge when the instrument is not in operation. Type 321A instruments, all serial numbers, have this feature. Type 321's below S/N 3259 have another charging provision. Please see the instrument manual for details.

422 AC/DC CHARGE RATES (Battery pack 016-0066-00)

A battery pack, consisting of 20 specially selected cells wired in series is provided for use with the Type 422 AC/DC oscilloscope. The Type 422 AC/DC power supply contains battery charging circuitry that may be operated from 115 V-AC or 230 AC. In the "Charge Batt 115 V-AC" or "Charge Batt 230 V-AC" positions of the POWER MODE switch, this internal battery pack is charged at approximately 400 milliamperes. In the "operate 115 V-AC or 230 V-AC" position, the batteries are trickle-charged at a 30 milliampere constant current rate.

Thermal cutouts in the 422 AC/DC power supply provide protection against overheating of the battery pack during the charging process. In the event the battery temperature exceeds the thermal monitor point, the charge rate is reduced to 30 milliamperes, the trickle charge rate. When the battery pack temperature drops sufficiently, the thermal cutout resets and the charger resumes the 400 milliampere charge rate. For more details, refer to the 422 AC/DC manual.

STORAGE AND SHELF LIFE

TEKTRONIX P/N 146-0005-00 cells may be stored in a charged or partially discharged condition. For best shelf-life, fully recharge cells at 3-6 month intervals. Although new cells are fully charged before packaging, they should be recharged when put in service.

Cells used in battery pack 016-0066-00 are in a state of total discharge during factory assembly, after which they are charged for 15 minutes at a 2 ampere rate for test purposes, and are shipped in this condition. The terminal voltage of this battery is 24 volts, and it is capable of delivering a tremendous amount of energy under short-circuit conditions. It is shipped in a separate carton and extra caution against accidentally shorting this battery in transit or storage is advisable.

Charge retention characteristics of NiCd cells vary with temperature. They may be stored at any temperature between -40°F and 120°F without damage, but the higher the ambient temperature, the faster will be the self-discharge rate. Cells stored at 70°F will lose approximately



50% of their stored charge in 3 months. For this reason, an occasional partial charge is recommended for cells that are in storage for any period of time.

NICKEL-CADMIUM BATTERY PERFORMANCE DATA

A battery of fully charged P/N 146-0005-00 cells should operate the Type 321 for about 4½ hours at ambient temperatures ranging from between 60°F and 80°F, or about 4 hours at 50° to 60°F and at 80° to 90°F. The 321A will operate somewhat longer than the 321 on the same cells, due to instrument improvements.

Operation of 4 hours may be expected of the 422 AC/DC using the internal battery pack, 016-0066-00, that is in a fully charged condition at the outset. Derating at extremes of temperature should be expected. Also, some derating with age and/or after dozens of charge-discharge cycles will be necessary.

Discharging a cell to an excessively low terminal voltage is not recommended since the likelihood of its reversing polarity is greatly increased. Cells with very low terminal voltage should not be charged in series with other cells without first trickle charging them for at least 72 hours.

If, after this time they do not have their proper terminal voltage, they should be discarded. If proper voltage is evident, then it may be charged normally.

Battery pack, 016-0066-00, should be regarded as a battery rather than a set of cells. The cells are evaluated as to their energy storage capabilities before assembly. It is not expected that any single cells will be replaced, but rather that the pack will be replaced. Any questions regarding this practice should be discussed with your TEKTRONIX Field Engineer or Representative.

Since the cells are strapped together in the pack, it is difficult to check the condition of a single cell. This may be done, however, using needle nose probe tips on the test leads of a suitable voltmeter. Such probe tips may be used to penetrate the foam cushion visible at the holes in the pack, behind which each cell is located. Any cell with a terminal voltage less than 1 volt should give cause for concern.

The battery pack is not designed to be disassembled. Refer to the 422 AC/DC manual for additional information on the use of this battery pack. Any questions of performance should be referred to your TEKTRONIX Field Engineer or Representative.

422 RM HARDWARE

422 RACKMOUNTING HARDWARE

A prototype of the hardware for rackmounting the 422 is shown in the accompanying picture.

This configuration has been chosen since 2 complete wrap-around cases of the 422 are easier to work with. Their side-by-side configuration simplifies the distribution of stress and strain.

It also provides the most versatility in that the user may mount two instruments side-by-side or one instrument and a storage compartment in place of the other.

The standard 422 may be mounted into this rackmounting adaptor and may be converted back into a portable instrument very easily. It only requires that the wrap-around to which the handle is affixed be put back on the instrument after removal from the rack.

The photo shows the configuration of scope and storage compartment. Some customers may want to build in their own equipment in place of the storage. A blank panel secured by 4 binder head screws could be supplied similar to the one on the rear of the storage compartment.

In a fixed rack situation such as in a lab or production situation, the instrument may be mounted as pictured.

However, for a mobile or environmental application, slides to provide support from the rear of the instrument will be necessary. They will be similar to tracks but will not be of the conventional type. They will support the instrument for easy removal but are more of a slide than a track.

** Other equipment, such as 184, 106, etc., could be fit in this hardware, if one were determined enough. They are not physically larger than the hole, but happen to be another shape.

This hardware gets its strength by virtue of two 422 wrap-arounds, minus handle hardware, being spot welded together. Any other instrument adapted to this hardware would have to fit inside a 422 case. Further discussion is simply more discouraging.

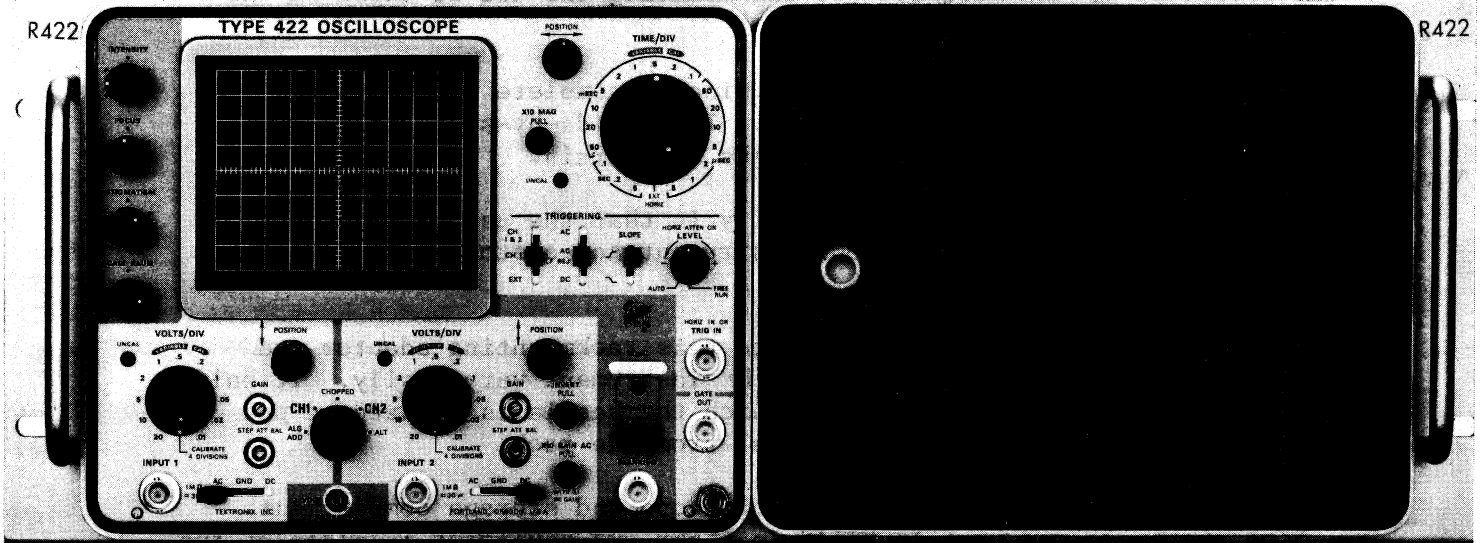
** Change information

Tony Bryan
9/22/65

R422

TYPE 422 OSCILLOSCOPE

R422



is a copy of the original of the

TECHNIQUES

422 SAWTOOTH OUT FOR USE WITH 132 AND 1L20/1L30

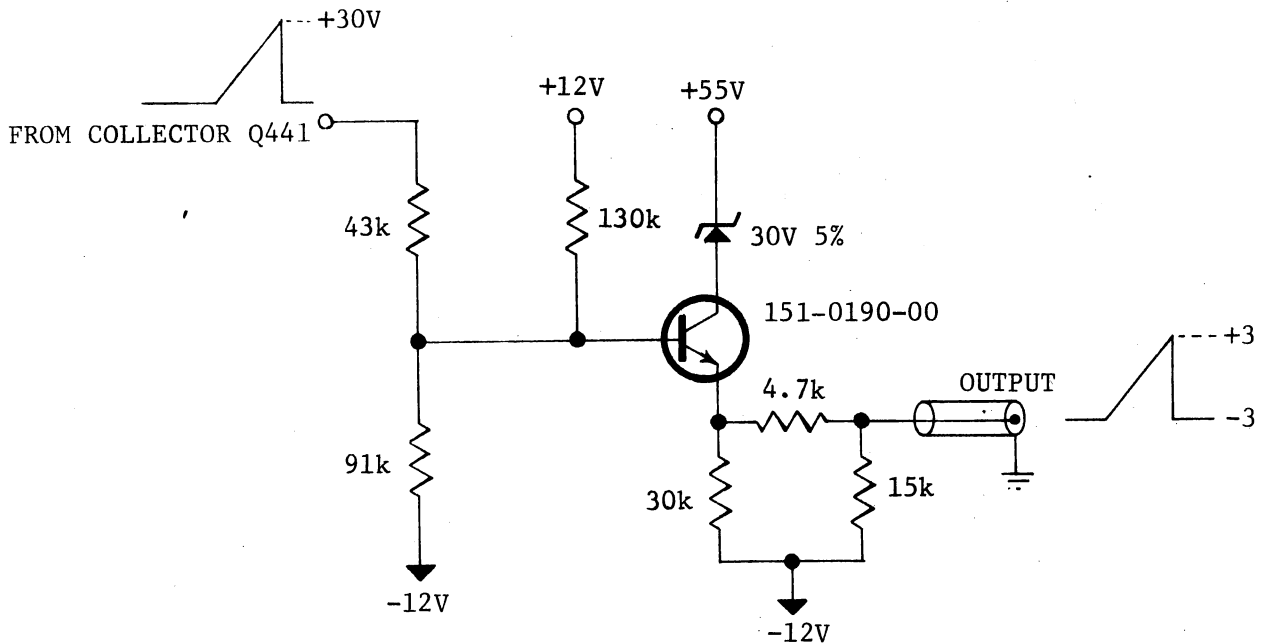
Dan Welch, 9-5-67

The following schematic illustrates how the sawtooth from a 422 may be taken in order to horizontally sweep a 1L20 or 1L30 Spectrum Analyzer operating in a 132 Power Supply.

The 422 may be used to display the output

of the 132 as well as sweep the Spectrum Analyzer.

The 1L20 or 1L30 must be modified by placing a strap across R202 and selecting the 100 volt sawtooth position with the sawtooth selector switch.



ALL RESISTORS ARE $\frac{1}{2}$ W 5%.
THIS CIRCUIT IS USEFUL ONLY FOR SPECTRUM ANALYZERS.
THE FASTEST SWEEP SPEEDS ARE DISTORTED.

MODIFIED PRODUCTS

<u>Product</u>	<u>Mod</u>	<u>Description</u>
422	172Z	External graticule.
422	152J	Panel with "Property of Friden, Inc."
422	702R	Flanged cabinet with front handles; cover, handle and feet deleted; parallel rear miniature connectors for 2 Vert, 1 Trig.
422	813X	INPUT 1, INPUT 2 and EXT HORIZ OR TRIG IN paralleled to rear BNC; probes changed to X1.
## R422	154B	Type-qualified for fungus-resistance by component screening against sample tested to Mil-E-5272C, Para. 4.8.

SPECIFICATION ADDENDUM

422-1 AND 422-2 SHOCK SPEC.

Tony Bryan, 11-19-65

The specification on Page 1-8 of the instrument spec #113 is revised under section 1.2.5. The revision will include *operating* shock of 30 g's and *non-operating* shock of 60 g's, for one-half sine, 11 millisecond duration.

The same revision will be applicable to spec #123

so as to call out *operating* 30 g's and *non-operating* 60 g's.

These changes will more nearly reflect the instrument's capabilities and make the spec comparisons with the 453 more meaningful.

Specification 113

November 30, 1964

**ENGINEERING
INSTRUMENT SPECIFICATION**

TYPE 422
OSCILLOSCOPE

Type A Supply

**FOR INTERNAL USE ONLY
TEKTRONIX, INC.**

Specification 113

November 30, 1964

ENGINEERING
INSTRUMENT SPECIFICATION
TYPE 422
OSCILLOSCOPE
A SUPPLY

Prepared by Technical Writing Dept.

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TEKTRONIX, INC.

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INTRODUCTION

This is the Instrument Specification of the Type 422 Oscilloscope with the Type 'A' power supply, and is the reference document for all company activity concerning performance requirements. This specification is for internal use only. It replaces the rough draft of the Type 422 Instrument Specification dated October 9, 1964.

General Information

The Type 422 is a dual-channel, 15-mc, portable oscilloscope. It has been designed and tested to meet Tektronix environmental instrument requirements. It may be operated on line voltage, or from a rechargeable DC power supply. The Type 'A' supply is AC only. Type 'B' will be AC, DC internal, or DC external.

The Type 422 has calibrated sweep rates from 0.5 sec/div to 0.5 μ sec/div extended to 0.05 μ sec/div with the X10 Magnifier.

The dual-channel vertical amplifier offers eleven calibrated Volts/Div steps from .01 to 20. X10 AC Gain extends the Ch 2 deflection factor to 1 mv/div. Ch 2 has provision for signal inversion.

Triggering sources are Ch 1 and Ch 2, Ch 1 only, and External. Trigger coupling available is AC, AC LF Reject, and DC. The 422 incorporates automatic triggering (AC coupled only) and normal triggering modes.

Characteristics Summary

All references to divisions are major divisions.

Vertical Deflection

Risetime

DC, X1	< 23 nsec
AC, X1	< 23 nsec
AC, X10	< 70 nsec

Frequency Response

DC, X1	> 15 mc
AC, X1	2 cps to 15 mc
AC, X10	5 cps to 5 mc

Signal Delay

150 nsec

Calibrated Scan

8 div

Amplitude Calibrator

Voltage Output

2 volt External
0.2 volt Internal

Horizontal Deflection

Time/Div Range

0.5 sec/div to 0.5 μ sec/div

Variable

> 2.5:1

Trigger Modes

DC, AC, AC LF Reject, Automatic

Trigger Slope

+ or -

Trigger Source

Ch 1 and 2, Ch 1, External

Sweep Magnification

X10 (extends sweep rate to 0.05 nSec)

External Horizontal Amplifier	
Deflection Factor	10 v/div - Mag in X1 1 v/div - Mag in X10
HF Response	DC to 500 kc (Mag in X10)
Variable Attenuator	10:1 range
Output Signal Amplitude	
Gate Out	0.5 volt from 800 Ω source, negative going
CRT Circuit	
Tube Type	T4220-31-1
Accelerating Potential	6 kv
Internal Graticule	Illuminated, 8 X 10 div
Power Source (Type 'A' supply)	115 vac \pm 10%, 50 cps to 400 cps \pm 10% Can be connected for 230 vac \pm 10%, 105 vac \pm 10%, 125 vac \pm 10%, 210 vac \pm 10%, and 250 vac \pm 10%
Environment	
Storage	-55°C to +75°C, to 50,000 feet
Operating Temperature	-15°C to +55°C
Operating Altitude	to 15,000 feet
Maximum Overall Dimensions	6.75" X 10.0" X 17.8" (main box, power supply, panel cover and handle) Power supply with batteries approximately 2 7/8" longer
Weight	Without panel cover 18 lb., 8 oz. With panel cover and power cord, 20 lb., 6 oz.

SECTION 1

1.0 Performance Requirements

1.1 Electrical

The following electrical characteristics are valid throughout the environment specified in Section 1.2 unless there is a modifying statement to the contrary. The electrical characteristics pertain to the type 'A' power supply only.

Test and measurements are performed according to Sections 3 and 4.

All references to divisions are major divisions.

+

VERTICAL AMPLIFIER			
1.1	Characteristic	Performance Requirement	Supplemental Information
<u>Deflection Factor</u>	Ch 1 and 2	10 mv/div to 20 v/div in 1-2-5 sequence	
	Ch 2 only, X10	1 mv/div to 2 v/div	
	<u>Accuracy</u>		
<u>Risetime</u>	Ch 1 and Ch 2 X1	$\pm 3\% \pm \text{cal. Tolerance}$	Set on internal calibrator
	Ch 2 X10	$\pm 7.5\%$	
<u>Frequency Response</u>	Ch 1 and Ch 2 X1	$\leq 23 \text{ nsec}$	
	Ch 2 X10	$\leq 70 \text{ nsec}$	
	DC, X1	DC to $\geq 15 \text{ mc}$ at 30% down	
	AC, X1	30% down $\leq 2 \text{ cps}$ to $\geq 15 \text{ mc}$	
	AC, X10	30% down $\leq 5 \text{ cps}$ to $\geq 5 \text{ mc}$	

+

VERTICAL AMPLIFIER

1.1 Continued

Characteristic	Performance Requirement	Supplemental Information
Variable Range	$\geq 2.5:1$	Extends maximum deflection factor to ≈ 50 v/div, uncalibrated
Signal Delay		≈ 150 nsec
Vertical Trace Drift with Line Voltage Change	≤ 0.4 div, 103.5 v to 126.5 v after 30 seconds	
Deflection Factor Change with Line Voltage Change	$\leq \pm 2\%$ 103.5 v to 126.5 v	
Transient Response Peak-to-Peak	$\leq 3\%$ overshoot, rolloff, ringing, or tilt, with 4-div pulse, centered vertically.	
	$\leq 5\%$ with 8-div pulse centered vertically.	
Linearity (Low Frequency)	≤ 0.2 div expansion or compression with 2 div of deflection	Includes CRT linearity
Common Mode Rejection Ratio	100:1 at 50 kc with optimized setting of GAIN adjustment	≤ 8 -div of 50-kc common-mode signal applied

VERTICAL AMPLIFIER			
1.1 Continued	Characteristic	Performance Requirement	Supplemental Information
	Input R and C (Low Frequency)	1 meg \pm 1% paralleled by \approx 30 pf (both channels matched for \leq 1% difference in time constant with same probe)	
	Position Range	\geq 2.5 screen diameters (20 div)	
	Trace Drift with Time	\leq 1 div in 24 hours after 20-minute warm-up	
	Input Grid Current	\leq 2 namps (0.2 div at 10 mv/div)	
	Attenuator Isolation	\geq 100,000:1 (50-volt pulse into one attenuator produces \leq 0.5 mv signal in other channel)	
	Maximum Input Voltage		300 volts dc + peak ac
	Chop Repetition Rate	100 kc \pm 20%	
	Vertical Input Characteristics with P6006 Probe		
	Attenuation Ratio		10:1
	Input R & C		10 meg, 8 pf
	Risetime	\leq 24 nsec	
	Transient Response	\leq 3% additional overshoot, rolloff, ringing, or tilt	
	High-Frequency Response	\geq 15 mc at 30% down	
	Low-Frequency Response	\leq 0.2 cps at 30% down	
	Maximum Input Voltage		600 volts dc + peak ac

HORIZONTAL AMPLIFIER and SWEEP			
1.1 Continued	Characteristic	Performance Requirement	Supplemental Information
<u>Time/div Range</u> Switch Positions			0.5 μ sec/div to 0.5 sec/div in 1, 2, 5 sequence
	Accuracy	$\pm 3\%$ Normal $\pm 5\%$ X10 Magnified	
	Normal/Magnifier Registration	± 0.2 div	
	Variable	$\geq 2.5:1$	Extends slowest sweep to ≈ 1.25 sec/div
<u>Expanded Sweep Linearity</u>		$\pm 1\%$ all sweep rates except 50 nsec/div $\pm 3\%$ at 50 nsec/div sweep rate after 1st 1% (1 div) of sweep	
<u>Sweep Expansion</u>			X10 with push-pull switch
<u>External Horizontal Amplifier</u>			
<u>Deflection Factor</u>			≈ 10 v/div - MAG in X1 ≈ 1 v/div - MAG in X10
<u>Bandwidth</u>		≥ 500 kc at 30% down	MAG in X10
<u>Variable Attenuator</u>		$\geq 10:1$ range	
<u>Trigger Sensitivity</u>			
<u>INT</u> DC AC AUTO AC LF REJ	DC	0.2 div up to 5 mc increasing to 1.0 div at 15 mc	
	AC	Same as DC except sensitivity decreases below 50 cycles	Low frequency response 30% down at ≈ 25 cps
	AUTO	0.8 div from 50 cps to 4 mc increasing to 2.5 div at 15 mc	
	AC LF REJ	Same as DC except sensitivity decreases below 50 kc	Low frequency response 30% down at ≈ 25 kc

TRIGGERS

1.1 Continued

Characteristic	Performance Requirement	Supplemental Information
Trigger Sensitivity (Cont.)		
DC	125 mv up to 5 mc increasing to 0.6 v at 15 mc	
AC	Same as DC except sensitivity decreases below 50 cycles	Low frequency response 30% down at \approx 25 cps
AUTO	0.6 v from 50 cps to 7 mc increasing to 1.2 v at 15 mc	
AC LF REJ	Same as DC except sensitivity decreases below 50 kc	Low frequency response 30% down at \approx 25 kc
AUTO Repetition Rate	Sweep free runs with no trigger	40 to 50 cps

CALIBRATOR

Voltage Accuracy		
Front-Panel Jack	$\pm 2.7\%$ @ 25°C ambient $\pm 3.6\%$ @ -15°C to +50°C	2 volts to Probe Cal jack on front panel (0.2 v internal)
Internal	$\pm 0.7\%$ @ 25°C ambient $\pm 1.6\%$ @ -15°C to +50°C	\approx 2 k output resistance
Repetition Rate	1 kc $\pm 20\%$	
Duty Cycle	45% to 55%	

CRT DISPLAY

Graticule Area		8 X 10 div @ 0.32 in/div Internal illuminated
Geometry	Trace orthogonality 90° ± 0.14 div	
External Blanking	+2 volts completely blanks CRT	Input resistance is \approx 235 Ω
Tube Type		T4220-31-1
Accelerating Voltage		\approx 6 kv

1.1 Continued			
CRT DISPLAY			
Characteristic	Performance Requirement	Supplemental Information	
Gun Voltage (CRT grid to ground)	1400 volts $\pm 5\%$	Measured across V829	
Trace Alignment Range	$\geq 4^\circ$ (additional 4° by reversing leads)		
OUTPUT SIGNAL			
Sweep Gate Out	≥ 0.5 volt rectangular pulse, negative going	$\approx 800 \Omega$ source resistance	
POWER SOURCE			
Input Voltage	115 vac $\pm 10\%$, 50 cps to 400 cps $\pm 10\%$ Sine wave $\leq 1\%$ distortion	Can be connected for: 105 vac $\pm 10\%$, 115 vac $\pm 10\%$, 125 vac $\pm 10\%$, 210 vac $\pm 10\%$, 230 vac $\pm 10\%$, 250 vac $\pm 10\%$	
Power Consumption		40 watts, maximum	
POWER SUPPLIES			
Tolerance (Type 'A' Supply only)	-81v	-12v +20v +55v +95v	+55v and +95v are low line measurements
	$\pm 1.2\%$	Adj. $\pm 2\%$ $\pm 7\%$ Unreg Unreg	-12v supply is adjusted within 1%
Ripple (peak-to-peak) Line Frequency HF Chopper	2 mv	1 mv 1 mv 1 mv 2.5 v 3.5 v	Chopper Repetition Rate 15 kc - 25 kc
		15 mv 10 mv	

1.2 Environmental Characteristics

The Type 422 is an environmental instrument. Only the following environmental limits are applicable.

1.2.1 Storage

No visible damage or electrical malfunction after storage at -55°C to $+75^{\circ}\text{C}$ 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 $+55^{\circ}\text{C}$ 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.

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 Shock

Nonoperating

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

1.2.6 Radio Frequency Interference

The instrument will perform to limits indicated in Section 4.6

1.2.7 Transportation

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

**Change Notice, 11-8-65*

SECTION 2

2.0 Miscellaneous Information

2.1 Ventilation

Safe operating temperature is maintained by convection cooling. Thermal cutout protects instrument from overheating.

2.2 Finish

Front panel has an anodized finish; the cabinet is finished in a blue vinyl paint.

2.3 Maximum Overall Dimensions

6.75" X 10.0" X 17.8" (main box, power supply, panel cover and handle). Power supply with batteries approximately 2.5" longer.

2.4 Weight

20 lbs., 3 oz. maximum (not including accessories, but including panel cover).

2.5 Connectors

TRIG IN, EXT BLANKING, GATE OUT, INPUT 1 and INPUT 2 are BNC type. 2 VOLT PROBE CALIBRATOR is tip jack.

2.6 Warm-up Time

Twenty minutes for rated accuracies at 25°C ±5°C.

2.7 Accessories

1	161-024	Line Cord
1	378-549	Light Filter
2	010-127	P6006 Probes
1	012-084	BNC to BNC Patch Cord
1	012-088	BNC to Banana Patch Cord
1	012-092	BNC Jack Post
1	103-013	3-Wire to 2-Wire Adapter
2	070-434	Manuals

2.8 Power Supplies

Type 'A' Supply AC line only

Type 'B' Supply AC line (battery trickle charge)
Internal Battery Operation

(Note: There will be a separate Specification for Type 'B' supply.) External DC (no battery charge)
Battery Charge (line, fast charging batteries, no operation) Note: The electrical test methods (Section 3) are for the Type 'A' supply only.

Front panel power lamp blinks when Internal or External DC supplies are below operating levels.



SECTION 3

3.0 Electrical Test Methods

3.1 Vertical Amplifier

3.1.1 Volts/div Accuracy

VARIABLE VOLTS/DIV is set to calibrated position. VOLTS/DIV error is measured as the percentage of deviation from correct amplitude (as indicated by input signal amplitude and VOLTS/DIV setting). A Precision 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.

3.1.2 Risetime

Risetime is measured using a pulse from a TU-5. Risetime is the time interval between the 10% and 90% amplitude points on the leading edge of the pulse. Using a 4-division pulse centered vertically, measure the time interval between the 10% and 90% points. 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.

3.1.3 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 display at 0.05 volt/div. Increase the frequency until 2.8 divisions of signal are observed. To check the low-frequency bandpass 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.

3.1.4 Variable Range

VARIABLE range is checked by applying exactly 5 divisions of signal from a Type 105. Turning the VARIABLE VOLTS/DIV control fully counterclockwise, will result in less than 2 divisions of display.

3.1.5 Deflection Factor Change with Line Voltage Change

Vertical Amplifier deflection factor change with line voltage change is checked by observing change in gain with a change in line voltage. Obtain exactly 5 divisions of deflection of a 1-kc signal at 115 vac (design-center) line voltage. With the line voltage varying between the specified limits (103.5 v and 126.5 v), deflection factor change is expressed as a percentage of 5 divisions.

3.1.6 Transient Response

Transient response is measured with the same setup used for risetime, (3-1-2). Transient response is calculated by measuring the maximum peak-to-peak pulse aberration in the form of overshoot, rolloff, ringing, or tilt along the entire pulse top, expressed in percentage of pulse amplitude.

3.1.7 Linearity (Low Frequency)

Linearity is measured using the 2-volt Calibrator signal into Ch 1. Obtain 2 divisions of deflection, centered vertically on the graticule. Positioning the display vertically + and - 3 divisions from center, linearity is the maximum change in pulse amplitude occurring at either defined limit.

3.1.8 Common Mode Rejection Ratio

Common mode rejection ratio is measured by applying a 50-kc signal from a Type 190B to Ch 1 and Ch 2 simultaneously. Adjust the respective gains until 8 divisions of display is obtained in both channels. Set Ch 2 to inverted with the PULL TO INVERT switch and set the channel selector to ALG ADD. The display should not exceed 0.08 div.

3.1.9 Input R and C

Input resistance is the resistance of the 1-meg input resistor. To adjust input capacitance, set C12 to midrange and connect a 10X probe between INPUT 1 and a calibrator signal. Compensate the probe for optimum square-wave response. Then connect the probe to INPUT 2 and adjust C112 so that the display is within 1% overshoot or rolloff of the Ch 1 display.

3.1.10 Position Range

Position range is checked by applying a 2-volt signal from the Calibrator to INPUT 1 through a 1X probe, ac-coupled, at 0.1 volt/div. (Note: Be sure the DC BAL control is properly adjusted). Turn the Vertical Position control counterclockwise; the top of the display should position below graticule center. Then turn the Vertical Position control clockwise; the bottom of the display should position above graticule center.

3.1.11 Input Grid Current

Input grid current is checked at 0.01 volt/div. 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-meg input resistance to determine grid current.

3.1.12 Attenuator Isolation

Attenuator isolation is checked by applying a 50-volt pulse from the Precision Square Wave Calibrator to Ch 1 with the deflection factor at 20 volt/div. Less than 0.5 mv will be produced in Ch 2. Ch 2 is checked in a similar manner.

3.1.13 Chopped Repetition Rate

Chopped repetition rate is checked by setting the sweep rate to 2 μ sec and the input selector switch to CHOPPED. Obtain 2 divisions of triggered display using the INPUT 1 and INPUT 2 POSITION controls. Check for one cycle $\pm 20\%$ of the chopped waveform for 5 divisions of calibrated sweep.

3.2 Horizontal Amplifier and Sweep

3.2.1 Accuracy

Sweep accuracy is determined by applying time markers from a Type 180A to a vertical input connector. 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 μ sec/div range where a 1- μ sec 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 marker from the 9th graticule line, expressed as a percentage of 8 divisions.

3.2.2 Sweep/Magnifier Registration

Magnifier registration is adjusted and checked by applying 5-msec markers from a Type 180A to a vertical input connector with the Time/div switch at 1 msec/div and the Mag in X10. Horizontally position the expanded sweep so that the middle 5-msec marker falls behind the center vertical graticule line. Change Mag to X1 and adjust R535 (MAG REGISTER) so that the middle 5-msec marker again falls behind the center vertical graticule line.

3.2.3 Expanded Sweep Linearity (Mag on)

Expanded sweep linearity is checked at two sweep rates. At a sweep rate of 1 msec/div, apply 1 msec, 5 msec, and 100 μ sec markers from a Type 180A to the vertical input connector. Position the 2nd marker behind the 1st graticule line and the 10th marker behind the 9th graticule line. 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. Note any displacement of the markers from their respective graticule line. 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 line. 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. Apply 10 mc from the Type 180A to the vertical input connector. Change the sweep rate to 0.5 μ sec/div. Excluding the 1st 1% of sweep (1 division), position the 2nd cycle behind the 1st graticule line and the 6th cycle behind the 9th graticule line. Note any displacement of the 3rd, 4th, and 5th cycles from their respective graticule line. Horizontal linearity is defined as the displacement of any marker from any graticule line, expressed as a percentage of 8 divisions.

3.3 External Horizontal Amplifier

3.3.1 High-Frequency Response

To check the high-frequency response of the external horizontal amplifier, set the TIME/DIV switch to EXT HORIZ, pull out the X10 MAG switch, and apply a 50-kc reference signal from a Type 190B to the HORIZ IN connector. Adjust the Type 190B output amplitude for 6 divisions of horizontal deflection. Then increase the frequency of the Type 190B signal until the deflection decreases to 4.2 divisions. Note the frequency.

3.3.2 External Horizontal Variable Attenuator

The 10:1 ratio of the variable attenuator is checked by applying a 10-volt signal from the Precision Square Wave Calibrator with the Mag at X10, and noting the deflection. Turn the HORIZ ATTEN full counterclockwise and increase the output of the precision calibrator to 100 volts. The horizontal deflection should be equal to or less than the previously noted display.

3.4 Triggers

3.4.1 Internal Triggering

Internal triggering is checked by applying a signal from the Type 190B to the vertical input connector. Amplitude of the Type 190B is decreased until a minimum stable display is obtained with an adjustment of the LEVEL control.

3.4.2 External Triggering

External triggering is checked with the same setup as internal triggering (3.4.1) with the exception that the Type 190B is applied to the TRIG IN connector as well as the vertical input connector.

3.5 Calibrator

3.5.1 Accuracy

The Calibrator is adjusted internally by applying a 0.2-volt square wave from a precision (0.25%) mixing-type voltage calibrator. The Calibrator output accuracy is checked by applying the 2-volt output to the precision mixing-type calibrator set at the 2-volt range. The deviation must not exceed 2.5% for the Calibrator to remain within its 2.7% performance requirement.

3.5.2 Repetition Rate

The repetition rate of the Calibrator is measured by displaying one cycle of the Calibrator waveform on an oscilloscope and measuring the period of one cycle. The repetition rate is the reciprocal of the period for one cycle.

3.5.3 Duty Cycle

The duty cycle is determined by displaying one cycle of Calibrator signal over 8 divisions horizontally, adjusted with VARIABLE TIME/DIV control if necessary. The positive half cycle must occupy between 4.6 and 5.4 divisions.

3.6 CRT Display

3.6.1 Geometry

Vertical geometry is checked by applying 1-msec and 100- μ sec markers from a Type 180A to a 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- μ sec markers will be 0.1 division apart. Position a 100- μ sec marker to the bottom of a vertical graticule line. The adjacent 100- μ sec markers must not cross the top of the same vertical graticule line. Horizontal geometry 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.

3.6.2 Orthogonality

Orthogonality is checked by aligning a free-running sweep trace at 0.5 msec/div horizontally with the trace rotation adjustment and applying 1-msec and 100- μ sec markers from a Type 180A. With a triggered display, adjust the VARIABLE TIME/DIV control so that seven, 1-msec markers occur every 10 divisions. The 100- μ sec markers will now be 0.14 division apart. Position a 100- μ sec marker on the bottom center graticule line. The adjacent 100- μ sec markers must not cross the top center graticule line.

3.6.3 External Blanking

From a Type 105 apply a 2-volt, 1-kc symmetrical square wave through a 105/TU-5 adapter to a vertical input connector. Set the vertical deflection factor to 1 v/div. Set the sweep rate to 1 msec/div and establish a Gnd. reference. Set the input coupling to DC and adjust the 105 amplitude to + 2 divisions. Through a BNC T-connector, apply this signal, terminated in 50 Ω , to the EXT BLANKING connector. The positive half cycle of the square waves should be blanked at normal intensity.

3.6.4 Gun Voltage

Gun voltage is measured using a calibrated 20k Ω /volt voltmeter ($\pm 3\%$) across V829.

3.7 Output Signals

3.7.1 Sweep Gate Out

Sweep gate out is measured using the test oscilloscope.

3.8 Power Supplies

3.8.1 DC Regulation

DC regulation is checked by using a John Fluke Type 801 differential voltmeter.

3.8.2 Ripple

Ripple is measured with an oscilloscope having a vertical deflection factor of 0.005 volt/div and a 1X probe.

SECTION 4

4.0 Environmental Test Methods

4.1 Temperature

4.1.1 Nonoperating

Store at -55°C for 4 hours at $+75^{\circ}\text{C}$ 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 $+55^{\circ}\text{C}$ 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

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

Operating

All instruments must be within their 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 422 must meet its electrical performance requirements before and after the 50,000 feet storage test.

Operating

The Type 422 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 Perform 5 cycles (120 hours) of Mil-Std-202B, Method 106A. Front cover must be in place. Delete freezing and vibration. Allow to dry for 24 hours at 40°C, 20% to 80% 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 422 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 Nonoperating

Perform resonant searches along all 3 axes at 0.030" total displacement from 10-55 cps. All major resonances should be above 55 cps.

4.4.2 Operating

Vibrate for 15 minutes along each of the 3 axes at $0.025'' \pm 0.003''$ 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.

4.4.3 Failure Criteria

Nonoperating

Broken leads, chassis, or other components, loose parts, excessive wear or component fatigue. Change in value of any component outside of its normal rated tolerance. Deformation which interferes with the normal mechanical function.

4.5 Shock

4.5.1 Nonoperating

Subject the completed product to a "guillotine" type shock of 60 g's, $\frac{1}{2}$ sine, nominal 11-ms duration. One shock to be applied in each direction along each of the 3 major axes for a total of 6 shocks.

4.5.2 Operating

- * Apply 2 shocks of 30 g's, $\frac{1}{2}$ sine and 11-ms duration along each direction of the 3 major axes. Total number of shocks = 12.

4.5.3 Failure Criteria

Nonoperating

Cracked or broken chassis components or leads or deformed chassis and components or deformation which interferes with the normal mechanical function. Failure of active components will not be permitted. The instrument and its components must remain with their rated electrical performance requirements before and after shock.

4.6 Radio Frequency Interference

4.6.1 Operating

Use the test set-up procedures and limits described in specification Mil-I-6181D and Mil-I-16910 A, Paragraph 3.6.1.1.5.1. The tests will be performed within an electrically shielded enclosure. The instrument must be equipped with a CRT face-plate shield. RFI will be checked over the following minimum frequency range:

Radiated Interference - from the instrument under test
14 kc to 1000 mc.

Conducted Interference - from the instrument under test
150 kc to 25 mc.

4.6.2 Failure Criteria

Radiated and Conducted Broadband

The instrument shall not exceed the limits described in Mil-I-6181D.

4.7 Transportation

The instrument when packaged must meet the National Safe Transit type of test.

4.7.1 Package Shake

1 hour on the vibration platform with an amplitude slightly in excess of 1 g and causing the package to just leave the vibration surfaces.

*Change Notice, 11-8-65

4.7.2 Failure Criteria

The unit must meet its electrical performance requirements before and after the transportation test. There must be no serious damage such as broken components, leads or chassis and no deformation which interferes with normal mechanical function will not be permitted.

4.7.3 Package Drop Test

Drop from a height of 30 inches on corners, edges, and flat surfaces.

4.7.4 Failure Criteria

The unit must meet its electrical performance requirements before and after the transportation tests. There must be no serious damage such as broken components, leads or chassis and no deformation which interferes with normal mechanical function will not be permitted.

**ENGINEERING
INSTRUMENT SPECIFICATION**

TYPE 422
OSCILLOSCOPE
AC-DC SUPPLY

**FOR INTERNAL USE ONLY
TEKTRONIX, INC.**

Specification 123

March 10, 1965

ENGINEERING
INSTRUMENT SPECIFICATION
TYPE 422
OSCILLOSCOPE
AC-DC SUPPLY

Prepared by Technical Writing Dept.

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INTRODUCTION

This is the Instrument Specification of the Type 422 Oscilloscope with the AC-DC power supply, and is the reference document for all company activity concerning performance requirements. This specification is for internal use only. It replaces the rough draft of the Type 422 AC-DC Instrument Specification dated December 31, 1964.

General Information

The Type 422 is a dual-channel, 15-mc, portable oscilloscope. It has been designed and tested to meet Tektronix environmental instrument requirements. It may be operated from line voltage, internal re-chargeable batteries, or from an external DC power source.

The dual-channel vertical amplifier offers eleven calibrated Volts/div steps from 0.01 v/div to 20 v/div in a 1-2-5 sequence. X10 AC Gain extends the Ch 2 deflection factor to 1 mv/div. Ch 2 has provision for signal inversion.

The Type 422 has calibrated sweep rates from 0.5 sec/div to 0.5 μ sec/div extended to 0.05 μ sec/div with the X10 Magnifier.

Triggering sources are Ch 1 & 2, Ch 1 only, and External. Trigger coupling available is AC, AC LF Reject, and DC. The Type 422 incorporates automatic triggering (AC coupled only) and normal triggering modes.

Characteristics Summary

(All references to divisions are major divisions.)

Vertical Deflection

Frequency Response	
DC, X1	≥ 15 mc
AC, X1	≤ 2 cps to ≥ 15 mc
AC, X10	≤ 5 cps to ≥ 5 mc
Signal Delay	150 nSec
Calibrated Scan	8 divisions

Horizontal Deflection

Time/div Range	0.5 sec/div to 0.5 μ sec/div
Variable	2.5:1
Trigger Modes	DC, AC, AC LF Reject, Automatic
Trigger Slope	+ or -
Trigger Source	Ch 1 & 2, Ch 1, External
Sweep Magnification	X10 (extends sweep rate to 0.05 μ sec/div)

External Horizontal Amplifier Deflection Factor	10 v/div - Mag in X1 1 v/div - Mag in X10
Frequency Response Variable Attenuator	DC to \geq 500 kc (Mag in X10) 10:1 range
Amplitude Calibrator Voltage Output	2 volt External 0.2 volt Internal
Output Signal Amplitude Gate Out	0.5 volt from a 600 Ω source, negative going
CRT Circuit Tube Type Accelerating Potential Internal Graticule	T4220-31-1 6 kv Illuminated, 8 X 10 div 1 div = 0.8 cm
Power Source AC	115 vac \pm 20%, 45 to 440 cps (Line voltage derated to +10%, -20% at 45 cps operation) Can be connected for 230 vac \pm 20%
DC External DC Internal	11.5 v to 35 v dc, 25 Watts 24 v Battery (re-chargeable) \approx 4 hours running time
Environment (without Batteries) Storage Operating Temperature Operating Altitude	-55°C to +75°C, to 50,000 feet -15°C to +55°C to 15,000 feet
Environment (with Batteries) Storage Operating Temperature Operating Altitude	-40°C to +60°C -5°C to +40°C (charge) -15°C to +40°C (discharge) to 15,000 feet
Overall Dimensions	6.75"H X 10.0"W X 20.7"L (panel cover and handle in carrying position)
Weight (with panel cover and accessories) With Batteries Without Batteries	\approx 29 lbs 12 oz \approx 21 lbs 14 oz

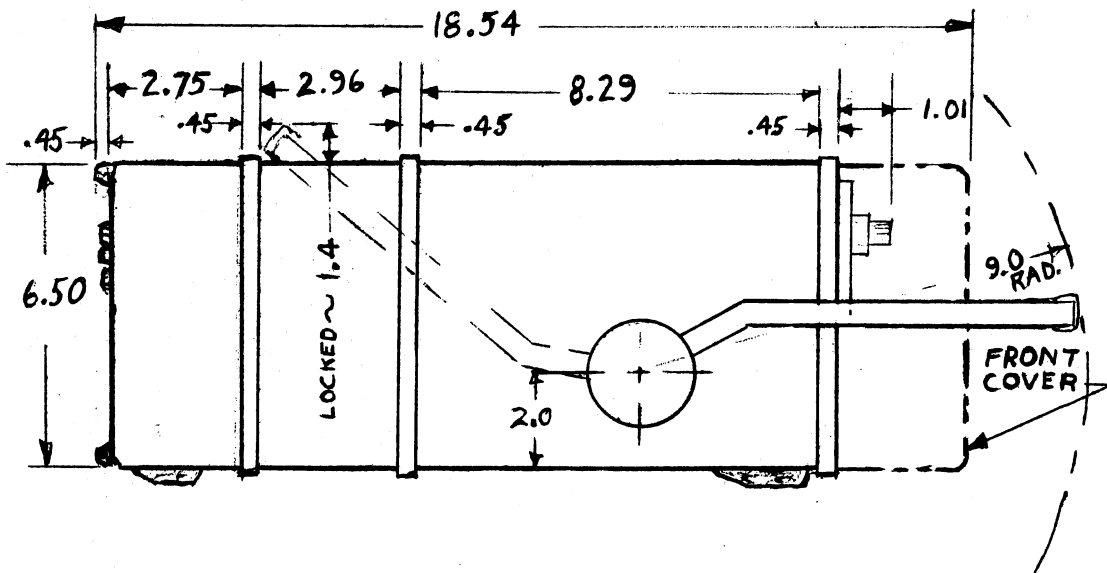


Fig. 1

Type 422 with AC-DC Supply

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. |
| T (Traceable) | Traceable to the National Bureau of Standards, to the limit of the Bureau's calibration facilities. |
| N (Nontraceable) | Cannot be traced to the National Bureau of Standards. |

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.

1.1 Continued		VERTICAL AMPLIFIER	
Characteristic	Performance Requirement	Code	Supplemental Information
<u>Deflection Factor</u>			
Ch 1 and 2	10 mv/div to 20 v/div in 1-2-5 sequence	GA-T	
Ch 2 only, X10	1 mv/div to 2 v/div	GA-T	
<u>Accuracy</u>			
Ch 1 and Ch 2 X1	± 3%	GA-T	Set on internal calibrator
Ch 2 X10	± 7.5%	GA-T	
<u>Frequency Response</u>			
DC, X1	DC to ≥ 15 mc at 30% down	GA-N	
AC, X1	30% down ≤ 2 cps to ≥ 15 mc	GS-N	
AC, X10	30% down ≤ 5 cps to ≥ 5 mc	GA-N	
<u>Gain Control Range</u>	+10%, -5% of calibrated setting	IA-T	
<u>Variable Range</u>	≥ 2.5:1	GA-T	Extends maximum deflection factor to ≈ 50 v/div, uncalibrated
<u>Signal Delay</u>			≈ 150 nsec
<u>Transient Response</u>	≤ 3% overshoot, rolloff, ringing, or tilt, with 4-div pulse, centered vertically.	IA-T	
	≤ 5% with 8-div pulse centered vertically.	IA-T	
<u>Linearity (Low Frequency)</u>	≤ 0.2 div expansion or compression with 2 div of deflection	GA-T	Includes CRT linearity

See page 1-1 for coding legend

VERTICAL AMPLIFIER				
1.1 Continued	Characteristic	Performance Requirement	Code	Supplemental Information
	Common Mode Rejection Ratio	$\geq 100:1$ at 50 kc with optimized setting of GAIN adjustment (Ch 1, Ch 2 centered vertically)	GA-T	8 div or less of 50-kc common mode signal applied
	Input R (Low Frequency)	1 meg \pm 2%. Both channels matched for $\leq 1\%$ difference in time constant with same probe.	GA-T	Input C \approx 30 pf
	Position Range	≥ 20 divisions	GA-T	
	Trace Drift with Time	≤ 1 div in 24 hours after 20-minute warm-up at 10 mv/div	GS-T	
	Input Grid Current	≤ 2 namps (0.2 div at 10 mv/div)	GA-N	
	Attenuator Isolation	$\geq 100,000:1$ (50-volt pulse into one attenuator produces ≤ 0.5 mv signal in other channel)	GA-N	
	Maximum Input Voltage			300 volts combined DC + peak AC
	Chop Repetition Rate	100 kc \pm 20%	GA-T	
	Vertical Input Characteristics with P6006 Probe			
	Attenuation Ratio			10:1
	Input R & C			10 meg, 8 pf Typical
	Transient Response	$\leq 3\%$ additional overshoot, rolloff, ringing, or tilt	IS-N	
	Frequency Response	DC to ≥ 15 mc at 30% down	GS-N	
	Maximum Input Voltage			600 volts combined DC + peak AC

1.1 Continued		HORIZONTAL AMPLIFIER and SWEEP	
Characteristic	Performance Requirement	Code	Supplemental Information
Time/div			
Switch Positions	0.5 μ sec/div to 0.5 sec/div in 1-2-5 sequence	GA-T	
Accuracy	$\pm 3\%$ Normal $\pm 5\%$ X10 Magnified	GA-T	
Normal/Magnified Registration	± 0.2 div	GA-N	
Variable	$\geq 2.5:1$	GA-T	Extends slowest sweep to ≈ 1.25 sec/div
Magnified Sweep Linearity	$\pm 1\%$ all sweep rates except 50 nsec/div; $\pm 3\%$ at 50 nsec/div sweep rate after 1st 1% (1 div) of sweep	GA-T	
Magnified Sweep Expansion Factor	X10		
External Horizontal Amplifier			
Deflection Factor	10 v/div $\pm 25\%$ - Mag in X1 1 v/div $\pm 25\%$ - Mag in X10	GA-T	
Bandwidth	≥ 500 kc at 30% down	GA-N	MAG in X10
Variable Attenuator	$\geq 10:1$ range	GA-T	
Input R and C			≈ 300 k paralleled by ≈ 30 pf
Sweep Length	10.4 to 12.1 divisions	GA-T	

See page 1-1 for coding legend

TRIGGERS				
1.1 Continued		Performance Requirement	Code	Supplemental Information
Characteristic	Trigger Sensitivity			
Int	DC	0.2 div DC to 5 mc increasing to 1.0 div at 15 mc	GA-T	
	AC	0.2 div, 50 cps to 5 mc increasing to 1.0 div at 15 mc	GS-T	Low frequency response 30% down at \approx 25 cps
	AUTO	0.8 div from 50 cps to 4 mc increasing to 2.5 div at 15 mc	GA-T	
	AC LF Rej	0.2 div, 50 kc to 5 mc increasing to 1.0 div at 15 mc	GS-T	Low frequency response 30% down at \approx 25 kc
AUTO	DC	125 mv DC to 5 mc increasing to 0.6 v at 15 mc	GA-T	Max input \pm 100 v rms \pm 250 v peak
	AC	125 mv, 50 cps to 5 mc increasing to 0.6 v at 15 mc	GS-T	Max input DC component \leq \pm 250 v AC component \leq 100 v rms Low frequency response 30% down at \approx 25 cps
	AUTO	0.6 v from 50 cps to 7 mc increasing to 1.2 v at 15 mc	GA-T	
	AC LF Rej	125 mv, 50 kc to 50 mc increasing to 0.6 v at 15 mc	GS-T	Max input DC component \leq \pm 250 v AC component \leq 100 v rms Low frequency response 30% down at \approx 25 kc
AUTO repetition Rate		40 cps to 50 cps	GA-T	

See page 1-1 for coding legend

1.1 Continued

CALIBRATOR

Characteristic	Performance Requirement	Code	Supplemental Information
Voltage Accuracy			
Front-Panel Jack	$\pm 2.7\%$ @ 25°C ambient	GA-T	2 volts to Probe Cal jack on front panel. $\approx 2 \text{ k}\Omega$ output resistance. (0.2 v internal)
Internal	$\pm 0.7\%$ @ 25°C ambient	GA-T	
Repetition Rate			
	1 kc $\pm 20\%$	GA-T	
Duty Cycle			
	45% to 55%	GA-T	
CRT DISPLAY			
Graticule			
			8 X 10 div, 1 div = 0.8 cm Internal, illuminated
Geometry			
Raster Distortion	± 0.1 div horizontal and vertical	GA-N	
Orthogonality	$90^\circ \pm 1^\circ$	GA-N	
External Blanking	+ 2 volts completely blanks CRT	GA-T	Input resistance is $\approx 235\Omega$
Tube Type			T4220-31-1
Accelerating Voltage			$\approx 6 \text{ kv}$
Gun Supply Voltage	1400 volts $\pm 5\%$	GA-N	Measured @ Pin 3 to Gnd.
Trace Alignment Range	$\geq 4^\circ$ (additional 4° by reversing leads)	GA-T	
OUTPUT SIGNAL			
Sweep Gate Out	≥ 0.5 volt rectangular pulse, negative going	GA-T	$\approx 600\Omega$ source resistance

See page 1-1 for coding legend

POWER SOURCE			
1.1 Continued	Characteristic	Performance Requirement	Code
Input Voltage	AC	115 vac $\pm 20\%$ or 230 vac $\pm 20\%$ (50 cps to 45 cps derate linearly the upper limit $\pm 10\%$ at 45 cps)	GA-T
	DC	50 cps to 440 cps; Sinewave distortion $\leq 1\%$	GS-T
	External	11.2 to 35 v dc @ P 1000	GA-T
	Internal	20 Nickle Cadmium (1.2 v/cell)	
Power Input	AC		
	DC		
	Chassis to Ext Power Source Potential	± 200 v max (Ext DC input only)	GS-N
Battery Charge		115 $\pm 10\%$, -20% , 45 cps to 440 cps	GS-T
			Supplemental Information
			≈ 0.3 v drop on line cord provided
			Front panel power lamp blinks when Internal battery is nearly discharged
			Typical 27 Watts Power input remains \approx constant at all input voltages
			Typical 23 Watts measured from chassis to power source

See page 1-1 for coding legend

POWER SUPPLY

1.1 Continued

Characteristic	Performance Requirement		Code	Supplemental Information
	Regulation	Ripple (Max p-p at 60cps line)		
Voltages		Line 8 kc		
-81	± 1.2%	2 mv	GA-T	
-110	± 3%	-- 0.5 v	GA-T	
-12	± 1% Adj	8 mv 20 mv	GA-T	-12 v is adjusted within ± 1%
+12	± 2%	8 mv 20 mv	GA-T	
+20	± 7%	2 mv --	GA-T	
+55	± 2%	-- 0.6 v	GA-T	
+95	± 2%	-- 0.8 v	GA-T	

#

#

See page 1-1 for coding legend

1.2 Environmental Characteristics

The 422 with AC-DC power supply is an environmental instrument. The following environmental limits are applicable.

1.2.1 Storage (without batteries)

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

Storage (with batteries)

No visible damage or electrical malfunction after storage at -40°C to $+60^{\circ}\text{C}$ and 50,000 feet, as described in Section 4.

1.2.2 Temperature (without batteries)

The instrument will perform to limits indicated in Section 1.1 over a range from -15°C to $+55^{\circ}\text{C}$ when tested according to Section 4.

Temperature (with batteries)

Charge temperature range: -5°C to $+40^{\circ}\text{C}$.
Discharge temperature range: -15°C to $+40^{\circ}\text{C}$.

1.2.3 Altitude (with or without batteries)

The instrument will perform to limits indicated in Section 1.1 to 15,000 feet.

1.2.4 Humidity (with or without batteries)

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

1.2.5 Vibration (with or without batteries)

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

1.2.6 Shock (with or without batteries)

Nonoperating

Sixty g's one-half sine, 11 millisecond duration along each major axes. One shock each direction for a total of 6 shocks.

Operating

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

1.2.6 Radio Frequency Interference

The instrument will perform to limits indicated in Section 4.

1.2.7 Transportation

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

SECTION 2

2.0 Miscellaneous Information

2.1 Ventilation

Safe operating temperature is maintained by convection cooling. Thermal cutout protects instrument from overheating at $\approx + 57^{\circ}\text{C}$ ambient (internal temperature $+ 70^{\circ}\text{C}$).

2.2 Finish

Front panel has an anodized finish; the cabinet is finished in a blue vinyl paint.

2.3 Maximum Overall Dimensions

6.75"H X 10.0"W X 20.7"L (panel cover and handle)

2.4 Weight

With batteries, panel cover and accessories ≈ 29 lbs 12 oz
Without batteries ≈ 21 lbs 14 oz

2.5 Connectors

TRIG IN, EXT BLANKING, GATE OUT, INPUT 1 and INPUT 2 are BNC type.
2 VOLT PROBE CALIBRATOR is tip jack.

2.6 Warm-up Time

Twenty minutes for rated accuracies.

2.7 Accessories

2	070-0471-00	Instruction Manual
2	010-0127-00	P6006 Probe
1	012-0084-00	Patch Cord, BNC to BNC
1	103-0033-00	Adapter, BNC to Binding Post
1	354-0248-00	Ring, Ornamental
1	378-0549-00	Filter, Light, Graticule, Smoke, Gray
1	386-0118-00	Plate, Protector, Clear, CRT
1	103-0013-00	Adapter, 3 Wire to 2 Wire
1	161-0015-00	Power Cord, 3 Wire AC w/Female Conn. and Male Plug
1	161-0016-00	Power Cord, 3 Wire DC w/Female Conn.
1	016-0066-00	Battery Pack

2.8 Power Supply

Mode Switch Functions

230 vac Charge Bat.	Battery full charge, no operation
230 vac Operate	Normal operation, battery trickle chg.
EXT. DC Operate	Normal operation
INT. BAT Operate	Normal operation
115 vac Operate	Normal operation, battery trickle chg.
115 vac Charge Bat.	Battery full charge, no operation

2.8.1 Battery Operation

The internal battery pack is twenty, 3.5 Amp-hour Nickle Cadmium cells in series.

Continuous operation time on a fully-charged battery pack is approximately 4 hours. When front panel power indicator light blinks indicating battery low voltage limit, operation should be limited to about 15 minutes.

Batteries are charged at a 400 ma constant current rate. Fully discharged, the battery will reach full charge in approximately 12 hours at the 400 ma charge rate. Batteries are trickle charged at a 30 ma constant current rate in the AC operation mode.

Temperature Derating for battery pack

Storage	-40°C to +60°C
Charge	-5°C to +40°C
Discharge	-15°C to +40°C

Note: Deratings are for optimum battery operation, if these limits are exceeded battery life may be shortened.

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. VOLTS/DIV error is measured as the percentage of deviation from correct amplitude (as indicated by input signal amplitude and VOLTS/DIV setting). 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.

3.1.2 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 display at 0.05 volt/div. Increase the frequency until 2.8 divisions of signal are observed. To check the low-frequency bandpass 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.

3.1.3 Gain Control Range

Set the LEVEL control to FREE RUN, sweep rate to 0.1 μ sec/div, Input Selector to Ch 1, deflection factor to CALIBRATE 4 DIVISIONS. Turn the GAIN control fully clockwise from the calibrated setting. The display will exceed 4.4 divisions. Turn the GAIN control counterclockwise and the display will be 3.8 divisions or less. Readjust the GAIN for 4 divisions. Repeat the above for Ch 2.

3.1.4 Variable Range

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

3.1.5 Transient Response

Measured using a 4 div pulse from a TU-5 centered vertically. Transient response is calculated 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.

3.1.6 Linearity (Low Frequency)

Linearity is measured using the 2-volt Calibrator signal into the Ch 1 vertical input connector. Obtain 2 divisions of deflection, centered vertically on the graticule. Positioning the display vertically + and - 3 divisions from center, linearity is the maximum change in pulse amplitude occurring at either defined limit.

3.1.7 Common Mode Rejection Ratio

Common mode rejection ratio is measured by applying a 50-kc signal from a Type 190B to Ch 1 and Ch 2 simultaneously. Adjust the respective gains until 8 divisions of display is obtained in both channels. Set Ch 2 to inverted with the PULL TO INVERT switch and set the channel selector to ALG ADD. The display should not exceed 0.08 div.

3.1.8 Input R and C

Input resistance is the resistance of the 1-meg input resistor, measured using a 0.25% resistance bridge.

3.1.9 Position Range

Position range is checked by applying a 2-volt signal from the Calibrator to INPUT 1 through a 1X probe, ac-coupled, at 0.1 volt/div. (Note: Be sure the DC BAL control is properly adjusted.) Turn the Vertical Position control counterclockwise; the top of the display should position on or below graticule center. Then turn the Vertical Position control clockwise; the bottom of the display should position on or above graticule center.

3.1.10 Input Grid Current

Input grid current is checked at 0.01 volt/div. 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.

3.1.11 Attenuator Isolation

Attenuator isolation is checked by applying a 100-volt pulse from the Precision Square Wave Calibrator to Ch 1 with the deflection factor at 20 volt/div. No greater than 1 mv will be produced in Ch 2. Ch 2 is checked in a similar manner.

3.1.12 Chopped Repetition Rate

Chopped repetition rate is checked by setting the sweep rate to 2 μ sec and the input selector switch to CHOPPED. Obtain 2 divisions of triggered display using the INPUT 1 and INPUT 2 POSITION controls. Check for one cycle $\pm 20\%$ of the chopped waveform for 5 divisions of calibrated sweep.

3.2 Horizontal Amplifier and Sweep

3.2.1 Accuracy

Sweep accuracy is determined by applying time markers from a Type 180A to a vertical input connector. 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 μ sec/div range where a 1- μ sec 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 lines' respective marker from the 9th graticule line, when the 2nd graticule lines' respective marker is positioned behind the 2nd graticule line, expressed as a percentage of 8 divisions.

3.2.2 Sweep/Magnifier Registration

Magnifier registration is adjusted and checked by applying 5-msec markers from a Type 180A to a vertical input connector with the Time/Div switch a 1 msec/div and the Mag in X10. Horizontally position the expanded sweep so that the middle 5-msec marker falls behind the center vertical graticule line. Change Mag to X1 and adjust R535 (MAG REGISTER) so that the middle 5-msec marker again falls behind the center vertical graticule line.

3.2.3 Magnified 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 μ sec markers from a Type 180A to the vertical input connector. Position the 1st marker behind the 1st graticule line and the 9th marker behind the 9th graticule line. (Markers are numbered 0-1-2-3 ect).

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.

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.

Apply 10 mc from the Type 180A to the vertical input connector. Change the sweep rate to 0.5 μ sec/div. Excluding the 1st 1% of sweep (1 division), position the 2nd cycle behind the 1st graticule line and the 6th cycle behind the 9th graticule lines. Note any displacement of the 3rd, 4th, and 5th cycles from their respective graticule lines.

Horizontal linearity is defined as the displacement of any marker from its graticule line when the sweep is correctly timed, expressed as a percentage of 8 divisions.

3.3 External Horizontal Amplifier

3.3.1 Frequency Response

Set the TIME/DIV switch to EXT HORIZ, pull out the X10 MAG switch and apply a 50-kc reference signal from a Type 190B to the HORIZ IN connector. Adjust the Type 190B output amplitude for 6 divisions of horizontal deflection. Then increase the frequency of the Type 190B signal until the deflection decreases to 4.2 divisions. Note the frequency.

3.3.2 External Horizontal Variable Attenuator Ratio

Checked by applying a 10-volt signal from the Standard Square Wave Calibrator with the Mag at X10, and noting the deflection. Turn the HORIZ ATTEN full counterclockwise and increase the output of the Standard calibrator to 100 volts. The horizontal deflection should be equal to or less than the previously noted display.

3.4 Triggers

3.4.1 Internal Triggering

Checked by applying a signal from the Type 190B to the vertical input connector. Amplitude of the Type 190B is decreased until a minimum stable display is obtained with an adjustment of the LEVEL control. Note display amplitude.

3.4.2 External Triggering

Checked with the same setup as internal triggering (3.4.1) with the exception that the Type 190B is applied to the TRIG IN connector as well as the vertical input connector. Note p-p voltage.

3.5 Calibrator

3.5.1 Accuracy

The Calibrator output accuracy is checked by applying the 2-volt output to the precision mixing-type calibrator set at the 2-volt range. The deviation must not exceed 2.5% for the Calibrator to remain within its 2.7% performance requirement.

3.5.2 Repetition Rate

The repetition rate of the Calibrator is measured by displaying one cycle of the Calibrator waveform on an oscilloscope and measuring the period of one cycle. The repetition rate is the reciprocal of the period for one cycle.

3.5.3 Duty Cycle

The duty cycle is determined by displaying one cycle of Calibrator signal over 8 divisions horizontally, adjusted with VARIABLE TIME/DIV control if necessary. The positive half cycle must occupy between 3.6 and 4.4 divisions.

3.6 CRT Display

3.6.1 Geometry

Vertical geometry is checked by applying 1-msec and 100- μ sec markers from a Type 180A to a 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- μ sec markers will be 0.1 division apart. Position a 100- μ sec marker to the bottom of a vertical graticule line. The adjacent 100- μ sec markers must not cross the top of the same vertical graticule line. Horizontal geometry 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.

3.6.2 Orthogonality

Orthogonality is checked by aligning a free-running sweep trace at 0.5 msec/div horizontally with the trace rotation adjustment and applying 1-msec and 100- μ sec markers from a Type 180A. With a triggered display, adjust the VARIABLE TIME/DIV control so that seven, 1-msec markers occur every 10 divisions. The 100- μ sec markers will now be 0.14 division apart. Position a 100- μ sec marker on the bottom center graticule line. The adjacent 100- μ sec markers must not cross the top center graticule line.

3.6.3 External Blanking

From a Type 105 apply a 2-volt, 1-kc symmetrical square wave through a 105/TU-5 adapter to a vertical input connector. Set the vertical deflection factor to 1 v/div. Set the sweep rate to 1 msec/div and establish a Gnd. reference. Set the input coupling to DC and adjust the 105 amplitude to + 2 divisions. Through a BNC T-connector, apply this signal, terminated in 50 Ω , to the EXT BLANKING connector. The positive half cycle of the square waves should be blanked at normal intensity.

3.6.4 High Voltage

High voltage is measured using a calibrated ($\pm 3\%$) 20k Ω /volt voltmeter across V829.

3.6.5 Trace Rotation Range

Checked by turning the Trace Rotation control fully clockwise. Position the start of a free-running, 1 msec/div trace to the graticule vertical center. Note where the trace intersects the 10th division graticule line below graticule center. Turn the Trace Totation control fully counterclockwise and position the start of the trace to the graticule vertical center. Note where the trace intersects the 10th division graticule line above graticule center. Note the total displacement of the end of sweep.

3.7 Output Signals

3.7.1 Sweep Gate Out

Sweep gate out amplitude is measured using the test oscilloscope.

3.8 Power Supplies

3.8.1 DC Regulation

DC regulation is checked by using a volt meter having an accuracy of 0.1% or better.

3.8.2 Ripple

Ripple is measured with an oscilloscope having a vertical deflection factor of 0.005 volt/div and a 1X probe. When measuring the 120 cps line ripple, disregard the 8 kc ripple.

When measuring the 8 kc ripple, disregard the 120 cps line and measure only the total 8 kc ripple.

3.8.3 Battery Charge

Substitute a bridged, 50- Ω , 10 Watt resistor for the battery pack. Set the POWER MODE switch to 115 VAC CHARGE BAT. position. Measure the voltage drop across the load resistor. To determine charge current divide the measured voltage by the bridged resistance. Repeat the above with the POWER MODE switch in the 115 VAC OPERATE.

Line voltage variations can be made using a Type TU-76.
Line frequency variations can be made using a Tel-Instrument Type 1400-I-HIOS.

SECTION 4

4.0 Environmental Test Methods

4.1 Temperature (see Section 1.2 for temperature ranges with batteries)

4.1.1 Nonoperating

Store at -55°C for 4 hours and at $+75^{\circ}\text{C}$ for 4 hours. Repeat this for a total of 4 cycles.

4.1.2 Operating (without batteries)

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 $+55^{\circ}\text{C}$ with the instrument still operating and held 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 Operating (with batteries)

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 . Turn off instrument and raise the ambient temperature to $+55^{\circ}\text{C}$ and hold for 4 hours. Turn on instrument and after 20 minutes warm-up perform complete electrical checks. Turn off instrument and return to room ambient and after 4 hours, or temperature stabilization, perform complete electrical checks after 20 minute warm-up.

4.1.3 Failure Criteria

Nonoperating

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

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

4.2 Altitude (with or without batteries)

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 (without batteries)

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 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 Operating (with batteries)

The instrument must be maintained at an altitude of 15,000 feet for 4 hours. At the end of this period turn on instrument and allow 20 minutes for warm-up. While the above conditions are maintained, the electrical checks will be 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.

4.2.4 Failure Criteria

Nonoperating

The Type 422 must meet all electrical performance requirements before and after the 50,000 feet storage test.

Operating

The Type 422 must meet all 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 (with or without batteries)

4.3.1 Perform 5 cycles (120 hours) of Mil-Std-202B, Method 106A. (with batt. derate temperature to +60°C.) Front cover must be in place. Delete freezing and vibration. Allow to dry for 24 hours at room conditions (25°C ±5°C, 20% to 80% 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 422 and all components must meet electrical performance requirements before and after the humidity test. Deformation which interferes with normal mechanical function will not be permitted.

4.4 Vibration (with or without batteries)

4.4.1 Nonoperating

Perform resonant searches along all 3 axes at 0.030" total displacement from 10-55 cps. All major resonances should be above 55 cps.

4.4.2 Operating

Vibrate for 15 minutes along each of the 3 axes at $0.025'' \pm 0.003''$ 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.

4.4.3 Failure Criteria

Nonoperating and operating

Broken leads, chassis, or other components, loose parts, excessive wear or component fatigue. Change in value of any component outside of its normal rated tolerance. Deformation which interferes with the normal mechanical function. The instrument must meet electrical performance requirements before and after the vibration test.

4.5 Shock (with or without batteries)

4.5.1 Nonoperating

Subject the instrument to a "guillotine" type shock of 60 g's, $\frac{1}{2}$ sine, nominal 11-ms duration. One shock to be applied in each direction along each of the 3 major axes for a total of 6 shocks.

4.5.2 Operating

*Apply 2 shocks of 30 g's, $\frac{1}{2}$ sine and 11-ms duration along each direction of the 3 major axes. Total number of shocks = 12.

4.5.3 Failure Criteria

Nonoperating and Operating

Cracked or broken chassis components or leads or deformed chassis and components or deformation which interferes with the normal mechanical function. Failure of active components will not be permitted. The instrument and all components must remain within rated electrical performance requirements before and after shock.

4.6 Radio Frequency Interference

4.6.1 Operating

Use the test set-up procedures and limits described in specification Mil-I-6181D and Mil-I-16910A, Paragraph 3.6.1.1.5.1. The tests will be performed within an electrically shielded enclosure. The instrument must be equipped with a CRT mesh filter shield. RFI will be checked over the following minimum frequency range:

Radiated Interference - from the instrument under test 14 kc to 1000 mc

Conducted Interference - from the instrument under test 150 kc to 25 mc both AC and DC inputs

4.6.2 Failure Criteria

Radiated and Conducted Broadband

The instrument shall not exceed the limits described in Mil-I-6181D and Mil-I-16910A

4.7 Transportation (with or without batteries)

The instrument when packaged must meet the National Safe Transit Type of test.

4.7.1 Package Shake

1 hour on the vibration platform with an amplitude slightly in excess of 1 g and causing the package to just leave the vibration surfaces.

4.7.2 Package Drop Test

Drop from a height of 30 inches on corners, edges, and flat surfaces.

4.7.3 Failure Criteria

The unit must meet its electrical performance requirements before and after the transportation tests. There must be no serious damage such as broken components, leads or chassis. Deformation which interferes with normal mechanical function will not be permitted.

SPECIFICATION CHANGE HISTORY

Change Number: None
Page: 1-8
Effective Date: 11-8-65
Characteristic: Environmental
New Spec: Change to:
Apply 2 shocks of 30 g's 1/2 sine and 11 ms duration
along each direction of the 3 major axes. Total number
of shocks = 12.
Reason: None given.

Change Number: None
Page: 4-3
Effective Date: 11-8-65
Characteristic: Shock, Failure Criteria
New Spec: Change to:
Nonoperating
Reason: None given.

SPECIFICATION CHANGE HISTORY

Change Number: None

Page: 1-9

Effective Date: 11-8-65

Characteristic: Environmental

New Spec: Change to:

Apply 2 shocks of 30 g's, 1/2 sine and 11 ms duration along each direction of the 3 major axes. Total number of shocks = 12.

Reason: None given.

Change Number: None

Page: 4-3

Effective Date: 11-8-65

Characteristic: Shock (with or without batteries), Operating

New Spec: Change to:

Apply 2 shocks of 30 g's, 1/2 sine and 11 ms duration along each direction of the 3 major axes. Total number of shocks = 12.

Reason: None given.

Change Number: 123-1

Page: 1-8

Effective Date: 9-29-66

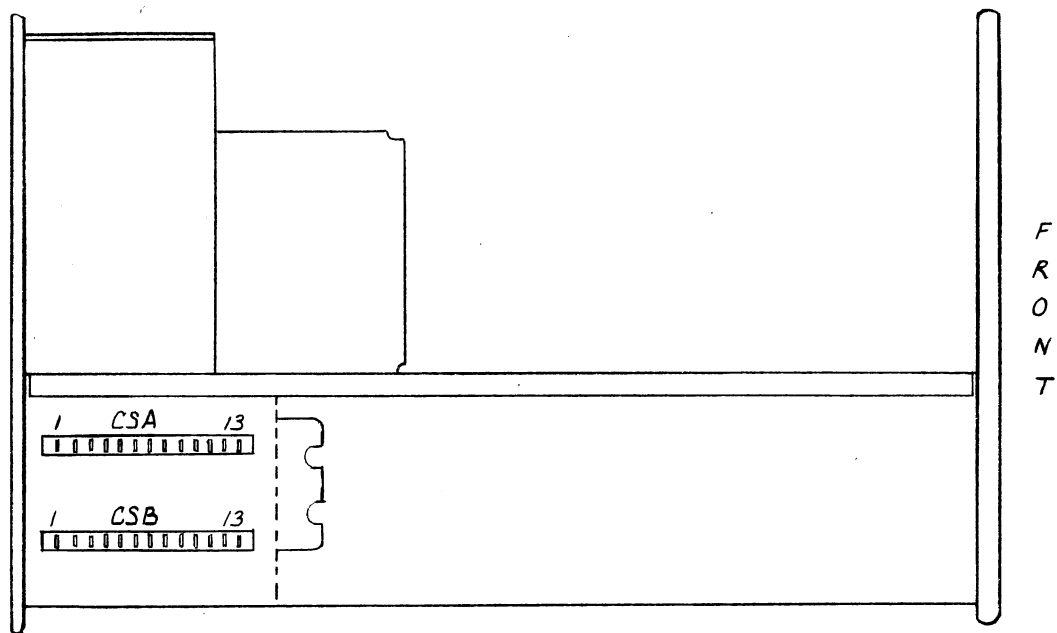
Characteristic: Voltages

New Spec: Change to:

<u>Voltages</u>	<u>Accuracy</u>	<u>Line</u>	<u>Ripple</u> <u>8 kHz</u>	<u>Code</u>
+55	+3%, -2%	--	0.6 V	GA
+95	+3%, -2%	--	0.8 V	GA

Reason: Clarification

STRIP LAYOUT~ 422



CHASSIS.

MOD #	
DATE	
KIT #	



MAINTENANCE NOTES

TWISTING OUTPUT TRANSISTOR LEADS CAN BREAK SEAL

Geoff Gass, 5-7-65

In some transistors of the TA-1938 family, it's possible to break the hermetic seal and twist off an internal connection by torque on the transistor leads under certain conditions of use in recent instruments (422 and 50 mc lines). The problem is temporary and has already been cured by the vendor.

The primary area of susceptibility is where the transistor leads are left long and the transistor is mounted with silicone grease on a heat sink. When the leads are bent over to make contact with connectors, the leverage is sufficient that twisting the lead can crack the seal. The silicone grease then penetrates the seal and lubricates the break, allowing the lead to be rotated freely, snapping off its internal connection.

The susceptible transistors are 151-0121-00, 151-0124-00 and 151-0524-00 (matched pairs of 151-0121-00's), carrying the following date codes: WC C 4, WC W 4, WC G 4, and WC I 4, and are confined to the ones using a green glass material for the hermetic seal. Those using black glass do not

have this problem.

The critical applications are

422:	Vertical output stage
544-6-7 (and RM's):	Vertical output stage
647 and RM:	Vertical output, horizontal output and Z-axis amplifier

The transistors with green glass seals are not in trouble when they are used in sockets with the leads clipped short, or even on the heat sinks if the leads haven't been twisted (e.g., by frequent removal for testing). Wholesale field replacement is not indicated.

It is recommended, however, that field office and repair center stocks of the TA-1938's with green glass seals be replaced with current-production types having better seals, to forestall any future problems. Beavertron can return the doubtful ones to the vendor for credit.

CHOPPING TRANSIENTS IN TRIGGER

Buck Murphy, 5-13-65

Alternate trace transients are causing some difficulty with proper trigger operation when the trigger selector switch is in Ch 1 only mode. Some instruments are worse than others because of wire placement in the laced cabling.

Mod 9491, starting sn 158, with about 12 exceptions.

Production instruments will use a modified cable harness, but the field version of this change can be as follows:

There is a 9-7 and a 9-0-5 wire from R35, the Ch 1 variable attenuator balance adjustment, to connection points F and G on the Ch 1 preamp board. Unsolder these two wires from R35, and pull them back, one at a time (with care -- #26 wire breaks easily), until they are free of the cabling. Now reconnect the wires to R35. Wire dress is not too important now -- just place the wires so they are not as close to the chopping information as they were when laced into the cable.

RECENT 422 MODS

Tony Bryan, 6-4-65

Instrument Mod Notice M9491-422, effective in production instruments at sn 158, takes care of three problems:

1. Trigger tends to fire on "chopped signal even when trigger source is "CH 1" Only (Vertical Mode switch in chopped).
2. Glitch on start of sweep.

3. Reduces jitter when using AC-DC supply.

The first and second problems were discussed in green sheets. Separation of some wires in a cable is all that is required. It is desirable to take care of this as it is noticeable in operation of the instrument.

HV PICKUP

Tony Bryan, 6-4-65

Otis Rich, Albuquerque, first noticed the Hi-Voltage pickup on Channel 1 in the .01 V/Div position. He traced the problem to the hole in the chassis that was formed when the tab was bent up to mount the vertical output EC Board.

A consequent Production Mod closed the hole by using a bracket instead of the tab from the chassis.

Those demo instruments may be cured by covering the hole! I have a box of "hole covers". If anyone needs one, drop me a note.

SWEEP START ABERRATION IN VERTICAL

Buck Murphy, 5-13-65

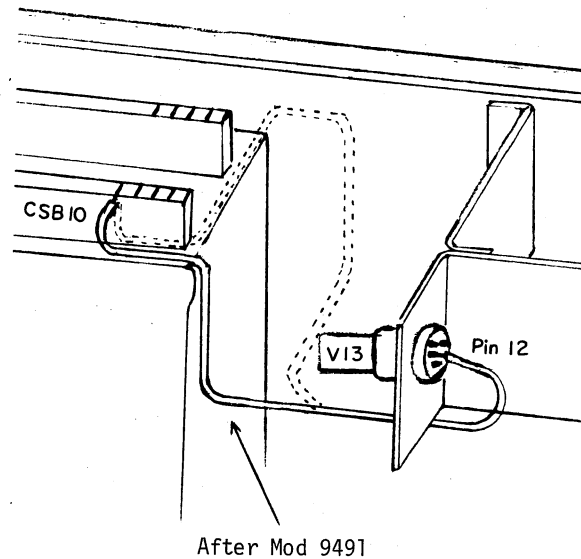
An aberration from the sweep start is getting into the vertical amplifier from intra-wire coupling in a tightly laced cable.

Mod 9491, starting sn 158, with about 12 exceptions.

Part 1: Sweep information is coupling into V13 filament wire. The 9-02 coded wire from pin 12, V13 to CSB10 must be removed from cable and reroute as shown. You may have trouble pulling this wire out of cable near the ceramic strips without breaking the wire. It may be necessary to cut the wire up close to the cable and use a new wire for this circuit.

Now reroute this wire back to the Cal Board, by passing it thru the grommet to the other side of the partition, and then back to connector (131-0371-00) on wire and restore to point M.

Part 2: There is a #26 stranded wire, coded 9-200, breaking out of the cable to connector M on the Cal Board. This wire must be partially removed from the cable, and to do so you must cut off the crimped connector so the wire can be pulled back thru the cable. (Be careful not to break this wire as it is only partially removed from the cable.) Pull this wire back several inches until it is even with the plastic grommet in the center bulkhead.



EC BOARD REPAIR

Tony Bryan, FEN 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.

bination causes corrosion, resulting in an instrument which is designed as "Environmental", but will not play under those conditions.

Under environmental conditions of high humidity, considerable damage can result to the board from the combination of moisture and flux. This com-

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

RFI LEAKAGE - S/N 101-699

Tony Bryan, 8-5-65

Incomplete contact between the "A" power-supply and indicator cabinets of the 422 s/n 101-699 allows radiated RFI far in excess of specification limits. The problem is caused by an insulating layer of paint on the forward edge of the "A" power supply housings used in pilot and early production (engineering models weren't so "perfectly"

painted). Most instruments shipped before July 20, 1965 will have this problem.

File, sand or scrape the forward edge of the drawn aluminum cabinet for the "A" power supply where it mates with the indicator cabinet, to provide a low-inductance ground for all parts of the cabinet.

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.

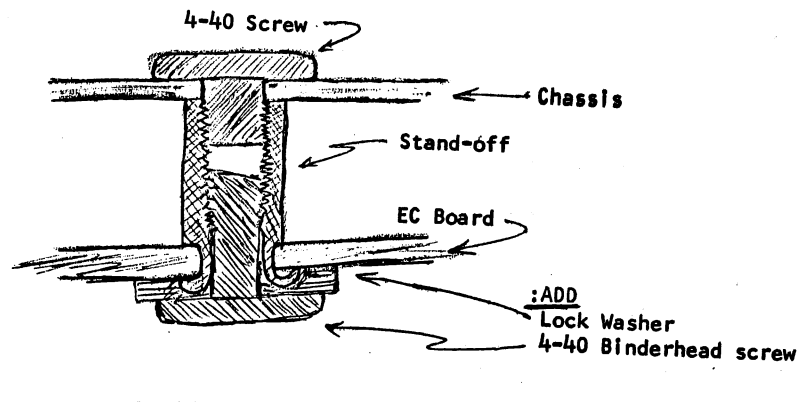
Tests on samples and random stand-offs exhibiting enough resistance to warrant further examination, reveal passivated metal films (first stages of corrosion) present. Presence of lacquers was also evident.

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.

422 H.V. REGULATOR

Tony Bryan, 3-26-65

The 422 H. V. Regulator V829 is the first usage of a new component, at least new to use by Tek.

The GV4S-1400 is a CORONA discharge regulator tube, as distinguished from a gas discharge regulator tube.

Internal pressure of the tube and electrode spacing govern the voltage at which the tube will conduct current due to ionization between the electrodes.

Where as the gas discharge glow regulators such as 5651, OG3, etc., have a voltage drop of approximately 87 volts when conducting 1.5 to 3.5 mills, the GV4S-1400 has approximately 1400 volts drop when conducting 300 μ amp to 1300 μ amp.

Tek purchases the tube to a Tek spec which is different than the "garden variety" GV4S-1400. For replacements, the customer should be directed to Tek.

AUTO TRIGGER DISCUSSION

Tony Bryan, 11-2-65

A customer recently reported a problem of getting the 422 to trigger in the Auto Mode using a time marker as a signal source. This is an interesting problem that is to be found in greater or lesser degree in all of our scopes with Auto Trigger, *except* those that *retain* the trigger level selection in the Auto Mode. In the more conventional Auto Trigger circuit, the trigger level is switched out and the trigger signal is AC coupled into the circuit. This sets two trigger circuit functions that you have no control over.

- 1) Triggering will occur only when signals exceed the Hysteresis of the trigger multi. (Schmitt or otherwise, such as phase shifter in 422). This Hysteresis is continually changing due to the feedback nature of the circuit.
- 2) The baseline DC following the coupling capacitor will be proportional to the duty factor of the input signal. The duty factor of time markers is such that there is very little average level above the baseline between the marker pips. When this is coupled into the Auto Multi, this average level is nearly mid-way between the Hysteresis extremes. During a marker pulse, the signal will penetrate

the Hysteresis extreme and flip the multi. As the marker pulse comes down, it only returns to the center of the Hysteresis gap, not enough to revert the multi. Result: The trigger multi does not follow the input signal and poor triggering is experienced. However, if the input signal has a duty factor of near 50%, then excellent and stable "No Hands" triggering is available.

The exceptions to these are those instruments that retain the *trigger level function* in the Auto Mode. For example, the 11B1, 544, 546, 547, 21A, 22A. These units might be described as "*Auto Sweep*" since their circuits control the sweep stability rather than a rearrangement of the trigger circuits. For this reason, the *trigger level* is retained to allow adjustment of the trigger multi and signal level relationship to assure trigger processing regardless of the trigger signal composition. Even these have some low-frequency limits that must be taken into account.

A conclusion to draw is that the *automatic* trigger modes are the most useful on uncomplicated signals.

AC/DC SUPPLY Q1194

Tony Bryan, 11-29-65

This transistor is mounted in an anodized heat sink. It is quite easy to cut thru the anodize by putting too much enthusiasm into tightening the nut on the heat sink. The heat sink is mounted to the EC board, where there is plenty of plating on both sides. There should be no ohmic contact between either the transistor and heat sink or heat sink and EC board. The instrument will work normally on EXT batteries and will work OK when operated on AC on the end of the inter-connecting cable.

When the power supply is attached to the main frame, it completes some connections between the

power supply bus and chassis and may take out Q1194.

The solution is to replace the heat sink and screw down the cover on the transistor firmly, but not too much.

The 0 V reference bus is tied to the power supply chassis but not to the main frame chassis. This is completed when the supply is attached to the main frame. The 0 V reference bus is NOT connected to chassis ground when used on EXT batteries.

Maintenance Notes - continued

CRT REPLACEMENT BELOW SN 1890

Tony Bryan, 12-3-65

At the above SN, an orthogonality coil was installed in production indicators to allow for Y-axis correction to CRT's that would otherwise have to be rejected.

A replacement CRT from Customer Service stock may suffer from less than perfect vertical/horizontal alignment. A replacement parts kit is forthcoming to install a new CRT shield with coil in-

stalled, the pot, and its mounting hardware.

The existence of this replacement kit, Tek # 050-0264-00, should be kept in mind when changing CRT's in the early 422's. The coil will allow approximately 5° correction to the vertical/horizontal alignment. Connections to the orthogonality coil may be reversed for ± correction factors.

BATTERY PACK VOLTAGE CHECK

Dan Welch, 7-12-66

A simple method for checking the 422 battery pack under normal load has been suggested by Joe Vistica of our Palo Alto Field Office.

First, the fuse cap for the 3 amp fuse must be modified by punching a hole thru the thin shell back. This can be accomplished quite easily with a metal scribe.

To check voltage, turn the power selector switch to the Int. Battery position, turn the front panel power switch to "ON" and check the voltage between the hole in the fuse cap and ground. This method allows an accurate check of battery pack voltage without removing the pack or the power supply from the instrument.

422 SOLDER SPOOL SHORTING HAZARD

Dan Welch, 11-14-66

A few catastrophic failures have been caused by the solder unraveling from the spool and shorting to the power supply EC board. The spool is mounted between the indicator and power supply.

The solution has been to remove the spool from the instrument proper and store it in the accessory compartment. We suggest this be done on all 422's to avoid any future failures of this nature.

LONGER LIFE GRATICULE BULBS FOR THE 422

Dan Welch, 2-17-67

A replacement parts kit, 050-0319-00, has been put together for the replacement of #336 graticule bulbs with #386 bulbs. The new bulbs have a life expectancy of 10,000 hours.

They require more current which necessitates changing R657 to a 15 Ω, 1W, 5%. The part number for the new bulb is 150-0059-00. The new bulbs are direct replacements in the AC-DC version of the 422 (Mod 125B).

422 POWER SUPPLY PROBLEMS

Dan Welch, 10-27-66

R614, R651, and R689 are 1 ohm fusible resistors in the +12 and -12 volt power supplies. Originally, they were held to ±5% tolerance by nicking the manganin resistance wire until the resistance fell within specs. This deformation of the wire formed a hot spot in the center of the 1/2 watt size form on which the resistance wire was wound, which caused a burn-out problem in several instruments.

The intent is for this fusing resistor to burn out quickly in the event of a power supply failure and not burn up the circuit board. Due to the deformation

of the wire, these resistors were burning out for no apparent reason.

This resistor has now been changed by Mod 11558 to a smaller physical size unit with ±10% tolerance, thereby removing the need to 'tailor' the wire to within specs.

Note that the physical size of the form on which the manganin wire is wound has no bearing on its power dissipating qualities.

The change will take place in latter October.

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

CRT Face Plate Discoloration Problems - continued

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 contaminants 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.

4. TYPE DISCOLORATION

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.

CAUSE

The yellowing was caused by a processing problem.

CURE

It was corrected by changing the process.

FEEDBACK

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.

REPAIR

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.

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 (TYPE A SUPPLY ONLY)

Voltage and ripple

	supply value	max line freq ripple	max HF ripple
	-12V	±1%	1mV
#	-81V	+2.5% (-83V) -1.25% (-80V)	2mV
	+12V	±2%	1mV
	+20V	±7%	1mV
	+75V	±7%	90mV
#	-1385V:	±5%, max	
	+4600V:	±20%, max	

SCALE ILLUMINATION

No illumination ccw
Max illumination cw

TRACE ALIGNMENT

Trace rotation range: 4°, min
Y Axis align 0.05 div, max

GEOMETRY

Adjust GEOM R854: 0.1 div, max
Horizontal Geometry: 0.1 div, max

ALTERNATE

Must alternate at all sweep rates

COMMON MODE CURRENT

R215: 0 ±0.25V, max

GAIN

CH 1 Gain Range: +10%, -5%, min
CH 2 Gain Range: +10%, -5%, min
ALG ADD ±2%, max

VOLTS/DIV

VOLTS/DIV accuracy: ±2%, max
VARIABLE range: 2.5:1, min
CH 2 X10 GAIN: ±3%, max

COMPRESSION, EXPANSION

Compression & expansion: 0.15 div, max

POSITION RANGE

Vertical Position range: 20 div, min

LINE VOLTAGE DRIFT

Trace drift with line voltage change:
0.2 div, max
Gain change with line voltage change:
±1%, max

MICROPHONICS AND GRID CURRENT

Microphonics: 0.5 div, max, no ringing type
Grid current: 0.1 div, max

POSITION CROSSTALK

0.1 div, max

TRACE STABILITY

1mV/div trace jump: 0.05 div, max
trace noise: 0.05 div, max

Test Limits - continued

VOLTS/DIV COMPENSATION

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

HIGH FREQUENCY COMPENSATION

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

BANDPASS

CH 1 bandpass: no more than 30% down at 15 MHz
 CH 2 bandpass: no more than 30% down at 15 MHz
 CH 2 X10 GAIN bandpass: no more than 30% down at 5 MHz

COMMON MODE REJECTION RATIO

Common Mode rejection ratio: 100:1, min

ATTENUATOR ISOLATION

Isolation: 100,000:1, min

AUTO CENTER

Auto center: 0V ±15mV
 Waveform amplitude: +160mV
 -200mV, min

TRIGGERING

Internal triggering:

Mode	Frequency	Amplitude
AUTO	4.5 MHz	.8 div
	16.5 MHz	2.5 div
DC, AC and AC LF REJ	5 MHz	.2 div
	15 MHz	1 div
AC LF REJ	50 kHz	.2 div

External triggering:

Mode	Frequency	Amplitude
AUTO	7 MHz	.6 V
	15 MHz	1.2 V
DC, AC and AC LF REJ	5 MHz	.125 V
	15 MHz	.6 V
AC LF REJ	50 kHz	.125 V

Low Freq triggering (50 Hz):

Mode	Internal	External
AC	.2 div	.125 V
AUTO	.8 div	.6 V

LF REJ: not triggered with 1 div of 50 Hz

MAG REGISTER AND SWEEP LENGTH

Mag register: ±.2 div, max
 Sweep length: 10.4 to 12.1 div

X10 MAG TIMING AND LINEARITY

X10 MAG timing: ±1%, max
 X10 MAG linearity: ±1%, max

VARIABLE TIME/DIV

VARIABLE range: 2.5:1, min

.5μSEC TIMING

.5μSEC X10 MAG linearity: ±2%, max

TIME/DIV ACCURACY

X10 MAG: ±3%, max
 TIME/DIV accuracy: ±2%, max

EXT HORIZ

Deflection factor: 10V/div
 ±25%, max

ATTEN range: 10:1, min
 Bandpass: no more than 30% down at 500 kHz

Test Limits - continued

CHOPPED OPERATION

Frequency: 100kHz $\pm 20\%$, max

EXT BLANKING

Blanking: +2 volts, min

GATE OUT

Amplitude: .5V, min

AUTO REPETITION RATE

40 to 55 Hz

CALIBRATOR

Cal Ampl: $\pm .5\%$, max

2 VOLT amplitude: $\pm 2\%$, max

Repetition rate: 1 kHz $\pm 20\%$

Duty cycle: 45% to 55%

MODIFICATION KIT

PORTABLE TO RACKMOUNT CONVERSION

For Tektronix Type 422 Oscilloscopes
with AC Power Supplies only -- SN 100-up

DESCRIPTION

This modification supplies an R422 rackmount assembly for rackmounting the above-listed instruments. Rear support installation instructions are included in Manual insert section supplied with this kit.

The R422 rackmount assembly has two oscilloscope compartments. This feature permits the rackmounting of two instruments, side by side, in the same relay rack. If it is desired that only one instrument be rack-mounted, then either the left or right compartment may be chosen. The remaining compartment may then be used as an instrument storage compartment. A convenient pull-down door is provided for the storage compartment to retain all accessories. Two rear support brackets are provided with the kit for the purpose of supporting two instruments in the same rack. If only one instrument is rackmounted, then support to the storage compartment is not necessary. The assembled R422 rackmount assembly may be installed into any standard 19 inch open or closed relay rack on slide-out tracks.

The slide-out tracks used on the Type 422 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.

When properly installed, the Rackmount Rear Support assembly permits the R422 to withstand an environmental shock or vibration as described in Characteristics section of the 422 Manual. If the 422 is not properly supported at the rear, then the instrument will not meet the given environmental characteristics.

The assembly consists of: 1) Removing the instruments from the cabinets. 2) Assembling the instruments into the R422 rackmount assembly. 3) Installing the rear support bracket assembly. 4) Rackmounting and providing rear support in a standard relay rack as described in the Manual Insert section.



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##PARTS LIST

Quantity	Part Number	Description
(1 ea)		Assembly, R422 Rackmounting, consisting of:
2 ea	210-0410-00	Nut, hex, 10-32 x 5/16
4 ea	210-0458-00	Nut, Keps, 8-32 x 11/32
2 ea	210-0805-00	Washer, flat, 0.204 ID x 0.438 OD
4 ea	213-0090-00	Screw, 10-32 x 1/2, HHS
1 pr	351-0104-00	Guide, chassis track
2 ea	367-0022-00	Handle
1 ea	436-0065-00	Compartment, storage assembly
1 ea	437-0082-00	Cabinet, rackmount assembly
(1 ea)		Hardware, Relay Rack and Rear Support, consisting of:
2 ea	210-0011-00	Washer, 1/4 int
4 ea	210-0803-00	Washer, #6
4 ea	210-0805-00	Washer, #10
4 ea	210-0833-00	Washer, finishing #10
4 ea	210-0866-00	Washer, 0.264 ID x 1-1/8 OD x 0.1106
4 ea	210-0917-00	Washer, plastic, 0.191 ID x 5/8 OD
2 ea	210-0984-00	Washer, support, Neoprene*
2 ea	210-0985-00	Washer, 7/8 OD x 0.512 ID x 0.054
4 ea	211-0517-00	Screw, 6-32 x 1 PHS
4 ea	212-0520-00	Screw, 10-32 x 1-1/4 hex head
4 ea	212-0567-00	Screw, 10-32 x 7/8 OHS
2 ea	213-0134-00	Screw, 1/4-20 x 3/4 hex head
2 ea	214-0502-00	Pin, support
4 ea	220-0410-00	Nut, Keps, 10-32 x 3/8 hex
1 pr	351-0100-00	Track, slide, stationary and inter-section w/mounting hardware
4 ea	361-0118-00	Spacer, sleeve
2 ea	361-0119-00	Spacer, block
2 ea	386-1066-00	Plate, retaining shaft
2 ea	407-0073-00	Bracket, angle support

*Carboline Co. registered trademark.

INSTRUCTIONS

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.

A. TO REMOVE THE INSTRUMENT FROM THE PORTABLE CABINET.

Refer to Fig 1 for steps 1-4.

- () 1. Remove the front cover assembly from the instrument.
- () 2. Unscrew the four 10-32 screws, located in the four rear rubber feet, which secure the AC Power Supply to the instrument.
- () 3. Remove the AC Power Supply from the instrument.
- () 4. Remove the three 4-40 x 5/16 screws which secure the wrap-around cabinet to the instrument. SAVE.

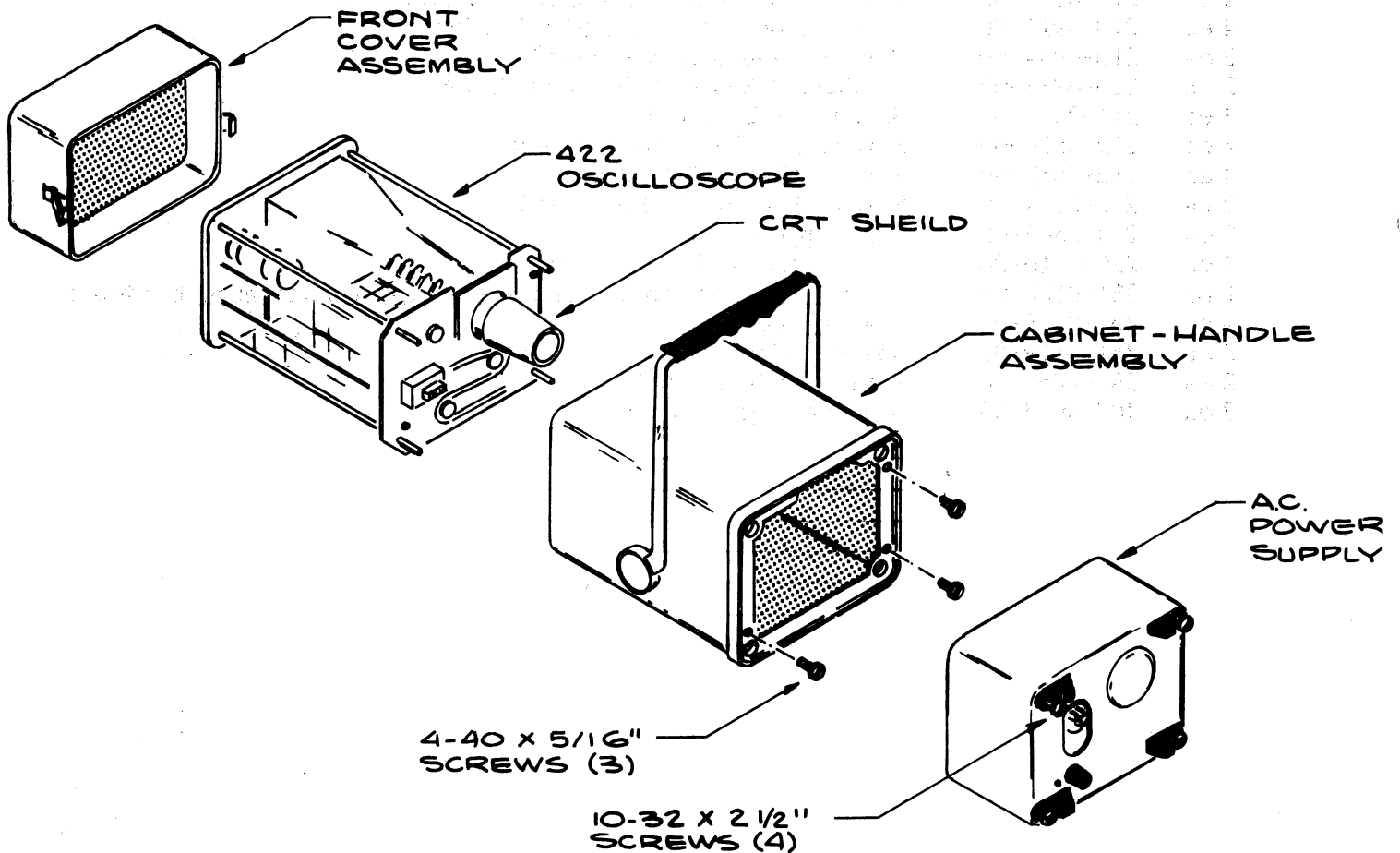


Fig 1

INSTRUCTIONS (cont)

A. Continued.

- () 5. Remove the wrap-around cabinet from the instrument. (Refer to Fig 2.)

NOTE: The R422 Rackmount assembly was designed with two 422 Oscilloscope compartments. The right-hand compartment is supplied with a convenient accessory storage unit with a pull-down door. Two 422 Oscilloscopes may be mounted in the R422 Rackmount assembly, side by side, or one 422 Oscilloscope may be mounted in either the left or right compartment. This can be accomplished by removing or transferring the storage compartment. The storage compartment is secured to the R422 rear panel with two 10-32 flat washers and nuts.

B. TO INSTALL THE OSCILLOSCOPES INTO THE R422 RACKMOUNT:

Refer to Fig 2 for steps 1 and 2.

- () 1. Slide the 422 Oscilloscope into the chosen compartment.
- () 2. Secure the oscilloscope to the R422 Rackmount assembly, using the three 4-40 x 5/16 screws removed in step 4.

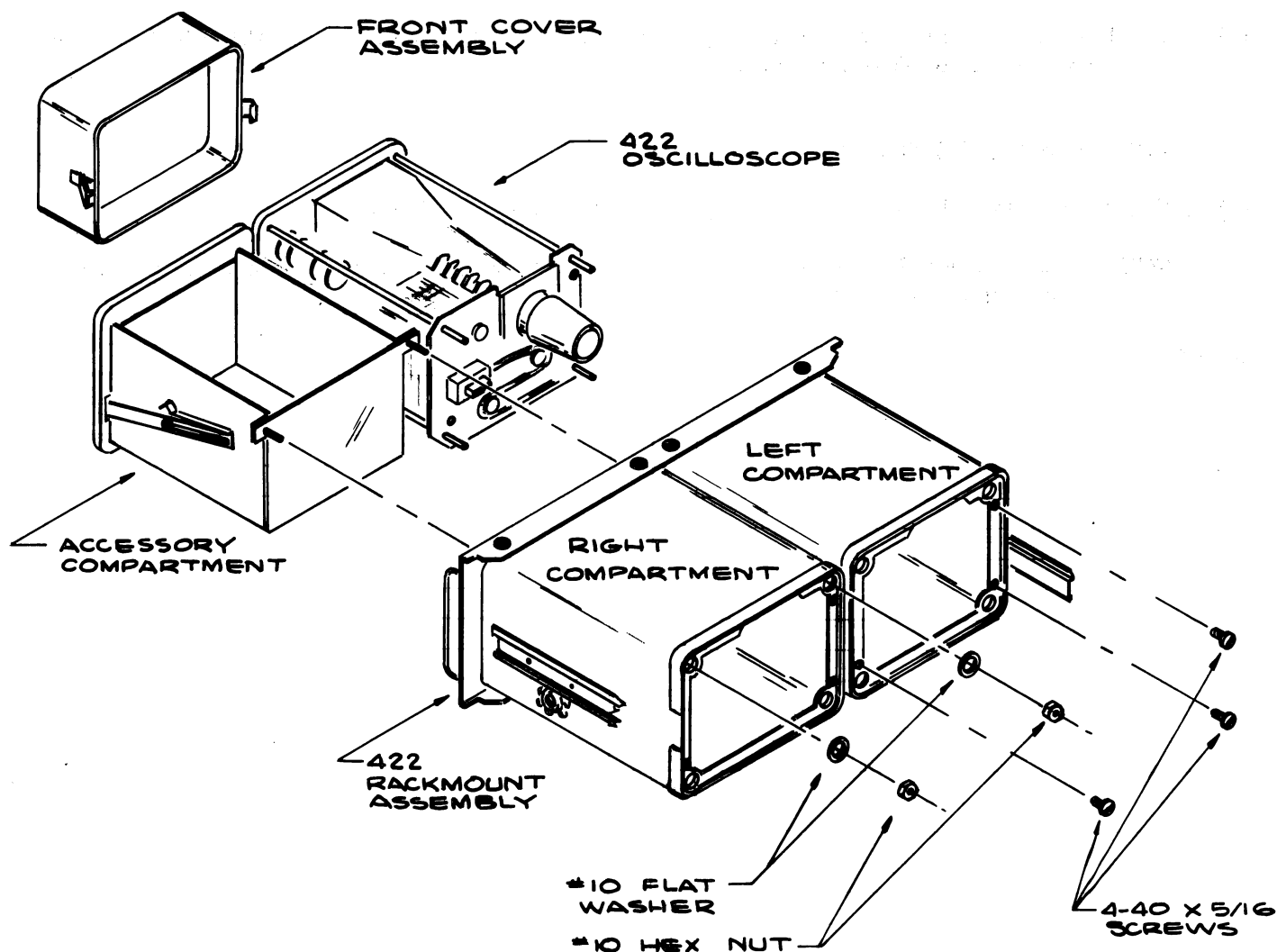


Fig 2

INSTRUCTIONS (cont)

B. Continued

- () 3. Secure the AC Power Supplies to their respective oscilloscopes. (See Fig 3).

C. TO INSTALL THE REAR SUPPORT BRACKETS ON THE AC POWER SUPPLIES:

Refer to Fig 3 for steps 1 through 4.

LEFT COMPARTMENT ONLY

- () 1. Remove the two 6-32 x 1/4 screws, located on the right side (rear view) of the AC Power Supply.
- () 2. Install the rear support bracket, spacers, and 6-32 x 1 screws on the right side (rear view) of the AC Power Supply.

RIGHT COMPARTMENT ONLY

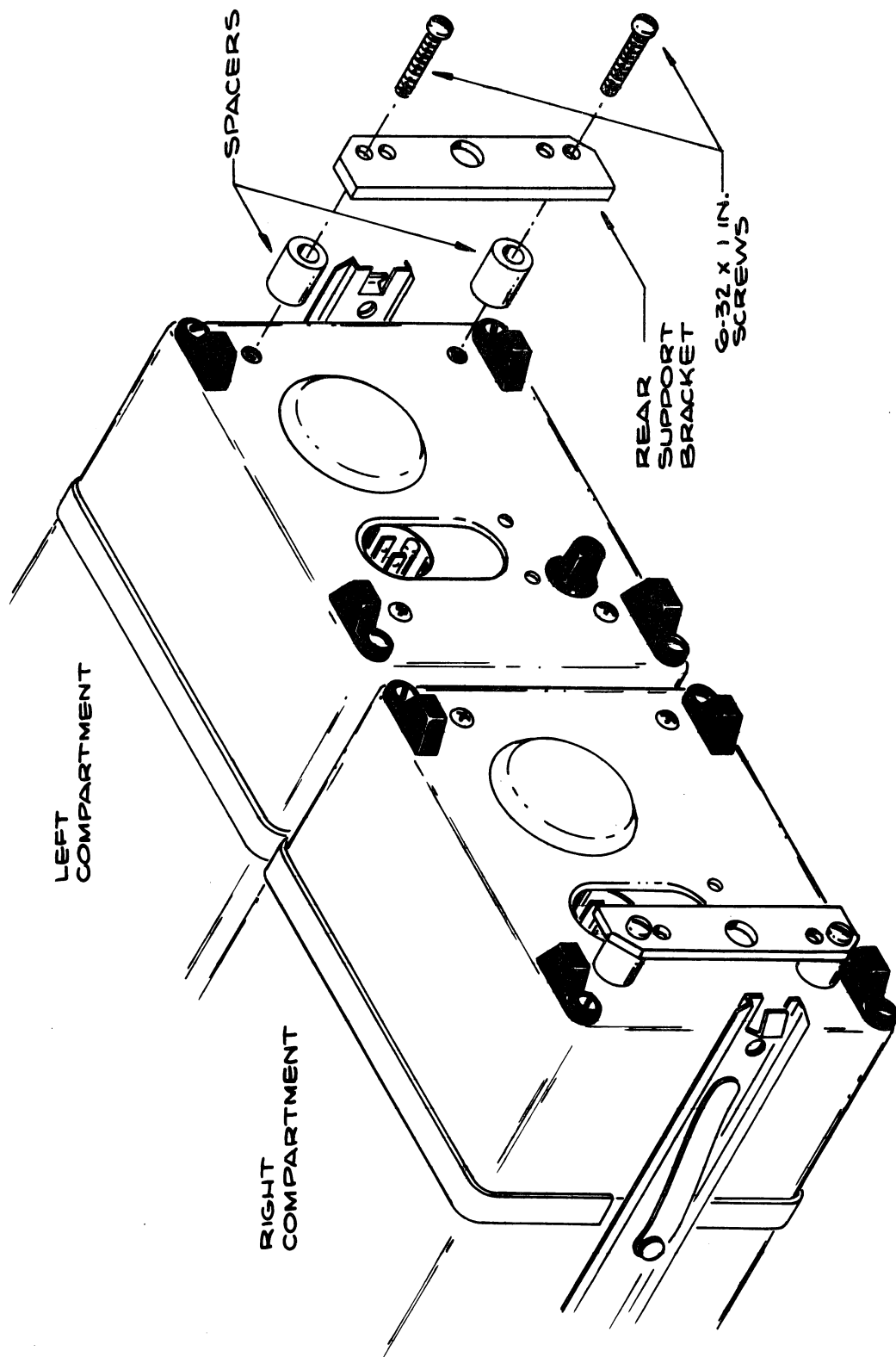
- () 3. Remove the two 6-32 x 1/4 screws, located on the left side (rear view) of the AC Power Supply.
- () 4. Install the rear support bracket, spacers, and 6-32 x 1 screws on the left side (rear view) of the AC Power Supply.

THIS COMPLETES THE INSTALLATION.

- () Fasten the Manual insert section to the front of your 422 Manual.

NOTE: See the R422 Manual Insert Section for relay rack and rear support installation instructions.

JB:cet



TWO 422 OSCILLOSCOPES WITH A.C. POWER SUPPLIES IN THE R422 RACKMOUNT ASSEMBLY (REAR VIEW)

Fig 3

MODIFICATION KIT

RACKMOUNT TO PORTABLE CONVERSION



For Tektronix Type R422 Oscilloscopes
Serial numbers 100-up

DESCRIPTION

This modification kit supplies a cabinet-handle assembly and front cover assembly for converting a single 422 Oscilloscope, which is contained within an R422 Rackmount assembly, to a standard 422 portable oscilloscope.

040-0421-00

The conversion to a portable instrument consists of:

- 1) Removing the 422 Oscilloscope and AC Power Supply from the R422 Rackmount.
- 2) Installing the 422 into the cabinet-handle assembly.
- 3) Installing the AC Power Supply on the 422 Oscilloscope.
- 4) Replacing the Rear Support Bracket assembly with two 6-32 screws.
- 5) Installing the front cover assembly.

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PARTS LIST

Quantity	Part Number	Description
(1 ea)		Assembly, cabinet-handle, consisting of:
## 2 ea	210-0805-00	Washer, flat
## 2 ea	213-0139-00	Screw, 10-24 x 3/8 HHS
1 ea	367-0063-00	Handle assembly
1 ea	437-0076-00	Cabinet assembly
## 1 ea	200-0604-02	Cover, front, assembly
2 ea	211-0565-00	Screw, 6-32 x 1/4 THS, Phillips

INSTRUCTIONS

NOTE: It is important that all mechanical components and hardware be saved for future use, especially if the instrument is to be reassembled into the R422 cabinet.

- () 1. Remove the R422 Rackmount assembly from the relay rack.
- () 2. Loosen the four 10-32 screws in the AC Power Supply rear feet and remove the power supply from the instrument.

REFER TO FIG 1 FOR STEPS 3 AND 4

- () 3. Remove the three 4-40 x 5/16 screws that secure the 422 oscilloscope to the R422 cabinet. Save screws.
- () 4. Remove the 422 Oscilloscope from the R422 cabinet.

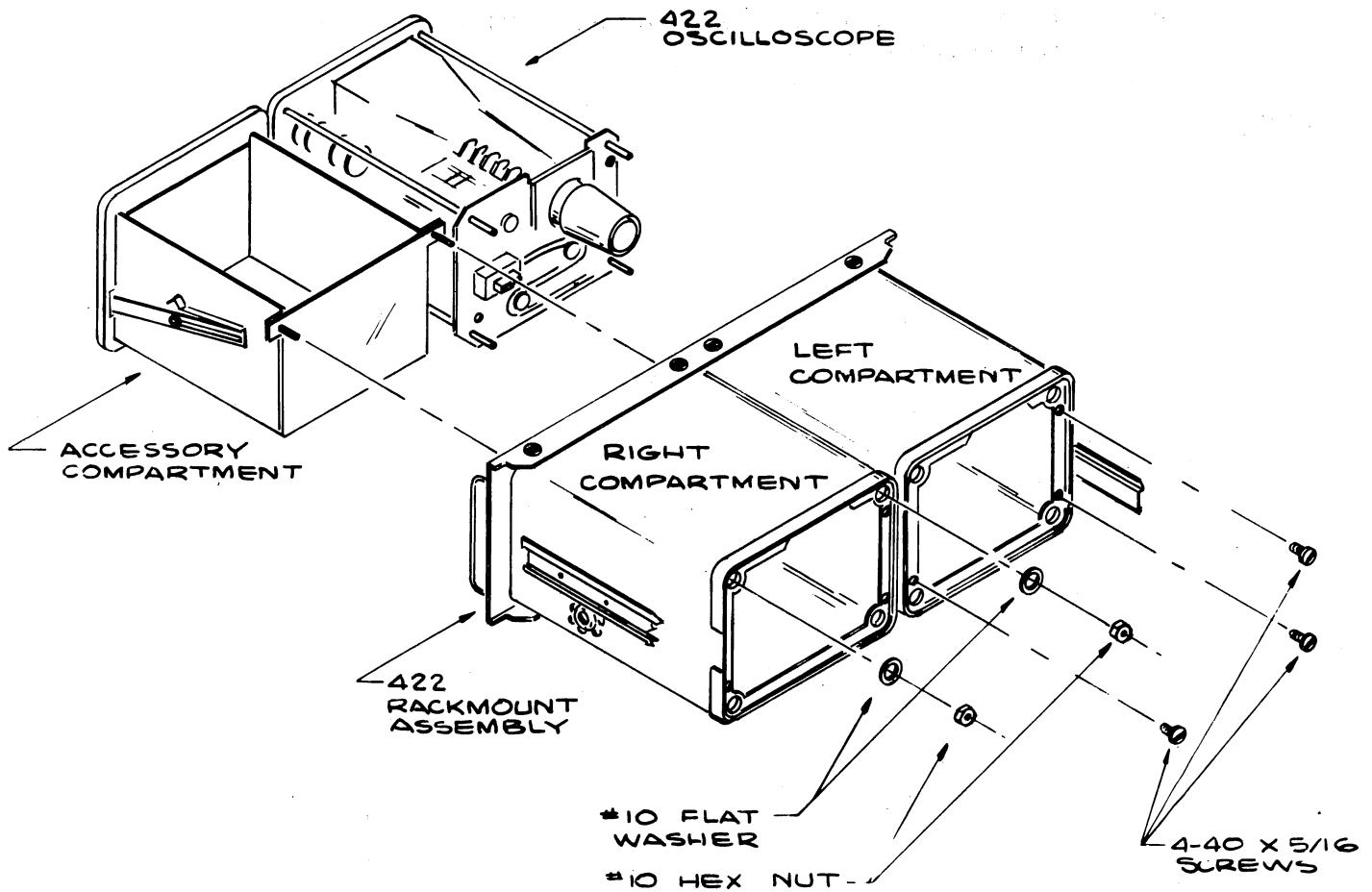


Fig 1

INSTRUCTIONS (cont)

REFER TO FIG 2 FOR STEPS 5 THROUGH 9

- () 5. Slide the 422 Oscilloscope into the cabinet-handle assembly (from kit) and secure the cabinet to the instrument using the three 4-40 x 5/16 screws removed in step 3.
- () 6. Place the AC Power Supply on the rear of the 422 Oscilloscope.
- () Secure the power supply to the instrument by tightening the four 10-32 screws in the AC Power Supply rear feet.
- () 7. Remove the rear support bracket, spacers, and hardware from the AC Power Supply.
- () 8. Install two 6-32 x 1/4 THS Phillips screws (from kit) in the holes vacated by the rear support hardware.
- () 9. Secure the front cover (from kit) on the front of the 422 Oscilloscope.

THIS COMPLETES THE INSTALLATION.

NOTE: The parts included in this kit are already listed in your Manual Parts List.

BE:ls

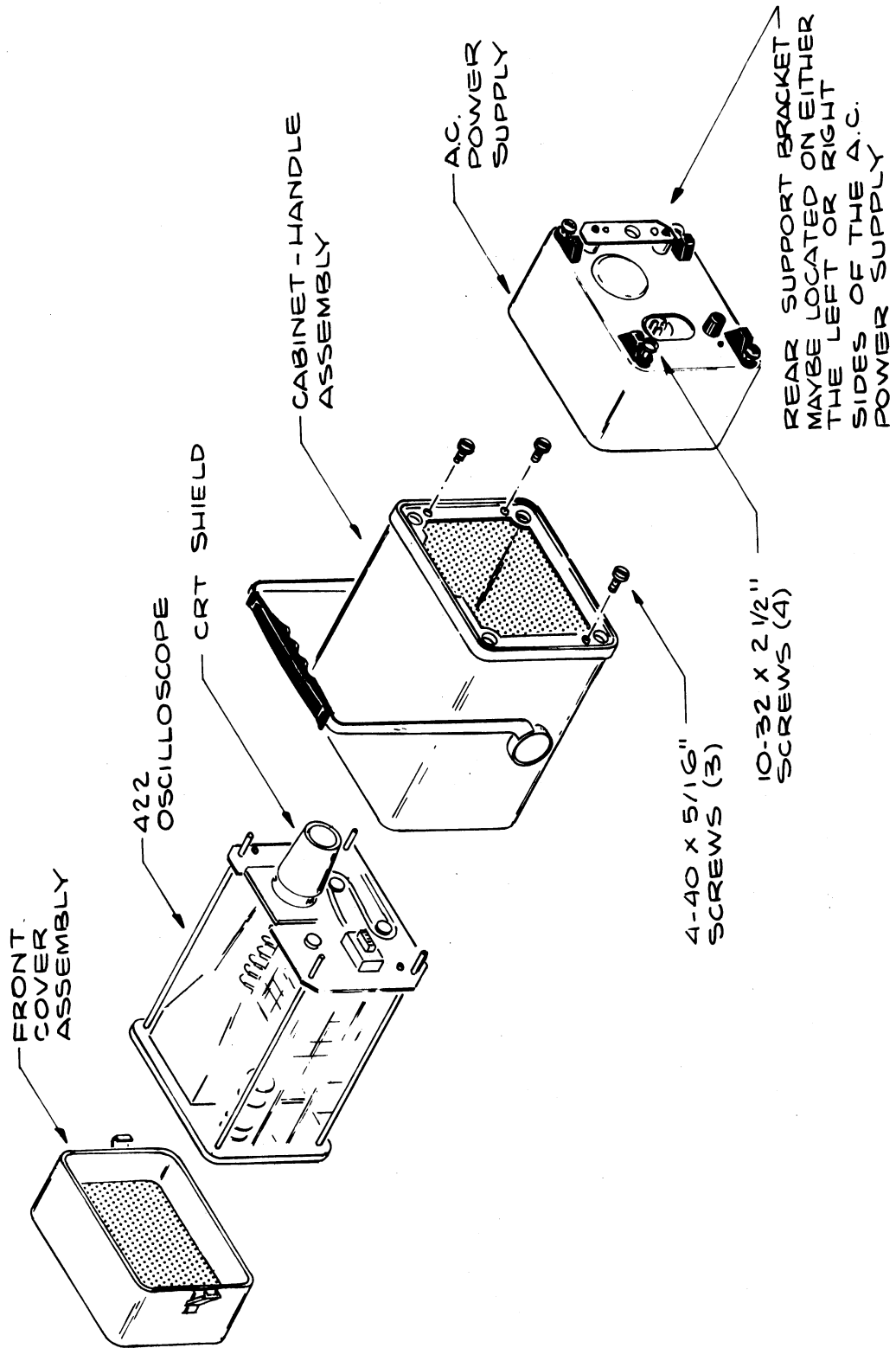


Fig 2

MODIFICATION KIT

IMPROVED POWER SWITCH ACTUATOR



For the following Tektronix Oscilloscopes:

Type 422 serial numbers 100-6989
Type 422-125B serial numbers 100-6989
Type R422 serial numbers 100-6989

DESCRIPTION

This modification provides an improved POWER switch actuator assembly, which eliminates failure of the 'press-fit' pivot pin.

The switch actuator and actuator rod have been modified to use a spiral spring pin.

The installation consists of replacing the POWER switch actuator, actuator rod, and pivot pin.

This kit replaces the following parts:

Actuator, switch	214-0526-00
Pin, escutcheon	214-0533-00
Rod, ass'y, POWER switch	384-0336-00

040-0439-00

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January 1967

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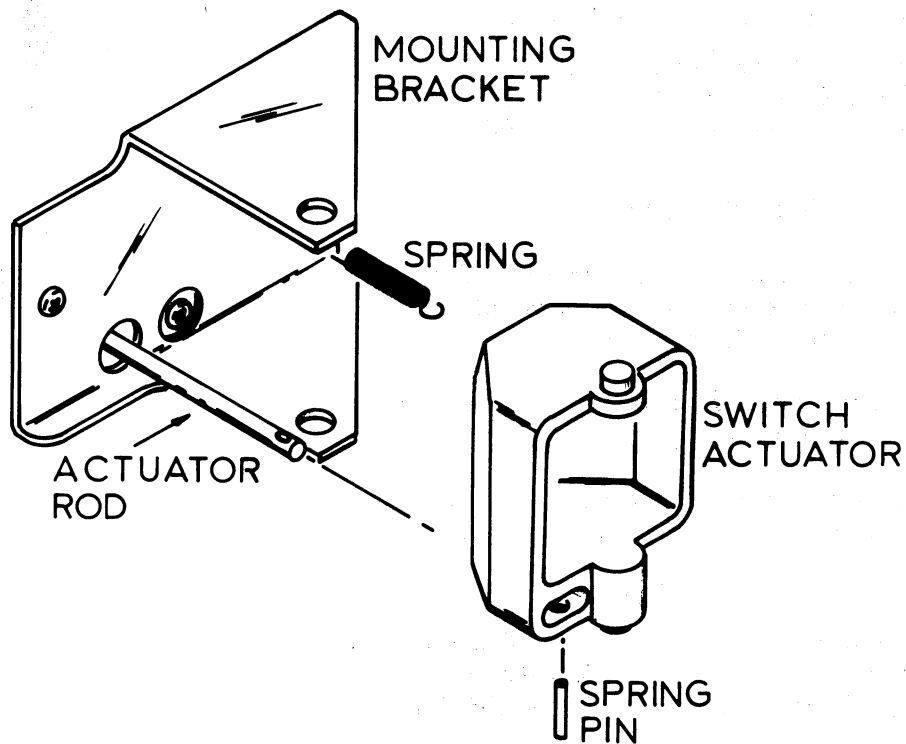
PARTS LIST

Quantity	Part Number	Description
1 ea	214-0526-01	Actuator, toggle switch, Delrin*, 0.650 x 1.050 x 1.260
1 ea	214-0863-00	Pin, spiral spring, 0.062 x 0.375
1 ea	384-0336-01	Rod, Power switch assembly, w/molded gray nylon knob

INSTRUCTIONS

- () 1. Disconnect the power supply and remove from the rear of the instrument.
- () 2. Remove the cabinet.
- () 3. Replace the POWER switch actuator, actuator rod and pivot pin, located on the rear of the instrument, with those from the kit. Refer to drawing.

NOTE: The 'spiral' spring pin can be easily installed, using a pair of pliers. 'Compress gently' and insert pin into the actuator rod. Refer to drawing.



- () 4. Replace cabinet.
- () 5. Replace the power supply and check operation of the new POWER switch actuator.

THIS COMPLETES THE INSTALLATION.

- () Correct the Mechanical Part List section of the Instruction Manual as required.

KH:ls

PARTS REPLACEMENT KIT

-12V SUPPLY ZENER DIODE

For Tektronix Type 422 Oscilloscopes:
AC Power Supply s/n 100-594 (tentative)

DESCRIPTION

1N936, 9 v Zener diode (152-0212-00) replaces
1N752A, 5.6 v Zener diode (152-0175-00) which
is no longer available.

To install the new diode, it is necessary to
change the values of several components in
the -12v power supply.

NOTE: If the serial number of your instru-
ment is above those listed or if this kit has
been installed, disregard the instructions as
part number 152-0212-00 is a direct replace-
ment.



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August 1965

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PARTS LIST

Quantity	Description	Part Number
1 ea.	Diode, Zener, 1N936 9v ±5%	152-0212-00
1 ea.	Potentiometer, WW 1.5k 5%	311-0532-00
1 ea.	Resistor, comp, 1k 1/4 w 5%	315-0102-00
1 ea.	Resistor, comp, 2.7k 1/4 w 5%	315-0272-00
1 ea.	Resistor, comp, 390 Ω 1/4 w 5%	315-0391-00
1 ea.	Resistor, prec, 953 Ω 1/8 w 1%	321-0191-00
1 ea.	Resistor, prec, 2.26k 1/8 w 1%	321-0227-00
1 ea.	Tag, MODIFIED INSTRUMENT, gummed back 1-910D	

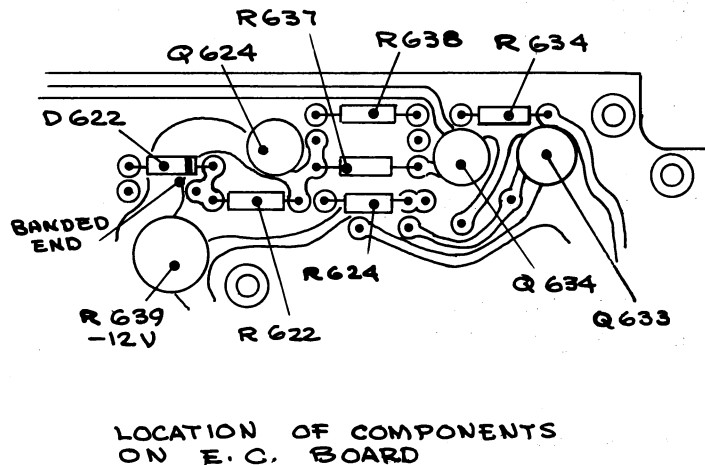


Fig. 1

INSTRUCTIONS

- () 1. Remove the six Phillips head screws that fasten the Power Supply cover in place and remove the cover.
- () 2. Temporarily unsolder the negative wire of C642 from the etched circuit board and remove the capacitor from the clip.
- 3. Refer to Fig. 1 and replace the following parts with the new parts from the kit:
 - () R639: Remove a 2.5 k potentiometer (-12 v), and install a 1.5 k WW potentiometer. (Reinstall C642, removed in step 2.)
 - () D622: Remove a 1N752A and install a 1N936, banded end toward Q624.
 - () R622: Remove a 1 k 1/4 w 5% resistor and install a 390 Ω 1/4 w 5% resistor.
 - () R624: Remove a 620 Ω 1/4 w 5% resistor and install a 1 k 1/4 w 5% resistor.
 - () R634: Remove a 2.4 k 1/4 w 5% resistor and install a 2.7 k 1/4 w 5% resistor.
 - () R637: Remove a 6.34 k 1/8 w 1% resistor and install a 953 Ω 1/8 w 1% resistor.
 - () R638: Remove a 4.02 k 1/8 w 1% resistor and install a 2.26 k 1/8 w 1% resistor.

THIS COMPLETES THE INSTALLATION.

- () Check wiring for accuracy.
- () Fasten the insert pages in your Instruction Manual.
- () Moisten the back of the MODIFIED INSTRUMENT tag (from kit) and place it on the AC Power Supply schematic.
- () Refer to the Calibration Section of your Instruction Manual and recalibrate as required.
- () Replace the Power Supply cover, removed in step 1.

JT/CH:ceb

-12V SUPPLY ZENER DIODE

Type 422 AC Power Supply s/n 100-594 (tentative)

Installed in Type 422 AC Power Supply s/n _____ Date _____

GENERAL INFORMATION

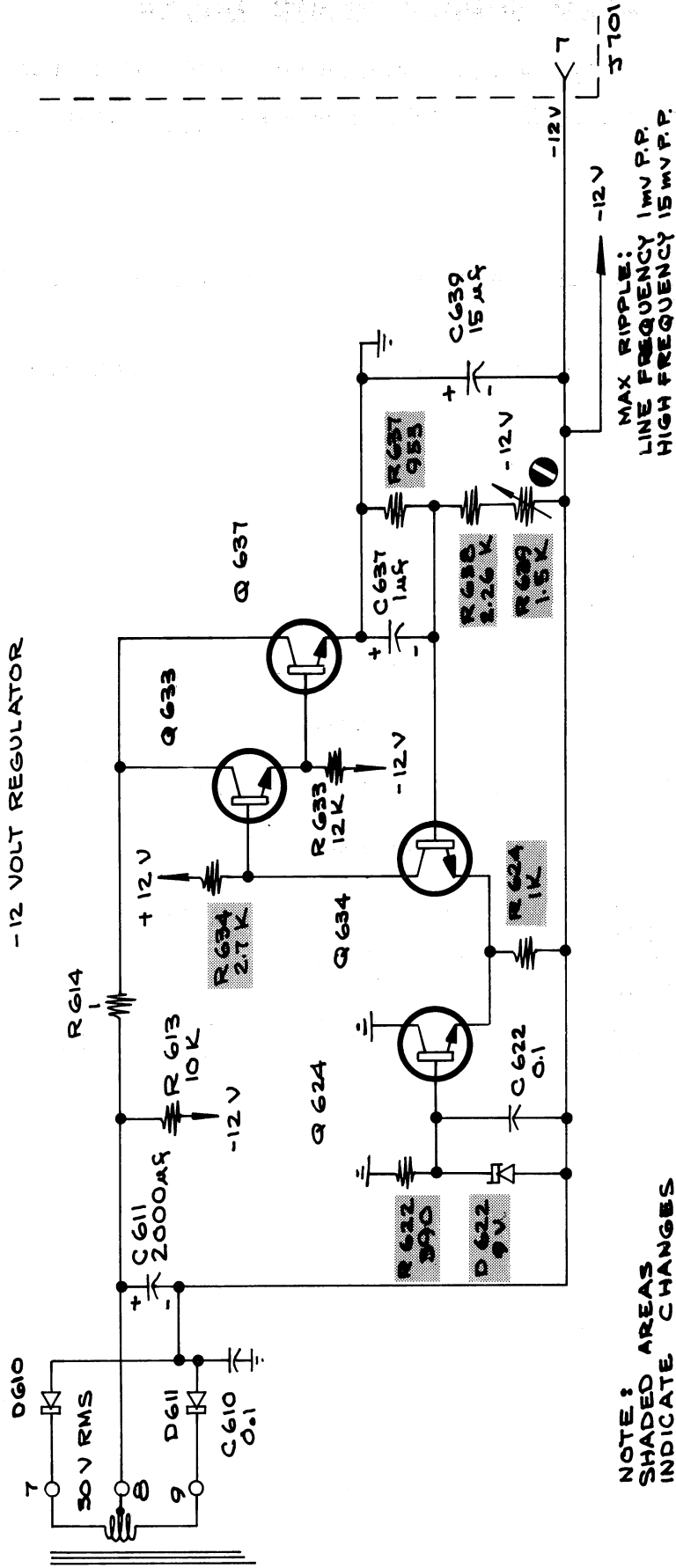
1N936, 9v Zener diode (152-0212-00) replaces 1N752A, 5.6v Zener diode (152-0175-00) which is no longer available.

The information on these pages supersedes the information in your Manual.

ELECTRICAL PARTS LIST

Values fixed unless marked variable.

Ckt. No.	Part Number	Description				
DIODES						
D622	152-0212-00	Zener	1N936	9 v	±5%	
RESISTORS						
R622	315-0391-00	390 Ω	1/4 w	comp	5%	
R624	315-0102-00	1 k	1/4 w	comp	5%	
R634	315-0272-00	2.7 k	1/4 w	comp	5%	
R637	321-0191-00	953 Ω	1/8 w	prec	1%	
R638	321-0227-00	2.26 k	1/8 w	prec	1%	
R639	311-0532-00	1.5 k		WW	var 5%	



PART OF AC POWER SUPPLY

NOTE: SHADED AREAS INDICATE CHANGES

TYPE 422 OSCILLOSCOPE

PARTS REPLACEMENT KIT

T4220 CATHODE RAY TUBE

For Tektronix Type 422 Oscilloscopes
Serial numbers 100-1889

DESCRIPTION

The orthogonality specifications for Type T4220 Cathode Ray Tubes have been modified. To reflect this change, the CRT part numbers were changed as indicated below:

<u>CRT</u>	<u>Part Number</u>	<u>Replaces</u>
T4220-31-1	154-0466-05	154-0466-00
T4220- 1-1	154-0466-06	154-0466-01
T4220- 2-1	154-0466-07	154-0466-02
T4220- 7-1	154-0466-08	154-0466-03
T4220-11-1	154-0466-09	154-0466-04

To assure orthogonal X-Y deflection, the new Cathode Ray Tubes must be used with a "Y" axis alignment coil and adjustment potentiometer. These are included in this kit as part of the new CRT shield assembly. The CRT's are manufactured with P31, P1, P2, P7, and P11 phosphors and must be ordered separately.

The installation consists of replacing the old CRT shield assembly with the new CRT shield assembly and soldering one wire to a +12 V ceramic strip terminal. A partial Calibration procedure is included for making the orthogonality adjustments.

NOTE: If the serial number of your instrument is above those listed, or if this kit has previously been installed, disregard these instructions as the new CRT's listed above are direct replacements.



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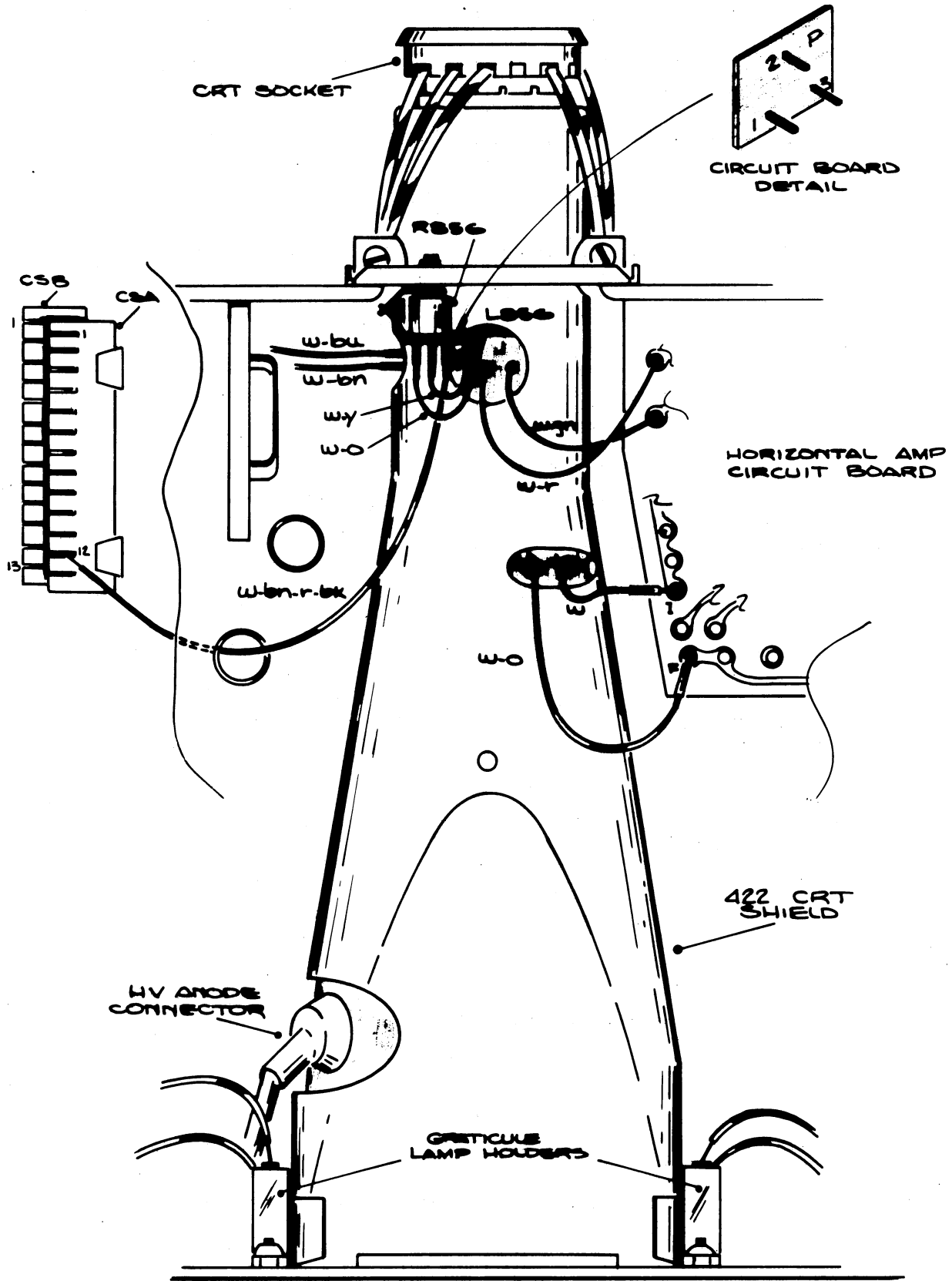
PARTS LIST

Quantity	Description	Part Number
1 ea	Assembly, CRT shield, consisting of:	
## 1 ea	Coil, fixed, Trace Rotator	108-0320-01
1 ea	Coil, fixed, "Y" Axis Alignment, assembly	108-0350-00
2 ea	Strip, liner, CRT clamp, polypropylene	124-0170-01
1 ea	Connector, contact, square pin	131-0371-00
6 ea	Lockwasher, steel, ext. #4	210-0003-00
1 ea	Lug, solder, 1/4" hole	210-0223-00
1 ea	Nut, hex, brass 1/4-32 x 5/16	210-0583-00
1 ea	Washer, flat, steel, 0.400OD x 0.254ID x 0.006 thick	210-0980-00
2 ea	Screw, 4-40 x 3/8 PHS	211-0012-00
2 ea	Screw, 4-40 x 5/16 FH stainless steel	211-0117-00
4 ea	Nut, 4-40 hex, stainless steel	220-0438-00
1 ea	Potentiometer, comp, 20k ±20% Model G	311-0579-00
1 ea	Shield, CRT, painted blue	337-0669-01
1 ea	Clamp, CRT rear mount, bottom	343-0115-00
1 ea	Clamp, CRT rear mount, top, w/2 mtg. ears	343-0116-00
4 ea	Cushion, CRT silicone sponge, adhesive back	348-0070-01
1 ea	Board, circuit	388-0678-00
1 ea	Bracket, shield, CRT	407-0105-01
## 1 ea	Wire, #26 stranded, 8-1/2 in. white-brown-red-black	(175-0529-00)
1 ea	Tag, MODIFIED INSTRUMENT, gummed back	1-910D

INSTRUCTIONS

- () 1. Remove the instrument from the cabinet.
- () 2. Carefully remove the CRT screen from the instrument to prevent any possible damage while performing mod.
- () 3. Remove the three screws and rear CRT shield. (SAVE)
- () 4. Remove the two bottom screws which secure the CRT shield bracket to the chassis. (SAVE)
5. Disconnect the following square pin connector wires which connect to the CRT and Horizontal Amplifier board:
 - () white to Horizontal Amplifier circuit board terminal I
 - () white-orange to Horizontal Amplifier circuit board terminal F
 - () white-red to "LEFT" CRT deflection plate pin
 - () white-green to "RIGHT" CRT deflection plate pin
 - () white-blue to "UPPER" CRT deflection plate pin
 - () white-brown to "LOWER" CRT deflection plate pin
- () 6. Disconnect the CRT HV anode connector from the CRT.
- () 7. Disconnect the CRT socket from the CRT.
- () 8. Remove both CRT graticule lamp holders from the CRT shield. (SAVE HARDWARE AND HOLDERS.)
- () 9. Carefully push the CRT and shield toward the rear of the instrument until it clears the rear front panel casting. Tilt the front of the CRT up and remove from the instrument.
- () 10. Loosen the two CRT clamp screws which secure the CRT to the shield and remove the CRT from the shield.
- () 11. Loosen the two CRT clamp screws on the new CRT shield assembly (from kit), install the new CRT in shield, and tighten the two CRT clamp screws.
- () 12. Install the new CRT and shield assembly in the instrument.
- () 13. Reinstall the two bottom CRT bracket screws removed in step 4.
IMPORTANT: Check the rear CRT socket pins to make sure none are bent.
- () 14. Reinstall the rear CRT socket on the CRT.
- () 15. Reinstall the rear CRT shield using the three screws removed in step 3.
- () 16. Reinstall both CRT graticule lamp holders removed in step 8.

INSTRUCTIONS (con'd)



INSTRUCTIONS (con'd)

Refer to the drawing for the following CRT wire locations:

17. Connect the following square pin connector wires from the CRT assembly and Horizontal Amplifier board:
 - () white to Horizontal Amplifier circuit board terminal I
 - () white-orange to Horizontal Amplifier circuit board terminal F
 - () white-red to "LEFT" CRT deflection plate pin
 - () white-green to "RIGHT" CRT deflection plate pin
 - () white-blue to "UPPER" CRT deflection plate pin
 - () white-brown to "LOWER" CRT deflection plate pin
 - () Dress the white-brown-red-black wire from the R856 circuit board terminal #3, through the chassis grommet and solder to CSA-12.
- () 18. Reconnect the CRT HV anode connector removed in step 6.
- () 19. Reinstall the CRT screen removed in step 2.

THIS COMPLETES THE INSTALLATION.

- () Adjust "Y" Axis Alignment potentiometer, R856, as described in the Manual Insert Recalibration section.
- () Moisten the back of the MODIFIED INSTRUMENT tag (from kit) and place it on the CRT Circuit Manual schematic page affected by this modification.
- () Fasten the insert pages in your Instruction Manual.
- () Reinstall the instrument in the cabinet.

BE:ls

T4220 CATHODE RAY TUBE

Type 422 Oscilloscopes -- s/n 100-1889

Installed in Type 422 s/n _____ Date _____

GENERAL INFORMATION

The orthogonality specifications for Type T4220 Cathode Ray Tubes have been modified. To reflect this change, the CRT part numbers were changed as indicated below:

<u>CRT</u>	<u>Part Number</u>	<u>Replaces</u>
T4220-31-1	154-0466-05	154-0466-00
T4220- 1-1	154-0466-06	154-0466-01
T4220- 2-1	154-0466-07	154-0466-02
T4220- 7-1	154-0466-08	154-0466-03
T4220-11-1	154-0466-09	154-0466-04

To assure orthogonal X-Y deflection, the new Cathode Ray Tubes must be used with a "Y" axis alignment coil and adjustment potentiometer. These are included in this kit as part of the new CRT shield assembly. The CRT's are manufactured with P31, P1, P2, P7, and P11 phosphors and must be ordered separately.

The installation consists of replacing the old CRT shield assembly with the new CRT assembly and soldering one wire to a +12 V ceramic strip terminal. A partial Calibration procedure is included for making the orthogonality adjustments.

The information on these pages supplements and/or supersedes the information in your Manual.

RECALIBRATION

NOTES

EQUIPMENT REQUIRED

- 1 Type 180 or 184 Time Mark Generator

NOTE: With exception of the Geometry control, this calibration procedure assumes that all other adjustments have remained the same and do not require further adjustment.

TYPE 422 BASIC FRONT PANEL SETTINGS

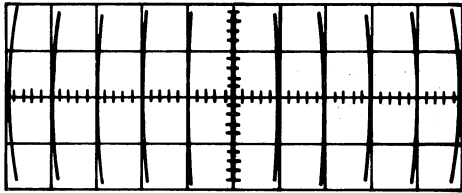
CH 1 input switch	-- DC
VOLTS/CM	-- 1
POSITION	-- midscreen
MODE	-- CH 1
TRIGGERING	-- CH 1
TRIG LEVEL	-- AUTO
TIME/DIV	-- 1 mSEC
TRACE ROTATION	-- to align with center horizontal graticule line

From a Type 180 or 184, apply 1 msec and 100 μ sec time markers to CH 1 input. Set the POSITION, VOLTS/CM, and VARIABLE to appropriate position so that the markers cover the entire graticule area. Set the ASTIGMATISM, FOCUS, and INTENSITY controls for a sharp display.

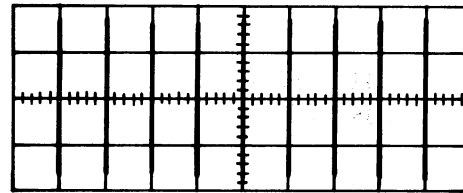
RECALIBRATION

NOTES

- 1) Adjust the Geometry control for minimum bowing of vertical lines.

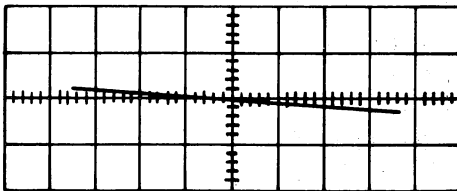


INCORRECT

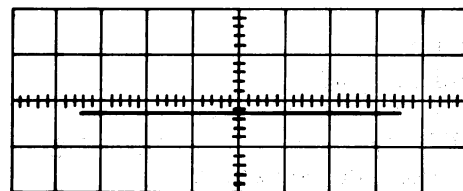


CORRECT

- 2) Remove vertical signal and free run sweep to produce a single line along the center Horizontal axis. Adjust the trace rotation control, R851, so that the trace is parallel to the center Horizontal graticule line.

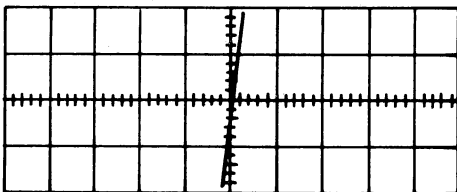


INCORRECT

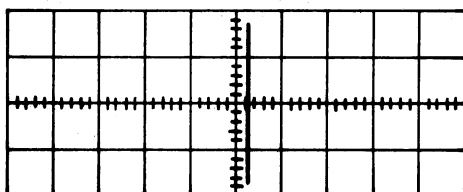


CORRECT

- 3) Remove sweep and connect vertical signal to produce a single line along the center Vertical Axis. Adjust the "Y" Axis alignment control, R856, so that the trace is parallel to the center Vertical graticule line.



INCORRECT



CORRECT

- 4) Interaction may occur between the Geometry, Trace Rotation and "Y" Axis alignment controls. Therefore, it may be necessary to repeat steps 1, 2, and 3 until the adjustments are accurate.

If it is not possible to properly adjust R856 so that the trace is parallel to the Vertical center graticule line, then reverse the white-orange and white-yellow wire terminals connected to the R856 circuit board and repeat steps 1 and 2.

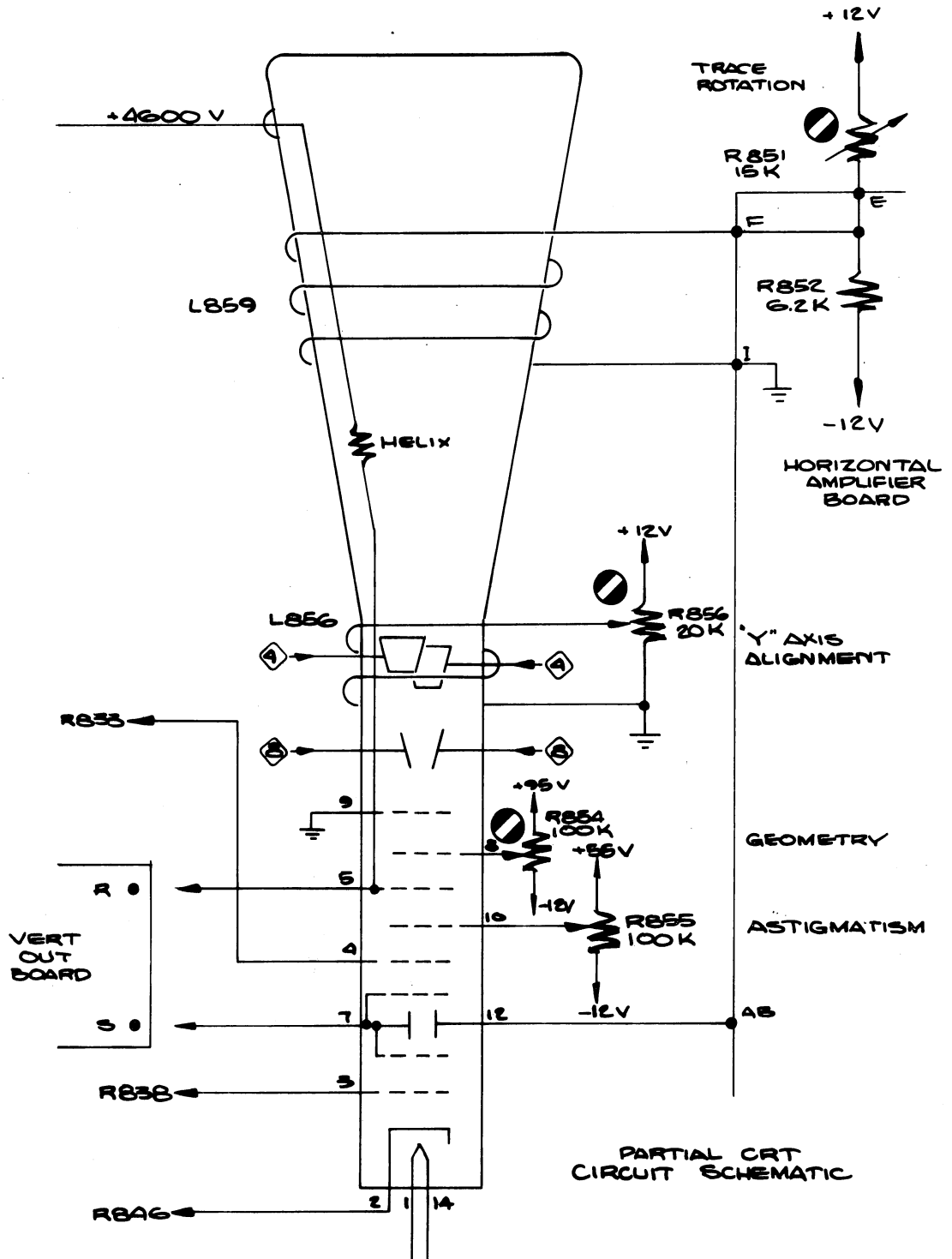
ELECTRICAL PARTS LIST

Ckt. No.	Part Number	Description
COILS		
L856	108-0350-00	"Y" AXIS ALIGNMENT
##L859	108-0320-01	TRACE ROTATION
RESISTORS		
R856	311-0579-00	20k comp ±20% "Y" AXIS ALIGNMENT

MECHANICAL PARTS LIST

	Part Number
Board, circuit	388-0678-00
Bracket, shield, CRT	407-0105-01
Clamp, CRT rear mount, bottom	343-0115-00
Clamp, CRT rear mount, top, w/2 mtg. ears	343-0116-00
Connector, contact, square pin	131-0371-00
Cushion, CRT silicone sponge, adhesive back	348-0070-01
Lockwasher, steel, ext #4	210-0003-00
Lug, solder, 1/4" hole	210-0223-00
Nut, hex, brass 1/4-32 x 5/16	210-0583-00
Nut, 4-40 hex, stainless steel	220-0438-00
Screw, 4-40 x 5/16 FH	211-0117-00
Screw, 4-40 x 3/8 PHS	211-0012-00
Shield, CRT, painted	337-0669-01
Strip, liner, CRT clamp, polypropylene	124-0170-01
Washer, flat steel, 0.400OD x 0.254ID x 0.006 thick	210-0980-00

SCHEMATICS



PARTS REPLACEMENT KIT

HORIZONTAL AMPLIFIER BOARD

For Tektronix Type 422 Oscilloscopes
Serial numbers 100-599



DESCRIPTION

Horizontal Amplifier circuit board kit assembly
670-0413-00 replaces assembly 670-0406-00.

The new board incorporates changes necessitated by a modification to the Type 422 at s/n 600. The changes include the addition of two square-pin male connectors (AC and AD), the relocation of R531 and connector pin "C", the addition of R515, and an increase in the value of R529 and R533.

The changes have no effect on the performance of instruments below s/n 600. If the serial number of your instrument is above those listed, or if this kit has already been installed, disregard the instructions and use part number 670-0413-00 as a direct replacement.

050-0285-00

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March 1966

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050-0285-00

PARTS LIST

Quantity	Description	Part Number
1 ea	Board, circuit, Horizontal Amplifier	670-0413-00

INSTRUCTIONS

NOTE: It is not necessary to make connections to the new Horizontal Amplifier board square-pin connectors "AC" and "AD".

- () Replace the old Horizontal Amplifier board with the new board from the kit.

THIS COMPLETES THE INSTALLATION

- () Change the part number for the Horizontal Amplifier circuit board, listed in the Manual Parts List, to 670-0413-00.

JB:cet

PARTS REPLACEMENT KIT

SILICON DIODE



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.

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Instructions for 050-0290-00
February 1966

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050-0290-00

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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.

INSTRUCTIONS (cont)

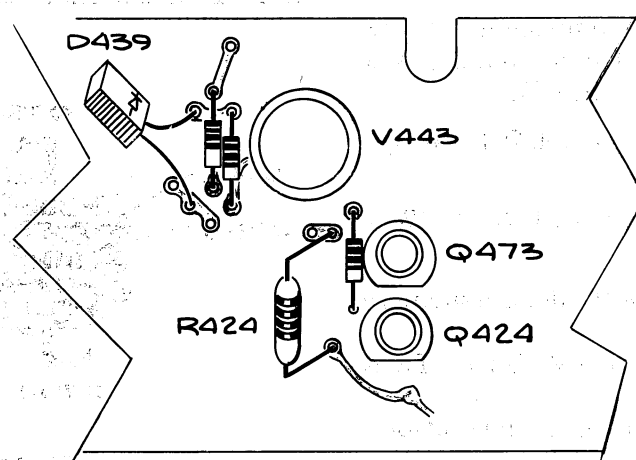


Fig 1

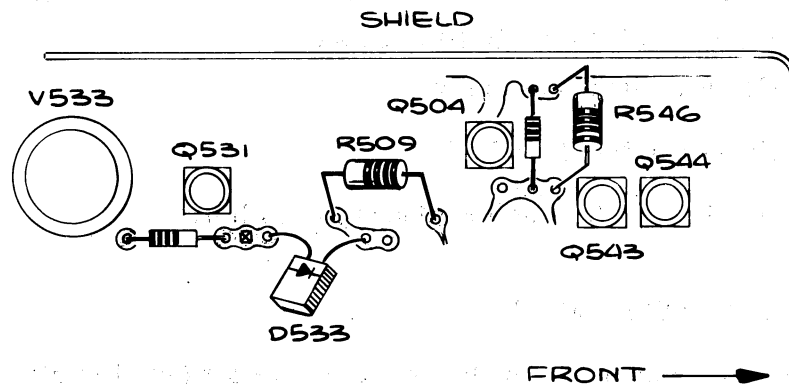


Fig 2

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.

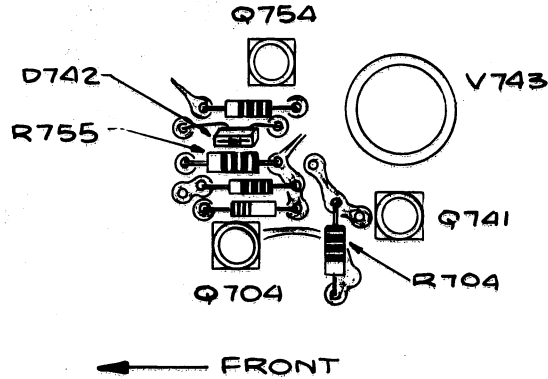


Fig 3

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

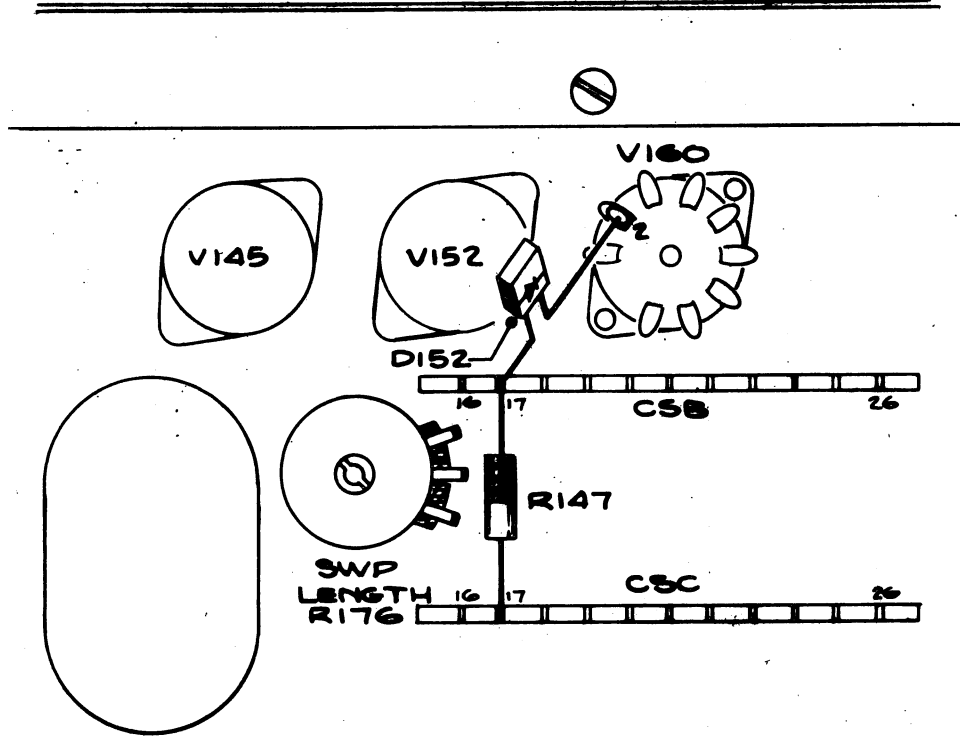


Fig 4

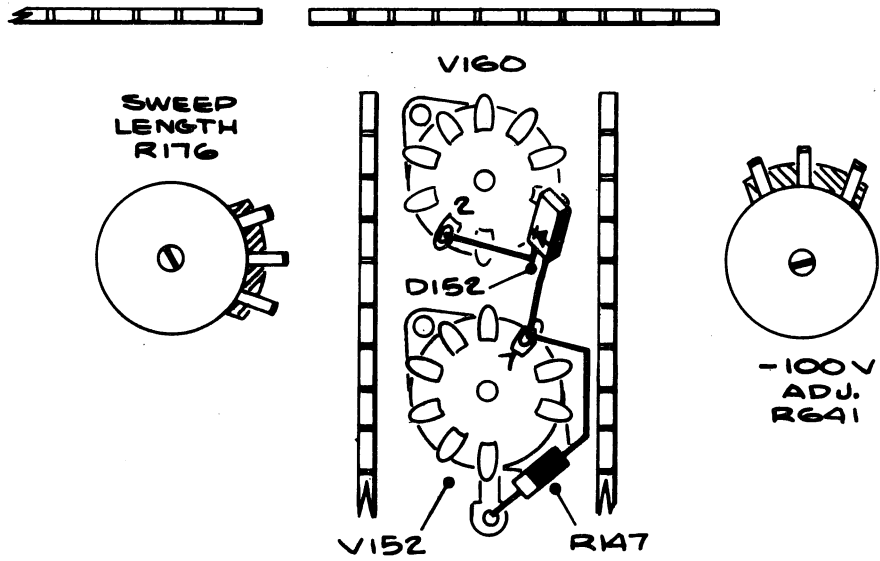


Fig 5

PARTS REPLACEMENT KIT

GRATICULE BULBS

For Tektronix Type 422 Oscilloscopes
with AC Power Supplies only
Serial numbers 100-7189

DESCRIPTION

Incandescent light bulb 150-0059-00 replaces
the old 150-0044-00 light bulb previously used
for graticule illumination.

The new light bulb has a longer life expectancy
than the old bulb.

The installation involves removing the AC
Power Supply and instrument cabinet to re-
place the two graticule bulbs B725, B726,
and series resistor R657.

NOTE: If the serial number of your instru-
ment is above those listed, or if this kit has
been installed, disregard the instructions
and use bulb part number 150-0059-00 as a
direct replacement.



050-0319-00

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050-0319-00

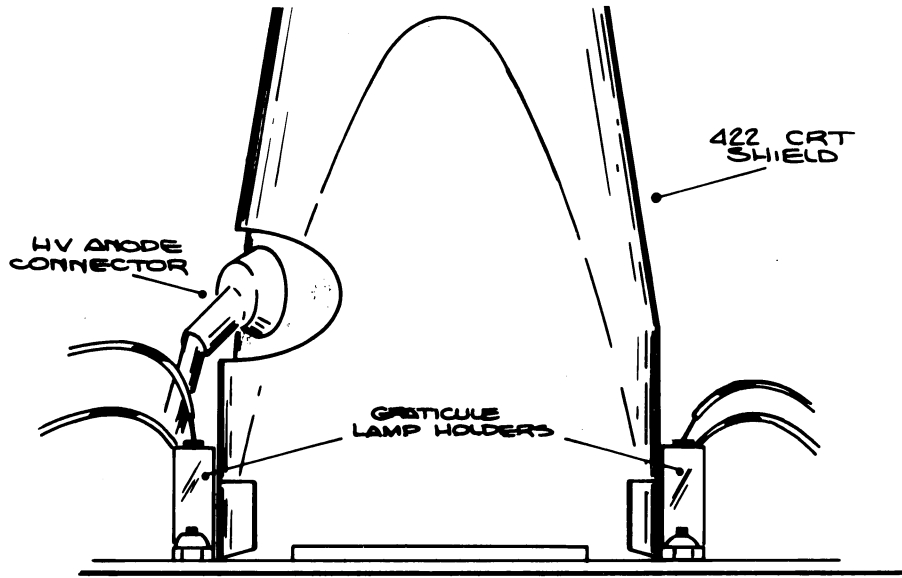


Fig. 1

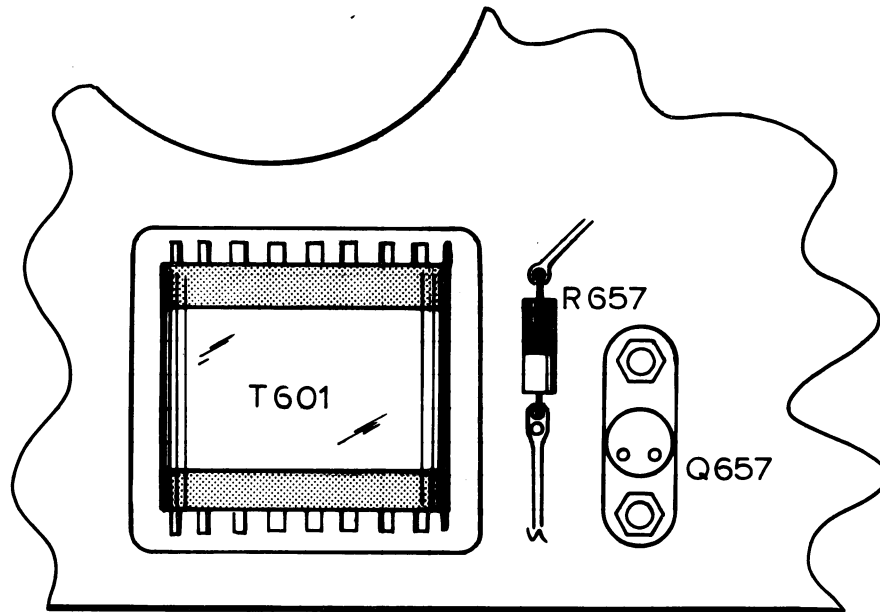


Fig. 2

AC POWER SUPPLY CIRCUIT BOARD
(Partial Diagram)

PARTS LIST

Quantity	Part Number	Description
2 ea	150-0059-00	Bulb, incandescent 14V T-1 3/4 bulb #386
1 ea	303-0150-00	Resistor, comp, 15 Ω 1W 5%

INSTRUCTIONS

- () 1. Remove the instrument's AC Power Supply and cabinet.
Refer to Fig. 1 while performing steps 2 through 4.
- () 2. Remove the graticule lamp holder nuts located above the CRT shield.
- () 3. Replace graticule lamps B725 and B726 with the new lamps from the kit.
- () 4. Reinstall the graticule lamp holders.
- () 5. Replace R657 located on the AC Power Supply circuit board between T601 and Q657 with a 15 Ω 1W 5% resistor from the kit. See Fig. 2.
- () 6. Reinstall the instrument cabinet and AC Power Supply.

THIS COMPLETES THE INSTALLATION

Change your Manual Parts List to read:

- | | | | |
|-----|------|-------------|-------------------|
| () | B725 | 150-0059-00 | Incandescent #386 |
| () | B726 | 150-0059-00 | Incandescent #386 |
| () | R657 | 303-0150-00 | 15 Ω 1W 5% |
- () Change value of R657 on the "AC POWER SUPPLY" schematic page to 15 Ω .
 - () Change B725 and B726 bulb type #336 on the "CALIBRATOR AND REGULATOR" schematic page to #386.

BE:ls

PARTS REPLACEMENT KIT

AC POWER SUPPLY CIRCUIT BOARD

For Tektronix Type 422 AC Power Supplies
Serial numbers 100-7189

DESCRIPTION

AC Power Supply wired circuit board with transistors, 670-0412-02, replaces 670-0412-00 previously used.

Circuit board resistor R657 was also changed in value to permit the use of new graticule light bulbs which offer a longer life expectancy than the old bulbs.

The installation involves removing the AC Power Supply and instrument cabinet to replace the circuit board and two graticule bulbs, B725 and B726. The new value of R657 is present on the new board and does not require replacement.

NOTE: If the serial number of your instrument is above those listed, or if this kit has been installed, disregard the instructions and use circuit board PN 670-0412-02 as a direct replacement.



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050-0320-00

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PARTS LIST

Quantity	Part Number	Description
2 ea	150-0059-00	Bulb, incandescent, 14V T - 1-3/4, bulb #386
1 ea	670-0412-02	Board, circuit, AC Power Supply w/plug-in components

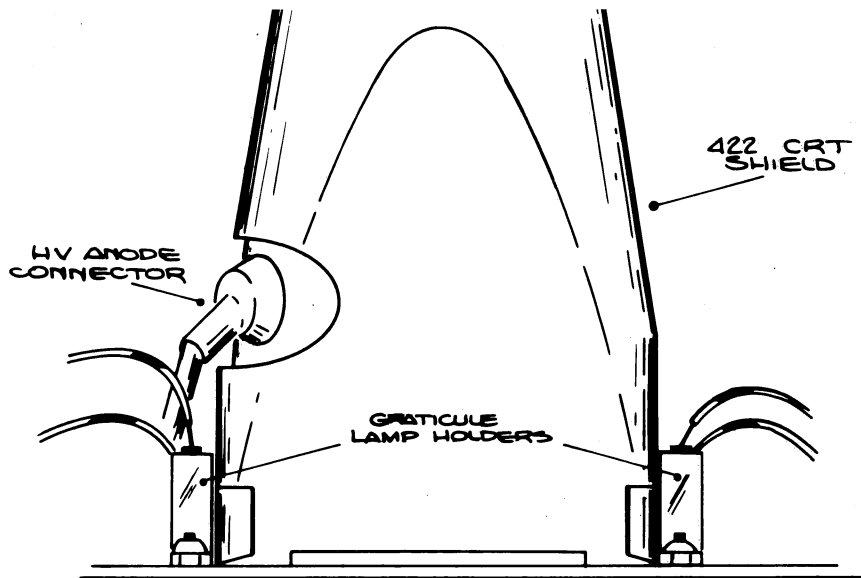
INSTRUCTIONS

A. TO REPLACE THE GRATICULE BULBS

- () 1. Remove the instrument AC Power Supply and cabinet.

Refer to drawing while performing steps 2 through 4.

- () 2. Remove the graticule lamp holder nuts, located above the CRT shield.
- () 3. Replace graticule lamps B725 and B726 with the new lamps from the kit.
- () 4. Reinstall the graticule lamp holders.



INSTRUCTIONS (cont)

B. TO REPLACE THE AC POWER SUPPLY CIRCUIT BOARD

- () 1. Remove the six AC Power Supply cabinet screws and blue cabinet.
- () 2. Replace the old circuit board with the new one from the kit.
- () 3. Reinstall the AC Power Supply in the blue cabinet with the six screws removed in step B-1.
- () 4. Reinstall the instrument cabinet and AC Power Supply.

THIS COMPLETES THE INSTALLATION

Change your Manual Parts List to read:

- () B725 150-0059-00 Incandescent #386
- () B726 150-0059-00 Incandescent #386
- () R657 303-0150-00 15 Ω 1W 5%
- () 670-0412-02 AC Power Supply Circuit Board
- () Change value of R657 on the "AC POWER SUPPLY" schematic page to 15 Ω
- () Change B725 and B726 bulb type #336 on the "CALIBRATOR AND REGULATOR" schematic page to #386.

BE:ls

MODIFICATION SUMMARY

422

This Modification Summary contains a summary of all production 'Modification Notices' for the Type 422 (Indicator and AC Power Supply), 422-125B (Indicator and AC-DC Power Supply) and R422. Unless otherwise indicated, the summarized mod applies to all three instruments.



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MODIFICATION SUMMARY

VERTICAL AMPLIFIER

<u>Mod No.</u>	<u>Description</u>	<u>Kit/MI No.</u>	<u>Eff SN</u>	<u>Page</u>
M9401	Compensation Adjustment Range Centered	MI - 9401	540	14
M9431-1	X10 Gain Switch Changed	Info Only	300	9
M9431-2	Invert Switch Changed	Info Only	300	9
M9491-1	Prevents Triggering on Chopped	MI - 9491-1	158	3
M9491-2	Improves Transient Response	MI - 9491-2	158	4
M9499-1	Compensation Adj. Range Centered	Info Only	760	24
M9499-2	Improves Transient Response	MI - 9499-2	760	24
M9499-3	Improves Transient Response	MI - 9499-3	760	25
M9537-1	Reduces Display Ripple	Info Only	678	22
M9537-2	Delay Line Mounting Improved	Info Only	678	23
M9553	Zener Diodes Changed to Reduce Noise	Info Only	1290	33
M9682	Attenuator Resistors Changed	Info Only	5700	68
M9798	Supply Decoupling Improved	MI - 9798	491	12
M9883	Attenuator Switch Noise Reduced	Info Only	2440	37
M9947	Improved Silicon Diodes Installed	Info Only	3080	50
M10012	Trace Ripple Reduced	MI - 10012	1550	32
M10297	Ferrite Cores Replaced	Info Only	5700	69
M10432	Vertical Aberrations Reduced	Info Only	2710	44
M10621	Attenuator Switch Shaft Couplers Replaced	Info Only	4930	67
M10800	Channel 2 Circuit Board Modified	MI - 10800	3347	56
M10801	Channel 2 Circuit Board Replaced	Info Only	4770	67
M12070	Delay Line Cable Clamp Changed	Info Only	8580	79
M12998	Variable Volts/Div Controls Replaced	Info Only	11370	84

-TRIGGER

M9676	Channel 1 Only Triggering Improved	MI - 9676	269	8
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MODIFICATION SUMMARY

SWEEP GENERATOR

<u>Mod No.</u>	<u>Description</u>	<u>Kit/MI No.</u>	<u>Eff SN</u>	<u>Page</u>
M9661	Nuvistor Insulator Removed	Info Only	1040	28
M9758-1	X10 Magnifier Linearity Improved	Info Only	1060	30
M9947	Improved Silicon Diodes Installed	Info Only	3080	50
M10311	Disconnect Diode Replaced	050-0290-00	3080	51
M11480	High Speed Timing Improved	Info Only	8150	77

HORIZONTAL AMPLIFIER

M9333	Horizontal Positioning Range Improved	Info Only	600	19
M9431-3	X10 Magnifier Switch Replaced	Info Only	300	10
M9491-3	Reduce Horizontal Jitter	MI - 9491-3	158	5
M9758-2	External Horizontal Gain Increased	Info Only	1060	31
M10000	X10 Magnifier Linearity Improved	MI - 10000	1055	29
M10230	Horizontal Amplifier Circuit Board Replaced	Info Only	4135	59
M10231	Timing Stability Improved	Info Only	2600	42
M10491	Ext Horiz Attenuation Range Increased	MI - 10491	2950	49
M10735	Timing Stability Improved	MI - 10735	5700	70
M11721-1	Sweep Cal Pot Changed to Reduce Timing Drift	Info Only	9563	81
M11721-3	E. C Board Changed to Model PG	Info Only	9563	82
# M13831	Osc Ferrite Beads Relocated to Suppression	MI-13831	11710	86
# M13877	Ferrite Bead added to Suppress Oscillation	Info Only	12374	89

CALIBRATOR

M9334	Improve Waveshape and Ground Reference	Info Only	766	26
M9669	Calibrator Amplitude Adj Pot Changed	Info Only	320	10
M9947	Improved Silicon Diodes Installed	Info Only	3080	50

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MODIFICATION SUMMARY

CRT

<u>Mod No.</u>	<u>Description</u>	<u>Kit/MI No.</u>	<u>Eff SN</u>	<u>Page</u>
M9637	CRT Filament Voltage Increased	MI - 9637	158	7
M9643	CRT Filter Support Pads Replaced	MI - 9643	2070	36
M9758-3	Unblanking Centering Adj. Improved	Info Only	1060	32
M9763	Orthogonality Coil Added	050-0264-00	1890	34
M9814	Graticule Light Socket Insulation Installed	MI - 9814	563	15
M9947	Improved Silicon Diodes Installed	Info Only	3080	50
M9993	CRT Cushions Replaced	MI - 9993	1400	28
# M10438	Trace Rotator Coil Leads	Info Only	12350	88
M10517-1	Deflection Sensitivity Stability Improved	MI-10517-1	4330	61
M10517-2	Constant CRT Filament Voltage Provided	Info Only	4330	64
M11721-2	Unblanking Transistors Failures Reduced	Info Only	9563	82
# M12971	CRT filter Support Spring Replaced	Info Only	12176	88
# M13523	Circuit Board Eliminated to Reduce Cost	Info Only	11930	87

AC POWER SUPPLIES

M9303	-12 V Supply Reliability Improved	MI - 9303	589	16
M9613	+12 V Supply Accuracy Improved	Info Only	158	6
M9872	RFI Shielding Improved	MI - 9872	699	23
M9947	Improved Silicon Diodes Installed	Info Only	3080	50
M10075	-12 V Supply Oscillations Eliminated	MI - 10075	2520	40
M10273	Circuit Board Damage Prevented	MI - 10273	4640	66
M10411	Scheduling Changed	Info Only	none	43
M10498	Capacitor Selection Eliminated	Info Only	6280	72
M10723	Q637 and Q657 Insulators Replaced	Info Only	7400	77
M11053	Graticule Light Bulbs Replaced	050-0319-00	7190	76
M11292	Power Cord Ground Connection Improved	040-0424-01	8580	78
M11487	Power Switch Actuator Changed	040-0439-00	6990	74
M11558	1Ω Resistors Changed	Info Only	5706	71
M12509	-81 V Supply Improved	MI - 12509	8761	80

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MODIFICATION SUMMARY

AC-DC POWER SUPPLIES

<u>Mod No.</u>	<u>Description</u>	<u>Kit/MI No.</u>	<u>Eff SN</u>	<u>Page</u>
M9860	Low Line Regulation Improved	Info Only	595 Only	17
M9872	RFI Shielding Improved	MI - 9872	699	23
M9877	Cadmium Plated Hardware Replaced	Info Only	2540	40
M9947	Improved Silicon Diodes Installed	Info Only	3080	50
M9975	Battery Pack Retaining Nuts Replaced	MI - 9975	none	13
M9992	RFI Reduced	MI - 9992	595	18
M10080	+ 12 V and - 12 V Supplies Ripple Reduced	Info Only	2680	43
M10122-1	Steering Switch Lockup Prevented	Info Only	2831	46
M10122-2	RFI Reduced		2831	47
M10122-3	RFI Reduced		2831	48
M10132-1	Converter Circuit Board Changed	Info Only	4043	57
M10132-2	Control Circuit Board Changed	Info Only	4043	57
M10411	Scheduling Changed	Info Only	none	43
M10684	Heat Sink Insulation Improved	MI - 10684	3195	52
M10708	Batteries Replaced	Info Only	none	55
M10723	Q637 and Q657 Insulators	Info Only	7400	77
M10808	Wiring and Color Coding Changed	MI - 10808	3912	56.1
M11053	Graticule Light Bulbs Replaced	050-0319-00	7190	76
M11292	Power Cord Ground Connection Improved	040-0424-01	8580	78
M11365	Transistor Selection Eliminated	Info Only	4530	65
M11373	D1192 Replaced	Info Only	6230	72
M11387	Transistor Breakdown Prevented	MI - 11387	6990	73
M11487	Power Switch Actuator Changed	040-0439-00	6990	74
M11526	Bracket Changed to Prevent Shorting	Info Only	5700	71
M12509	-81 V Supply Improved	MI - 12509	8761	80
# M13796	Transistors Changed to Improve Stability & Reduce Cost	Info Only	11682	85

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MODIFICATION SUMMARY

MISCELLANEOUS

<u>Mod No.</u>	<u>Description</u>	<u>Kit/MI No.</u>	<u>Eff SN</u>	<u>Page</u>
Pilot - 2	Front Casting Gasket Changed	Info Only	122	3
M9271	New Motor Base Installed	Info Only	9530	81
M9638	Patch Cord Removed From Accessory Kit	Info Only	350	11
M9960	Replace Storage Compartment Hinges & Pins	MI - 9960	4000	58
M10202	Instrument Handle Assy. Changed	Info Only	3200	53
M10727	Instr. & Power Supply Serial Numbers Matched	Info Only	none	55
## M11191	Zener Diodes Replaced with 5% Type	Info Only	12820	90
M11427-1	Solder Spool Location Changed	Info Only	8580	78
M11427-2	Improved Latch Installed	MI-11427-2	8580	79
M11641	P6006 Probe Replaced	Info Only	6990	75
M12876	Motor Base Changed to Improve Ground Conn	MI-12876	10650	83
# M13768	I.D. Tag Added to Power Cable	Info Only	12610	90

FRONT SUBPANEL CHANGED
TO MORE SATISFACTORY TYPE

INFORMATION ONLY

PILOT-2**

Effective Prod s/n 122

DESCRIPTION:

The old front subpanel gasket was changed to a new gasket which is poured and baked into the front panel casting. The old gasket was glued in and cannot be replaced by the new molded gasket in older instruments.

Parts Removed:

Gasket, front subpanel 214-0552-00

** Pilot-1, 2, etc, designate modifications installed in Pilot Production that were not assigned a standard mod number.

VERTICAL AMPLIFIER CABLE CHANGE
DECREASES TENDENCY TO TRIGGER
ON CHOPPING IN CH 1 ONLY MODE

See SQB

M9491-1

Effective Prod s/n 158 Usable in field instruments s/n 100-157
w/exceptions 102-3, 107, 128, 133, 141, 146-7, 154, 156

FRONT PANEL SYMPTOM:

A tendency for triggering on the chopped signal with TRIGGER SOURCE switch in Ch 1 Only and VERTICAL MODE switch in Chopped.

PROBLEM:

Wire dress in the cable is such that the chopping transients are fed to the trigger circuit causing the instrument to trigger on the chopping transients. Some instruments are worse than others.

PRODUCTION CHANGE:

The breakout points of the Variable Balance pot (R35) wires have been changed in the Vertical cable to reduce feed-through from the chopper.

INSTALLATION INSTRUCTIONS:

See MI - 9491-1.

CH 1 VERTICAL AMPLIFIER CABLE
CHANGE REDUCES ABERRATION
CAUSED BY SWEEP START

See SQB

M9491-2

Effective Prod s/n 158

Usable in field instruments s/n 100-157

w/exceptions 102-3, 107, 128, 133, 141, 146-7, 154, 156

FRONT PANEL SYMPTOM:

Vertical aberration near start of sweep.

PROBLEM:

Sweep start transients are being fed into the vertical amplifier by way of the filament wire of V13 and the wire from connector M, Cal Board to connector D, Ch 2 Input Amp Board.

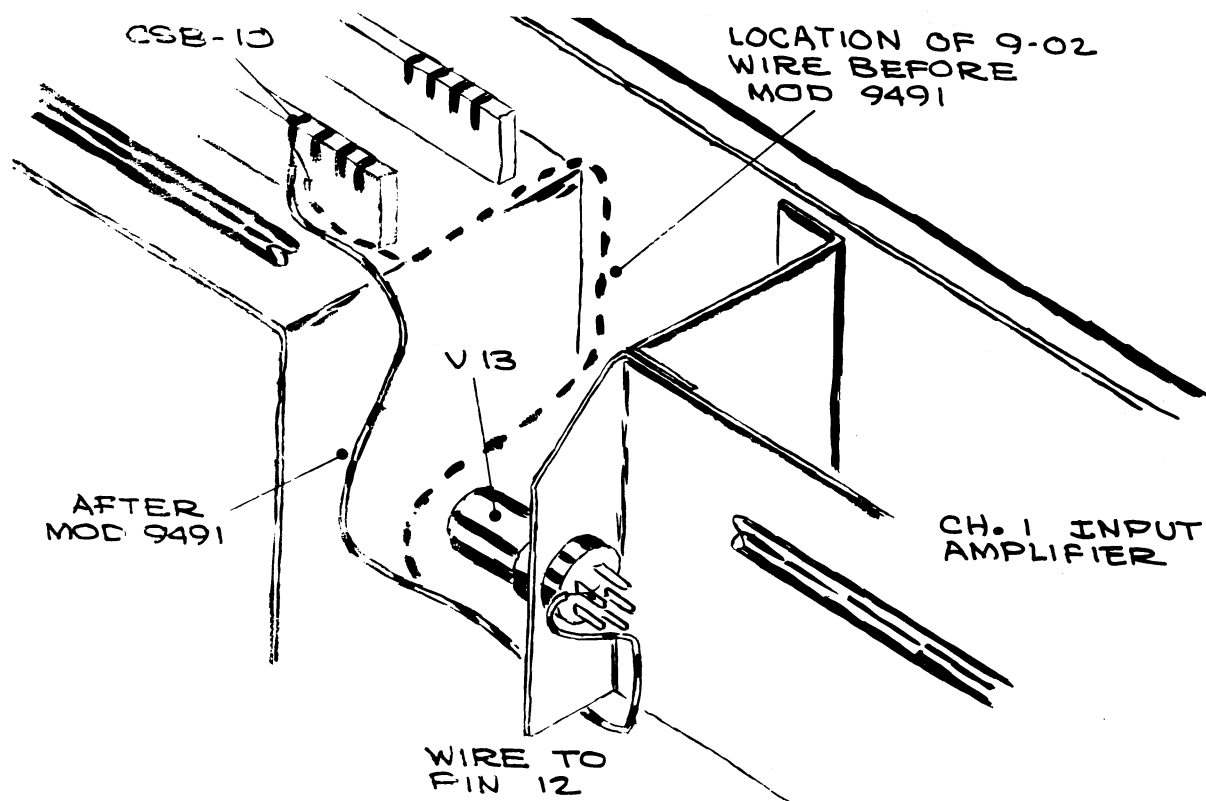
PRODUCTION CHANGE:

The sweep feed-through is reduced by:

- 1) Removing the filament wire from V13 from the cable and rerouting it.
- 2) Partially removing from the cable the wire from connector M, Cal Board to connector D, Ch 2 Input Amp Board.

INSTALLATION INSTRUCTIONS:

See MI - 9491-2.



HORIZONTAL POSITION CONTROL
DECOUPLING IMPROVED TO REDUCE
JITTER WITH AC-DC POWER SUPPLY

See SQB

M9491-3

Effective Prod s/n 158

Usable in field instruments s/n 100-157

w/exceptions 102-3, 107, 128, 133, 141, 146-7, 154, 156

FRONT PANEL SYMPTOM:

Horizontal jitter.

PROBLEM:

Noise on the -12 volts from the AC-DC power supply is causing horizontal jitter.

PRODUCTION CHANGE:

Improve the decoupling to the Horizontal Position control by increasing R531 to 620Ω and C531 to 22μf.

Parts Removed:

C531	Capacitor, EMT, 3.3 μf 15 v	290-0246-00
R531	Resistor, comp, 330Ω 1/4w 5%	315-0573-00

Parts Added:

C531	Capacitor, EMT, 22 μf 15 v	290-0134-00
R531	Resistor, comp, 620Ω 1/4w 5%	315-0621-00

INSTALLATION INSTRUCTIONS:

See MI - 9491-3.

**+12V POWER SUPPLY RESISTOR VALUE
CHANGED TO REDUCE THE EFFECT
OF TOLERANCE BUILDUP**

INFORMATION ONLY

M9613
(422, R422 ONLY)

Effective Prod s/n 158
w/exceptions 102-3, 128, 133, 136, 141, 146, 147, 154, 156

FRONT PANEL SYMPTOM:

None.

PROBLEM:

Due to the buildup of tolerances it was some times necessary to select resistors to maintain the proper voltage output.

PRODUCTION CHANGE:

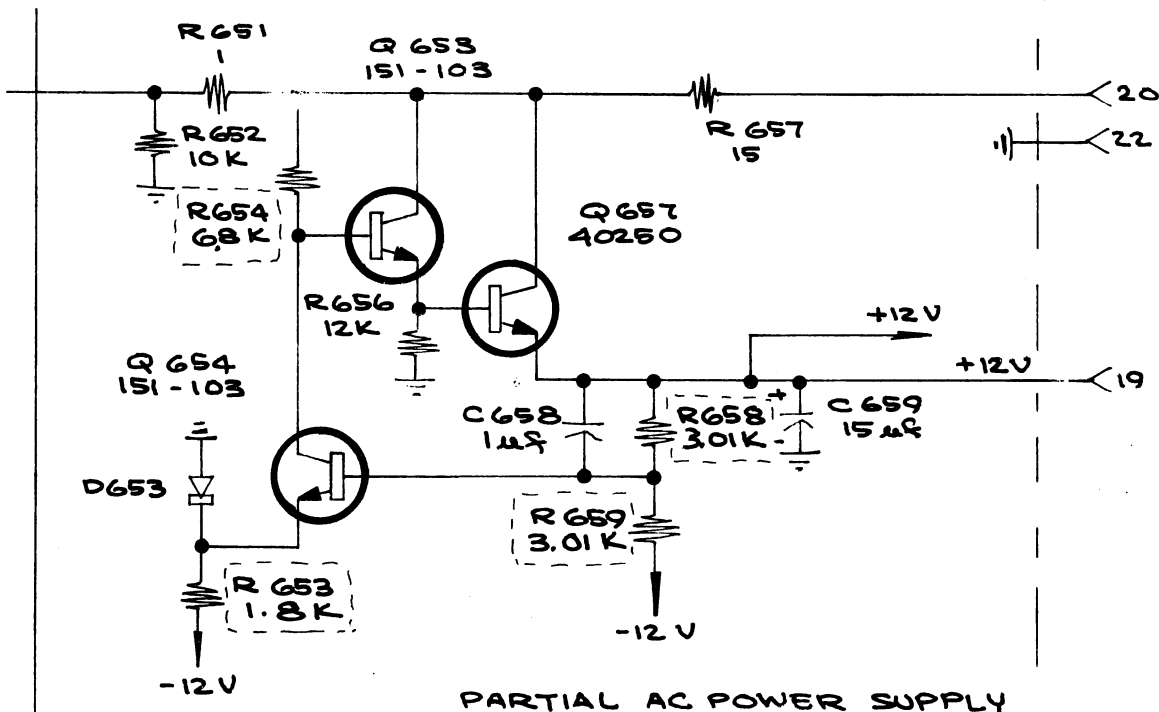
Several resistor values have been changed to reduce the need of selecting parts.

Parts Removed:

R653	Resistor, comp, 2k 1/4w 5%	315-0202-00
R654	Resistor, comp, 6.2k 1/4w 5%	315-0622-00
R658	Resistor, prec, 4.87k 1/8w	321-0259-00
R659	Resistor, prec, 4.99k 1/8w	321-0260-00

Parts Added:

R653	Resistor, comp, 1.8k 1/4w 5%	315-0182-00
R654	Resistor, comp, 6.8k 1/4w 5%	315-0682-00
R658, R659	Resistor, prec, 3.01k 1/8w	321-0239-00



NOTE:
DOTTED LINES
INDICATE CHANGES

NOTE:
SHADED AREAS
INDICATE CHANGES

**CRT FILAMENT VOLTAGE INCREASED
BY CHANGING HV TRANSFORMER
AND FILAMENT RECTIFIER-CAPACITOR**

See SQB

M9637

Effective Prod s/n 158

Usable in field instruments s/n 100-157

w/exceptions 102-3, 126, 128, 133, 136, 141, 146, 147, 154, 156

FRONT PANEL SYMPTOM:

May have slower than normal writing rate.

PROBLEM:

CRT filament voltage is too low, the filament supply rectifier D849 is too slow turning on, and the AC resistance of the filter capacitor C849 is too high.

PRODUCTION CHANGE:

The CRT filament winding on HV transformer 120-0378-00 was increased from 11 to 12 turns.

D849 was changed from 153-0007-00 to 152-0179-00 which has a faster switching time.

C849 was changed from 290-0248-00 to 290-0248-01 which has a lower AC resistance allowing faster charging.

Parts Removed:

T801	Transformer, HV	120-0378-00
D849	Diode, 152-0047-01, checked	153-0007-00
C849	Capacitor, EMT, 150µf 15v w/ins sleeve	290-0248-00

Parts Added:

T801	Transformer, HV	120-0378-01
D849	Diode, rectifier, transatron, Unitrode	152-0179-00
C849	Capacitor, EMT, 150µf w/ins sleeve (Sprague)	290-0248-01

INSTALLATION INSTRUCTIONS:

See MI - 9637.

SWEEP TRIGGER AMPLIFIER
 GAIN INCREASED TO IMPROVE
 CHANNEL 1 ONLY TRIGGERING

See SQB

M9676

Effective Prod s/n 269					Usable in field instruments s/n 100-268				
w/exceptions	102	128	154	188	209	218-21	231-3	249	260-3
	107	143	156	197	212-3	226	240	252-4	265
	113	146-7	158	204	215	228-9	244	256	267

FRONT PANEL SYMPTOM:

None.

PROBLEM:

It is necessary to select components to meet the Channel 1 Only triggering requirement at 4.5 MHz with 0.8 divisions of displayed signal.

PRODUCTION CHANGE:

The trigger input emitter follower (Q323) emitter resistor, R323, was changed from a 16k 1/4w 5% to a 5.6k 1/4w 5% resistor to increase the base current drive to Q324.

Parts Removed:

R323	Resistor, comp, 16k 1/4w 5%	315-0163-00
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Parts Added:

R323	Resistor, comp, 5.6k 1/4w 5%	315-0562-00
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INSTALLATION INSTRUCTIONS:

See MI - 9676.

CHANNEL 2 X10 GAIN AC SWITCH
CHANGED TO TYPE WITHOUT DETENTS
TO IMPROVE ROUGH SWITCHING ACTION

INFORMATION ONLY

M9431-1

Effective Prod s/n 300

FRONT PANEL SYMPTOM:

None.

PROBLEM:

The combination of the actuator and the detent make the switching action rough.

PRODUCTION CHANGE:

The Channel 2 X10 GAIN AC switch was replaced with a new type switch without detents.

Parts Removed:

SW150	Switch, X10 GAIN AC, w/detents	260-0583-00
-------	--------------------------------	-------------

Parts Added:

SW150	Switch, X10 GAIN AC, w/o detents	260-0583-01
-------	----------------------------------	-------------

CHANNEL 2 INVERT SWITCH
CHANGED TO TYPE WITHOUT DETENTS
TO IMPROVE ROUGH SWITCHING ACTION

INFORMATION ONLY

M9431-2

Effective Prod s/n 300

FRONT PANEL SYMPTOM:

None.

PROBLEM:

The combination of the actuator and the detent make the switching action rough.

PRODUCTION CHANGE:

The Channel 2 INVERT switch was replaced with a new type switch without detents.

Parts Removed:

SW195	Switch, INVERT, w/detents	260-0583-00
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Parts Added:

SW195	Switch, INVERT, w/o detents	260-0583-01
-------	-----------------------------	-------------

HORIZ AMP X10 MAG SWITCH
CHANGED TO TYPE WITHOUT DETENTS
TO IMPROVE ROUGH SWITCHING ACTION

INFORMATION ONLY

M9431-3

Effective Prod s/n 300

FRONT PANEL SYMPTOM:

None.

PROBLEM:

The combination of the actuator and the detent make the switching action rough.

PRODUCTION CHANGE:

The HORIZ AMP X10 MAG switch was replaced with a new type switch without detents.

Parts Removed:

SW535	Switch, X10 MAG, w/detents	260-0583-00
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Parts Added:

SW535	Switch, X10 MAG, w/o detents	260-0583-01
-------	------------------------------	-------------

CAL AMPLITUDE POT VALUE CHANGED
TO ACCOMMODATE SPECIFICATION
CHANGE ON ZZ1000 GAS TUBE

INFORMATION ONLY

M9669

Effective Prod s/n 320

FRONT PANEL SYMPTOM:

None.

PROBLEM:

The manufacturer has changed the specifications of the ZZ1000 gas regulator tube used for V739. This allows a wider range for the -81 v supply and the 5 k Cal Ampl range may not be sufficient in all cases.

PRODUCTION CHANGE:

The Calibrator Amplitude potentiometer has been changed from 5k to 10k. Instruments with a 5 k pot should not have a problem unless V739 has been replaced.

Parts Removed:

R780	Potentiometer, 5 k \pm 20% linear w/EC mtg type FR	311-0463-00
------	---------------------------------------------------------	-------------

Parts Added:

R780	Potentiometer, 10 k \pm 20% linear w/EC mtg type FR	311-0510-00
------	----------------------------------------------------------	-------------

PATCH CORD REMOVED FROM ACCESSORY
KIT BECAUSE OF NO APPARENT NEED

INFORMATION ONLY

M9638

Effective Prod s/n 350

FRONT PANEL SYMPTOM:

None.

PROBLEM:

No apparent need for a BNC to BNC black 6 in patch cord.

PRODUCTION CHANGE:

The patch cord, 012-0084-00, has been removed from the standard accessory list.

Parts Removed:

Cord, patch, BNC-BNC, 6in. long

012-0084-00

**CHANNEL 2 INPUT AMPLIFIER DECOUPLING
IMPROVED TO REDUCE TRACE RIPPLE
WHEN USING THE AC-DC POWER SUPPLY**

See SQB

M9798

Effective Prod SN 491

Usable in field instruments SN 100-490

w/exceptions	146	366	388	404-6	430	464
	154	369	390	411-12	433	470
	156	376-80	392	416	437	472-9
	256	382	398-9	422	445-6	481-9
	327	386	401	427	449-59	

FRONT PANEL SYMPTOM:

Ripple on trace in the 0.01 MV/DIV X10 GAIN Mode when using the AC-DC power supply.

PROBLEM:

The ripple and noise on the +12 volts can cause trace ripple when using the AC-DC power supply.

PRODUCTION CHANGE:

The value of C122 was changed from 22 μ f to 47 μ f to reduce the power supply noise and ripple.

Parts Removed:

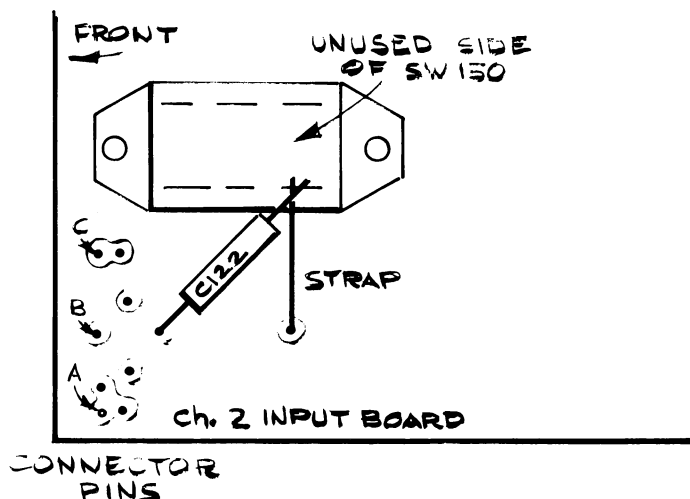
C122 Capacitor, EMT, 22 μ f 15 v \pm 20% 290-0134-00

Parts Added:

C122 Capacitor, EMC, 47 μ f 6 v \pm 20% 290-0114-00

INSTALLATION INSTRUCTIONS:

See MI - 9798.



**BATTERY PACK RETAINING NUTS
CHANGED TO STAINLESS STEEL TO
FACILITATE BATTERY PACK INSTALLATION**

See SQB

M9975
(125B ONLY)

Effective Prod s/n not given

Usable in field instruments s/n *

FRONT PANEL SYMPTOM: Difficulty in removing and installing battery pack retaining screws.

PROBLEM: The plating on the retaining screw flakes off and binds up when used with cadmium plated brass nuts. It is sometimes very difficult to remove and install the screws a second time.

PRODUCTION CHANGE: The cadmium plated retaining nuts were replaced with stainless steel nuts, which do not bind as badly.

Parts Removed:

Nut, hex, brass, 6-32 x 1/4 (9) 210-0407-00

Parts Added:

Nut, hex, stainless steel 6-32 x 1/4 (9) 220-0456-00

INSTALLATION INSTRUCTIONS:

See MI -9975.

NOTE: Without having the brass and stainless steel nuts together, it is difficult to identify the differences. The replacement criteria should be based upon the above listed "Problem".

OUTPUT AMPLIFIER HF COMPENSATION
RANGE CENTERED BY CHANGING C238

See SQB

M9401

Effective Prod s/n 540

Usable in field instruments s/n 100-539

FRONT PANEL SYMPTOM:

None.

PROBLEM:

C237 adjustment range is not centered.

PRODUCTION CHANGE:

C238 was changed from 5.6pf to a 3.3 pf capacitor. This more nearly centers the range of adjustment.

Parts Removed:

C238	Capacitor, cer, 5.6pf 500v NPOA	281-0544-00
------	---------------------------------	-------------

Parts Added:

C238	Capacitor, cer, 3.3 pf 500v NPO	281-0534-00
------	---------------------------------	-------------

INSTALLATION INSTRUCTIONS:

See MI - 9401.

**GRATICULE LAMP SOCKET INSULATION
ADDED TO PREVENT POSSIBLE SHORT CIRCUIT**

See SQB

M9814

Effective Prod SN 563

Usable in field instruments SN 100-562

w/exceptions	146	327	390	411	449-59	491	505	551-2
	147	369	392	412	476	494-5	508	554-61
	154	376	398	416	479	499	510-19	
	156	379	406	446	488	500	546-8	

FRONT PANEL SYMPTOM:

May cause graticule lamps to be inoperative.

PROBLEM:

Graticule lamp sockets may short to the CRT shield. This may overheat R657 in the AC power supply, and may damage D1214 and D1215 in the AC-DC power supply. Some instruments may have been shipped with +12v connected in error to the outside terminal of the socket.

PRODUCTION CHANGE:

- 1) The graticule lamp holder was insulated (inside) with 3/16 in. of clear no.7 vinyl tubing, to prevent the center electrode spring from buckling and causing a short circuit to the inside of the shell terminal.
- 2) The graticule lamp holder was insulated (outside) with a 1/2 in. length of no.2 clear vinyl tubing, to prevent the outside of the shell terminal from shorting to the CRT shield.

Parts Added:

Tubing, clear vinyl, no.7	5/32 in.	(2)	162-0012-00
Tubing, clear vinyl, no.2	1/2 in.	(2)	162-0019-00

INSTALLATION INSTRUCTIONS:

See MI - 9814.

-12 V POWER SUPPLY COMPONENTS
CHANGED TO PROVIDE GREATER RELIABILITY
UNDER ENVIRONMENTAL CHANGES

See SQB

M9303
(Not for 125B)

Effective Prod s/n 589

Usable in field instruments s/n 100-588

w/exceptions -- 412 shipped w/modified AC Power Supply
697 shipped w/unmod'd AC Power Supply

FRONT PANEL SYMPTOMS:

None.

PROBLEM:

- 1) The -12v reference zener diode D622 is no longer available with the desired temperature range compensation.
- 2) Resistor R639 (-12v) is prone to change resistance under humid conditions.
- 3) -12v power supply transistors Q624 and Q634 were changed to reduce costs while providing equal quality.

PRODUCTION CHANGE:

- 1) D622 was changed from a 1N752A (5.6v) to a 1N9369 (9v) diode.
- 2) R639 was changed from a 2.5k resistor to a 1.5k potentiometer. This also made it necessary to change the following resistors. R622, R624, R634, R637 and R638.
- 3) -12v power supply transistors Q624 and Q634 were changed from 2N2219 to special Tek made 151-0151-00 transistors.

Parts Removed:

D622	Diode, 1N752A	152-0175-00
R639	Potentiometer, comp, 2.5k \pm 20%	311-0496-00
R622	Resistor, comp, 1k 1/4w 5%	315-0102-00
R634	Resistor, comp, 2.4k 1/4w 5%	315-0242-00
R624	Resistor, comp, 620 Ω 1/4w 5%	315-0621-00
R638	Resistor, prec, 4.02k 1/8w 1%	321-0251-00
R637	Resistor, prec, 6.34k 1/8w 1%	321-0270-00
Q624, Q634	Transistor, 2N2219	151-0103-00

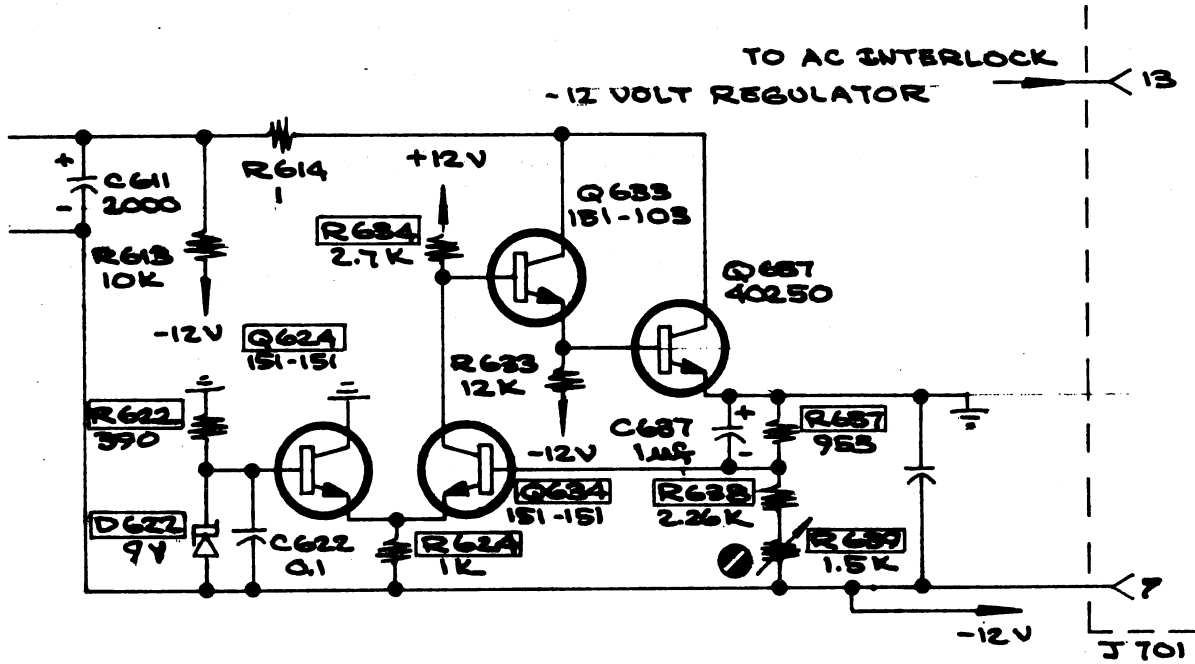
Parts Added:

D622	Diode, 1N936	152-0212-00
R639	Potentiometer, WW, 1.5k \pm 5%	311-0532-00
R624	Resistor, comp, 1k 1/4w 5%	315-0102-00
R634	Resistor, comp, 2.7k 1/4w 5%	315-0272-00
R622	Resistor, comp, 390 Ω 1/4w 5%	315-0391-00
R637	Resistor, prec, 953 Ω 1/8w 1%	321-0191-00
R638	Resistor, prec, 2.26k 1/8w 1%	321-0227-00
Q624, Q634	Transistor, silicon, NPN T05 B=100 at 0.5ma GP low current	151-0151-00

INSTALLATION INSTRUCTIONS:

See MI - 9303.

continued



PART OF AC POWER SUPPLY

NOTE:
BLOCKED AREAS INDICATE
COMPONENTS CHANGED.

**POWER REGULATOR ERROR AMPLIFIER
TRANSISTOR CHANGED TO SELECTED PART
TO IMPROVE LOW LINE REGULATION**

INFORMATION ONLY

M9860
(125B ONLY)

Effective Prod s/n 595 only

FRONT PANEL SYMPTOM:

None.

PROBLEM:

If Q1154 doesn't have high enough beta, poor power supply regulation at low line results.

PRODUCTION CHANGE:

Q1154 has been changed from 2N2219 to a 2N2219 selected for a minimum beta of 150.
Also see M13796.

Parts Removed:

Q1154	Transistor, 2N2219 NPN	151-0103-00
-------	------------------------	-------------

Parts Added:

Q1154	Transistor, 2N2219 (151-0103-00 selected for minimum beta of 150)	153-0539-00
-------	-------------------------------------------------------------------	-------------

AC-DC POWER CONNECTOR
GROUND LEAD CONNECTING
POINT CHANGED TO REDUCE RFI

See SQB

M9992
(125B ONLY)

Effective Prod s/n 595
w/exceptions 160-4

Usable in field instruments s/n 100-594

FRONT PANEL SYMPTOM:

The 422-2 (AC-DC power supply) may have excessive RF radiation.

PROBLEM:

The ground lead connecting point for the AC-DC power connector is not located in the best place for low RFI.

PRODUCTION CHANGE:

The power connector ground lead tie-point was changed from the converter etched circuit board to a ground lug adjacent to the power connector.

Parts Removed:

Wire, no.22 solid, white	10in.	175-0522-00
--------------------------	-------	-------------

Parts Added:

Lug, solder, SE4		210-0201-00
Nut, hex, 4-40 x 3/16		210-0406-00
Stud, pem, 4-40 x 1/4		** 355-0055-00
** subpart of 407-0123-00		

INSTALLATION INSTRUCTIONS:

See MI - 9992.

**HORIZONTAL AMPLIFIER CIRCUIT
CHANGES INSURE ADEQUATE
HORIZONTAL POSITIONING RANGE**

INFORMATION ONLY

M9333

Effective Prod s/n 600

FRONT PANEL SYMPTOM:

Poor Horizontal positioning range.

PROBLEM:

An offset current is required in the Horizontal Amplifier Input to position the spot near the center of the CRT when switching from Normal Sweep to External Horizontal Mode.

PRODUCTION CHANGE:

The offset current was supplied by adding extra switch contacts to ground the base of Q513 through a 100Ω resistor in all positions of the TIME/DIV switch, except the Ext Horiz position. The EC board number was changed because of the resistor change. Parts Replacement Kit 050-0285-00 is available to facilitate the replacement of the HORIZONTAL AMPLIFIER BOARD only.

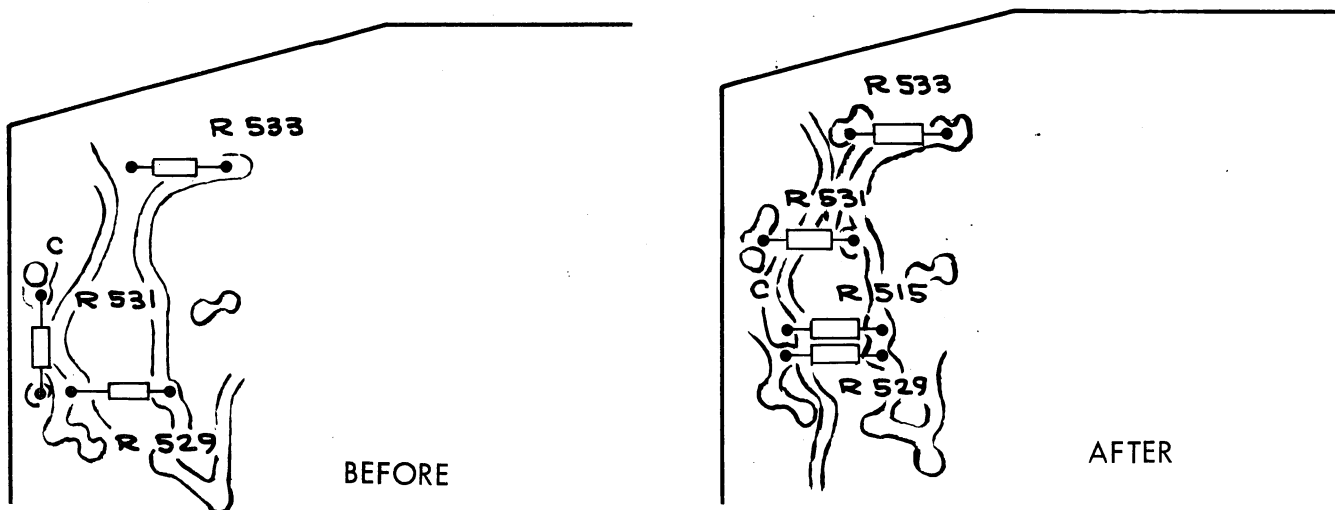
Parts Removed:

SW440	Switch, TIME/DIV, wired	262-0711-00
R529	Resistor, comp, 120k 1/4w 5%	315-0124-00
R533	Resistor, comp, 27k 1/4w 5%	315-0273-00
	EC Board, Horizontal Amplifier	388-0615-00

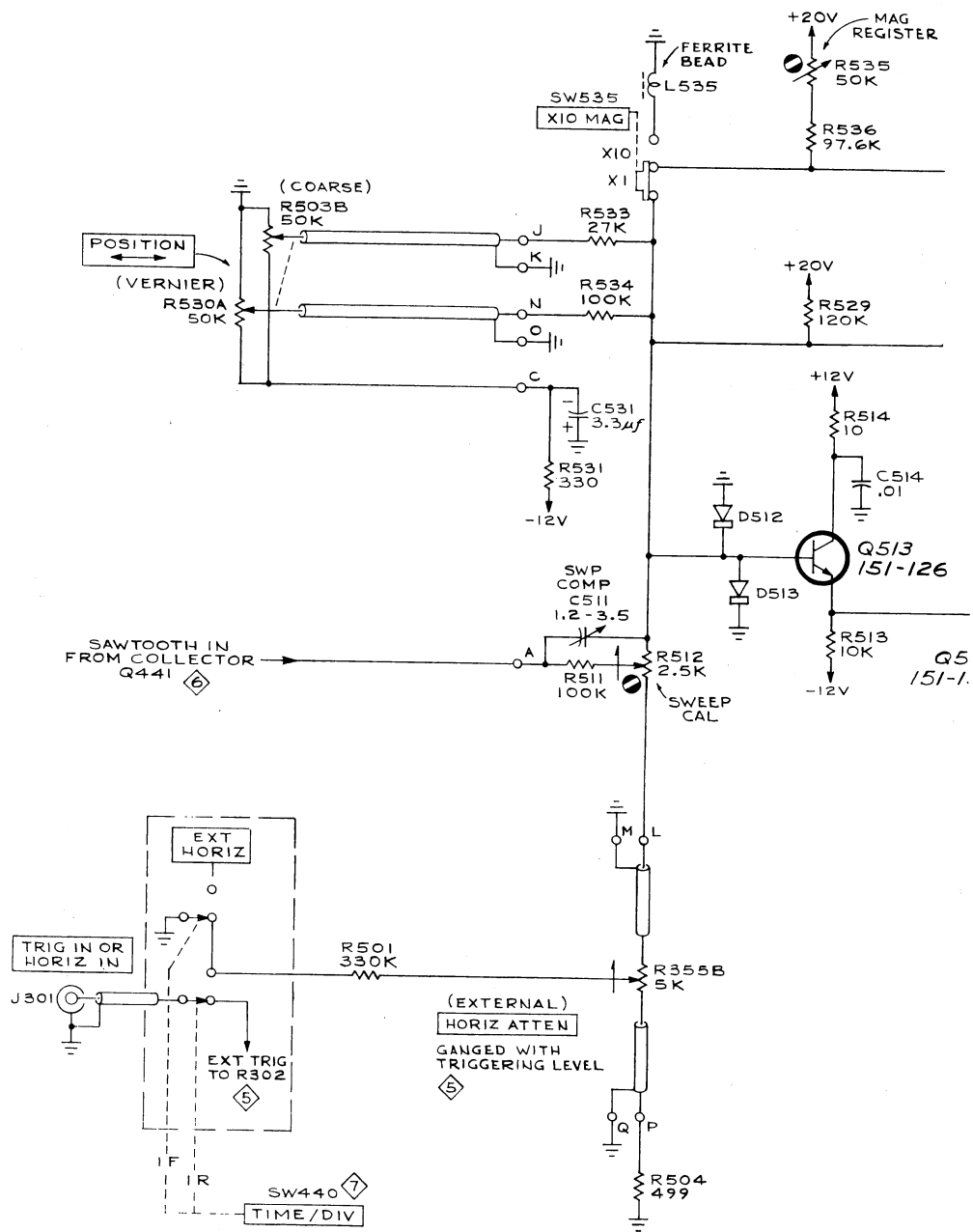
Parts Added:

SW440	Switch, TIME/DIV, wired	262-0722-00
R515, **R516	Resistor, comp, 100k 1/4w 5%	315-0104-00
R529	Resistor, comp, 330k 1/4w 5%	315-0334-00
R533	Resistor, comp, 36k 1/4w 5%	315-0363-00
	EC Board, Horizontal Amplifier	388-0615-01
	Wire, no.26 str, white-yellow 5-3/4 in.	175-0529-00
	Wire, no.26 str, white-brown-red 4-1/4 in.	175-0529-00
	Connector, single contact (2)	131-0371-00

** Subpart of TIME/DIV switch



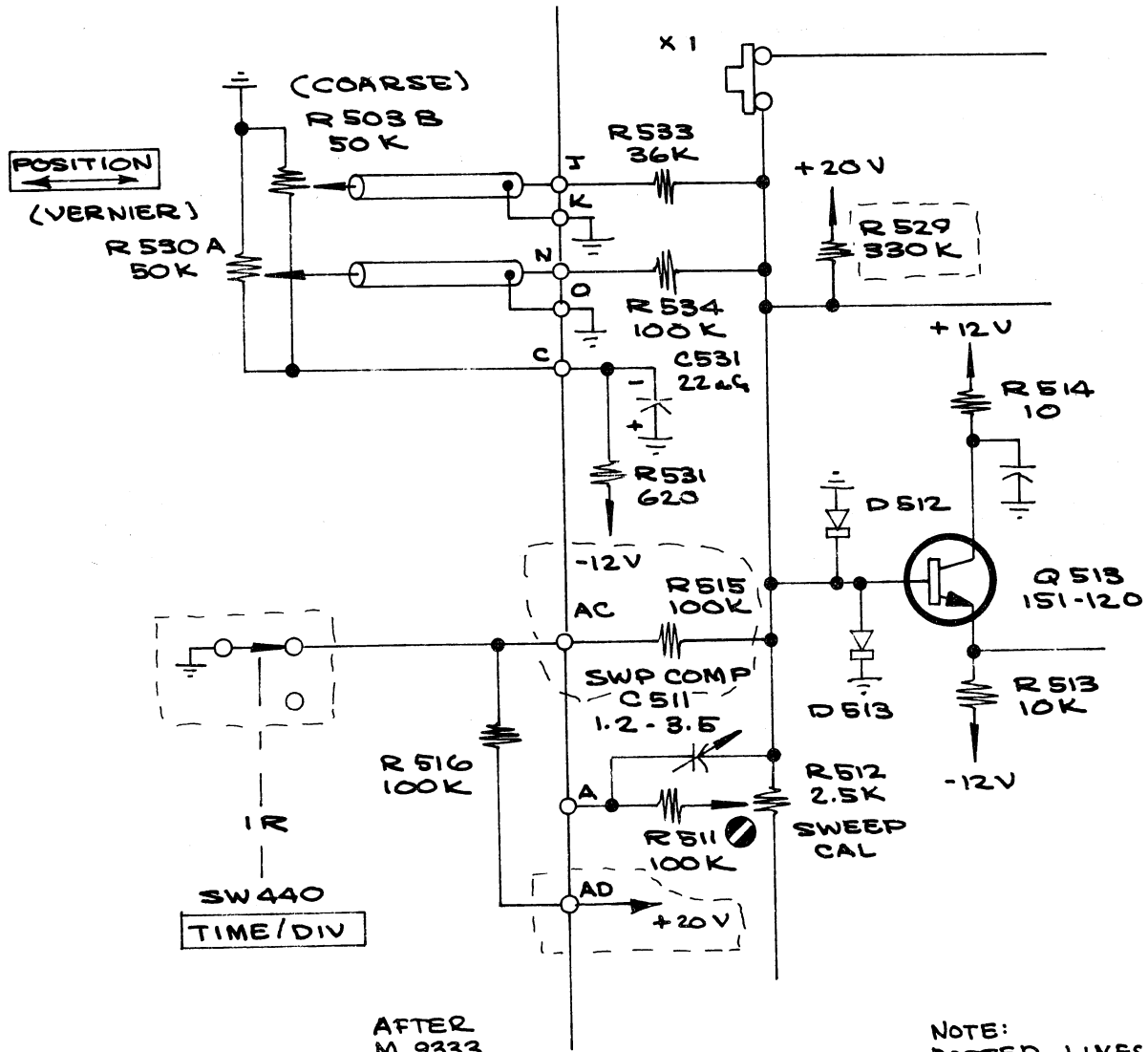
See Before and After schematics on following pages.



REFERENCE DIAGRAMS:

- ⑤ SWEEP TRIGGER
- ⑥ SWEEP GENERATOR
- ⑦ TIMING SWITCH
- ⑧ CRT CIRCUIT

BEFORE
M9333



VERTICAL SWITCHING AND OUTPUT AMPLIFIER
CIRCUIT BOARD MOUNTING BRACKET ADDED
TO REDUCE HIGH VOLTAGE RADIATION

INFORMATION ONLY

M9537-1

Effective Prod s/n 678

FRONT PANEL SYMPTOM:

Small amount of high voltage pickup may be seen on CRT at high Vertical sensitivity setting.

PROBLEM:

High voltage ripple radiates through the opening remaining when the Vertical Switching and Output Amplifier circuit board mounting tab is formed.

PRODUCTION CHANGE:

The circuit board was mounted with a bracket and thereby eliminated the rise of the tab. The tab was eliminated by changing the chassis design and designing a new bracket to take the place of the tab.

Parts Removed:

Chassis, main frame		441-0601-00
Nut, hex, 4-40 x 3/16	(2)	210-0406-00

Parts Added:

Chassis, main frame		441-0601-01
Bracket, angle		407-0205-00
Screw, 4-40 x 1/4 PHS		211-0008-00
Nut, locking, 4-40 x 1/4	(4)	210-0589-00

DELAY LINE ASSEMBLY MOUNTING
IMPROVED BY INCREASING LENGTH
AND NUMBER OF MOUNTING STUDS

INFORMATION ONLY

M9537-2

Effective Prod s/n 678

FRONT PANEL SYMPTOM:

None.

PROBLEM:

The delay line assembly is not adequately held with two captive studs.

PRODUCTION CHANGE:

The length of the present mounting studs were increased and two additional mounting studs were added to strengthen the mounting of the delay line assembly.

Parts Removed:

Delay Line assembly:	Cover, Delay Line		200-0606-00
	Screw, 4-40 PHS, thread-forming	(2)	213-0088-00
	Holder, Delay Line		352-0083-00

Parts Added:

Delay Line assembly:	Cover, Delay Line		200-0606-01
	Eyelet	(2)	210-0601-01
	Holder, Delay Line		352-0083-01

POWER SUPPLY RFI SHIELDING
IMPROVED BY REMOVING PAINT
FROM CABINET EDGE

See SQB

M9872

Effective Prod SN 699

Usable in field instruments SN 100-698

FRONT PANEL SYMPTOM: In applications where RFI is critical, the 422 may cause excessive RF radiation.

PROBLEM: Incomplete contact between the AC power supply and indicator cabinets (in 125B AC-DC power supply assembly housing, indicator cabinet and battery pack box) was allowing radiated RFI in excess of specification limits. The problem is caused by an insulating layer of paint on the forward edge of the AC power supply housing.

PRODUCTION CHANGE: Paint is no longer applied to front edges of the power supply cabinets, power supply assembly housing and battery pack box.

INSTALLATION INSTRUCTIONS:

See MI - 9872.

INPUT CAPACITANCE RANGE OF
ADJUSTMENT MORE NEARLY CENTERED
WITH NEW VALUE CAPACITORS

INFORMATION ONLY

M9499-1

Effective Prod s/n 760

FRONT PANEL SYMPTOM:

None.

PROBLEM:

When properly adjusted, C12 and C112 are consistently near one end of the adjustment range.

PRODUCTION CHANGE:

The value of C12 and C112 has been changed from 1.7-11 pf to 1.3-5.4 pf.

Parts Removed:

C12, C112	Capacitor, variable, air 1.7-11 pf	281-0102-00
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Parts Added:

C12, C112	Capacitor, variable, air 1.3-5.4 pf	281-0099-00
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VERT AMP COMPENSATION
CHANGED TO REDUCE FRONT
CORNER OVERTHOOT

See SQB

M9499-2

Effective Prod s/n 760

Usable in field instruments s/n 100-759

FRONT PANEL SYMPTOM:

Front corner 1% 2 μ sec spike.

PROBLEM:

The vertical amplifier compensation is not optimum for all instruments. In some cases this results in a 1% 2 μ s time constant spike on the leading edge.

PRODUCTION CHANGE:

R227 has been changed to a test-selected part with a 9.1k nominal value.

INSTALLATION INSTRUCTIONS:

See MI -9499-2.

VERT AMP COMPENSATION
CHANGED TO REDUCE DELAY
LINE TERMINATION BUMP

See SQB

M9499-3

Effective Prod s/n 760

Usable in field instruments s/n 100-759

FRONT PANEL SYMPTOM:

Aberration 300ns after leading edge.

PROBLEM:

Due to changes in transistor characteristics, the value of C242 and C252 (18 pf) no longer provides proper compensation for optimum termination of the delay line.

PRODUCTION CHANGE:

C242 and C252 have been changed to 4.7 pf to improve the delay line termination.

Parts Removed:

C242, C252	Capacitor, ceramic, 18 pf	281-0542-00
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Parts Added:

C242, C252	Capacitor, ceramic, 4.7 pf	281-0592-00
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INSTALLATION INSTRUCTIONS:

See MI - 9499-3.

CALIBRATOR RESISTORS CHANGED
TO REDUCE ROLL-OFF AND
IMPROVE REFERENCE TO GROUND

INFORMATION ONLY

M9334

Effective Prod s/n 766

FRONT PANEL SYMPTOM:

- 1) Roll-off on the front of the Calibrator Waveform.
- 2) The starting base line of the Calibrator Waveform is not referenced to ground when the input is in DC.

PROBLEM:

Same as Front Panel Symptom.

PRODUCTION CHANGE:

- 1) R775 was removed and the circuit board was changed to complete its circuit.
- 2) The EC board was redesigned to conveniently relocate all components. See Before and After drawings.

Parts Removed:

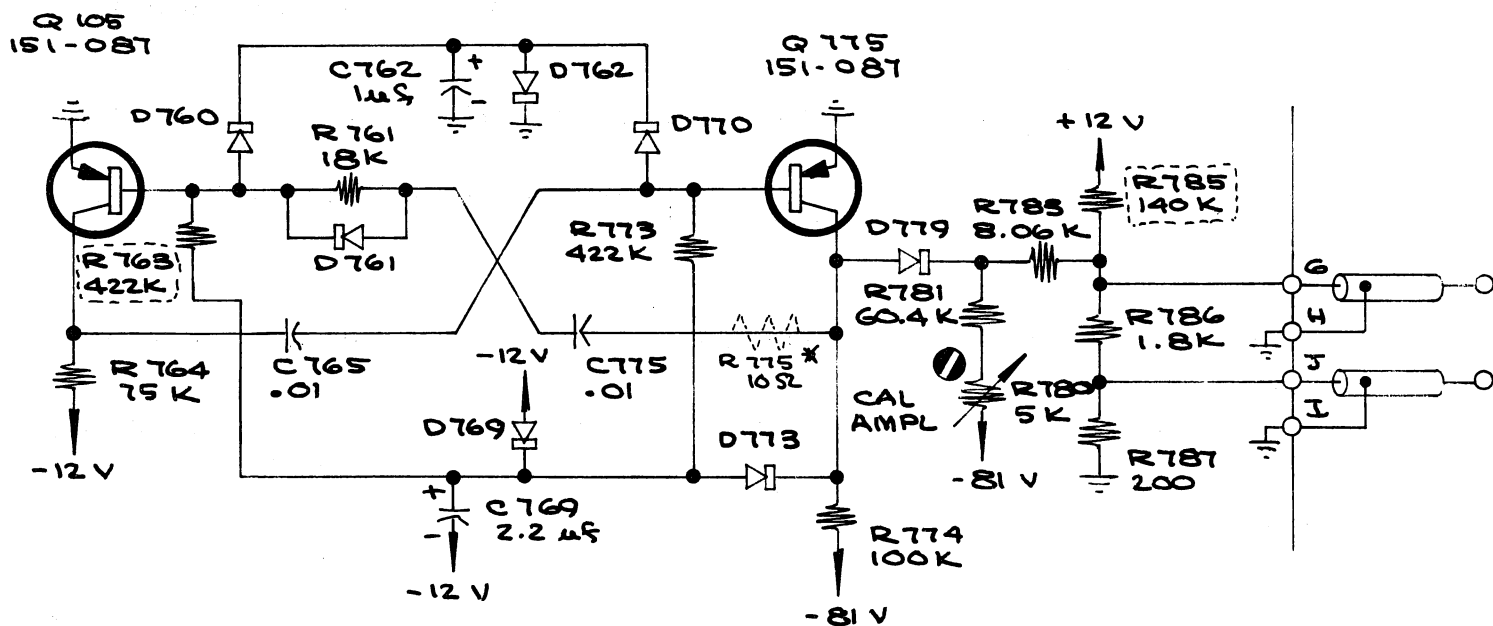
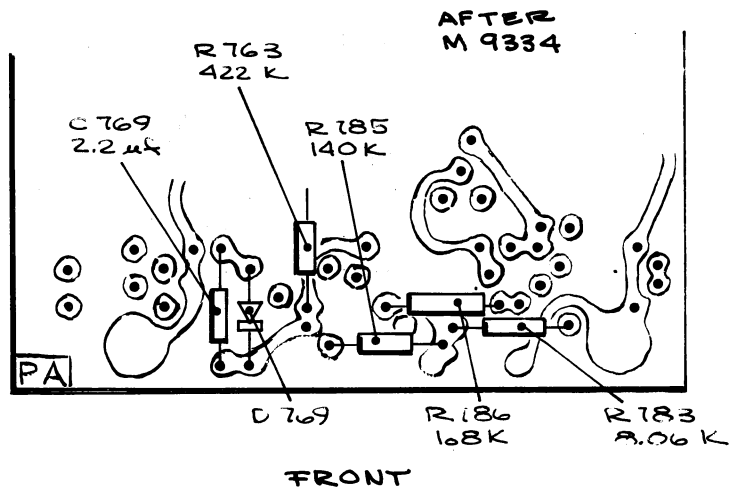
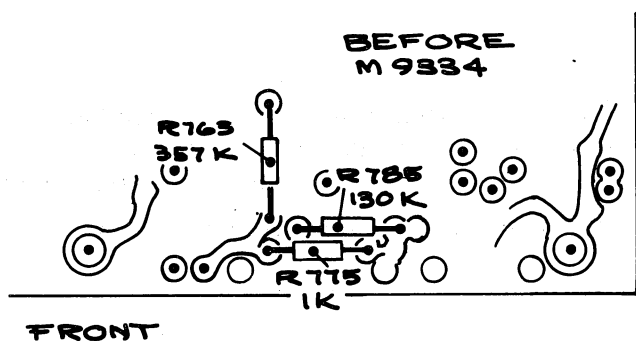
R775	Resistor, comp, 1k 1/4w 5%	315-0102-00
R785	Resistor, comp, 130k 1/4w 5%	315-0134-00
R763	Resistor, prec, 357k 1/8w 1%	321-0438-00
	EC Board, Calibrator	388-0617-00

Parts Added:

R785	Resistor, prec, 140k 1/8w 1%	321-0399-00
R763	Resistor, prec, 422k 1/8w 1%	321-0445-00
	EC Board, Calibrator	388-0617-00

See Before and After drawings, and partial schematic of Calibrator and Regulators on the following page.

continued



* NOTE: M9334 DELETES R775
FIELD INSTALLATIONS
REPLACE IT WITH A
10Ω, 1/4 W 5% RESISTOR.
DOTTED LINES INDICATE
RESISTOR VALUE CHANGES

PART OF CALIBRATOR AND REGULATORS

TRIGGER AND SWEEP NUVISTOR
INSULATING PLATE REMOVED
BECAUSE OF NO APPARENT NEED

INFORMATION ONLY

M9661

Effective Prod s/n 1040

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 was deleted from the instrument.

Parts Removed:

Plate, teflon insulating

387-0603-00

CRT VINYL CUSHION MATERIAL
CHANGED TO SILICONE SPONGE TO
ELIMINATE POSSIBLE CRT FACE FOGGING

See SQB

M9993

Effective Prod s/n 1400

Usable in field instruments s/n 100-1399

FRONT PANEL SYMPTOM: None.

PROBLEM: Under high temperature conditions, the vinyl CRT cushions were causing fogging of the silastic RTV used for bonding 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, .180 x .700 x 2.030 (4)

348-0070-00

Parts Added:

Cushion, CRT silicone sponge, .188 x .690 x 2.030 (4)

348-0070-01

INSTALLATION INSTRUCTIONS:

See MI - 9993.

HORIZONTAL AMPLIFIER TRANSISTOR
 SELECTION FOR MAG LINEARITY
 REDUCED BY ADDING A DIODE

See SQB

M10000

Effective Prod SN 1055 w/exceptions	Usable in field instruments SN 101-1054							
146-7	515	566	648	838	918	1007	1048-50	
156	546-8	581	659	850	942	1009	1053	
369	554	617	676	858	946-8	1010		
398	556	622	762	892	950-1	1017		
411	558	634	819	908	994-5	1037		
416	563	646	821	910	1004	1042-4		

FRONT PANEL SYMPTOM:

X10 Mangifier non-linearity (4-5%) at the start of CRT display.

PROBLEM:

It has been necessary to select Q524 for low storage time to minimize X10 Mag non-linearity. When the leading edge of the trace was positioned off screen to the left, Q544 would saturate, allowing the base of Q513 to rise. At the end of Q524 storage time, Q513 base sees a large error signal and the operational amplifier makes a rapid transition to correct the error. This fast change appears as non-linearity.

PRODUCTION CHANGE:

A diode has been added from base to collector of Q524 with the cathode to Q524 base. This prevents Q524 from saturating. The wiring of protection diode D512 is also changed by connecting the anode to Q513 emitter rather than ground.

Parts Added:

D524	Diode, silicon, 6233	152-0233-00
------	----------------------	-------------

INSTALLATION INSTRUCTIONS: (See below or MI - 10000)

Parts Required: See 'Parts Added'

Installation Procedure:

NOTE: It will be necessary to temporarily remove the Horiz Amp board to relocate D512 and add D524. This may be accomplished by removing three screws which secure the board to the instrument. Care should be exercised when lifting up the board so that wire terminal clips do not bend or accidentally become disconnected.

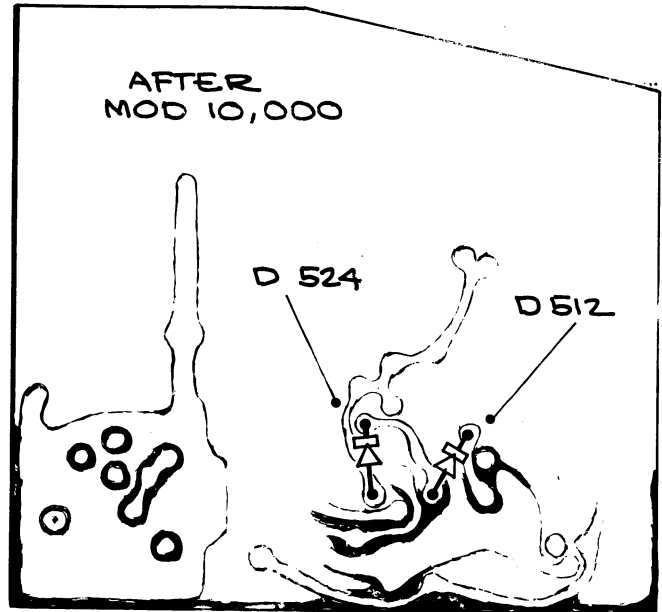
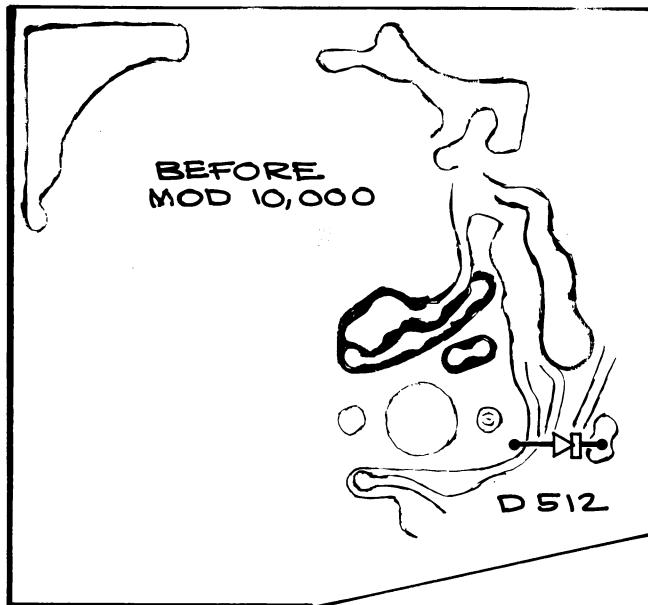
- a) Add D524 between the base* and collector of Q524, which is located on the bottom of the Horiz Amp EC board.
- b) Relocate D512 (6185 diode), located at the top of the Horiz Amp EC board between the base* of Q513 and ground, to the bottom of the board between the base* and emitter of Q513.

* Denotes cathode end of diode.

See Before and After drawings of Horiz Amp EC board on following page.

continued

TOP OF HORIZ. AMPLIFIER
E.C. BOARD 388-0615-00



BOTTOM OF HORIZ. AMPLIFIER
E.C. BOARD 388-0615-00

SWEEP GENERATOR PLASTIC
INSULATED WIRE CHANGED TO TEFLON
FOR IMPROVED MAGNIFIED LINEARITY

INFORMATION ONLY

M9758-1

Effective Prod s/n 1060

FRONT PANEL SYMPTOM:

Non-linearity in 10 μ sec X10 Mag position.

PROBLEM:

The 'soak' effect of the plastic insulated wire causes non-linearity of the time base when used to connect the sweep generator to the timing switch, however, the non-linearity is normally within specifications.

PRODUCTION CHANGE:

Magnifier linearity was improved by changing from plastic to teflon insulation on the wires from connectors 'W' and 'X' on the Sweep Generator board to the TIME/DIV switch contacts 3FR2 and 4FR2 respectively.

continued

Parts Removed:

Wire, no.26 plastic stranded,	white-brown	175-0529-00
Wire, no.26 plastic stranded,	white-green	175-0529-00
Wire, no.26 plastic stranded,	white-green w/connector	175-0529-00

Parts Added:

Wire, no.24 teflon stranded,	brown	10 in.	175-0639-00
Wire, no.24 teflon stranded,	blue	8 in.	175-0640-00
Wire, no.24 teflon stranded,	blue	3-1/2 in.	175-0640-00
	(w/connector	131-0371-00)	

EXTERNAL HORIZ INPUT RESISTOR VALUE
CHANGED TO ASSURE ADEQUATE GAIN
UNDER WORST CASE TOLERANCE CONDITION

INFORMATION ONLY

Effective Prod s/n 1060

FRONT PANEL SYMPTOM:

None.

PROBLEM:

Under worst case tolerance conditions it was possible to have insufficient Ext Horizontal gain. This required selection of components.

PRODUCTION CHANGE:

The value of R501 was changed from 330k to 300k to provide more drive to the Horizontal Amplifier.

Parts Removed:

R501	Resistor, comp, 330k 1/4w 5%	315-0334-00
------	------------------------------	-------------

Parts Added:

R501	Resistor, comp, 300k 1/4w 5%	315-0304-00
------	------------------------------	-------------

CRT CIRCUIT ZENER DIODE TOLERANCE
TIGHTENED TO ASSURE PROPER ADJUSTMENT
RANGE OF UNBLANKING CENTER POT

INFORMATION ONLY

M9758-1

Effective Prod s/n 1060

FRONT PANEL SYMPTOM: None.

PROBLEM: If D841 is a $\pm 20\%$ part, it is possible for the Unblanking Center potentiometer to not have sufficient range. It was sometimes necessary to select D841 prior to this mod. The original design called for $\pm 10\%$.

PRODUCTION CHANGE: D841 has been changed to a $\pm 10\%$ tolerance, assuring adequate range for the Unblanking Center potentiometer.

Parts Removed:

D841	Diode, Zener, 1N976 400 mW 43 V $\pm 20\%$	152-0167-00
------	--------------------------------------------	-------------

Parts Added:

D841	Diode, Zener, 1N976A 400 mW 43 V $\pm 10\%$	152-0234-00
------	---------------------------------------------	-------------

CHANNEL 1 INPUT AMPLIFIER
DECOUPLING IMPROVED TO
REDUCE TRACE RIPPLE

See SQB

M10012

Effective Prod s/n 1550

Usable in field instruments s/n 100-1549

FRONT PANEL SYMPTOM: Trace ripple on Channel 1.

PROBLEM: D21 was apparently causing zener noise to be introduced into the Channel 1 input amplifier. This noise was more noticeable when the Step Atten. Bal. was adjusted near the end connected to D21 and R20.

PRODUCTION CHANGE: C22 was changed from $3.3 \mu\text{F}$ to $5.6 \mu\text{F}$ to provide better decoupling at the base of Q24.

Parts Removed:

C22	Capacitor, EMT, $3.3 \mu\text{F}$ 15 V $\pm 10\%$ w/insulating sleeve	290-0246-00
-----	--------------------------------------------------------------------------	-------------

Parts Added:

C22	Capacitor, EMT, $5.6 \mu\text{F}$ 6 V $\pm 10\%$ w/insulating sleeve	290-0247-00
-----	-------------------------------------------------------------------------	-------------

INSTALLATION INSTRUCTIONS:

See MI - 10012.

CHANNEL 2 INPUT AMPLIFIER AND
+20V REGULATOR ZENER DIODES
CHANGED TO REDUCE TRACE NOISE

INFORMATION ONLY

M9553

Effective Prod s/n 1290

FRONT PANEL SYMPTOM: Trace jump and noise when operating at 1 mV sensitivity on Channel 2.

PROBLEM: It was necessary to select zener diodes D121, D141 and D713 for low noise in order to avoid excessive trace jump and noise in the 1 mV position of Channel 2.

PRODUCTION CHANGE: Zener diodes D121, D141 and D713 were replaced with diodes having a low noise specification.

Parts Removed:

D121	1N751A (5.1 V)	152-0195-00
D141, D713	1N753A (6.2 V)	152-0166-00

Parts Added:

D121	1N751A (5.1 V)	152-0226-00
D141, D713	1N753A (6.2 V)	152-0227-00

CRT ORTHOGONALITY COIL
ADDED TO IMPROVE CRT YIELD

See SQB

M9763

Effective Prod s/n 1890

Usable in field instruments s/n 100-1889

FRONT PANEL SYMPTOM: None.

PROBLEM: In the past, CRT's have been selected to minimize any orthogonality deviation.

PRODUCTION CHANGE: A Y-Axis alignment coil and adjustment potentiometer were added to the CRT shield assembly for adjusting CRT orthogonality (see drawing on next page).

Parts Removed:

V859	Tube, CRT, T4220-31-1 w/graticule	154-0466-00
	T4220-1-1 w/graticule	154-0466-01
	T4220-2-1 w/graticule	154-0466-02
	T4220-7-1 w/graticule	154-0466-03
	T4220-11-1 w/graticule	154-0466-04
	Strip, liner, CRT clamp (2)	124-0170-00
	Shield, CRT, painted	337-0669-00
	Bracket, shield, CRT	407-0105-00

Parts Added:

V859	Tube, CRT, T4220-31-1 w/graticule	154-0466-05
	T4220-1-1 w/graticule	154-0466-06
	T4220-2-1 w/graticule	154-0466-07
	T4220-7-1 w/graticule	154-0466-08
	T4220-11-1 w/graticule	154-0466-09
L856	Coil, Y-Axis alignment assembly	108-0350-00
R856	Potentiometer, comp, 20k \pm 20% model G	311-0579-00
	Strip, liner, CRT clamp (2)	124-0170-01
	Shield, CRT, painted	337-0669-01
	Bracket, shield, CRT	407-0105-01
	Board, etched circuit	388-0678-00
	Connector, single contact	131-0371-00

INSTALLATION INSTRUCTIONS:

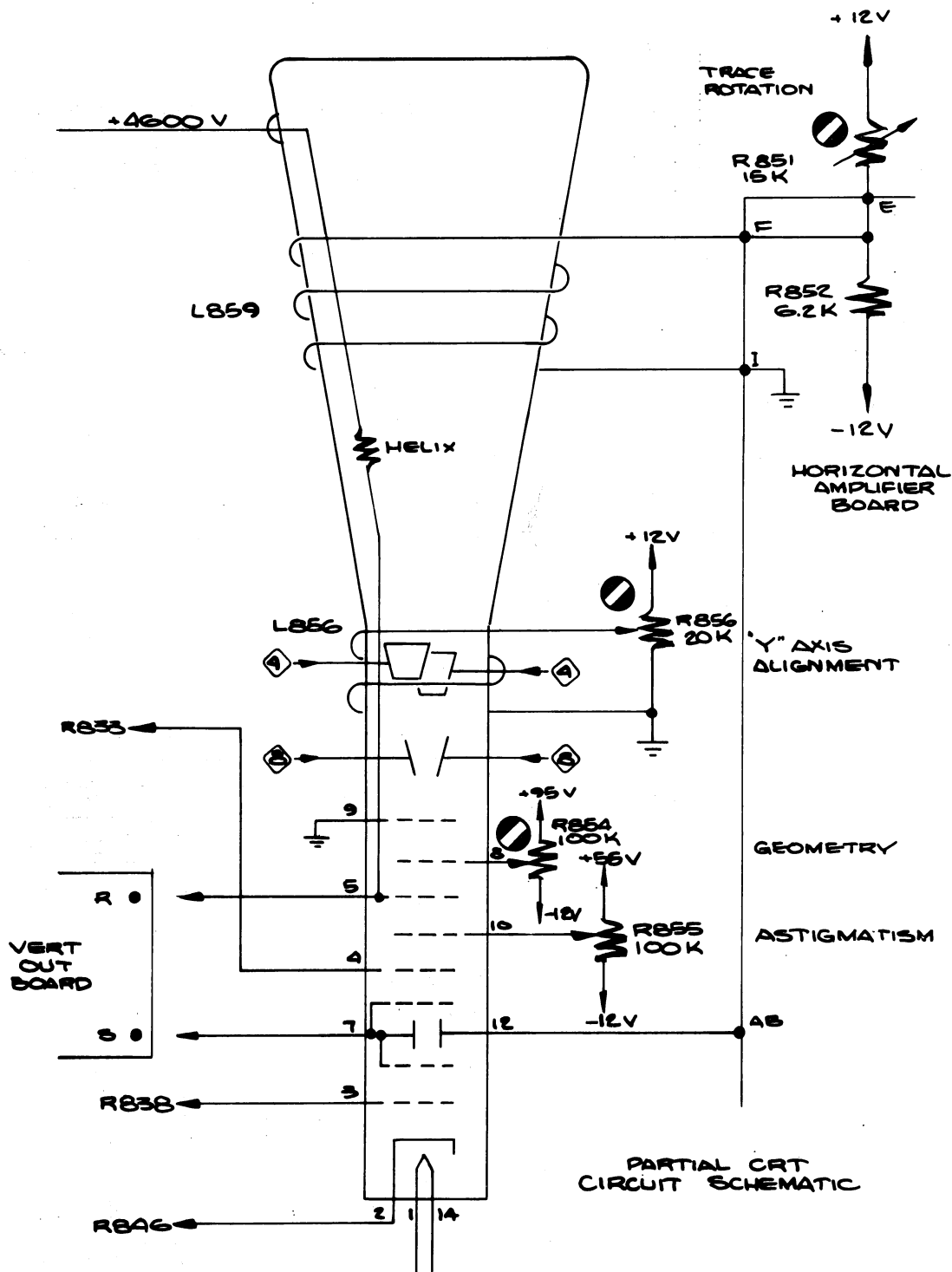
Parts Required: Parts Replacement Kit 050-0264-00

Installation Procedure: Refer to kit instructions.

NOTE: The new CRT silicone cushions installed by M9993 are included in 050-0264-00.

continued

SCHEMATICS



CRT FILTER FOAM SUPPORT PADS
REPLACED WITH A SPRING FOR
ADEQUATE MESH FILTER SUPPORT

See SQB

M9643

Effective Prod s/n 2070

Usable in field instruments s/n 100-2069

FRONT PANEL SYMPTOM: None.

PROBLEM: The neoprene foam tape pads do not provide adequate support for the mesh filter.

PRODUCTION CHANGE: The neoprene foam pads have been replaced with a filter spring.

Parts Removed:

Tape, neoprene, 1/2 in. (2) 253-0069-00

Parts Added:

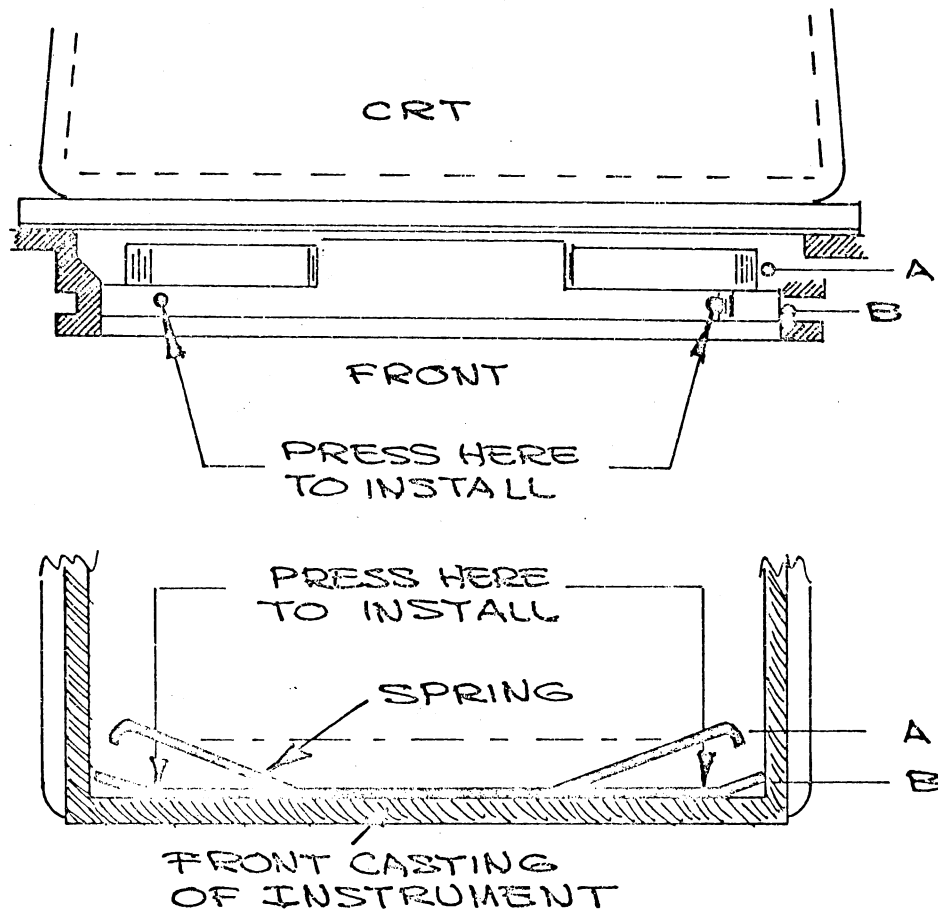
Spring, filter 214-0654-00

INSTALLATION INSTRUCTIONS: (See below or MI - 9643)

Parts Required: See 'Parts Added'.

Installation Procedure: Refer to drawing for installation procedure.

Replace the 1/2 in. lengths of neoprene foam tape with a filter spring located in the bottom of the CRT front cast opening.



CHANNEL 1 AND CHANNEL 2
ATTENUATOR SWITCHES REPLACED
TO REDUCE MECHANICAL NOISE

INFORMATION ONLY

M9883

Effective Prod s/n 2440

FRONT PANEL SYMPTOM: Attenuator switches are mechanically noisy when rotated.

PROBLEM: A misalignment of the attenuator switch and variable attenuator pot causes interference between the rotor and stator insulators. This results in mechanical noise when the attenuator is rotated.

PRODUCTION CHANGE: The variable attenuator mounting and coupling was changed to more properly align the attenuator switch and variable attenuator pot (see sketch).

NOTE: Serial numbered instruments 2440-2689 used the old shaft and coupler because of a parts shortage on 103-0049-00 and 103-0050-00.

Parts Removed:

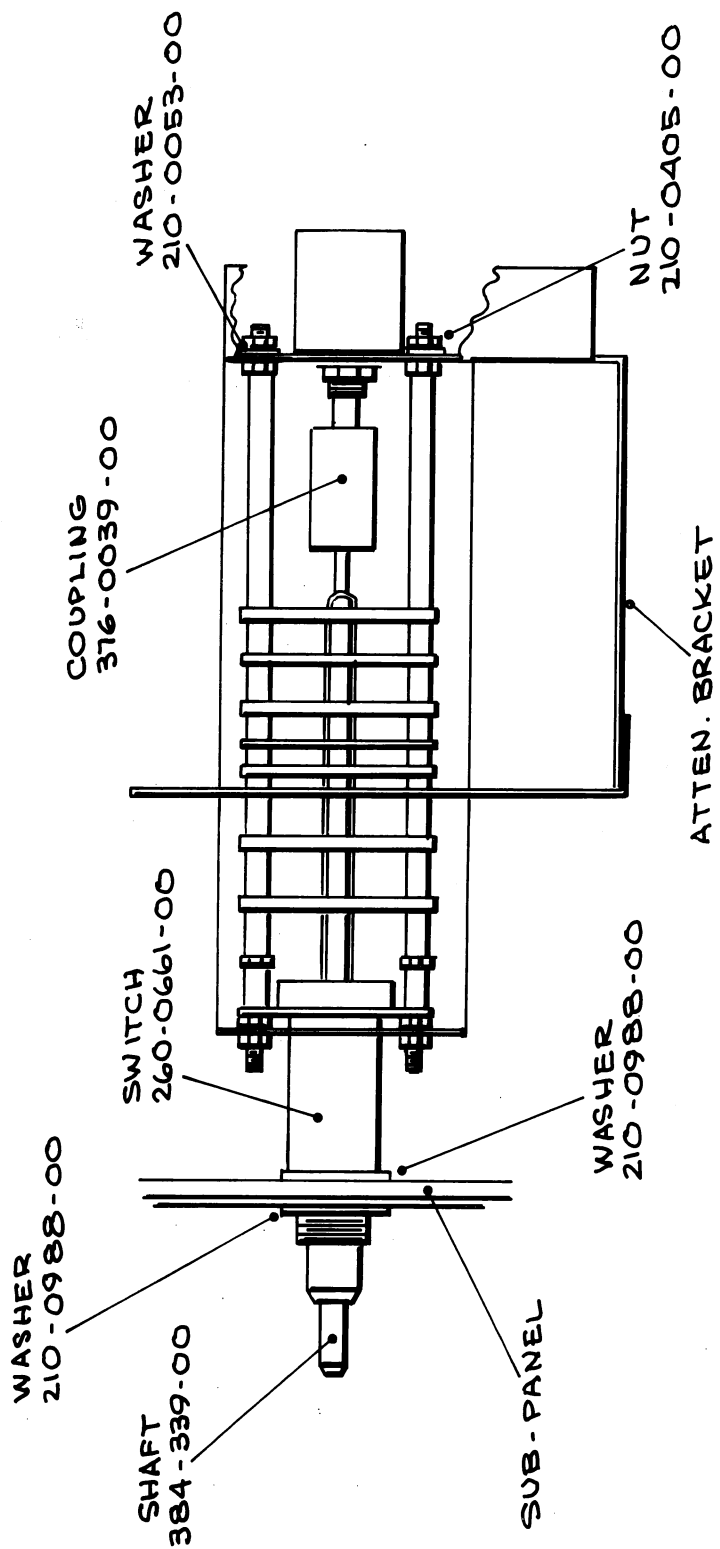
Lockwasher, #2 split	(2)	210-0053-00
Nut, hex 2-56 x 3/16	(2)	210-0405-00
Switch, rotary, Atten 6 sec 12 pos.		260-0661-00
Coupling, shaft		376-0039-00
Shaft, atten 4.700" long		384-0339-00
Washer, spherical .562 O.D x 406 I.D	(4)	210-0988-00

Parts Added:

Lockwasher, shakeproof int		210-0046-00
Nut, hex 1/4-32 x 5/16		210-0583-00
Switch, rotary, Atten 6 sec 12 pos.		260-0661-01
Coupling, pot, S steel wire		376-0014-00
Shaft, atten 4.460" long		384-0398-00
Adapter, shaft coupling		103-0049-00
Adapter, shaft coupling		103-0050-00
Washer, flat .562 O.D x .390 I.D.	(4)	210-0976-00

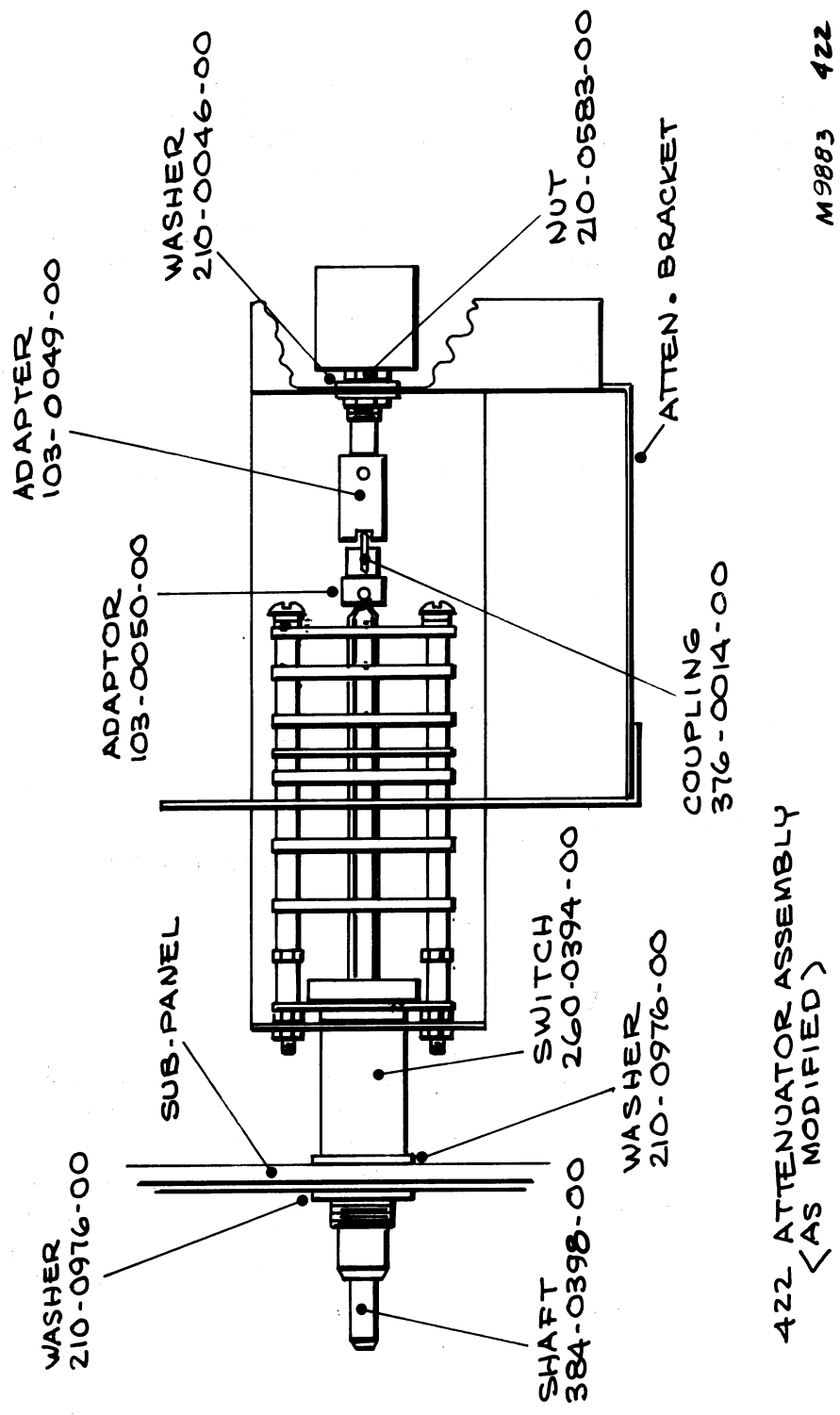
NOTE: Refer to drawings on following pages.

continued



422 ATTENUATOR ASSEMBLY
(BEFORE MOD)

continued



-12 V POWER SUPPLY
CAPACITOR CHANGED TO
ELIMINATE OSCILLATION

See SQB

M10075
(Not for 125B)

Effective Prod s/n 2520

Usable in field instruments s/n 100-2519

FRONT PANEL SYMPTOM: Trace widening.

PROBLEM: The -12 V supply was sometimes breaking into oscillation because of the high internal resistance of C639. The supply would oscillate at about 15 MHz, damp out and re-occur at about 20 kHz rate. The problem increased as temperature was lowered.

PRODUCTION CHANGE: C639 was changed from a 15 μ F 20 V Sprague capacitor to a 15 μ F 20 V Sencor (or equal) capacitor, which has lower internal resistance.

Parts Removed:

C639	Capacitor, EMT, 15 μ F 20 V	290-0135-00
------	---------------------------------	-------------

Parts Added:

C639	Capacitor, EMT, 15 μ F 20 V Sencor (or equal)	290-0135-01
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INSTALLATION INSTRUCTIONS:

See below or MI - 10075

Parts Required: See 'Parts Added'.

Installation Procedure:

Replace C639, located on the AC power circuit board near Q624 and D622, with a Sencor (or equal) 15 μ F 20 V capacitor.

CADMIUM PLATED HARDWARE REPLACED
WITH NICKEL PLATE TO REDUCE CORROSION
IN HIGH HUMIDITY ATMOSPHERE

INFORMATION ONLY

M9877
(125B ONLY)

Effective Prod s/n 2540

FRONT PANEL SYMPTOM: None.

PROBLEM: Cadmium plated hardware used for securing components to gold pads on circuit board was corroding in high humidity atmosphere, resulting in unreliable electrical connections. Also, a lockwasher was needed under the head of battery terminal securing screws to assure good electrical contact.

PRODUCTION CHANGE: The hex nut and flatwasher for securing Q1174 and Q1184 were changed from cadmium plated steel to nickel plated brass. The purchase spec for the split lockwasher was changed from cadmium plated steel to nickel plated phosphor-bronze. The solder lug was changed from purchased cadmium plated brass to Tek made albaloy plate over purchased raw brass lug.

The securing hardware on positive and negative battery pack terminals was changed by adding a #10 flatwasher (nickel plated brass) and a #10 split lockwasher under the head of the securing screw. The purchase spec on this #10 split lockwasher was changed from cadmium plated steel to nickel plated phosphor-bronze.

See Before and After drawings on the following page.

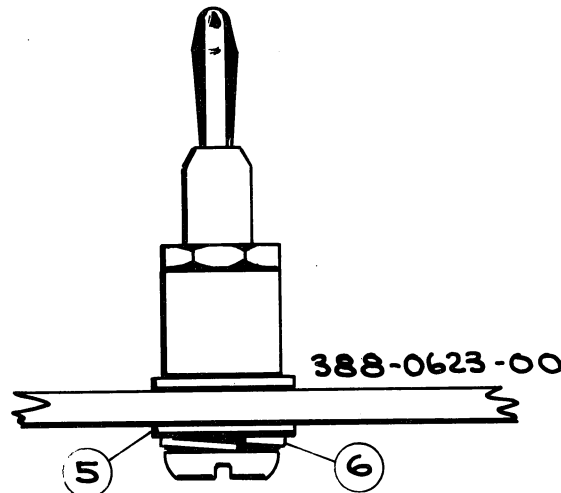
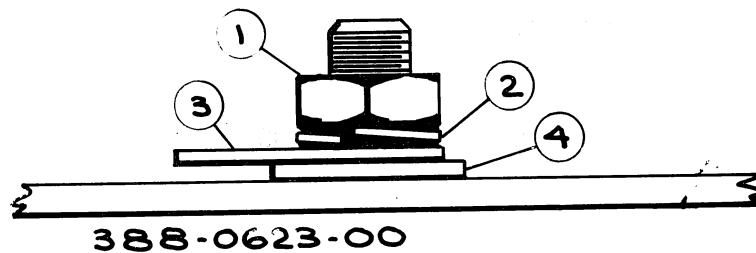
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Parts Removed:

Nut, hex, steel, 5/16-24 x 1/2 cad plated	(2)	210-0524-00
Washer, flat, steel, 5/16ID x 5/8OD x .050 cad plated	(2)	210-0807-00
Lug, solder, brass, 5/16 cad plated	(2)	210-0217-00

Parts Added:

Nut, hex, brass, 5/16-24 x 1/2 nickel plated	(2)	210-0524-01
Washer, flat, brass, 5/16ID x 5/8OD x .050 nickel plated	(2)	210-0807-01
Lug, solder, 210-0217-01 albaloy plated	(2)	210-0217-00
Washer, flat, #10 brass, nickel plated	(2)	210-1003-00
Washer, split, lock, #10, brass, nickel plated	(2)	210-0056-00



- 1) Replace 210-0524-00 with 210-0524-01.
- 2) Changes from cad plated steel to nickel plated phos-bronze. Part number remains 210-0057-00.
- 3) Changes from purchased cad plated to Tek made albaloy plated brass. Part number remains 210-0217-00.
- 4) Replace 210-0807-00 with 210-0807-01.
- 5) Add one 210-1003-00 per terminal.
- 6) Change purchase spec of 210-0056-00 from cad plated to nickel plated phos-bronze and add one per terminal.

HORIZ AMP CAPACITOR TYPE CHANGED
TO IMPROVE HIGH SPEED TIMING
STABILITY AT HIGH TEMPERATURES

INFORMATION ONLY

M10231

Effective Prod s/n 2600

FRONT PANEL SYMPTOM: The two fastest sweep speeds may change timing by 1/2-1% more than the other ranges at 55° C.

PROBLEM: The temperature stability of C556, 330 pf ceramic, was not good enough to meet the high speed timing stability requirements at high temperatures (55° C).

PRODUCTION CHANGE: C556 was changed from a 330 pf ceramic to 304 pf mica capacitor to improve high speed timing stability.

Parts Removed:

C556	Capacitor, cer, 330pf 500 v	281-0546-00
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Parts Added:

C556	Capacitor, mica, 304 pf 300 v	283-0604-00
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POWER SELECTOR CIRCUIT
CAPACITOR VALUE INCREASED
TO REDUCE POWER SUPPLY RIPPLE

INFORMATION ONLY

M10080
(125B ONLY)

Effective Prod s/n 2680

FRONT PANEL SYMPTOM: None.

PROBLEM: The capacitance of C1003 and C1004 was not adequate for circuit requirements when at the minimum tolerance value. The result was excessive ripple on the plus and minus 12 volt supplies. Test has been selecting the 1200 μ F capacitors to meet 1300 μ F.

PRODUCTION CHANGE: C1003 and C1004 were changed from 1200 μ F +75% -10% to 1300 μ F +75% -10% to assure adequate capacitance.

Parts Removed:

C1003,C1004	Capacitor, EMT, 1200 μ F +75% -10%	290-0275-00
-------------	----------------------------------------	-------------

Parts Added:

C1003,C1004	Capacitor, EMT, 1300 μ F +75% -10%	290-0300-00
-------------	----------------------------------------	-------------

AC AND AC-DC POWER SUPPLIES
SCHEDULED SEPARATELY WITH
SEPARATE S/N SEQUENCES TO
FACILITATE PRODUCTION

INFORMATION ONLY

M10411
(NOT R422)

Effective Date February 1966

FRONT PANEL SYMPTOM: None.

PROBLEM: Prior to this mod, the bill of materials, move tickets and operation cards were duplicated on the 422.

PRODUCTION CHANGE: The bill of materials for the Indicator w/AC power supply, 016-0072-00, and the Indicator w/AC-DC power supply, 016-0073-00 was deleted. The 422, AC, and AC-DC power supplies were scheduled as three separate instruments. The AC and AC-DC power supply part numbers will remain the same as before M10411.

Parts Added:

Package, half, shipping 5.750 x 15.875 x 26.750 (2)	004-0220-00
Pad set, consisting of 3 top pads	004-0539-00
Pad set, DC sheet .620 x 8.10	004-0588-00
Carton, shipping 16.70 x 12.5 x 27.5	004-0679-00
Bag, polyethylene, 18 x 29	006-0342-00

VERTICAL AMPLIFIER DELAY LINE
AND OTHER COMPONENTS CHANGED
TO REDUCE VERT ABERRATIONS

INFORMATION ONLY

M10432

Effective Prod SN 2710

FRONT PANEL SYMPTOM: Vertical aberration (within allowable limits) with fast rise input pulse.

PROBLEM: Excessive Vertical aberrations were resulting from the long preshoot cycle time** of the delay line. Also, Plastics Department was having difficulty meeting the electrical length specification of 160 +10 -5 nsec because the vendor changed the wire coating specification.

PRODUCTION CHANGE: The electrical length specification of the delay line was changed to 150 ±5nsec which reduced the preshoot cycle time.** The delay line matching network was changed as shown in before and after schematics, in order to be compatible with both new and old delay lines.

Parts Removed:

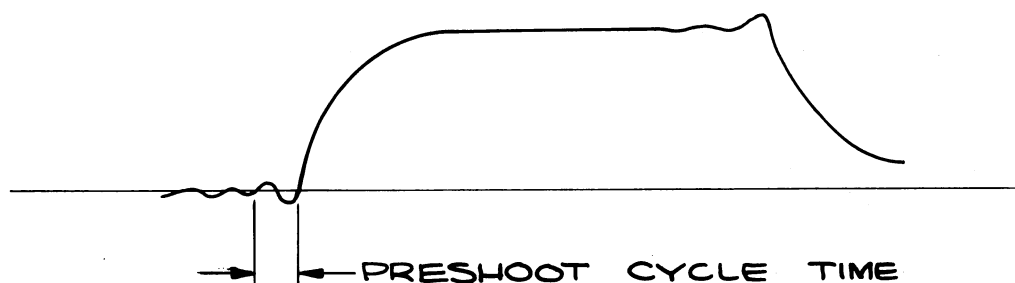
L240	Delay Line assembly	119-0037-00
C227, C228	Capacitor, cer, 10pF 500 V NPOA (2)	281-0504-00
C238	Capacitor, cer, 3.3p F NPO	281-0534-00
C235	Capacitor, cer, 5.6p F 500 V NPOA	281-0544-00
R237	Pot, comp, 2.5k ±20% linear w/ etched ckt mtg.	311-0496-00

Parts Added:

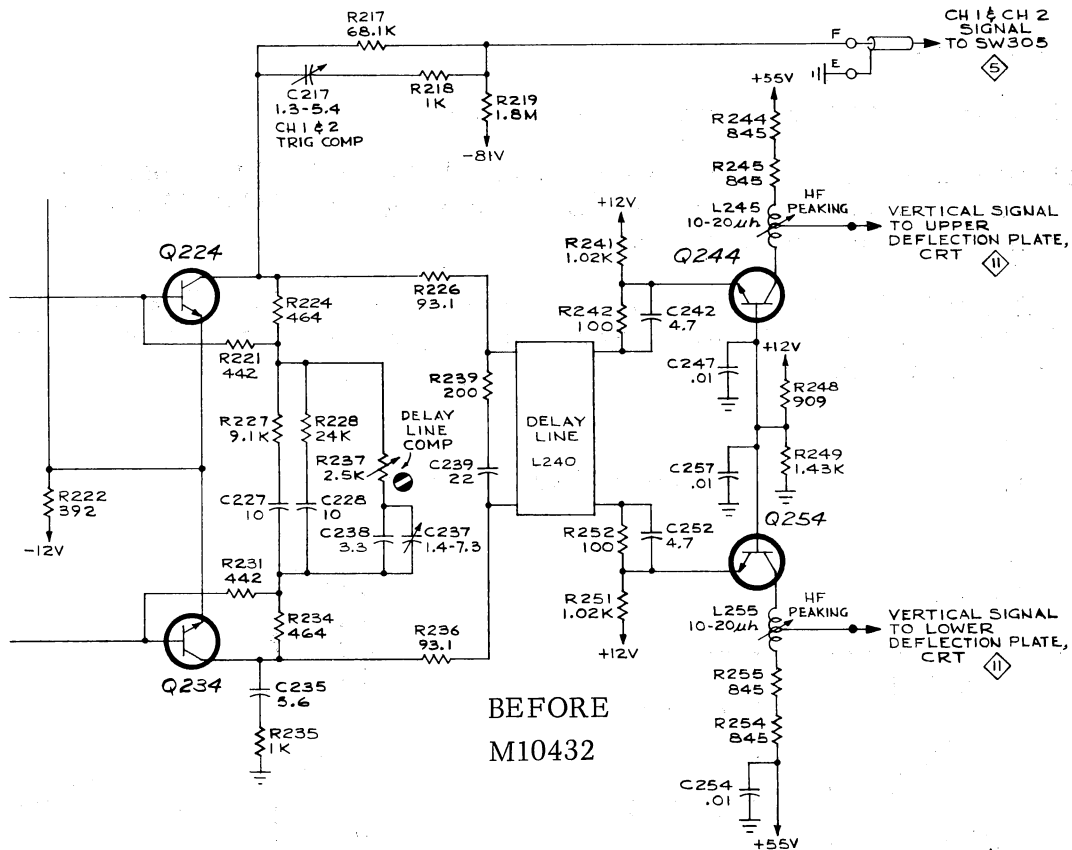
L240	Delay Line assembly	119-0037-01
C227, C235	Capacitor, cer, 8pF 500 V NPOA (2)	281-0503-00
C228	Capacitor, cer, 12pF 500 V NPOA	281-0505-00
R237	Pot, comp, 5k ±20% linear w/ etched ckt mtg.	311-0463-00

** PRESHOOT CYCLE TIME

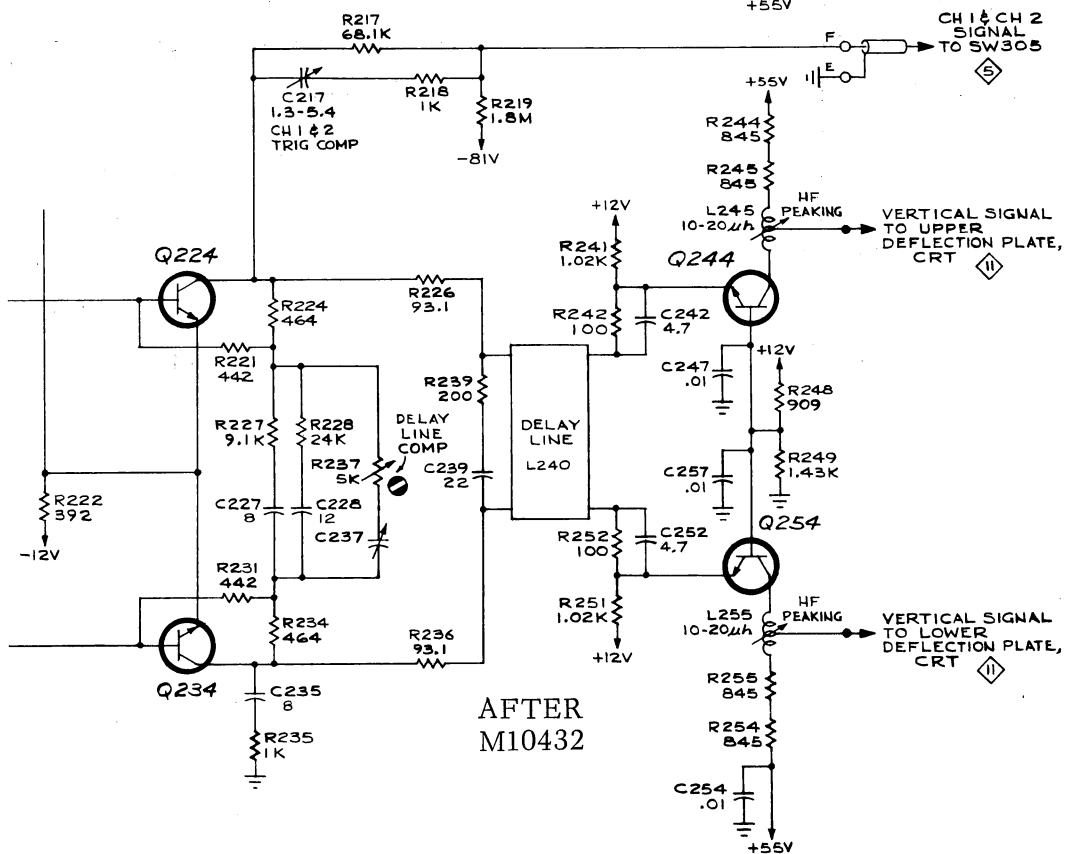
Because the delay line does not delay 'very high' frequencies, as much as lower frequencies, pre-ringing or preshoot appears before the main pulse reflection. The time between the zero crossing of the last cycle of the preshoot is an indication of the quality of the line. The shorter this time, the better the line.



continued



BEFORE
M10432



AFTER
M10432

**POWER REGULATOR STEERING
SWEEP LOCKUP PREVENTED
WITH ADDITIONAL RESISTOR**

INFORMATION ONLY

M10122-1
(125B ONLY)

Effective Prod s/n 2831

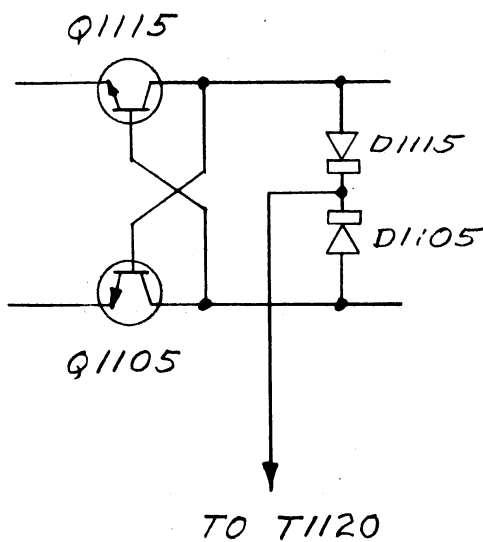
FRONT PANEL SYMPTOM: Inoperative instrument.

PROBLEM: It was necessary to sometimes select Q1104 and Q1114 in order to prevent lockup of the steering switch. Problem was caused because the 151-0087-00 has undergone a change and is now a faster transistor.

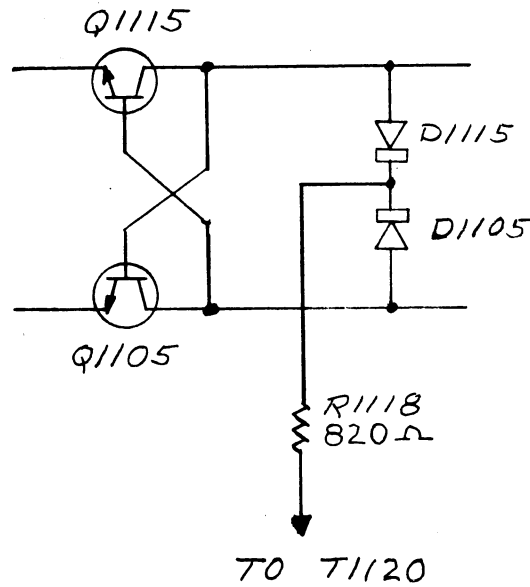
PRODUCTION CHANGE: An 820Ω resistor was added in line from T1120 to the junction of D1105 and D1115. This will prevent lockup by adding some phase shift. See Before and After drawings.

Parts Added:

R1118	Resistor, comp, 820Ω 1/4W 5%	315-0821-00
-------	------------------------------	-------------



Before



After

**POWER REGULATOR HIGH FREQUENCY
SHUNT CAPACITOR ADDED TO REDUCE RFI**

See SQB

M10122-2
(125B ONLY)

Effective Prod s/n 2831

Usable in field instruments s/n 100-2830

FRONT PANEL SYMPTOM: Approximately 80MHz RF radiating out power cord.

PROBLEM: The AC-DC power supply had about 80MHz RF present and it was being coupled out through the line cord. The impedance of C1171, C1172 is too high at 80MHz to effectively shunt the unwanted signal.

PRODUCTION CHANGE: A 0.1 μ F capacitor was added in parallel with C1171 and C1172 to provide better high frequency coupling. M10122-3 should also be installed if M10122-2 is used. See Before and After schematic.

Parts Added:

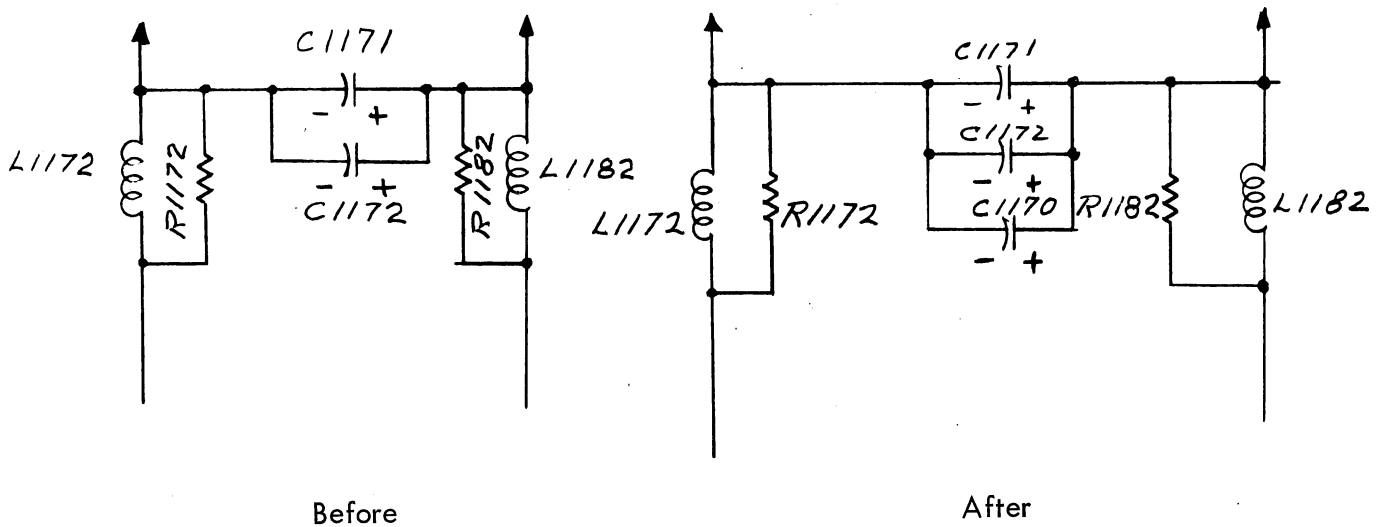
C1170	Capacitor, cer, 0.1 μ F 50 V discap	283-0111-00
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INSTALLATION INSTRUCTIONS:

Parts Required: See 'Parts Added'.

Installation Procedure:

Add C1170, a 0.1 μ F 50 V capacitor, in parallel with C1171 and C1172 located on the lower left hand corner of the DC power connector circuit board. "C1171" and "C1172" are stamped on the board. Also, see the AC-DC power supply instruction manual (page 4-3) for additional locational information.



RFI LINE FILTER CAPACITOR VALUE
INCREASED TO REDUCE RFI

See SQB

M10122-3
(125B ONLY)

Effective Prod s/n 2831

Usable in field instruments s/n 100-2830

FRONT PANEL SYMPTOM: Approximately 80 MHz RF radiating out power cord.

PROBLEM: C1011 was too small to provide a good RFI line filter to 80 MHz RF described in M10122-2.

PRODUCTION CHANGE: C1011 was changed from 0.1 μ F to 0.56 μ F to improve the RFI line filter performance. If M10122-3 is installed, M10122-2 should also be used. Refer to schematic with M10122-2 on previous page.

Parts Removed:

C1011	Capacitor, cer, 0.1 μ F 500 V discap	283-0008-00
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Parts Added:

C1011	Capacitor, cer, 0.56 μ F 100 V	283-0129-00
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INSTALLATION INSTRUCTIONS:

Parts Required: See 'Parts Added'.

Installation Procedure:

Replace C1011, located on the right hand corner of the DC Power Converter circuit board (C1011 is the one nearest the large circuit board hole) with a 0.56 μ F 100 V ceramic capacitor. Also see AC-DC power supply instruction manual (page 4-3) for additional locational information.

HORIZONTAL AMPLIFIER RESISTOR
VALUE CHANGED TO ASSURE ADEQUATE
RANGE OF EXT HORIZONTAL ATTENUATOR

See SQB

M10491

Effective Prod s/n 2950

Usable in field instruments s/n 100-2949

FRONT PANEL SYMPTOM: None.

PROBLEM: It was possible for all parts to be within tolerance and still have insufficient range of the External Horizontal attenuator.

PRODUCTION CHANGE: R504 was changed from a 499Ω 1/8W 1% to 392Ω 1/8W 1% resistor.

Parts Removed:

R504	Resistor, prec, 499Ω 1/8W 1%	321-0164-00
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Parts Added:

R504	Resistor, prec, 392Ω 1/8W 1%	321-0154-00
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INSTALLATION INSTRUCTIONS:

See MI - 10491.

**SILICON DIODE TYPE CHANGED TO
PROVIDE TIGHTER FORWARD VOLTAGE
CONDUCTION SPECIFICATIONS**

INFORMATION ONLY

M9947

Effective Prod s/n 3080

FRONT PANEL SYMPTOM: None.

PROBLEM: Certain critical circuits were designed to use silicon diodes with tighter forward voltage conduction specifications than was provided by type 6185 (152-0185-00).

PRODUCTION CHANGE: Silicon diodes D201, D204, D205, D208, D401, D430, D435, D436, D479, D653, D735, D779 and D865 were changed from type 6185 (152-0185-00) to type 6233 (152-0233-00).

Parts Removed:

D201, D204, D205, D208, D401, D430, D435, D436, D479, D735, D779, D865, D653	Diode, silicon	6185	152-0185-00
---------------------------------------------------------------------------------------	----------------	------	-------------

Parts Added:

D201, D204, D205, D208, D401, D430, D435, D436, D479, D735, D779, D865, D653	Diode, silicon	6233	152-0233-00
---------------------------------------------------------------------------------------	----------------	------	-------------

SWEEP GENERATOR DIODE CHANGED
TO ELIMINATE TIMING ERROR AND
BECAUSE OF UNAVAILABILITY

See SQB

M10311

Effective Prod s/n 3080

Usable in field instruments s/n 100-3079

FRONT PANEL SYMPTOM: Slow sweep timing error under environmental conditions
(high temperatures).

PROBLEM: Diode type 152-0173-00 used for D439 caused a slow speed timing error and
was also discontinued by the vendor.

PRODUCTION CHANGE: D439 was 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. To electrically accommodate the new
diode, it was necessary to change R424 from 9.35 k 1/8W 1% to 10 k 1/8W 1%.
Parts Replacement Kit 050-0290-00 is available to facilitate the replacement of
152-0173-00 diodes in pre-modified instruments.

Parts Removed:

D439	Diode, silicon, Tek Spec.	152-0173-00
R424	Resistor, prec, 9.53 k 1/8W 1%	321-0287-00

Parts Added:

D439	Diode, silicon, assembly,	152-0249-00
R424	Resistor, prec, 10 k 1/8W 1%	321-0289-00

INSTALLATION INSTRUCTIONS:

Parts Required.	Parts Replacement Kit	050-0290-00
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Installation Procedure: Refer to kit instructions.

DC-DC REGULATOR INSULATION ADDED
TO TRANSISTOR MOUNTING TO PREVENT
HEAT SINK OF Q1194 FROM SHORTING
TO GROUND

See SQB

M10684
(125B ONLY)

Effective Prod SN 3195

Usable in field instruments SN 100-3194

FRONT PANEL SYMPTOM: Blown fuse.

PROBLEM: The anodized heat sink for Q1194 was sometimes shorting to ground. This was a result of burring the anodizing on the threads when the securing nut was installed. If the fuse does not blow, the power supply will go out of regulation making the instrument inoperative.

PRODUCTION CHANGE: The heat sink for Q1194 was insulated from ground by adding a mica washer between the circuit board and the flat washer of the heat sink.

Parts Removed: None required.

Parts Added:

Washer, mica, silicon 0.625 OD x 0.196 ID x 0.002 thick

210-0909-00

INSTALLATION INSTRUCTIONS:

See MI - 10684.

**CARRYING HANDLE MANUFACTURE
CHANGED TO SIMPLIFY ASSEMBLY
AND INCREASE STRENGTH**

INFORMATION ONLY

M10202
(Not for R422)

Effective Prod s/n 3200

FRONT PANEL SYMPTOM: None.

PROBLEM: It was possible to simplify the assembly and increase the strength of the carrying handle by manufacturing it differently.

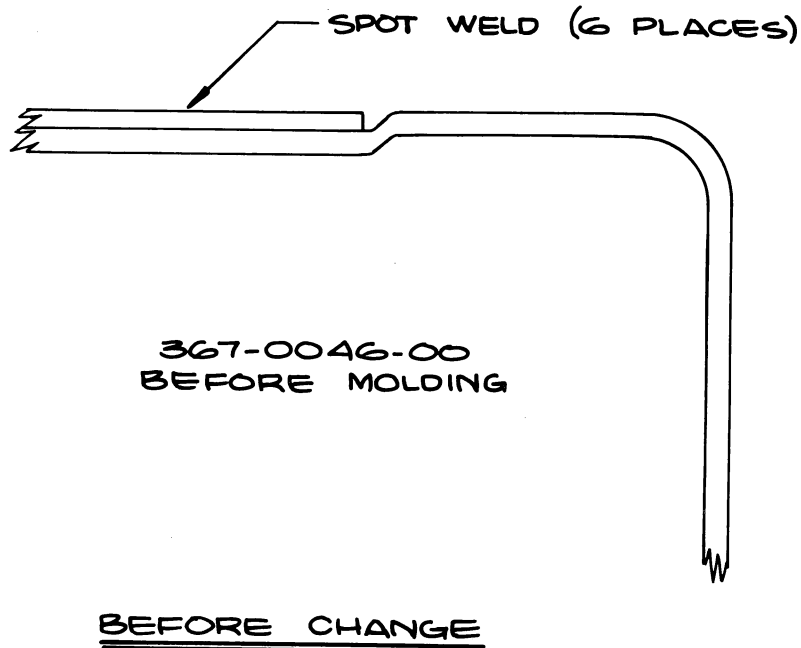
PRODUCTION CHANGE: The carrying handle assembly was replaced with a new assembly that is identical in appearance but will use the 453 stainless steel left and right sides with a new cross tie, rather than cold rolled steel with overlapping joint. The finish was changed from chrome plate satin to type C-1 satin. See Before and After drawings.

Parts Removed:

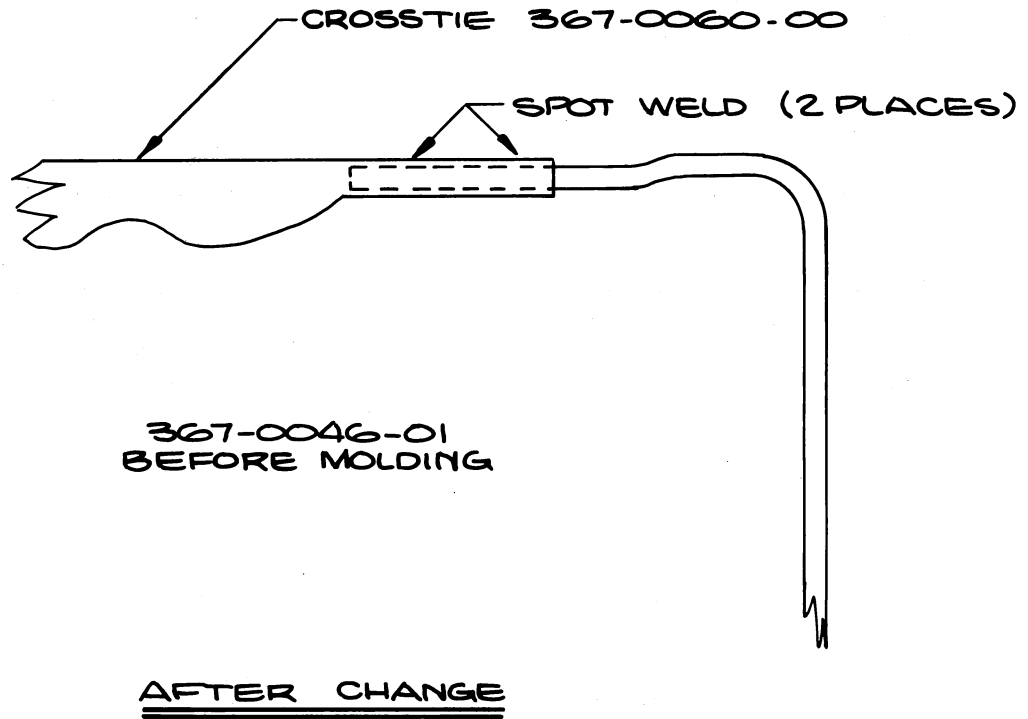
Handle, carrying assembly	367-0046-00
---------------------------	-------------

Parts Added:

Handle, carrying assembly		367-0046-01
Index hub	(2)	214-0515-00
Index ring	(2)	214-0513-00
Screw, 6-32 x .500 FH	(4)	211-0512-00
Index spring	(2)	214-0516-00
Cover	(2)	200-0602-00



continued



BATTERY VENDOR AND BATTERY PART
NUMBER CHANGED TO OBTAIN INCREASED
AMPERE HOUR CAPACITY

INFORMATION ONLY

M10708
(125B ONLY)

Effective Prod SN none given

FRONT PANEL SYMPTOM: None.

PROBLEM: None.

PRODUCTION CHANGE: The source of supply and part number of the nickel cadmium batteries were changed to provide more reliable operation at high temperatures. This change should also extend battery life at normal temperatures.

Parts Removed:

Battery, nickel cadmium w/solder tabs	(20)	146-0008-00
Bracket, spring		407-0128-01

Parts Added:

Battery, 4.0 amp hrs. for high temp application w/solder tabs	(20)	146-0010-00
Bracket, spring		407-0128-00

INDICATOR AND POWER SUPPLY SERIAL
NUMBERS MATCHED BY CHANGING
BILL OF MATERIALS

INFORMATION ONLY

M10727

Effective Prod SN none given

FRONT PANEL SYMPTOM: None.

PROBLEM: Serial numbers of power supplies and indicators did not match. Marketing requires that the 422 package (Indicator and Power Supply) have matching serial numbers and be listed as a single item.

PRODUCTION CHANGE: The bill of materials for the 422 was changed to consist of the 422X (Indicator only) and 016-0072-00 (AC Power Supply only). The 422-125B was set up to consist of the 422X and 016-0073-00 (AC-DC Power Supply only). The indicators and power supplies when shipped together will have matching serial numbers and when shipped individually, will all use the one sequence of serial numbers.

CHANNEL 2 INPUT AMP CIRCUIT BOARD
WIRING CHANGED TO ELIMINATE SHORT
CIRCUIT OF -12V DC POWER SUPPLY

See SQB

M10800

Effective Prod SN 3347

Usable in field instruments SN 100-3346

w/exceptions 850, 1133, 1475, 1610, 1640, 1647, 1724, 1732, 1736, 2104, 2841, 2853-5,
2867, 2875, 2997, 3033, 3076, 3078, 3092, 3106, 3118, 3124, 3132, 3135, 3159, 3162, 3169,
3171, 3178, 3181, 3182, 3185, 3186, 3198, 3200, 3201, 3205, 3212, 3218, 3236-8, 3241, 3250,
3254, 3258, 3260, 3268, 3274, 3277, 3284, 3287-89, 3292, 3294, 3297, 3301-2, 3306, 3308-11,
3313-14, 3316, 3320, 3323, 3325-29, 3331-35, 3340, 3342-44

FRONT PANEL SYMPTOM: Smoke from bottom of instrument.

PROBLEM: A possible short circuit exists between the tab on the 'INVERT' switch actuator rod (ground) and copper strapping on the Channel 2 INPUT AMPLIFIER circuit board (-12V DC) and could cause destruction to the -12VDC cable wire and circuit board.

PRODUCTION CHANGE: The copper strapping on the Channel 2 INPUT AMPLIFIER circuit board was peeled off and replaced with a 2-1/2in. length of #22 solid white-red wire.

See top and bottom view drawings. NOTE: M10801 will soon follow M10800 and will relocate the -12VDC circuit board circuitry away from the switch area.

Parts Removed:

Parts Added:

Wire, #22 solid white-red 2-1/2 in. 175-0522-00

INSTALLATION INSTRUCTIONS:

See MI - 10800

continued

AC-DC POWER SUPPLY WIRE COLOR-CODING
CHANGED AND REWIRED TO PLACE FUSE
AND SWITCH IN HOT SIDE OF LINE

See SQB

M10808
(125B ONLY)

Effective Prod SN 3912 (Interim**) Usable in field instruments SN 100-3911
4467 (Permanent)
Modified (w/interim mod) out of sequence: 3800 3827 3859 3879 3890
3822 3842 3874 3887 3900

FRONT PANEL SYMPTOM: None.

PROBLEM: The fuse (F1000) and Power switch (SW1001) are wired in the cold side of the AC line; the connectors to Thermal Cutouts (TK1000 and TK1039) are interchanged; and, the wire color-coding used is not standard.

PRODUCTION CHANGE: **As an interim measure the Power plug, fuse, RFI Inductor, and Thermal Cutouts were rewired as described below in the "Installation Procedure". The wire color-coding was not changed.

These changes, along with a change in the wire color-coding, was made a permanent change at SN 4467. See 'Before' and 'After' schematics on following pages.

Parts Replacement Kit 050-0328-00 was made available to facilitate the replacement of the DC Power Converter assembly (670-0082-00) in pre-modified instruments.

Parts Removed: Cable harness, B POWER SUPPLY 179-0977-00
Cable harness, AC-DC 179-0978-00

Parts Added: Cable harness, B POWER SUPPLY 179-0977-01
Cable harness, AC-DC 179-0978-01
* Wire, #22 stranded, black, 2 in. (interim change only) 175-0523-00

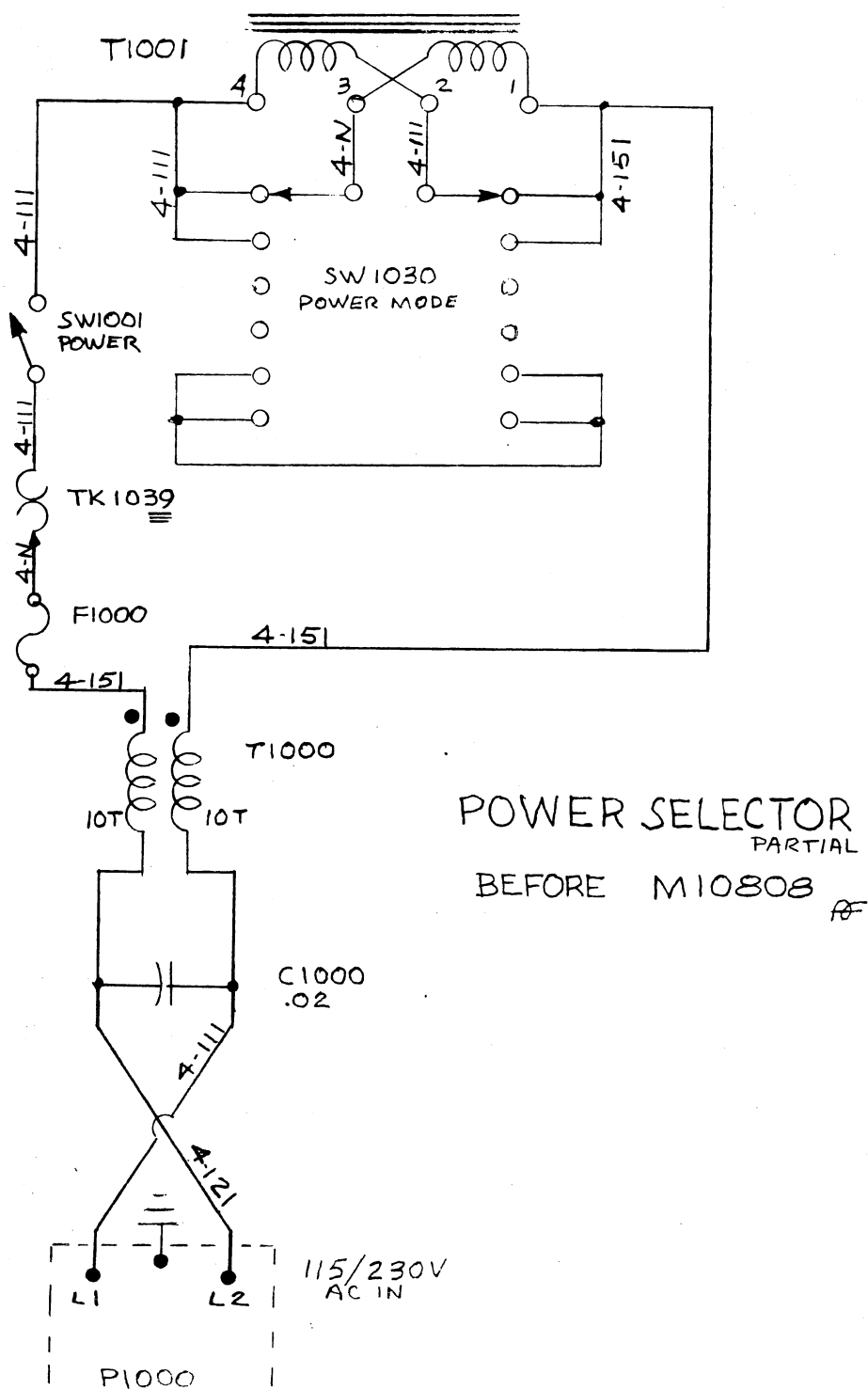
INSTALLATION INSTRUCTIONS: (See below or MI - 10808).

Parts Required: See 'Parts Added' with asterisk.

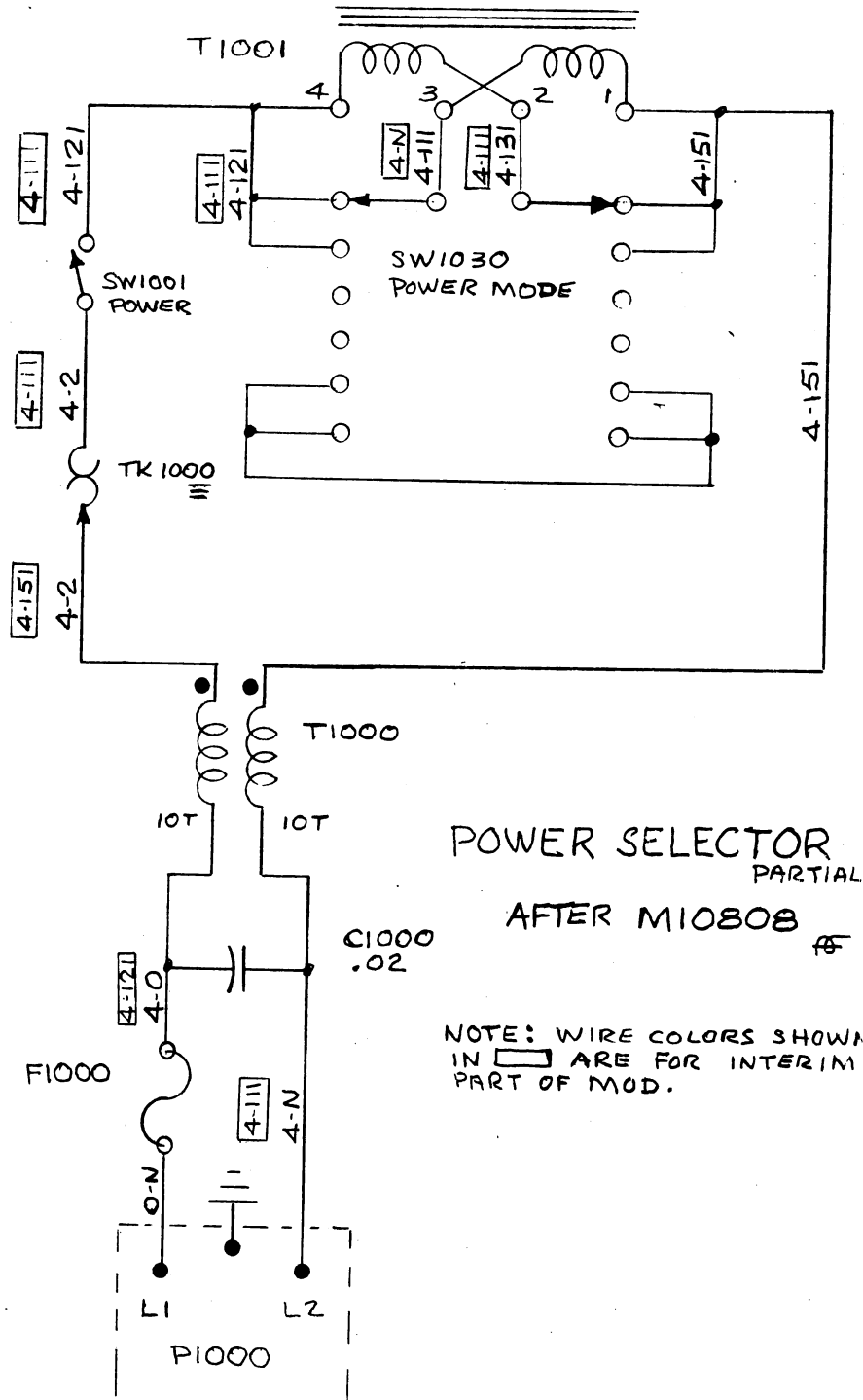
Installation Procedure:

- a) Remove the AC-DC POWER SUPPLY from the power supply housing.
- b) Remove the 4 in. yellow wire, located between fuse F1000 (end connection) and thermo cutout TK1039 (inboard connection), from the cable.
- c) Unsolder the yellow-brown-green-brown wire from the fuse holder F1000 (side terminal).
- d) Relocate the yellow-brown-red-brown wire from the AC line plug P1000 (terminal L2), to fuse F1000 (side terminal).
- e) Relocate the yellow-brown-brown-brown wire from the AC line plug P1000 terminal L1 to terminal L2.
- f) Add a 2 in. length of #22 stranded black wire, between P1000 (terminal L1) and F1000 (end terminal).
- g) Unsolder the yellow-brown-brown-brown wire, connected to thermo cutout TK1039.
- h) Relocate the two white-red wires connected to TK1000 to TK1039 (inboard and outboard terminals respectively).
- i) Solder the yellow-brown-brown-brown wire (removed in step g) to TK1000 (inboard terminal nearest TK1039).
- k) Remove enough of the yellow-brown-green-brown wire (unsoldered in step c) from the cable harness and solder to TK1000 (outboard terminal).
- m) Reinstall the AC-DC POWER SUPPLY in the housing.

continued



continued





DC POWER CONVERTER CIRCUIT
BOARD CHANGED TO PROVIDE
BETTER PARTS LAYOUT

INFORMATION ONLY

M10132-1
(125B ONLY)

Effective Prod s/n 4043

FRONT PANEL SYMPTOM: None.

PROBLEM: C1231 and C1242 were touching the case of Q1193 and mounting holes were needed to install R1118. R1118 was added by M10122.

PRODUCTION CHANGE: The mounting holes for C1231 and C1242 were relocated to the left of Q1193. This required a slight change in the location of D1232 and D1233 mounting holes. The new holes were added to install R1118 between the junction of D1105-D1115 and connection of T1171.

DC POWER CONTROL CIRCUIT
BOARD CHANGED TO ELIMINATE
POSSIBILITY OF POWER LEAD
CONNECTIONS SHORTING

INFORMATION ONLY

M10132-2
(125B ONLY)

Effective Prod s/n 4043

FRONT PANEL SYMPTOM: None.

PROBLEM: The plant was painting the power lead connections to avoid a possible short circuit and mounting holes were required for C1170, which was added by M10122.

PRODUCTION CHANGE: The power lead connections were staggered to eliminate possible short circuit. Two holes were added in parallel with C1172 and C1174 to mount C1170.

STAINLESS STEEL HINGE PINS REPLACED
BY DELRIN TO ELIMINATE SQUEAK IN
STORAGE COMPARTMENT DOOR

See SQB

M9960

Effective Prod SN 4000 (approximate)

Usable in field instruments SN 100-3999

FRONT PANEL SYMPTOM: Noisy hinges on the front cover Accessory Compartment Door and R422 Storage Compartment Door.

PROBLEM: Stainless steel hinge pins used on front cover Accessory Compartment Door and R422 Storage 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.

422, 422-125B

Parts Removed:

Pin, hinge, 0.095 dia s.s. rod, 1.718" long (2) 214-0518-00

Parts Added:

Pin, hinge, 0.095 dia Delrin, 1.785" long (2) 214-0756-00

R422

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, 1.295" long (2) 214-0755-00

INSTALLATION INSTRUCTIONS:

See MI - 9960.

*Du Pont Registered Trademark

HORIZONTAL AMPLIFIER CIRCUIT BOARD
LAYOUT CHANGED TO PERMANENTLY
ACCOMMODATE PREVIOUS MODIFICATIONS

INFORMATION ONLY

M10230

Effective Prod SN 4135

FRONT PANEL SYMPTIM: None.

PROBLEM: It was necessary to change the Horizontal Amplifier circuit board layout to accommodate the parts location changes and additions made by M9491 and M10000.

PRODUCTIONS CHANGE: D512, D513, D524, and C531 were relocated as shown on BEFORE and AFTER drawings. To provide more space for relocated components, transistor sockets for Q513, Q524, and Q543 were changed to a smaller type and the layout of the Horizontal Amplifier board was changed.

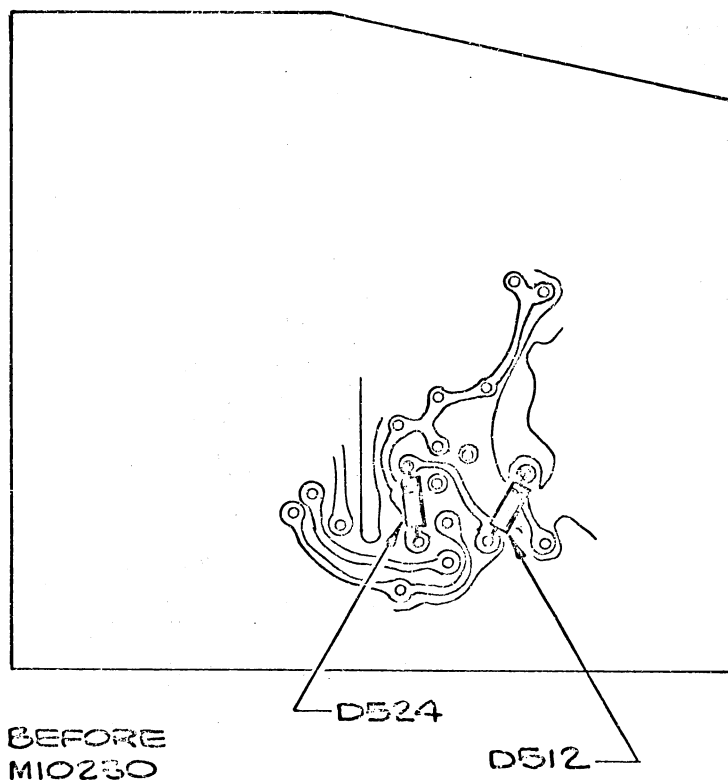
Parts Removed:

Socket transistor, 3 pin w/etched ckt. contacts	(3)	136-0183-00
Board, circuit, Horiz/Sweep PB		388-0615-01

Parts Added:

Socket, transistor, 3 pin w/ etched ckt. contacts	(3)	136-0220-00
Board, circuit, Horiz/Sweep PE		388-0615-02

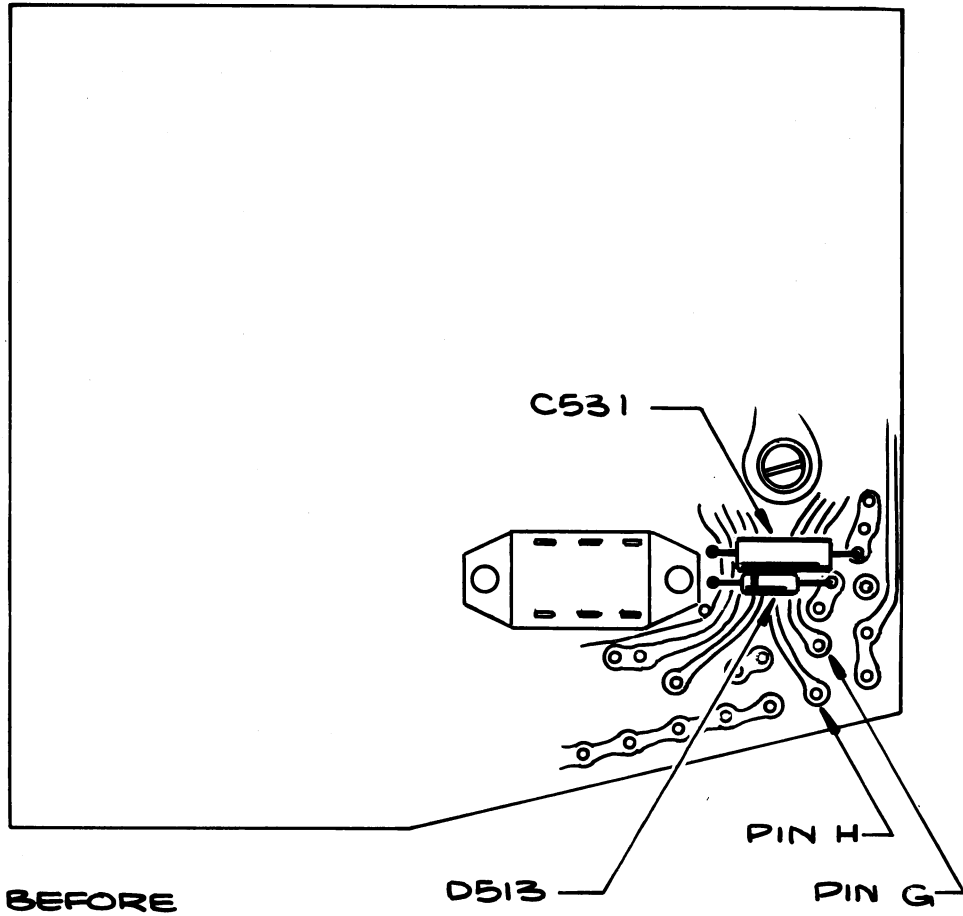
BOTTOM VIEW



continued

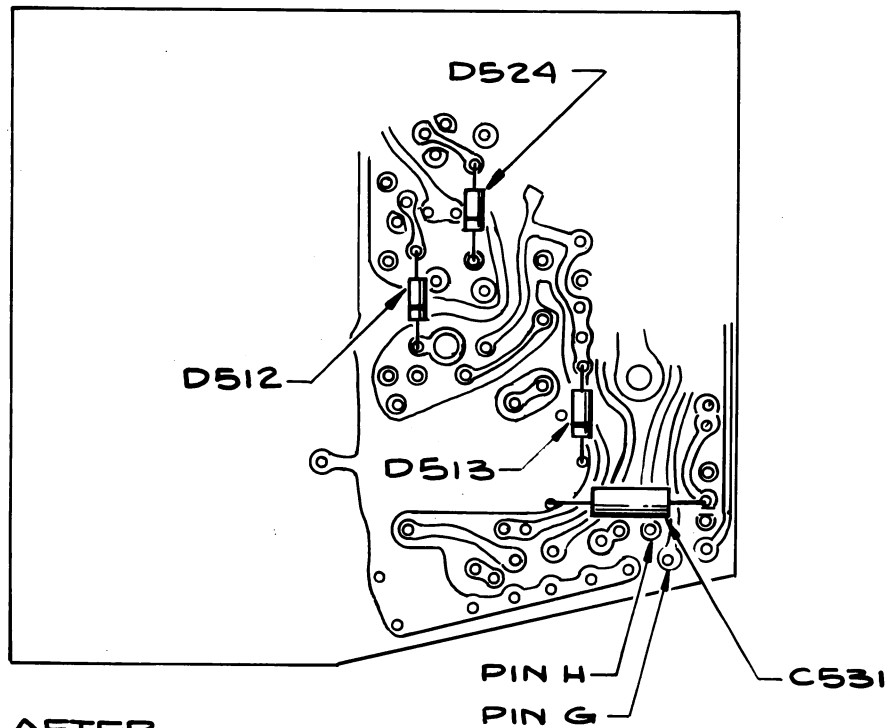
TOP VIEW

M10230
(cont)



BEFORE
M10230

TOP VIEW



AFTER
M10230

CRT CIRCUIT ZENER DIODE AND
RESISTOR ADDED TO ELIMINATE
CHANGE IN DEFLECTION SENSITIVITY

See SQB

M10517-1

Effective Prod SN 4330

Usable in field instruments SN 100-4329

FRONT PANEL SYMPTOM: Deflection sensitivity varies by approximately 1% when the INTENSITY is changed from dim to fairly bright.

PROBLEM: Deflection sensitivity changes of approximately 1% occur when the INTENSITY control was rotated from dim to fairly bright. The CRT grid to cathode voltage regulation was not optimum over this range of INTENSITY settings.

PRODUCTION CHANGE: A 51 Volt Zener diode and a 221 k resistor were added as shown in the AFTER schematic, to improve the CRT grid to cathode voltage regulation. This reduced the CRT sensitivity changes caused by intensity variations to approximately 0.3%.

Parts Removed:

Board, circuit HV Regulator	388-0619-00
-----------------------------	-------------

Parts Added:

*D839	Diode, Zener, 51 V 5% 400 mW	152-0255-00
*R839	Resistor, prec, 221 k 1/8 W 5%	321-0418-00
	Board, circuit HV Regulator	388-0619-01

INSTALLATION INSTRUCTIONS:

See below or MI - 10517-1

Parts Required: See 'Parts Added' w/asterisks and parts listed below.

Eyelet, (Tek #210-0663-00) Au plated, small	210-0629-00
Eyelet, (Tek #210-0617-00) Au dipped, large (2)	210-0632-00

Installation Procedure:

- Remove the HV Power Supply assembly from the instrument.
- Remove the "DANGER HIGH VOLTAGE" cover (337-721) from the HV Power Supply assembly.

NOTE: For future reference, observe how the HV circuit boards and HV transformer are mounted in the plastic container.

- Remove the HV circuit boards and HV transformer from the plastic container.

MAKE THE FOLLOWING CHANGES TO THE
HIGH VOLTAGE REGULATION CIRCUIT BOARD:

- Remove approximately 3/16" of the circuit run (with an X-acto[®] blade or equivalent) as shown in Fig. 1.

continued

- e) Drill two #41 holes in the circuit board. See Fig.1
 - f) Install, from Fig.1 side of board, the 210-0632-00 (large) eyelets in the holes (do not crimp), and solder to circuit runs. DO NOT fill eyelets with solder.
 - g) Add D839 (51V 5% 400mW Zener diode) and R839 (221 k 1/8W 5% metal film resistor) in parallel between the two eyelets. Banded end of Zener diode toward C829. Solder eyelets (see Fig.2).
 - h) Drill a #51 hole in the circuit board. See Fig.1.
 - i) Install, from Fig.1 side of board, a 210-0629-00 (small) eyelet in the hole, crimp*, and solder it to circuit run. DO NOT fill eyelet with solder.
- *NOTE: The blue .065" pliers from the FMS Switch Repair Kit can be used to crimp this eyelet.
- k) Unsolder the two white-orange wires from "BOARD REFERENCE 'A'." See Fig.2.
 - m) Use an ohmmeter to determine which wire connects to the CRT socket pin #3.
 - n) Insert the white-orange wire into the eyelet, installed in step 9, and solder (see Fig. 2).
 - p) Resolder the remaining white-orange wire to the "BOARD REFERENCE 'A'." See Fig. 2.
 - q) Reinstall components removed in steps c, b, and a respectively.

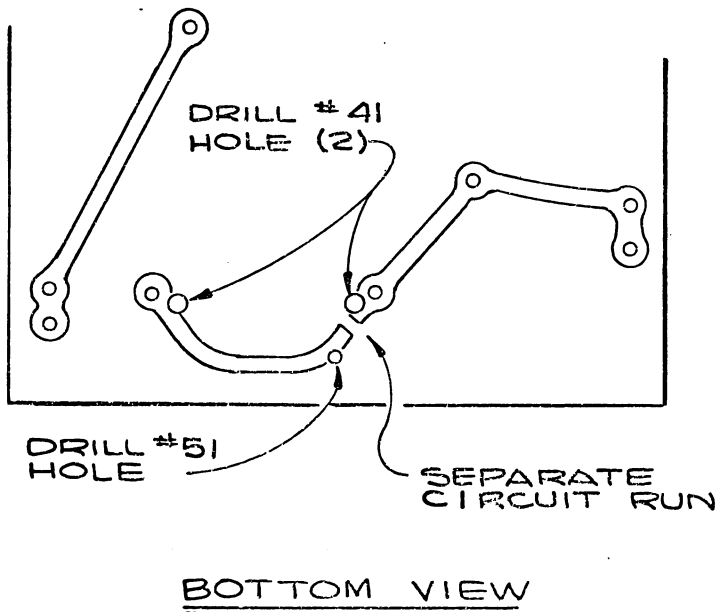


FIG. 1

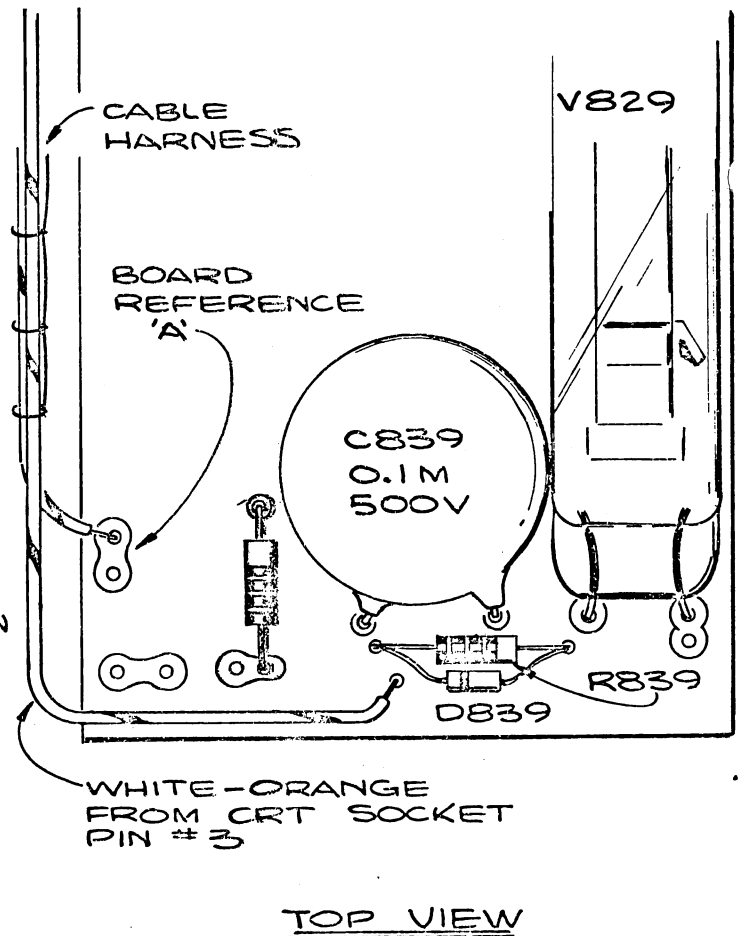
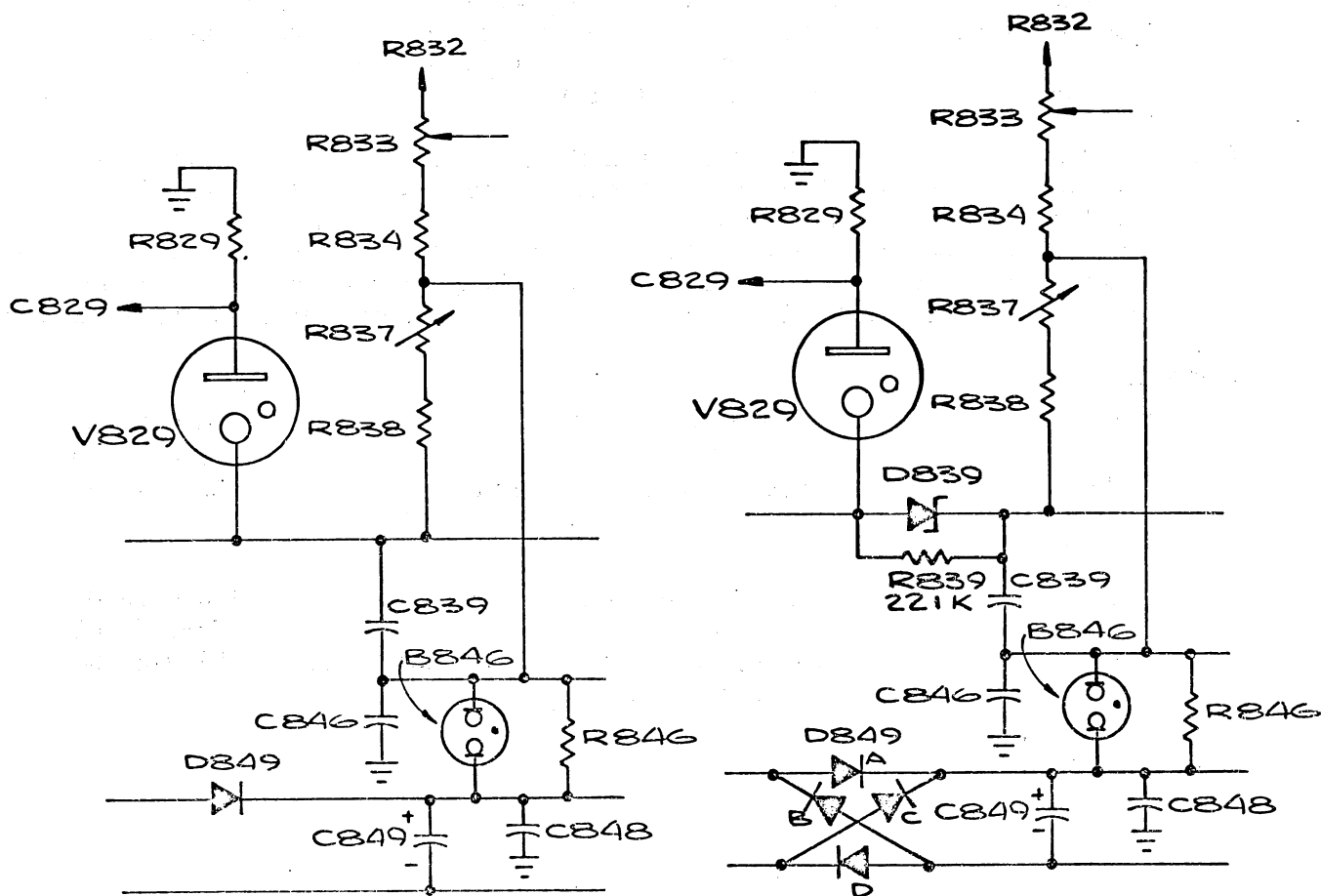


FIG. 2

continued



BEFORE M10517

AFTER M10517

PARTIAL CRT CIRCUIT

CRT CIRCUIT CHANGED TO PROVIDE
SAME CRT FILAMENT VOLTAGE WHEN
USING EITHER AC OR AC-DC
POWER SUPPLIES

INFORMATION ONLY

M10517

Effective Prod SN 4330

FRONT PANEL SYMPTOM: None.

PROBLEM: The CRT filament voltage was approximately 10% higher than the nominal 6.3 V when the Type 422 Oscilloscope was powered with the AC Power Supply. The input squarewave drive for T801 is 8 kHz from the AC-DC supply, and 20 kHz from the AC supply. Because of this, the CRT filament half-wave rectifier was supplying as much as 7 V when used with the AC supply.

PRODUCTION CHANGE: The CRT filament half-wave rectifier was replaced with a capsulated full-wave bridge rectifier 'package' to make the CRT filament voltage equal when used with either type power supply. Secondary winding 9-10 of HV transformer T801 changes from 12 to 13 turns and from 7.6 to 8.3 volt. Primary center taps (2 and 5) are relocated one turn, changing windings 1-2 and 5-6 from 38 to 39 turns, respectively and winding 2-3 and 4-5 from 4 to 3 turns respectively.

Parts Removed:

T801	Transformer, HV	120-0378-01
	Cable, HV	179-0961-00
D849	Diode, rectifier, unitrode	152-0179-00

Parts Added:

T801	Transformer, HV	120-0378-02
	Cable, HV	179-0961-01
D849A-D	Diode, rectifier, molded bridge assy	152-0260-00
	UBR 261	

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 parts 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:

D549, D559	1N718A 15 V 250 mW	152-0031-00
D325	1N4372 3 V $\pm 10\%$	152-0076-00
D841	1N976A 43 V $\pm 10\%$	152-0234-00

Parts Added:

D549, D559	1N965B 15 V 400 mW	152-0243-00
D325	1N4372A 3 V $\pm 5\%$	152-0278-00
D841	1N976B 43 V $\pm 5\%$	152-0283-00

POWER SUPPLY ZENER DIODE
VOLTAGE SPEC INCREASED TO
ELIMINATE SELECTION OF
SWITCHING TRANSISTORS

INFORMATION ONLY

M11365
(125B ONLY)

Effective Prod SN 4530

w/exceptions	4453	4474-9	4485-6	4496	4500-1
	4462-3	4482-3	4488-92	4499	4504-5

FRONT PANEL SYMPTOM: No display.

PROBLEM: V_{be} of same energy storage switch transistors (Q1174 and Q1184) is at upper limit and voltage of Zener diode D1192 is at lower limit. This results in insufficient voltage on the bases of Q1174 and Q1184 to start the supply oscillating.

PRODUCTION CHANGE: D1192 voltage rating was increased from 7.5 V to 8.2 V to assure proper biasing of transistors Q1174 and Q1184.

This modification is superseded by M11373.

Parts Removed:

D1192	Diode, Zener 1N755A 7.5 V 5%	152-0127-00
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Parts Added:

D1192	Diode, Zener 1N756 8.2 V 5%	152-0217-00
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AC POWER SUPPLY RESISTORS
CHANGED TO ELIMINATE POSSIBLE
CIRCUIT BOARD DAMAGE

See SQB

M10273
(422 and R422 ONLY)

Effective Prod s/n 4640

Usable in field instruments s/n 100-4639

FRONT PANEL SYMPTOM: None.

PROBLEM: Over-heating of R614, R651 and R689 (1 Ω 1/2W 5% WW resistors), when mounted in close proximity to the circuit board, was causing damage to the circuit board.

PRODUCTION CHANGE: R614, R651 and R689 were changed from 1/2W to 1/4W, and the mounting was changed so that the resistor body is not as close to the circuit board. The lower wattage rating allows the resistor to open before enough heat is generated to damage the circuit board.

Parts Removed:

R614, R651, R689	Resistor, WW, 1 Ω 1/2W \pm 5%	308-0141-00
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Parts Added:

R614, R651, R689	Resistor, WW, 1 Ω 1/4W \pm 5%	308-0415-00
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INSTALLATION INSTRUCTIONS:

See below or MI - 10273

Parts Required: See 'Parts Added'.

Installation Procedure:

NOTE: Also see page 4-16 of the 422 Manual for addition component location information.

- a) Replace R614, located on the AC Power Supply circuit board near D645, with a 1 Ω 1/4W \pm 5% resistor (308-0415-00).
- b) Replace R651, located on the AC Power supply circuit board near D610, with a 1 Ω 1/4W \pm 5% resistor.
- c) Replace R689, located on the AC Power Supply circuit board near D655, with a 1 Ω 1/4W \pm 5% resistor.

CH 2 PREAMP CIRCUIT BOARD
REDESIGNED TO ELIMINATE
WIRE INSTALLED BY M10800

INFORMATION ONLY

M10801

Effective Prod SN 4770

FRONT PANEL SYMPTOM: None.

PROBLEM: Production Mod 10800 replaced a circuit 'run' on the Channel 2 Preamplifier circuit board (388-0614-00) with a length of wire to eliminate a possible short circuit.

PRODUCTION CHANGE: The Channel 2 Preamplifier circuit board was replaced with a newly redesigned circuit board.

The 'run' on the new board was relocated to eliminate the need for the wire which was installed by M10800. The length of the circuit board was increased 0.09" to 4.844" to accommodate the new 'run'.

Parts Removed:

Ckt Board, Preamp., Ch 2 388-0614-00

Parts Added:

Ckt Board, Preamp., Ch 2 388-0614-01

CH 1 AND 2 ATTEN SWITCH SHAFT
COUPLERS REPLACED TO STANDARDIZE
AND PROVIDE A COST SAVINGS

INFORMATION ONLY

M10621

Effective Prod SN 4930

FRONT PANEL SYMPTOM: None.

PROBLEM: The usage of the Channel 1 and 2 switch shaft couplers was replaced with the Type 453 Oscilloscope shaft couplers to eliminate stocking extra parts and thereby provide a cost savings.

PRODUCTION CHANGE: The 103-0049-00 and 103-0050-00 switch shaft couplers were replaced with the 103-0049-04 and 103-0050-02 switch shaft couplers respectively.

Parts Removed:

Adapter, shaft coupling, alum 103-0049-00
Adapter, shaft coupling, alum 103-0050-00

Parts Added:

Adapter, shaft coupling brass ni-albaloy plated 103-0049-04
Adapter, shaft coupling brass ni-albaloy plated 103-0050-02

ATTENUATOR RESISTORS
CHANGED TO 1/2% METAL FILM
FOR IMPROVED ACCURACY

INFORMATION ONLY

M9682

Effective Prod SN 5700

FRONT PANEL SYMPTOM: Vertical calibration close to edge of specification.

PROBLEM: Possible worst-case tolerance accumulation between calibrator and attenuator did not support high customer confidence level in measurement accuracy.

PRODUCTION CHANGE: All critical or wider tolerance resistors in the calibrator and attenuator circuits were replaced with 1/2% metal film resistors of the same value. This was done to improve the basic accuracy of the calibrator and attenuator circuits.

Parts Removed:

The following are subparts of ATTENUATOR switches 262-0709-00 and 262-0710-00:

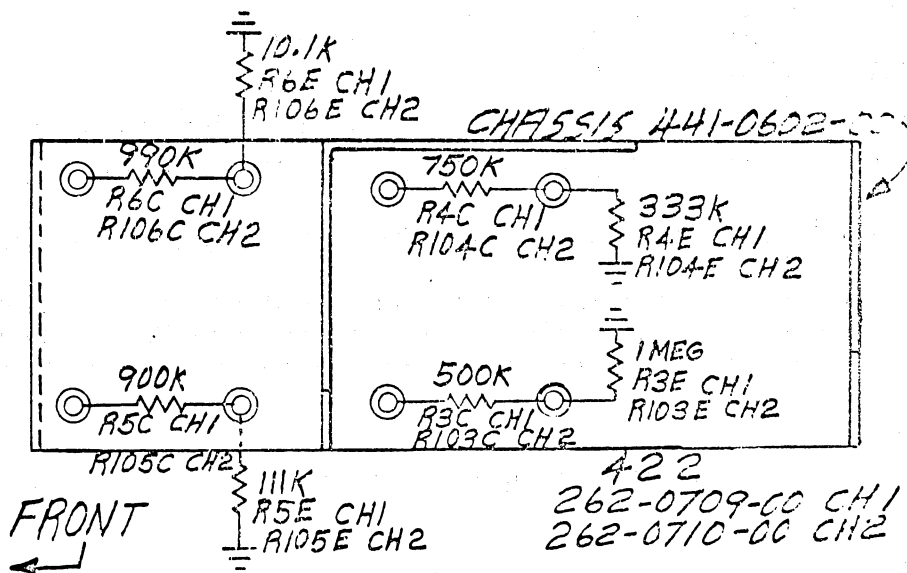
R10, R110, R3E, R103E	Resistor,	1 M	1/4 W	1%	MF	322-0481-00
R3C, R103C	Resistor,	500 k	1/4 W	1%	MF	322-0610-00
R4C, R104C	Resistor,	750 k	1/4 W	1%	MF	322-0469-00
R4E, R104E	Resistor,	333 k	1/8 W	1%	MF	321-0628-00
R5C, R105C	Resistor,	900 k	1/4 W	1%	MF	322-0621-00
R5E, R105E	Resistor,	111 k	1/8 W	1%	MF	321-0617-00
R6C, R106C	Resistor,	990 k	1/4 W	1%	MF	322-0624-00
R6E, R106E	Resistor,	10.1 k	1/8 W	1%	MF	321-0614-00

Parts Added:

The following are subparts of ATTENUATOR switches 262-0709-00 and 262-0710-00:

R10, R110, R3E, R103E	Resistor,	1 M	1/4 W	1/2%	MF	322-0481-01
R3C, R103C	Resistor,	500 k	1/4 W	1/2%	MF	322-0610-01
R4C, R104C	Resistor,	750 k	1/4 W	1/2%	MF	322-0469-01
R4E, R104E	Resistor,	333 k	1/8 W	1/2%	MF	321-0628-01
R5C, R105C	Resistor,	900 k	1/4 W	1/2%	MF	322-0621-01
R5E, R105E	Resistor,	111 k	1/8 W	1/2%	MF	321-1389-01
R6C, R106C	Resistor,	990 k	1/4 W	1/2%	MF	322-0624-01
R6E, R106E	Resistor,	10.1 k	1/8 W	1/2%	MF	321-1289-01

continued



FERRITE CORE REPLACED WITH
MORE READILY AVAILABLE TYPE
AND TO REDUCE COST

INFORMATION ONLY

M10297

Effective Prod SN 5700

FRONT PANEL SYMPTOM: None.

PROBLEM: The 0.7 μ H ferrite core is not available in sufficient quantity and is replaceable with a 0.6 μ H ferrite core at a cost saving.

PRODUCTION CHANGE: The 0.7 μ H ferrite cores L41, L63, L73, L141, L163 and L173 were replaced by a 0.6 μ H ferrite core. Due to circuit requirements, L423 will remain a 0.7 μ H ferrite core.

Parts Removed:

L41, L63, L73, L141, L163, L173	0.7 μ H ferrite core	276-0532-00
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Parts Added:

L41, L63, L73, L141, L163, L173	0.6 μ H ferrite core	276-0507-00
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HORIZ AMP RESISTOR CHANGED TO
IMPROVE TEMPERATURE COEFFICIENT
CHARACTERISTICS AT HIGH TEMPS

See SQB

M10735

Effective Prod SN 5700

Usable in field instruments SN 100-5699

FRONT PANEL SYMPTOM: At 55°C, with X10 MAG ON, the timing was about 2% short.

PROBLEM: The gain of the Horizontal Amplifier was changing with a change in temperature.

PRODUCTION CHANGE: R542 was changed from a 5.1Ω, 1/4 W ±5% composition resistor to a 5.1Ω 1/2 W wire wound ±2% with a temperature coefficient of +3400 PPM/°C. At 55°C with X10 MAG on this reduced the error to approximately 3/4 of 1% (short).

Parts Removed:

R542	Resistor, comp 1/4 5.1Ω ±5	307-0113-00
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Parts Added:

R542	Resistor, WW 5.1Ω ±2% axial leads, +3400 PPM/°C, 1/2 W temp. coefficient (R.C.L. Type T 1/2A)	308-0417-00
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INSTALLATION INSTRUCTIONS:

See MI - 10735.

DC POWER CONVERTER SIDE BRACKET
MODIFIED TO PREVENT OCCASIONALLY
SHORTING OF DC CIRCUITRY

INFORMATION ONLY

M11526
(125B ONLY)

Effective Prod SN 5700

FRONT PANEL SYMPTOM: None.

PROBLEM: One of the mounting tabs on the side bracket occasionally shorts to the adjacent circuitry on the DC Power Converter circuit board.

PRODUCTION CHANGE: A notch of 45° x 0.200" was made in the inside corner of the mounting tab, without the captive nut.

Parts Removed: Bracket side, 0.040 alum 407-0125-00

Parts Added: Bracket side, 0.040 alum 407-0125-01

POWER SUPPLY 1Ω WIREWOUND
RESISTORS CHANGED TO MORE
DEPENDABLE 10% PART

INFORMATION ONLY

M11558

Effective Prod SN 5706

w/exceptions	5184-5	5445	5517	5587	5623	5648
	5195-6	5455	5530-1	5589	5625	5655
	5201-2	5467	5538	5595	5628-30	5662
	5288-9	5476	5549	5597-5600	5633	5666
	5291-2	5482	5555	5603	5635	5670
	5337	5497	5559	5605	5637	5675-6
	5395-7	5508	5571-2	5608-9	5641	5679
	5410-1	5511	5582	5611-2	5643-4	5700
	5417	5515	5584-5	5616-8	5646	5703-4

FRONT PANEL SYMPTOM: Inoperative instrument.

PROBLEM: The 1Ω 5% resistors must be 'tailored' by filing the resistive wire to achieve 5% tolerance. This filing causes a localized hot-spot resulting in early resistor failure.

PRODUCTION CHANGE: The 1Ω WW Tek-made resistors were changed from a 5% part to a 10% part.

Parts Removed:

R614,R651,R689 Resistor, WW, 1Ω 1/4 W 5% 308-0415-00

Parts Added:

R614,R651,R689 Resistor, WW, 1Ω 1/4 W 10% 308-0433-00

POWER SUPPLY ZENER DIODE
CHANGED TO NOMINAL VALUE
PART NOW AVAILABLE

INFORMATION ONLY

M11373
(125B ONLY)

Effective Prod SN 6230

FRONT PANEL SYMPTOM: None.

PROBLEM: Proper value part was not available.

PRODUCTION CHANGE: D1192 was changed from an 8.2V Zener diode to a 9.1V Zener.
This mod supersedes M11365. See M11365 for additional details.

Parts Removed:

D1192	Diode, Zener, 1N756A, 8.2V 5%	152-0217-00
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Parts Added:

D1192	Diode, Zener, 1N960B, 9.1V 5%	152-0306-00
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POWER SUPPLY CAPACITOR
REPLACED TO ELIMINATE
SELECTION FOR LOW
DISSIPATION FACTOR

INFORMATION ONLY

M10498

Effective Prod SN 6280

FRONT PANEL SYMPTOM: None.

PROBLEM: C639 and C659 require a low dissipation factor that could not be guaranteed by the vendor. (Only capacitors with low dissipation factor were used in instruments).

PRODUCTION CHANGE: C639 and C659 were replaced with a selected 290-0135-02 capacitor.

Parts Removed:

C639	Capacitor, EMT 15 μ F 20 V	290-0135-01
C659	Capacitor, EMT 15 μ F 20 V	290-0135-00

Parts Added:

C639, C659	Capacitor, 290-0135-01 selected to 10% max D-F at 1 k Hz	290-0135-02
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POWER REGULATOR TRANSISTOR
CHANGED TO PREVENT
TRANSISTOR BREAKDOWN

See SQB

M11387
(125B ONLY)

Effective Prod SN 6990

Usable in field instruments SN 100-6989

FRONT PANEL SYMPTOM: None.

PROBLEM: The power supply will not regulate because starting voltage exceeds the rating of some brands of transistors presently used at Q1194.

PRODUCTION CHANGE: Transistor J3138, used at Q1194, was replaced with a 2N4036 transistor to prevent transistor breakdown.

Parts Removed:

Q1194	Transistor, silicon, J3138 PNP TO-5	151-0087-00
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Parts Added:

Q1194	Transistor, silicon, 2N4036 PNP TO-5	151-0208-00
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INSTALLATION INSTRUCTIONS:

See MI - 11387.

POWER SWITCH ACTUATOR CHANGED
TO ELIMINATE PIVOT PIN FAILURE

See SQB

M11487

Effective Prod SN 6990

Usable in field instruments SN 100-6989

FRONT PANEL SYMPTOM: Power switch inoperative.

PROBLEM: Pivot pin used to hold the actuator rod to the switch actuator is too short and won't retain a 'press' fit.

PRODUCTION CHANGE: The Power switch actuator pivot pin was replaced by a stainless steel 'spiral' spring pin, which necessitates the changing of the pin mounting hole in the Power switch rod from a 'clearance' to a 'press fit' hole, and changing the mounting hole in the Power switch actuator from a 'press fit' to a 'clearance' hole.

Parts Removed:

Actuator, toggle switch	214-0526-00
Pin, escutcheon	214-0533-00
Rod, Power switch assembly, w/molded gray nylon knob	384-0336-00

Parts Added:

Actuator, toggle switch	214-0526-01
Pin, spiral spring, stainless steel	214-0863-00
Rod, Power switch assembly, w/molded gray nylon knob	384-0336-01

INSTALLATION INSTRUCTIONS:

Parts Required: See part listed below.
Field Modification Kit 040-0439-00

Installation Procedure:

Refer to mod kit instructions.

P6006 PROBE REPLACED BY P6012
TO STANDARDIZE ON PROBE TYPES

INFORMATION ONLY

M11641

Effective Prod SN 6990

FRONT PANEL PROBLEM: None.

PROBLEM: New P6012 probe is now available to replace the P6006 probe, offering the following improvements:

- 1) Usable with oscilloscopes having bandwidths up to 33 MHz.
- 2) Its very small size permits use on subminiature circuitry.
- 3) It is capable of matching inputs of oscilloscopes with input capacitances of from 15 pF to 47 pF.

PRODUCTION CHANGE: P6006 probe was replaced by the P6012 as a standard accessory.

Parts Removed:

Probe, P6006,	10M	10X	42 in.	010-0127-00
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Parts Added:

Probe, P6012,	10M	10X	42 in. (2)	010-0203-00
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**CALIBRATOR AND REGULATOR GRATICULE
LAMP TYPE CHANGED TO EXTEND THE
OPERATING LIFE OF GRATICULE LAMPS**

See SQB

M11053
(NOT R422)

Effective Prod SN 7190

Usable in field instruments SN 100-7189

modified out of sequence:	5184-5	5395-7	5482	5589	5805-9	5876-7
	5195-6	5410-1	5515	5608-9	5825	5923
	5201	5417	5517	5628	5852	5953
	5288-9	5445	5530	5646	5869	
	5291-2	5467	5571	5740	5871	
	5337	5476	5587	5753-4	5874	

FRONT PANEL SYMPTOM: Graticule illumination reduced, or not present, after approximately 1500 hours of operation.

PROBLEM: The 150-0044-00 lamps have a filament life of only 1500 hours at 95% rated voltage applied. The new 150-0059-00 lamps have a life of 10,000 hours at 115% rated voltage applied. Both lamps illuminate with the same brightness.

PRODUCTION CHANGE: Graticule lamps B725 and B726 were replaced with 150-0059-00 lamps. To accommodate this change, series resistor R657 was decreased in value from 27Ω to 15Ω. The AC circuit board part numbers were changed as follows: Board with plug-in components from 670-0412-00 to 67-0412-03, and board without plug-in components from 670-0412-01 to 670-0412-02.

This modification applies only to the 422 AC type power supply. When the new graticule lamps are used in conjunction with the AC-DC type supply, they are a direct replacement.

Parts Removed:

B725,B726	Bulb, incandescent, 14 V T1, 3/4 bulb #336	150-0044-00
R657	Resistor, comp, 27Ω 1W 5%	303-0270-00

Parts Added:

B725,B726	Bulb, incandescent, 14 V T1, 3/4 bulb #386	150-0059-00
R657	Resistor, comp, 15Ω 1W 5%	303-0150-00

INSTALLATION INSTRUCTIONS:

Parts Required: Parts Replacement Kit 050-0319-00

Installation Procedure: Refer to kit instructions.

+12V AND -12V POWER SUPPLY
TRANSISTOR MOUNTING HARDWARE
CHANGED TO ELIMINATE POSSIBLE SHORT

INFORMATION ONLY

M10723

Effective Prod SN 7400

FRONT PANEL SYMPTOM: None.

PROBLEM: The possibility exists that Q637 or Q657 transistors in the +12 and -12 volt 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 Q637 and Q657 were changed from anodized aluminum washers to shouldered fiber washers.

Parts Removed:

Washer, shouldered alum, w/#6 hole black anodized	(4)	210-0983-00
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Parts Added:

Washer, fiber, #6 shouldered	(4)	210-0811-00
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SWEEP GENERATOR RESISTOR TOLERANCE
CHANGED TO IMPROVE ABILITY TO
MEET TIMING SPECIFICATIONS

INFORMATION ONLY

M11480

Effective Prod SN 8150

FRONT PANEL SYMPTOM: Timing error, aging, and tracking.

PROBLEM: Sweep timing may be 3% to 5% short in the 50 μ s, 5 μ s and 0.5 μ s sweep ranges caused by R440F being out of tolerance.

PRODUCTION CHANGE: Sweep timing resistor R440F tolerance changed from 1% to 0.1%, to improve timing and reduce tracking error to a possible 1.1%.

Parts Removed:

R440F	Resistor, prec, 1.47M 1/2W 1% MF	323-0497-00
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Parts Added:

R440F	Resistor, prec, 1.47M 1/2W 0.1% MF	323-0497-07
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3-WIRE POWER CORD FEMALE
GROUND CONNECTION IMPROVED
BY THE ADDITION OF A SPRING

See SQB
(Accessories)

M11292

Effective Prod SN 8580

Usable in field instruments SN 100-8579

FRONT PANEL SYMPTOM: None.

PROBLEM: Inadequate ground connection between power cord and instrument motor base.

PRODUCTION CHANGE: A ground spring was added to the non-current carrying ground receptacle on the female connector end of the power cord.

Parts Removed: None.

Parts Added: Spring, power cord ground 214-0698-00
(subpart of power cord 161-0024-01)

INSTALLATION INSTRUCTIONS:

Parts Required:

See 'Parts Added', or part listed below.
Modification Kit 040-0424-01

NOTE: Modification Kit includes enough springs to modify 25 power cords.

Installation Procedure:

Refer to mod kit instructions.

SOLDER SPOOL MOVED TO ACCESSORY
COMPARTMENT TO ELIMINATE SHORT
CIRCUIT HAZARD

INFORMATION ONLY

M11427-1

Effective Prod SN 8580

FRONT PANEL SYMPTOM: None.

PROBLEM: The possibility existed that the solder spool could unwind and short out the power supplies.

PRODUCTION CHANGE: The solder spool and its mounting spacer were moved from the rear frame plate to the accessory cover lid.

Parts Removed: None.

Parts Added: None.

FRONT COVER IMPROVED LATCH
INSTALLED ON ACCESSORY
COMPARTMENT LID

See SQB

M11427-2

Effective Prod SN 8580

Usable in field instruments SN 100-8579

FRONT PANEL SYMPTOM: None.

PROBLEM: The previously used latch assembly was difficult to engage and frequently broke.

PRODUCTION CHANGE: A new improved latch assembly was installed consisting of latch stem 214-0787-00 and latch body 204-0282-00. The addition of the new latch assembly caused the front cover assembly to be changed to 200-0604-02.

Parts Removed: Cover, front assembly 200-0504-00

Parts Added: Cover, front assembly 200-0604-02

INSTALLATION INSTRUCTIONS:

See MI-11427 -2

DELAY LINE CABLE CLAMP
SIZE CHANGED TO PREVENT
DELAY LINE DAMAGE

INFORMATION ONLY

M12070

Effective Prod SN 8580

FRONT PANEL SYMPTOM: None.

PROBLEM: Diameter of the cable clamps was too small, causing interference pressure on the delay line with the possibility of damage to delay line insulation.

PRODUCTION CHANGE: Replaced the two 3/32 cable clamps with 1/8 cable clamps that are used to secure the DELAY LINE to the SWITCHING and OUTPUT AMPLIFIER circuit board assembly.

The interleaved mounting of the clamps is no longer necessary due to the increased diameter.

Parts Removed: Clamp, cable, 3/32" black nylon (2) 343-0119-00

Parts Added: Clamp, cable, 1/8" black nylon (2) 343-0144-00

**-81V SUPPLY MODIFIED TO
STABILIZE NOMINAL VOLTAGE**

See SQB

MI2509

Effective Prod SN 8761
modified out of sequence:

Usable in field instruments SN 100-8760

4983	7603	8123	8597	8629	8678	8700	8722
5364	7717	8136	8600-1	8651	8680	8702-5	8725-6
6638	7728	8453	8606	8654-5	8684	8707-8	8728-30
7348	7746	8471	8609	8660	8687	8711	8733-6
7455	8036-7	8541	8624	8666	8693-4	8713	8738
7546	8045	8583	8626	8675	8697	8717-8	8740-59

FRONT PANEL SYMPTOM: Timing shift of approximately 2% from one turn on to the next.

PROBLEM: The supply reference element does not always reference to the same voltage and circuit conditions exceed the base-to-emitter voltage rating of the transistor type used at Q737.

PRODUCTION CHANGE: A 0.01 μ F capacitor was added to insure sufficient ignition current for V739. Q737 was changed from a 2N2905 to a 2N4036 type transistor.

Parts Removed:

Q737	Transistor, 2N2905	151-0134-00
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Parts Added:

Q737	Transistor, 2N4036	151-0208-00
C735	Capacitor, ceramic, 0.01 μ F 500V	283-0068-00

INSTALLATION INSTRUCTIONS:

See MI - 12509

MOTOR BASE CONNECTOR
CHANGED TO FACILITATE
ASSEMBLY & REDUCE COST

INFORMATION ONLY

M9271

Effective Prod SN 9530

FRONT PANEL SYMPTOM: None.

PROBLEM: To reduce cost and facilitate fabrication of Tektronix made motor bases by adapting them for automated machinery.

PRODUCTION CHANGE: Tek-made motor base 131-0150-00 was replaced with a new Tek-made motor base 131-0150-01. New and old differ in method used for their assembly and their subparts. Old motor bases use a #4 nut, lockwasher and screw on one side and a #4 nut, lockwasher and externally threaded ground post on other side.

New motor bases use a #4 self-tapping screw into new cover 200-0185-01 on one side and a #4 sems screw into new internally threaded ground post 129-0041-01 on other side.

This mod is superseded by M12876.

The ground connection for the 3-wire motor base installed by this mod proved to be inadequate.

Parts Removed:	Motor base	131-0150-00
Parts Added:	Motor base	131-0150-01

HORIZONTAL AMPLIFIER SWEEP CAL
POT CHANGED TO REDUCE TIMING
DRIFT DUE TO AGEING

INFORMATION ONLY

M11721-1

Effective Prod SN 9563
modified out of sequence: 9544-49 and 9555

FRONT PANEL SYMPTOM: Timing error of 3% to 5% appears as the instrument ages.

PRODUCTION CHANGE: The Sweep Cal pot R512 was changed from 2.5k to 10k and a 3.3k 1/4 W 5% resistor (R510) was installed in parallel with it. The network reduces the effect of any change that may now occur in R512.

Parts Removed:

R512	Pot, comp 2.5k ±20% E.C. mounting	311-0496-00
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Parts Added:

R512	Pot, comp 10k ±20% E.C. mounting	311-0510-00
R510	Resistor, comp 3.3k 1/4 W 5%	315-0332-00

CRT UNBLANKING CIRCUIT RESISTORS
ADDED TO REDUCE FAILURE OF
Q863 AND Q864

INFORMATION ONLY

M11721-2

Effective Prod SN 9563
modified out of sequence: 9544-49 and 9555

FRONT PANEL SYMPTOM: Unable to obtain a presentation on the CRT.

PROBLEM: Excessive voltage pulses are coupled to Q863 from the CRT unblanking plates.

PRODUCTION CHANGE: A 1.5k 1/4 W 5% resistor was added in series with Q863's collector and a 300 Ω 1/4 W 5% resistor was added between the unblanking pulse output terminal and the junction of D864 and the emitter of Q863.

Parts Removed: None.

Parts Added:

R860	Resistor, comp 1.5k 1/4 W 5%	315-0152-00
R862	Resistor, comp 300 Ω 1/4 W 5%	315-0 301-00

HORIZONTAL AMPLIFIER EC BOARD
CHANGED TO ALLOW INSTALLATION
OF PARTS ADDED IN M11721-1 & M11721-2

INFORMATION ONLY

M11721-3

Effective Prod SN 9563
modified out of sequence: 9544-49 and 9555

FRONT PANEL SYMPTOM: None.

PROBLEM: None.

PRODUCTION CHANGE: The parts layout of the Horizontal Amplifier etched circuit board was changed and additional holes provided to mount R510, R860 and R862 added in production mods M11721-1 and M11721-2.

The board changes from PE to PG.

Parts Removed: Circuit board, Horiz Sweep Amp 388-0615-02

Parts Added: Circuit board, Horiz Sweep Amp 388-0615-03

MOTOR BASE CHANGED TO
IMPROVE GROUND CONNECTION

See SQB

M12876

Effective Prod SN 10650

Usable in field instruments SN 100-10649

FRONT PANEL SYMPTOM: None.

PROBLEM: The present motor base grounding is not adequate, due to cold flow of the plastic between the ground post and the mounting plate.

PRODUCTION CHANGE: The method used to attach the ground post in the motor base assemblies was changed. The new mounting eliminates plastic between the ground post and the mounting plate and provides a metal to metal ground connection. To insure a good fit between mating parts, the size of the mounting screws was changed from #4 to #6, and the clearance holes in the mounting plate and shell were increased to #6.

To prevent corrosion between new ground post and mounting plate, the plate was changed from etched aluminum to cad plated steel.

Parts Removed:	Motor base	131-0150-01
Parts Added:	Motor base	131-0572-00

INSTALLATION INSTRUCTIONS:

See MI - 12876

VARIABLE VOLTS/DIV CONTROLS
REPLACED TO IMPROVE UNCAL
NEON SWITCH RELIABILITY

INFORMATION ONLY

M12998

Effective Prod SN 11370

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.

Parts Removed:

R90/SW741, R190/SW743	Resistor, variable, comp., 250 Ω \pm 10% 1/2 W linear w/SPST sw.	311-0385-00
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Parts Added:

R90/SW741, R190/SW743	Resistor, variable, comp., 250 Ω \pm 10% 1/2 W linear w/SPST sw	311-0385-01
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AC-DC PCWER SUPPLY TRANSISTORS
CHANGED TO PROVIDE MORE STABLE
OPERATION AND REDUCE RIPPLE

INFORMATION ONLY

M13796

Effective Prod SN 11682
modified out of sequence
10919, 11300, 11304, 11384, 11431, 11558, 11619

FRONT PANEL SYMPTOM: None.

PROBLEM: Transistors presently being used cause unstable operation and failure to meet ripple specifications.

PRODUCTION CHANGE: The following transistors were changed: Q1104, Q1114, Q1163, Q1154, Q1164, Q1134, and Q1144. Changing these transistors necessitated a change in the gain of the error amplifier which resulted in a change of C1133, R1161, R1134, And R1144.

Parts Removed:

Q1104, Q1114, Q1144, Q1163	Transistor, J3138	151-0087-00
Q1154	Transistor, 2N2219 (Selected 151-0103-00)	153-0539-00
Q1164	Transistor, 2N2219	151-0103-00
Q1134	Transistor, 2N2156	151-0133-00
C1133	Capacitor, EMT 68 μ F, 60 V	290-0273-00
R1161	Resistor, comp. 7.5 k, 1/4 W, 5%	315-0752-00
R1134, R1144	Resistor, comp. 10k, 1/4 W, 5%	315-0103-00

Parts Added:

Q1104, Q1114, Q1163	Transistor, 2N4036	151-0208-00
Q1154, Q1164	Transistor, 2N3692	151-0224-00
Q1134, Q1144	Transistor, 2N4122	151-0220-00
C1133	Capacitor, EMT 47 μ F, 50 V	290-0272-00
R1161	Resistor, comp. 8.2 k, 1/4 W, 5%	315-0822-00
R1134, R1144	Resistor; comp. 5.1 k, 1/4 W, 5%	315-0512-00

HORIZONTAL AMPLIFIER RELOCATED TO SUPPRESS OSCILLATION FERRITE BEADS

See SQB

M13831

Effective Prod SN 11710
modified out of sequence

Usable in field instruments 100-11709

4983	10760	11207	11425	11597
9464	10761	11209	11427	11608-10
9713	10763-64	11213	11433	11612
10161	10786	11218	11439	11631
10280-81	10811	11221	11441	11636-37
10283	10824	11224	11459	11642
10392	10826	11230-39	11462	11647-48
10480	10829	11265	11493	11650-52
10522	10831	11277	11501	11656-60
10545	10850	11304	11509	11662-71
10551	10865	11323	11543	11674-79
10609	10901	11327	11545	11682-84
10659	10910	11336	11549	11686-91
10666	10935	11339	11557	11693-97
10720	10989	11351	11560	11699
10744	11068	11356	11567	11701
10748	11090-91	11394	11581	11703-08
10750	11094	11403	11587-88	
10753	11115	11410-11	11590-91	
10759	11120	11417	11595	

FRONT PANEL SYMPTOM: None.

PROBLEM: If Q543 is replaced, the Horizontal Amplifier may oscillate. The vendor of this transistor (2N3251, 151-0133-00) has apparently improved the bandpass capability of the transistor, and this increased capability is conducive to oscillation.

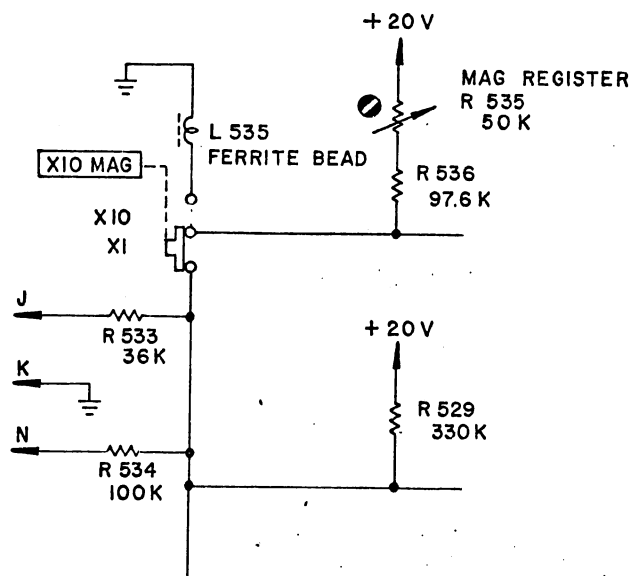
PRODUCTION CHANGE: FERRITE BEAD, L535, on the Horizontal Amplifier circuit board was relocated from the end strap to the center strap of "X10 MAG" switch, SW535.

Parts Removed: None

Parts Added: None

INSTALLATION INSTRUCTIONS:

See MI-13831.



Effective Prod SN 11930

FRONT PANEL SYMPTOM: None.

PROBLEM: Cost saving by elimination of unnecessary part.

PRODUCTION CHANGE: Potentiometer circuit board in the Y-AXIS ALIGN circuit was removed. All leads and ground straps were connected directly to the pot contacts instead of the circuit board square pins. Alignment coil, L856, was modified by removing the connectors on the 9-3 and 9-4 leads, and on the 9-120 lead. The 9-120 lead has been added by FINALS, and is used to connect R856 with the center tap of TRACE ROTATION pot, R851.

Parts Removed:	Connector, Single Contact, Malco #26	131-0371-00
	Circuit Board, Potentiometer	388-0678-00
	Connector, Single Contact, Malco #26	131-0371-00

Parts Added: None

CRT FILTER SUPPORT SPRING
REPLACED WITH IMPROVED PART

INFORMATION ONLY

M12971

Effective Prod SN 12176

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
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Parts Added:	Spring, grounding, CRT Mesh filter	214-0996-00
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TRACE ROTATOR COIL LEADS
CHANGED TO PREVENT DAMAGES
TO COIL FORM

INFORMATION ONLY

M10438

Effective Prod SN 12350

FRONT PANEL SYMPTOM: None.

PROBLEM: The connections to the coil were made by soldering to terminals on the coil form. The heat from the soldering iron would damage the form unless extreme care was taken.

PRODUCTION CHANGE: The eyelet connection points were removed from the trace rotator coil, and the coil was wound with permanently installed 3" leads. The coil form was changed from 276-0094-00 to 276-0094-01.

Parts Removed:

L859	Coil, fixed, on form 276-0094-00	108-0320-00
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Parts Added:

L859	Coil, fixed, on form 276-0094-01	108-0320-01
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HORIZONTAL AMPLIFIER OSCILLATION
SUPPRESSION BY ADDITION OF FERRITE BEAD

INFORMATION ONLY

M13877

Effective Prod SN 12374

FRONT PANEL SYMPTOM: If the trace is positioned to the left, the trace length will appear shorter.

PROBLEM: Q543 sometimes has an unusually high f_t , which will pass high frequency ground currents causing oscillations.

PRODUCTION CHANGE: Ferrite bead L546 was added to the ground lead of C546.

Parts Removed: None

Parts Added:

L546

Core, shield bead

276-0532-00

POWER CORD IDENTIFICATION
TAG ADDED

INFORMATION ONLY

M13768

Effective Prod SN 12610

FRONT PANEL SYMPTOM: None.

PROBLEM: Foreign customers may change the power plug, and wiring color code may not agree with the U.S. 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

10 AND 20% ZENER DIODES
CHANGED TO STANDARD 5% UNITS

INFORMATON ONLY

M11191

Effective Prod SN 12820

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 parts 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:

D549, D559	1N718A 15 V 250 mW	152-0031-00
D325	1N4372 3 V ±10%	152-0076-00
D841	1N976A 43 V ±10%	152-0234-00

Parts Added:

D549, D559	1N965B 15 V 400 mW	152-0243-00
D325	1N4372A 3 V ±5%	152-0278-00
D841	1N976B 43 V ±5%	152-0283-00

BD



MODIFICATION INSTRUCTIONS

MI - 9303

Type 422 AC Power Supply

Serial Numbers 100-588

COMPONENTS CHANGED IN -12 V POWER SUPPLY TO IMPROVE RELIABILITY UNDER ENVIRONMENTAL CHANGES

In order to provide greater instrument reliability, the -12 V adjust, R639, was changed from a 2.5 k 20% composition element potentiometer to a 1.5 k 5% wirewound potentiometer. The composition element is prone to change resistance in high humidity.

Changing the value of R639 required changing the values of R622, R624, R634, R637, and R638 to allow the circuit to function correctly again.

Also, since 1N752A zener diodes are no longer available with the desired temperature compensation, D622 was changed to a 1N936 zener diode.

PARTS REQUIRED

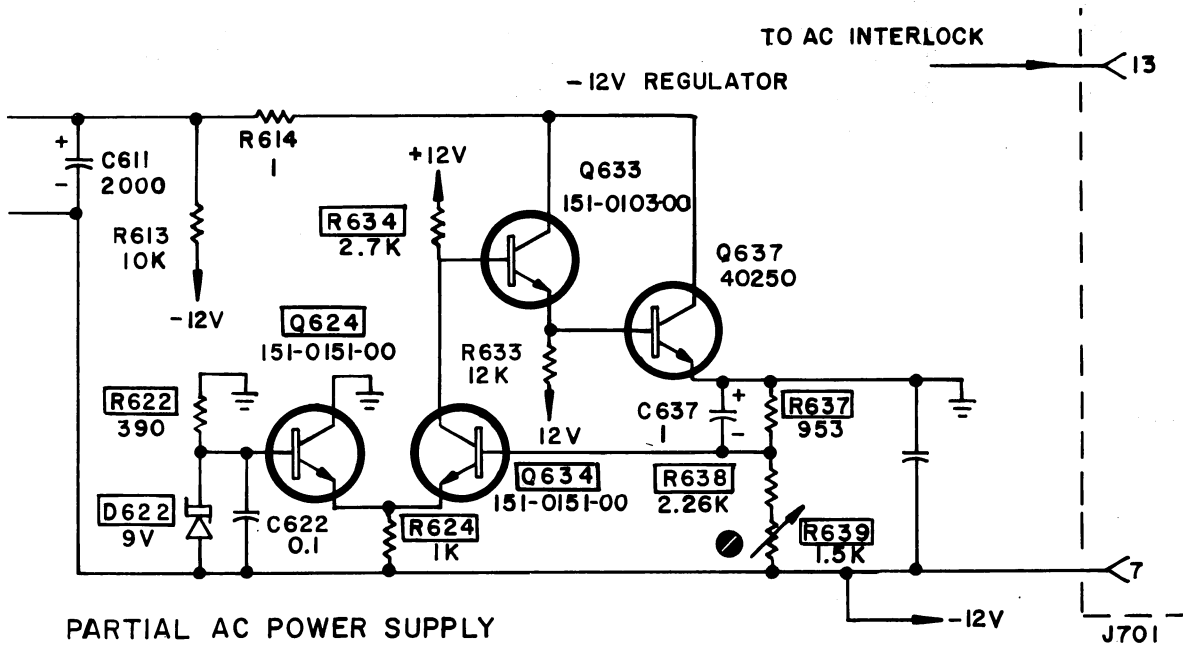
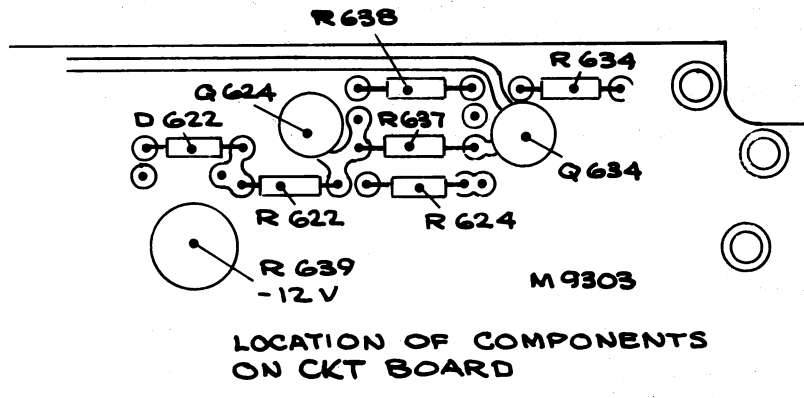
Quantity	Tektronix Part Number	Description
1 ea	152-0212-00	Diode, zener, 1N936
1 ea	311-0532-00	Potentiometer, WW, 1.5 k 5%
1 ea	315-0102-00	Resistor, comp, 1 k 1/4W 5%
1 ea	315-0272-00	Resistor, comp, 2.7 k 1/4W 5%
1 ea	315-0391-00	Resistor, comp, 390 Ω 1/4W 5%
1 ea	321-0191-00	Resistor, prec, 953 Ω 1/8W 1%
1 ea	321-0227-00	Resistor, prec, 2.26 k 1/8W 1%

continued

INSTALLATION

Refer to the illustration and perform the following component changes:

- 1) Change R639 from a 2.5 k composition potentiometer to a 1.5 k wirewound potentiometer.
- 2) Change R622 from 1 k 1/4W 5% to 390Ω 1/4W 5%.
- 3) Change R634 from 2.4 k 1/4W 5% to 2.7 k 1/4W 5%.
- 4) Change R624 from 620Ω 1/4W 5% to 1 k 1/4W 5%.
- 5) Change R638 from 4.02 k 1/8W 1% to 2.26 k 1/8W 1%.
- 6) Change R637 from 6.34 k 1/8W 1% to 953Ω 1/8W 1%.
- 7) Replace D622 with a 1N936 zener diode as needed.



INDICATES CHANGE



MODIFICATION INSTRUCTIONS

MI - 9401

Type 422 Oscilloscope

Serial numbers 100-539

HIGH FREQUENCY COMPENSATION ADJUSTMENT RANGE CENTERED

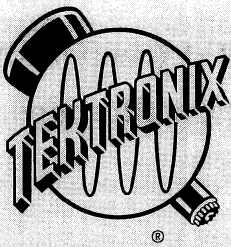
This modification changes the value of high frequency compensation capacitor C238 to more nearly center the range of adjustment of high frequency compensation variable capacitor C237.

PARTS REQUIRED

Quantity	Tektronix Part Number	Description
1 ea	281-0534-00	Capacitor, ceramic, 3.3 pF 500V NPO

INSTALLATION

Replace C238 with a 3.3 pF capacitor. C238 is located on Vertical Switching and Output Amplifier circuit board between the two variable capacitor C217 and C237 and next to Delay Line Compensation potentiometer R237.



MODIFICATION INSTRUCTIONS

MI - 9491-1

Type 422 Oscilloscope

Serial numbers 100-157

VERTICAL AMPLIFIER CABLE MODIFIED TO IMPROVE CHANNEL 1 ONLY TRIGGERING

This modification changes the routing of the leads to the Channel 1 Variable Balance potentiometer (R35) and the leads to the Channel 1 Vertical POSITION potentiometer (R60) to reduce the amount of chopping transients coupled into the triggering circuit.

This reduces the possibility of triggering on the chopping transients.

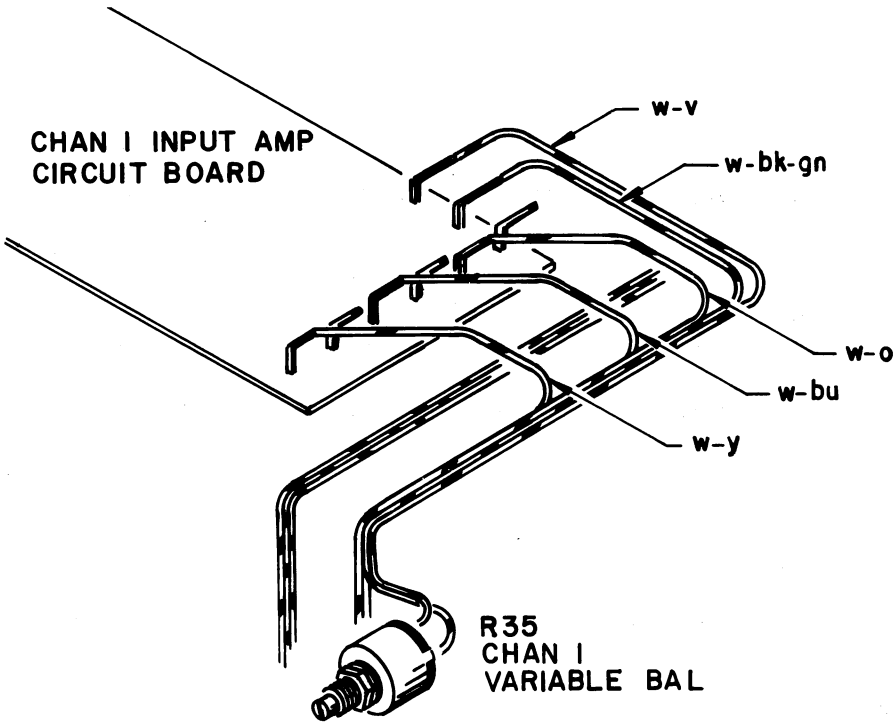
PARTS REQUIRED

Quantity	Tektronix Part Number	Description
5 ea	131-0371-00	Connector, single contact

INSTALLATION

- 1) Remove the wires attached to contacts F, G, I, M and K of the Channel 1 Input Amplifier circuit board.
- 2) Cut the connectors off of the wires immediately behind the connectors.
- 3) Pull these five wires out of the cable back to a point adjacent to the Geometry potentiometer. Use caution when removing, as these #26 wires break easily.
- 4) Remove approximately 3/16" of insulation from the end of each wire and install new connectors (131-0371-00) either by crimping onto the wire or soldering.
- 5) Re-install the wires to the pins from which they were removed, referring to the drawing for the proper dress and connection.

continued





MODIFICATION INSTRUCTIONS

MI - 9491-2

Type 422 Oscilloscope
Serial numbers 100-157

VERTICAL AMPLIFIER CABLE CHANGED TO REDUCE VERTICAL ABERRATIONS

This modification reduces vertical aberrations near the start of the sweep caused by sweep start transients being fed into the Vertical Amplifier. These transients were being inductively coupled into the Vertical Amplifier by the filament lead for V13 (Channel 1 input nuvistor) and the +20V supply lead from the Calibrator-Regulator board to the Channel 2 Input Amplifier circuit board. Moving these two wires out of the cable accomplishes this reduction.

PARTS REQUIRED

Quantity	Tektronix Part Number	Description
1 ea	131-0371-00	Connector, single contact
1 ea		Wire, #26 stranded, 175-0529-00, white-black-red, 5-1/2 in.

INSTALLATION

- 1) Unsolder the white-black-red wire from pin 12 of V13 and ceramic strip notch CSB-10. See Fig. 1.
- 2) Cut the wire at either end flush with where it enters the cable.
- 3) Install a new 5-1/2 inch #26 stranded white-black-red wire between CSB-10 and pin 12 of V13, referring to Fig. 1 for the proper routing and dress.
- 4) Remove the #26 white-red-black-black wire from pin M of the Calibrator-Regulator board, located behind the timing switch.
- 5) Cut the connector off of the wire immediately behind the connector and remove the wire from its cable back to the point where the cable passes below a 3/8" grommet in the instrument chassis near pin Y of the Sweep Trigger/Generator circuit board. See Fig. 2.
- 6) Remove approximately 3/16" of insulation from the wire and install a new connector (131-0371-00) on the wire, either by crimping it on or soldering.
- 7) Dress the wire through the 3/8" grommet and along the chassis as indicated in Fig. 2 and re-install the wire on pin M of the Calibrator-Regulator board.

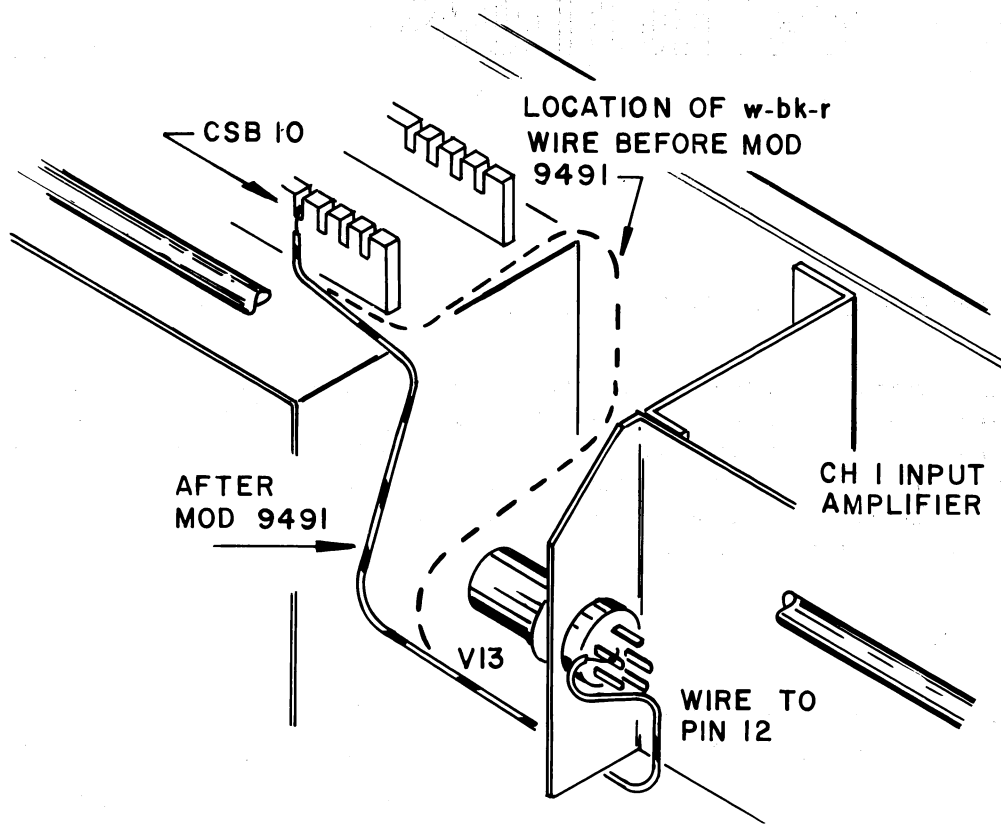


FIG. 1

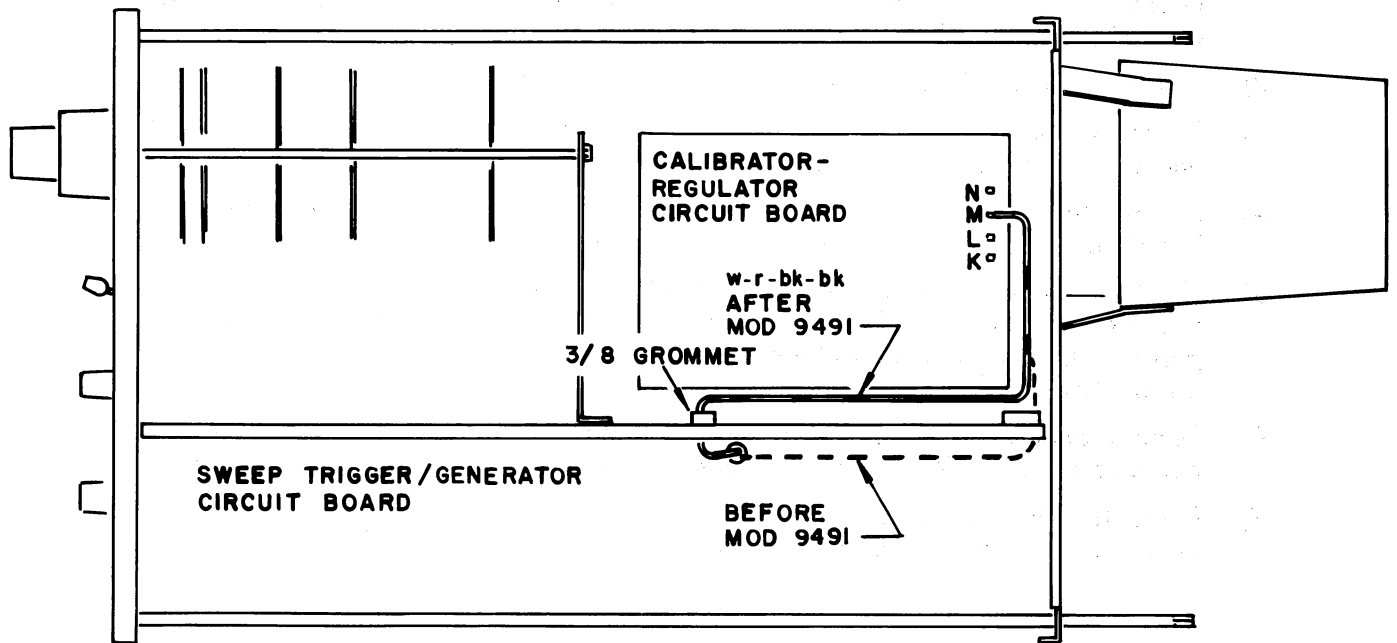


FIG. 2



MODIFICATION INSTRUCTIONS

MI - 9491-3

Type 422 Oscilloscope

Serial numbers 100-157

HORIZONTAL POSITION CONTROL DECOUPLING IMPROVED TO REDUCE HORIZONTAL JITTER

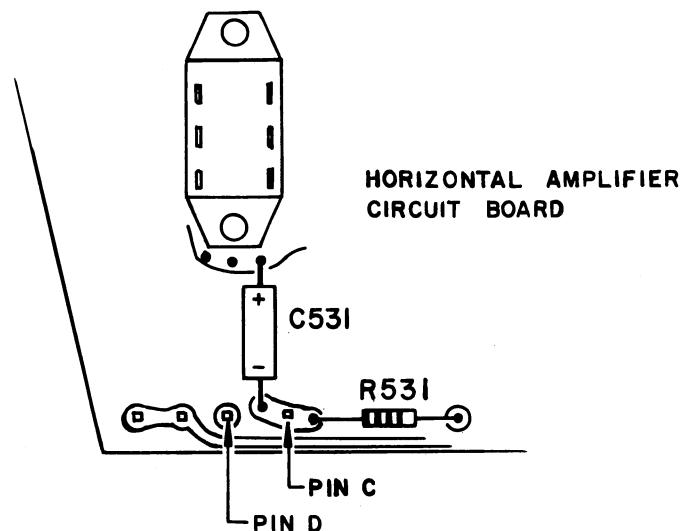
This modification improves the decoupling to the Horizontal POSITION control by increasing the value of R531 to 620Ω and the value of C531 to $22\mu\text{F}$, thereby reducing horizontal jitter caused by noise on the -12V supply when the AC-DC Type 422 power supply is used.

PARTS REQUIRED

Quantity	Tektronix Part Number	Description
1 ea	290-0134-00	Capacitor, EMT, $22\mu\text{F}$ 15V
1 ea	315-0621-00	Resistor, comp, 620Ω 1/4W 5%

INSTALLATION

- 1) Replace R531 with a 620Ω 1/4W 5% composition resistor. Refer to the illustration for location.
- 2) Replace C531 with a $22\mu\text{F}$ 15V EMT capacitor. Refer to illustration for location.



BE:ls



MODIFICATION INSTRUCTIONS

MI - 9499-2

Type 422 Oscilloscope

Serial numbers 101-759

R227 SELECTED TO IMPROVE VERTICAL AMPLIFIER COMPENSATION

Occasionally, when adjusting Vertical Amplifier compensation, a 1% $2\mu\text{s}$ time constant spike may be observed on the leading edge of a fast rise input waveform. This overshoot is caused by the fact that the compensation used is not optimum for all instruments. By selecting R227, a selectable resistor with a nominal installed value of 9.1 k, the overshoot can be reduced to acceptable limits.

PARTS REQUIRED

Quantity	Tektronix Part Number	Description
1 ea	Selected Part	Resistor, comp, 1/4W 5%

INSTALLATION

When necessary, replace R227, located near the center of the Vertical Switching and Amplifier circuit board between C217 and C237, with a 1/4W 5% resistor having a value that will cause less than 0.5% overshoot.

BE:ls



MODIFICATION INSTRUCTIONS

MI - 9499-3

Type 422 Oscilloscope

Serial Numbers 100-759

C242 AND C252 CHANGED TO IMPROVE DELAY TERMINATION

Due to changes in transistor characteristics, the values of C242 and C252 (both 18 pF) may not always provide proper compensation for optimum termination of the delay line. This will be indicated by an aberration occurring approximately 300 ns after the leading edge of the transient response waveform. Changing C242 and C252 from 18 pF to 4.7 pF eliminated the unwanted aberration.

PARTS REQUIRED

Quantity	Tektronix Part Number	Description
2 ea	281-0592-00	Capacitor, ceramic, 4.7 pF

INSTALLATION

Replace C242 and C252 with 4.7 pF capacitors when necessary. C242 and C252 are 18 pF capacitors located near the emitter clips for Q244 and Q254 on the rear edge of the Vertical Switching circuit board.

BE:ls

1-10-68



MODIFICATION INSTRUCTIONS

MI - 9637

Type 422 Oscilloscope

Serial numbers 100-157

HIGH VOLTAGE TRANSFORMER AND CIRCUITRY MODIFIED TO INCREASE CRT FILAMENT VOLTAGE

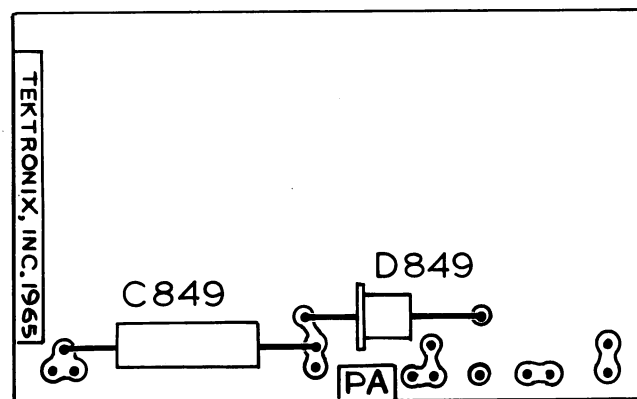
This modification increases the CRT filament voltage by installing a new high voltage transformer, which has an increased number of turns on the filament supply winding; replacing the rectifying diode D849 with a 152-0179-00 diode, which has a faster switching time; and changing the filter capacitor C849 to a type with lower AC resistance, allowing faster charging. The higher filament voltage increase the CRT writing rate.

PARTS REQUIRED

Quantity	Tektronix Part Number	Description
1 ea	120-0378-01	Transformer, HV
1 ea	152-0179-00	Diode, rectifier, transitron
1 ea	290-0248-01	Capacitor, EMT, 150 μ F w/ins sleeve

INSTALLATION

- 1) Replace T801 with a 120-0378-01 transformer.
- 2) Replace C849 on the High Voltage Regulator board with a 290-0248-01 capacitor, carefully noting the proper polarity. See drawing for location.
- 3) Replace D849 on the High Voltage Regulator board with a 152-0179-00 diode, carefully noting the proper polarity. See drawing for location.



BE:ls





MODIFICATION INSTRUCTIONS

MI - 9643

Type 422 Oscilloscope

Serial numbers 100-2069

CRT FILTER SUPPORT IMPROVED

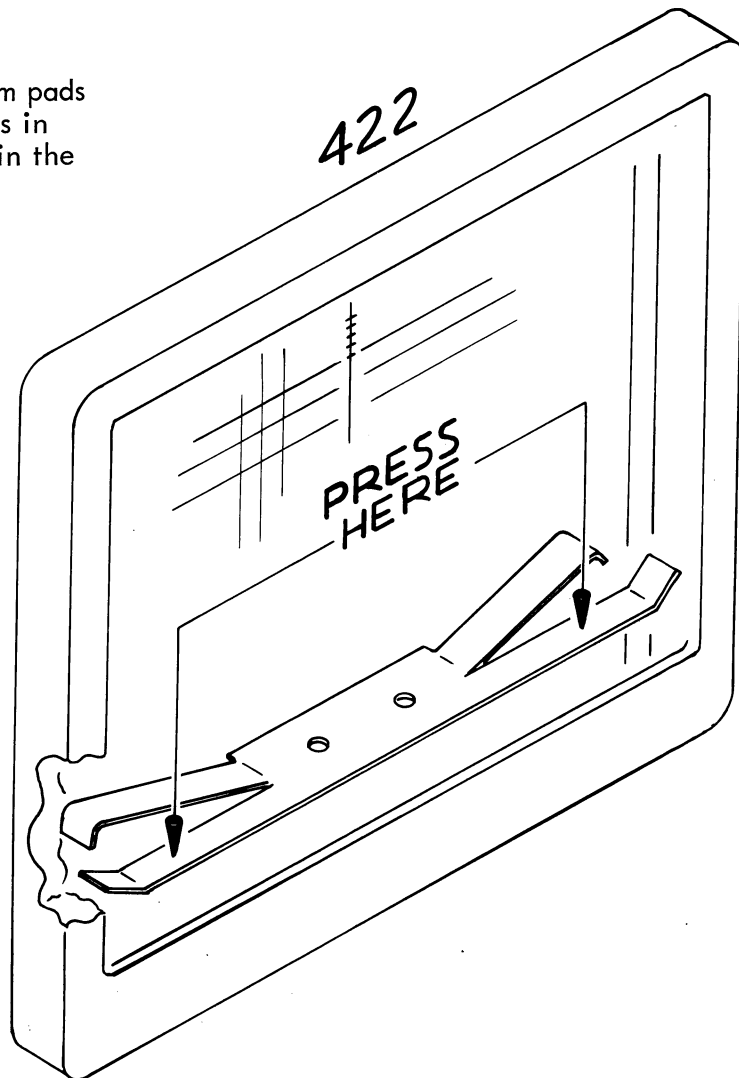
To provide better support for the CRT mesh filter, the neoprene foam pads previously used have been replaced by a support spring.

PARTS REQUIRED

Quantity	Tektronix Part Number	Description
1 ea	214-0654-00	Spring, filter support

INSTALLATION

Remove the adhesive backed foam pads from in front of the CRT and press in the new support spring as shown in the illustration.



BE:ls

2-12-68



MODIFICATION INSTRUCTIONS

MI - 9676

Type 422 Oscilloscope

Serial numbers 100-268

TRIGGER AMPLIFIER GAIN INCREASED TO IMPROVE "CHANNEL 1 ONLY" TRIGGERING

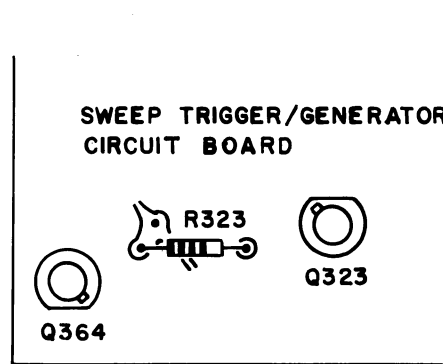
This modification increases the gain of the trigger amplifier by changing the trigger input emitter follower (Q323) emitter resistor, R323, from 16k to 5.6k, which increases the base current drive to Q324. The increased gain will improve triggering capabilities near the minimum trigger amplitude specification level.

PARTS REQUIRED

Quantity	Tektronix Part Number	Description
1 ea	315-0562-00	Resistor, composition, 5.6k 1/4W 5%

INSTALLATION

Replace R323 with a 5.6k 1/4W 5% composition resistor. R323 is a 16k 1/4W 5% resistor located between Q323 and Q364 on the Sweep Trigger/Generator circuit board.



FRONT OF INSTRUMENT

BE:ls



MODIFICATION INSTRUCTIONS

MI - 9798

Type 422 Oscilloscope
Serial Numbers 100-490

C122 CHANGED TO IMPROVE CHANNEL 2 DECOUPLING

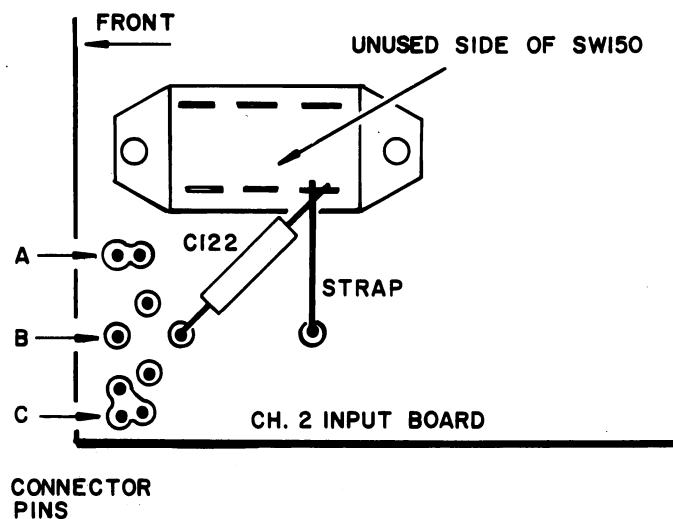
When using a 422 Indicator in conjunction with an AC-DC Power Supply, ripple on the CRT trace may be excessive when observing the 0.01 MV/DIV position in Channel 2 with the X10 GAIN switch on. To prevent this, additional decoupling in Channel 2 was provided by increasing the value of C122 from 22 μ F to 47 μ F.

PARTS REQUIRED

Quantity	Tektronix Part Number	Description
1 ea	290-0114-00	Capacitor, EMC, 47 μ F 6V 20%

INSTALLATION

Replace C122 with a 47 μ F capacitor. C122 is a 22 μ F capacitor located on the terminal side of Channel 2 X10 GAIN switch SW150.



BE:ls

1-10-68



MODIFICATION INSTRUCTIONS

MI - 9814

Type 422 Oscilloscope
Serial numbers 100-562

INSULATION ADDED TO GRATICULE LIGHT SOCKETS TO PREVENT POSSIBLE SHORT CIRCUIT

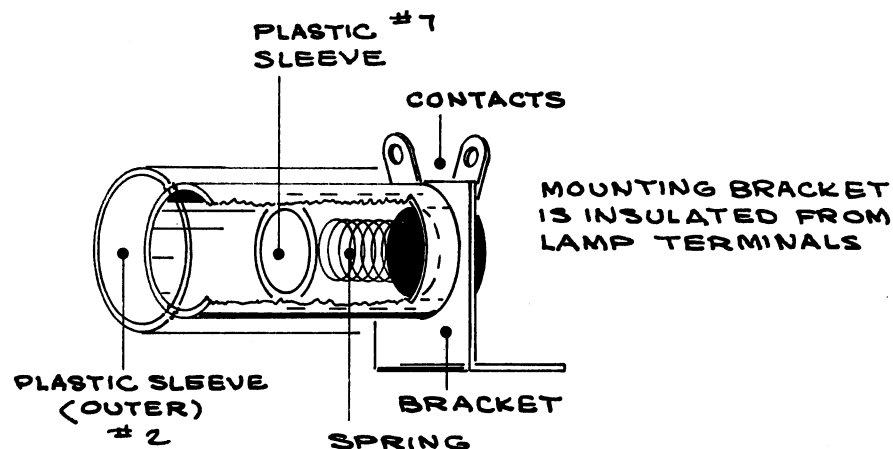
This modification adds insulation tubing to the inside and around the outside of the graticule light sockets to prevent the possibility of either the center electrode spring buckling and shorting to the inside of the shell terminal, or the outside of the shell terminal shorting to the CRT shield.

PARTS REQUIRED

Quantity	Tektronix Part Number	Description
2 ea	162-0012-00	Tubing, clear vinyl, #7 5/32 in.
2 ea	162-0019-00	Tubing, clear vinyl, #2 1/2 in.

INSTALLATION

- 1) Remove the light sockets from the front casting and remove the bulbs from the sockets.
- 2) Install the 5/32 in. #7 clear vinyl tubing inside the sockets over the contact springs.
- 3) Install the 1/2 in. #2 clear vinyl tubing over the outside of each lamp socket.
- 4) Re-install the bulbs in the sockets and then install the sockets onto the front casting.



BE:ls



MODIFICATION INSTRUCTIONS

MI - 9872

Type 422 Oscilloscope

Serial numbers 100-698

PAINT REMOVED FROM CABINET EDGE TO IMPROVE RFI SHIELDING

RF radiation from the Type 422 can be reduced by removing an insulating layer of paint on the forward edge of the Power Supply housing to lower the contact resistance between the Power Supply and Indicator cabinets.

PARTS REQUIRED

None

INSTALLATION

Carefully sand the front edge of the AC Power Supply cabinet, or AC-DC battery pack box and assembly housing where they mate with the Indicator cabinet and pack box, respectively.

BE:ls

2-10-68



MODIFICATION INSTRUCTIONS

MI - 9960

Instr Type	Serial numbers
422	100 - 4000*
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 - 9975

Type 422 Oscilloscope
Serial numbers not given

CADMIUM PLATED HARDWARE REPLACED FOR EASIER ASSEMBLY

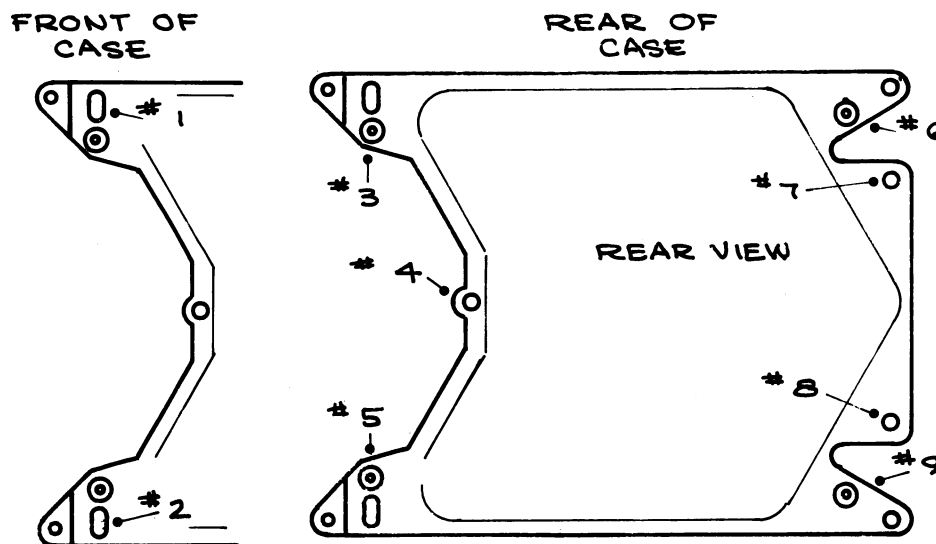
This modification replaces the cadmium plated battery pack retaining nuts with stainless steel nuts to prevent binding caused by flaking of the plating on the retaining screws.

PARTS REQUIRED

Quantity	Tektronix Part Number	Description
9 ea	220-0456-00	Nut, hex, stainless steel, 6-32 x 1/4

INSTALLATION

Replace the nine 6-32 x 1/4 cad plated brass nuts, used for assembling the battery pack, with nine 6-32 x 1/4 stainless steel nuts.



422 BATTERY CASE
(NUT LOCATIONS)



MODIFICATION INSTRUCTIONS

MI - 9992

Type 422 AC-DC Power Supply

Serial Numbers 100-594

POWER CORD GROUND LEAD CONNECTING POINT CHANGED TO REDUCE RFI

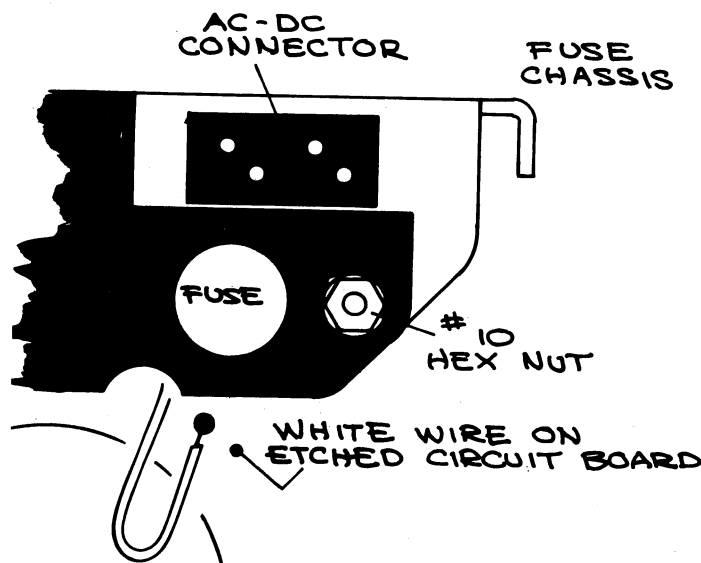
To reduce the amount of RFI radiated from the instrument, the power cord ground lead connecting point is removed from the circuit board and installed in a ground solder lug near the power connector.

PARTS REQUIRED

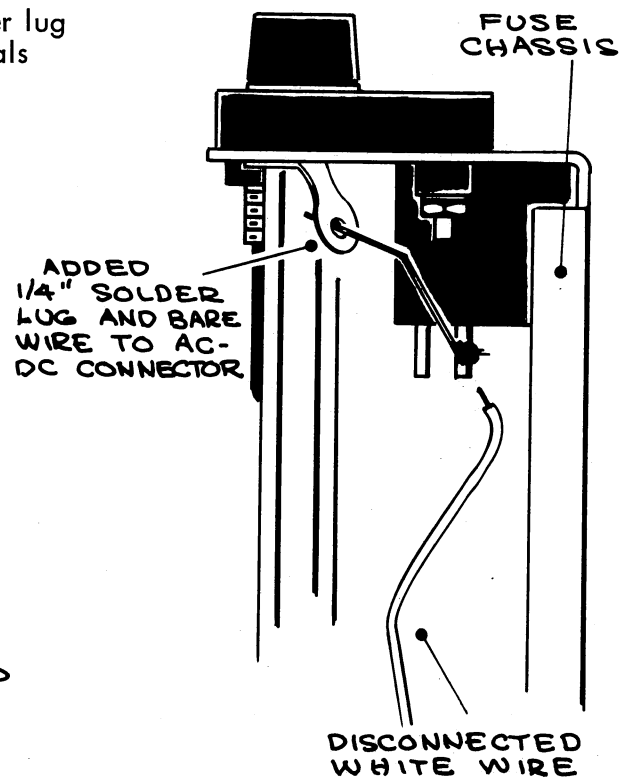
Quantity	Tektronix Part Number	Description
1 ea	210-0223-00	Lug, solder, 1/4"
1 ea		Wire, #22 solid, 176-0122-00, bare, 12in.

INSTALLATION

- 1) Temporarily remove the foam rubber protector encircling the fuse holders.
- 2) Temporarily remove the #10 hex nut securing the long hex rod to the circuit board.
See drawing A.
Mount a 1/4" solder lug between the hex rod and chassis, re-install and tighten the #10 hex nut. See drawing B.
- 3) Unsolder the #22 solid white wire between the circuit board and the AC-DC power connector. See drawings A and B.
Cut the ends of the white wire flush at the cable breakout points.
- 4) Solder a #22 solid wire between the solder lug and the AC-DC power connector, terminals nearest chassis. See drawing B.
- 5) Re-install the fuse holder foam rubber protector.



A



B



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

MI - 10000

Type 422 Oscilloscope

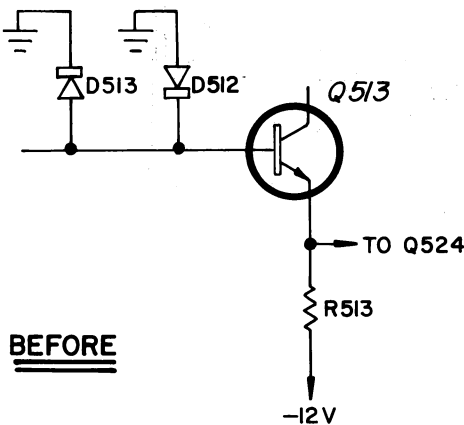
Serial numbers 101-1054*

LINEARITY OF X10 MAGNIFIER IMPROVED

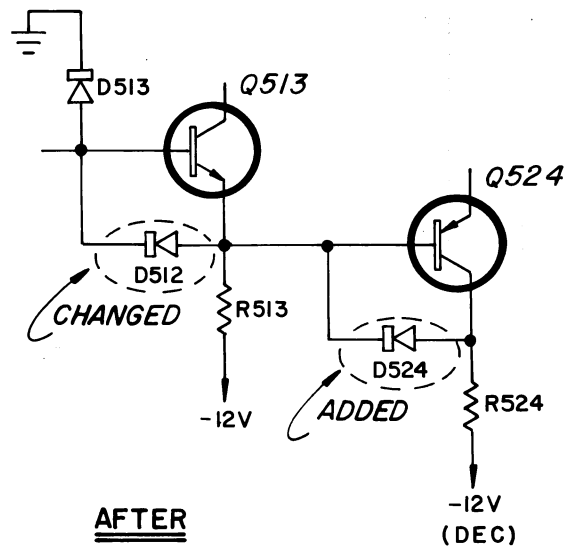
Linearity at the start of the CRT display, in the X10 MAG mode can be improved by adding a diode (D524) between the collector and base of Q524 and rewiring diode, D512, to connect its anode to the emitter of Q513 instead of ground. The diodes prevent Q524 from saturating, thereby reducing the storage time, and improving the linearity.

PARTS REQUIRED

Quantity	Tektronix Part Number	Description
1 ea	152-0233-00	Diode, silicon, 6233



PARTIAL HORIZ. AMP.



AFTER

continued

* The following serial numbered instruments were modified at the factory:

146-7	416	558	622	676	850	918	1004	1037
156	515	563	634	762	858	942	1007	1042-4
369	546-8	566	646	819	892	946-8	1009	1048-50
398	554	581	648	821	908	950-1	1010	1053
411	556	617	659	838	910	994-5	1017	

INSTALLATION

- 1) Remove D512, a 6185 diode, from its location as shown in Fig. 1.
Save for later use.
- 2) Remove the three mounting screws from the Horizontal Amplifier circuit board and lift the board so the bottom side is readily accessible.

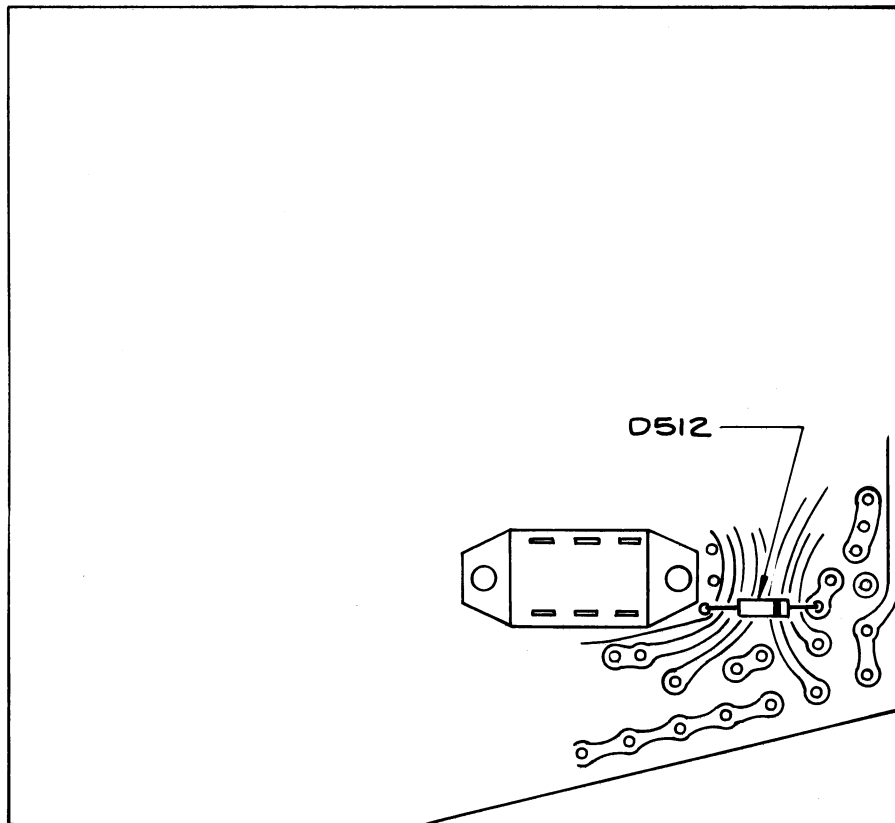


FIG. 1

continued

- 3) Install D512 (removed in step 1) between the emitter and base of Q513 as shown in Fig. 2.
- 4) Install D524, a 6233 diode, between the base and collector of Q524 as shown in Fig. 2.

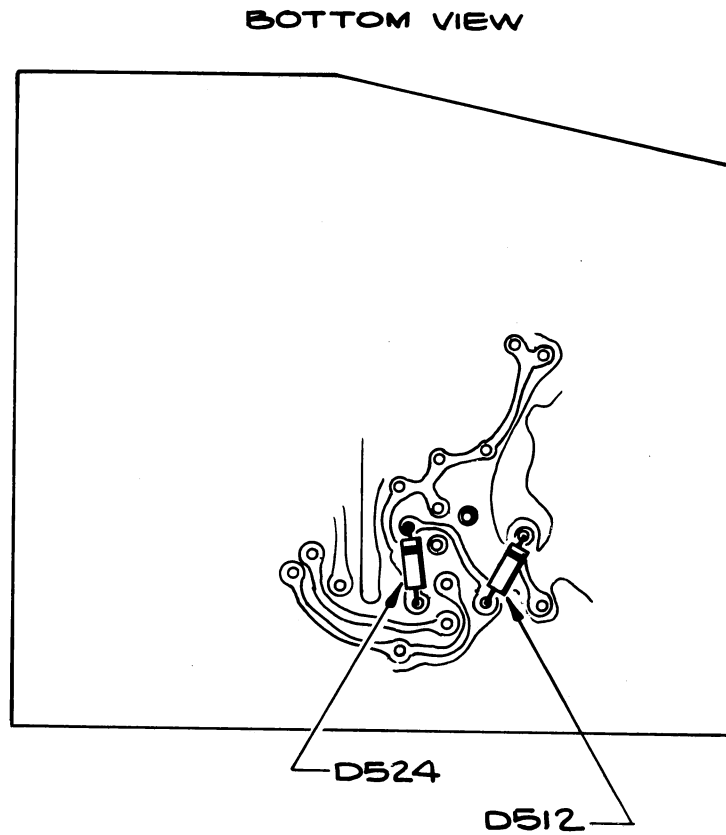


FIG. 2

BE:ls



MODIFICATION INSTRUCTIONS

MI - 10012

Type 422 Oscilloscope

Serial Numbers 100-1549

C22 CHANGED TO REDUCE RIPPLE ON CHANNEL 1 TRACE

Occasionally when the Channel 1 Step Attenuator Balance control is near the end connected to R20 and D21, there is an unusual amount of ripple on the Channel 1 trace. The source of this noise is zener noise generated by D21 and coupled into the amplifier via Q24. Changing C22, Q24 base decoupling capacitor, from $3.3\mu\text{F}$ to $5.6\mu\text{F}$ provides enough additional decoupling to reduce trace ripple to an acceptable level.

PARTS REQUIRED

Quantity	Tektronix Part Number	Description
1 ea	290-0247-00	Capacitor, EMT, $5.6\mu\text{F}$ 6V $\pm 10\%$ w/insulating sleeve

INSTALLATION

Replace C22, a $3.3\mu\text{F}$ EMT capacitor located directly adjacent to connector pin B on the Channel 1 circuit board, with a $5.6\mu\text{F}$ EMT capacitor.

BE:ls



MODIFICATION INSTRUCTIONS

MI - 10075

Type 422 AC Power Supply

Serial numbers 100-2519

STABILITY OF -12V SUPPLY IMPROVED

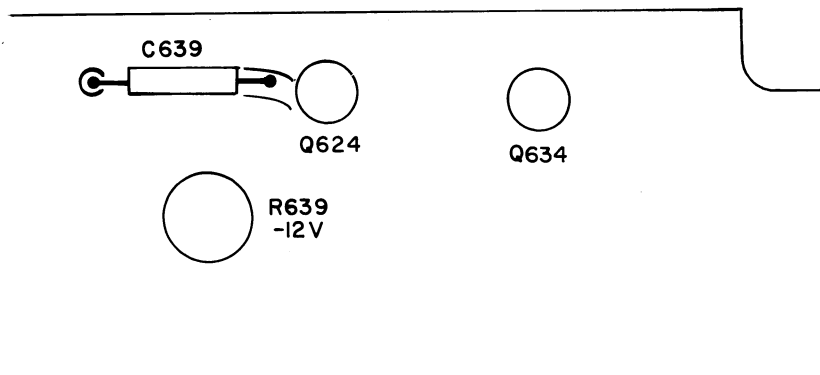
In the -12V Power Supply, the capacitor used as C639 has a high internal resistance which can sometimes cause the -12V supply to oscillate. The oscillation takes the form of bursts of 15 MHz occurring at a 20 kHz rate, and causes a thickening of the CRT trace. The problem usually becomes worse as the operating temperature is lowered. Replacement of C639 with a type having a lower internal resistance eliminates this oscillation.

PARTS REQUIRED

Quantity	Tektronix Part Number	Description
1 ea	290-0135-01	Capacitor, EMT, 15 μ F 20V

INSTALLATION

Refer to the illustration for correct component location on the AC Power circuit board and replace C639 with a 15 μ F capacitor.



BE:ls



MODIFICATION INSTRUCTIONS

MI - 10273

Type 422 AC Power Supply

Serial numbers 100-4639

FUSE RESISTORS REPLACED TO PREVENT DISCOLORATION OF CIRCUIT BOARD

To prevent discoloration of the Power Supply circuit board, fuse resistors R614, R651, and R689 are changed from 1/2 W to 1/4 W rating. This allows the resistors to open before enough heat can be generated in the resistors to discolor the board.

PARTS REQUIRED

Quantity	Tektronix Part Number	Description
3 ea	308-0415-00	Resistor, WW, 1Ω 1/4W 5%

INSTALLATION

- 1) Replace R614, located on the AC Power Supply circuit board near D645, with a 1Ω 1/4W 5% wirewound resistor.
- 2) Replace R651, located on the AC Power Supply circuit board near D610, with a 1Ω 1/4W 5% wirewound resistor.
- 3) Replace R689, located on the AC Power Supply circuit board near power connector J701, with a 1Ω 1/4W 5% wirewound resistor.

BE:ls

2-12-68



MODIFICATION INSTRUCTIONS

MI - 10491

Type 422 Oscilloscope
Serial Numbers 100 - 2949

R504 CHANGED TO ASSURE ADEQUATE EXT HORIZ ATTENUATOR RANGE

It was possible under worst case accumulation of parts tolerances to have insufficient range in the External Horizontal Attenuator. To prevent this from occurring, R504 was decreased in value from 499Ω to 392Ω .

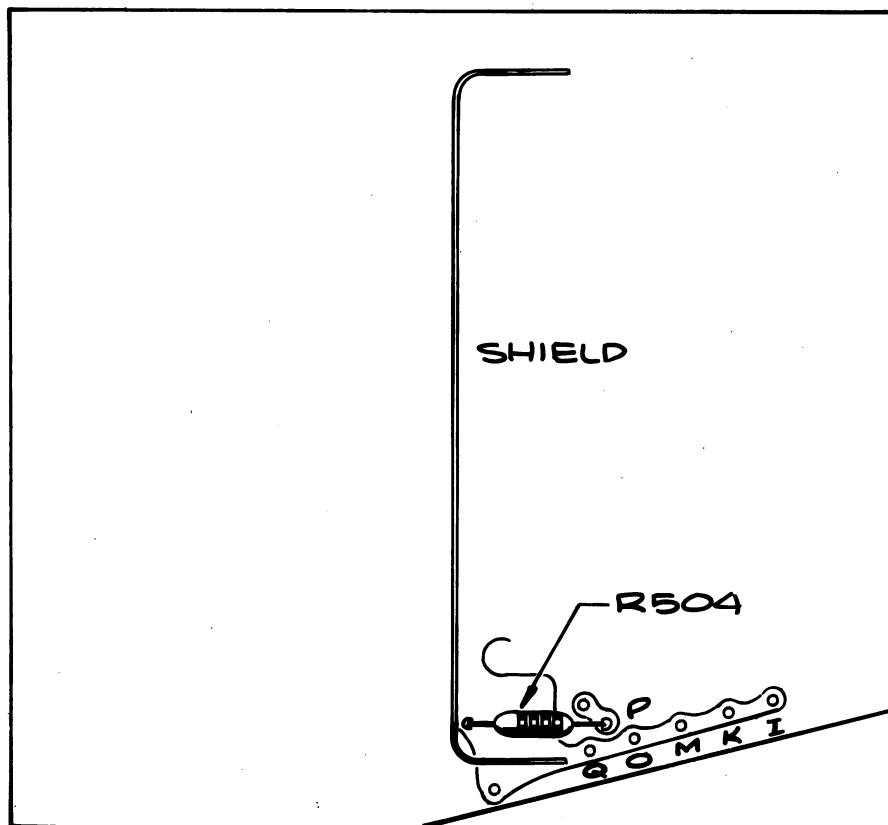
PARTS REQUIRED

Quantity	Tektronix Part Number	Description
1 ea	3210-0154-00	Resistor, precision, 392Ω 1/8W 1%

INSTALLATION

Replace R504, if needed, with a 392Ω resistor. R504 is a 499Ω precision resistor located on the Horizontal Amplifier circuit board as shown in the illustration.

TOP OF HORIZ. AMPLIFIER
CIRCUIT BOARD 388-0615-00



BE:ls

1-10-68



MODIFICATION INSTRUCTIONS

MI - 10517-1

Type 422 Oscilloscope

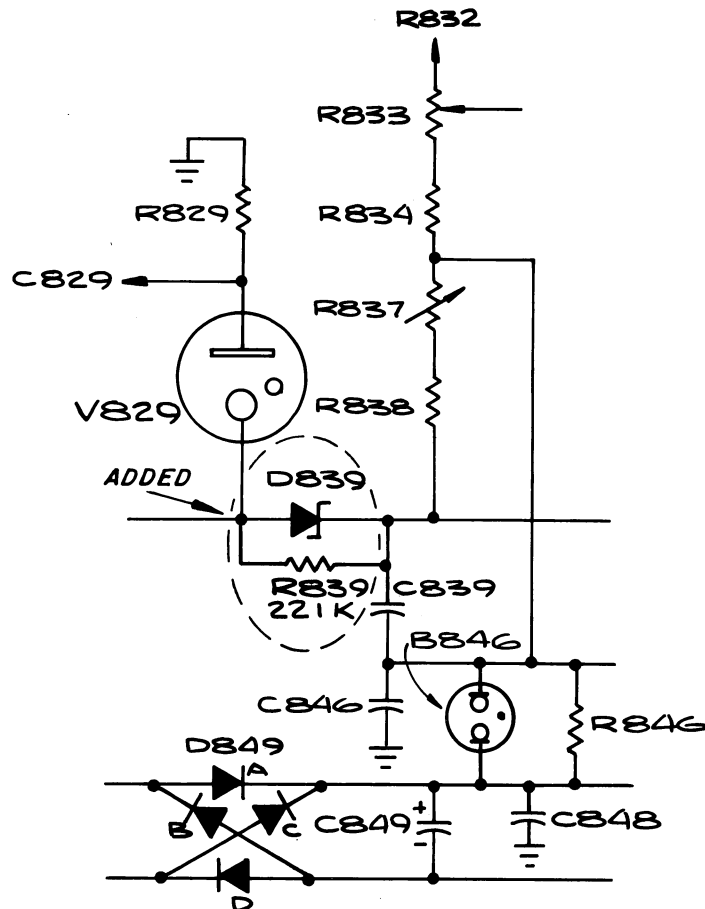
Serial numbers 100-4329

CRT DEFLECTION SENSITIVITY STABILITY IMPROVED

Immunity to changes in CRT sensitivity with changes in the CRT display intensity can be improved by installing a 51 V zener diode in parallel with a 221 k precision resistor as shown in the included schematic. The addition of these two components helps to maintain a more constant CRT cathode voltage with respect to the potential of the deflection plate area. This difference in potential is the major sensitivity determining factor in the CRT.

PARTS REQUIRED

Quantity	Tektronix Part Number	Description
1 ea	152-0255-00	Diode, zener, 51 V 5%
1 ea	210-0629-00	Eyelet, small
2 ea	210-0632-00	Eyelet, large
1 ea	321-0418-00	Resistor, precision, 221 k 1/8W 5%

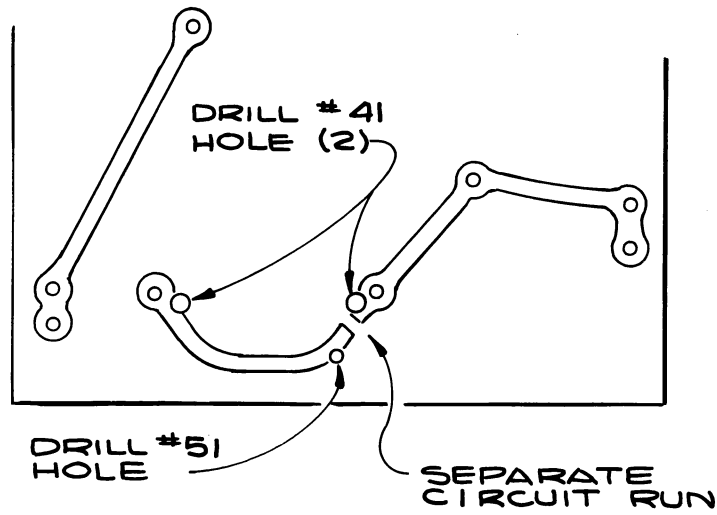


continued

INSTALLATION

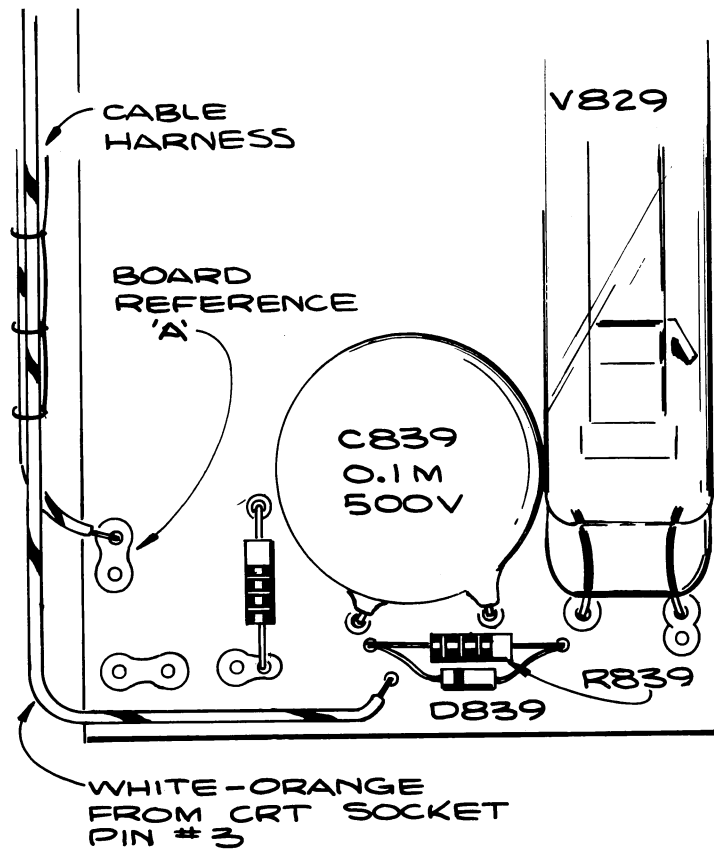
- 1) Remove the HV Power Supply assembly from the instrument.
- 2) Remove the metal shield and the plastic lid from the HV Power Supply assembly.
NOTE: For future reference, observe how the HV circuit boards and HV transformer are mounted in the plastic container.
- 3) Remove the HV circuit boards and HV transformer from the plastic container.
- 4) Cut and remove approximately 3/16" of the circuit run on the High Voltage Regulation circuit board as shown in Fig. 1.
- 5) Drill two holes, using a #41 drill, in the location on the circuit board as shown in Fig. 1.
- 6) Install, from the Fig. 1 side of the circuit board, the two large eyelets into the holes drill in step 5 and solder to the runs. Do not crimp the eyelets or fill them with solder.
- 7) Install a 51 V zener diode (D839) and a 221 k 1/8 W 5% resistor (R839) in parallel between the two eyelets as shown in Fig. 2. The cathode (striped) lead of D839 should be toward C829. Solder to the eyelets.
- 8) Drill a hole, using a #51 drill, in the location shown in Fig. 1.
- 9) Install the small eyelet into the hole from the Fig. 1 side of the board. Crimp the eyelet, using a pair of rivet pliers from the FMS Switch Repair Kit, and solder the rivet to the run. Do not fill the eyelet with solder.
- 10) Unsolder the two white-orange wires from "Board Reference A". See Fig. 2.
- 11) Use an ohmmeter to determine which of the white-orange wires goes to pin 3 of the CRT socket and solder this wire into the rivet installed in step 9.
- 12) Resolder the remaining white-orange wire to the "Board Reference A" as shown in Fig. 2.
- 13) Perform steps 1 through 3 in reverse order.

continued



BOTTOM VIEW

FIG. 1



TOP VIEW

FIG. 2



MODIFICATION INSTRUCTIONS

MI - 10684

Type 422 AC-DC Power Supply

Serial Numbers 100-3194

Q1194 HEAT SINK INSULATION IMPROVED

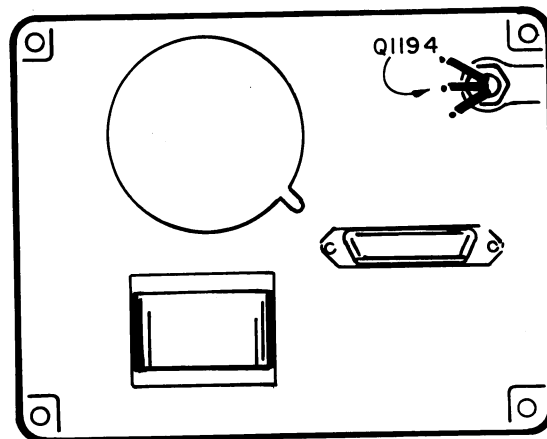
Sometimes when installing the anodized heat sink for Q1194, the anodizing on the threads is burred by the securing nut. As a result, a potential short exists between the heat sink and ground. To prevent this, a mica insulating washer was installed between the DC POWER CONTROL circuit board and the flat washer of the Q1194 heat sink.

PARTS REQUIRED

Quantity	Tektronix Part Number	Description
1 ea	210-0909-00	Washer, mica

INSTALLATION

Install a 210-0909-00 mica washer between the DC POWER CONTROL circuit board and the flat washer of the heat sink on transistor Q1194. Refer to the illustration for the location of Q1194.



BE:ls

2-10-68



MODIFICATION INSTRUCTIONS

MI - 10735

Type 422 Oscilloscope
Serial Numbers 100-5699

R542 CHANGED TO IMPROVE HORIZONTAL AMPLIFIER GAIN STABILITY DURING OPERATING TEMPERATURE CHANGES

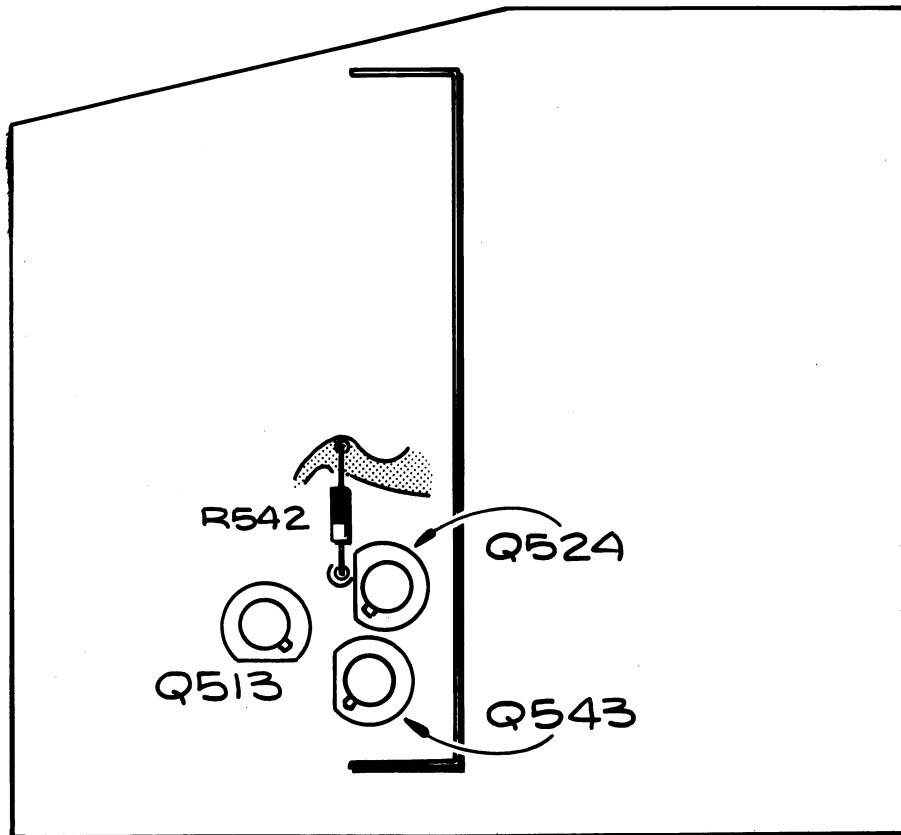
Improvements in Horizontal Amplifier gain stability can be achieved by changing R542 from a composition type resistor to a wirewound resistor. The timing error resulting from a temperature rise from ambient to 55°C is reduced to approximately three-fourths of one percent.

PARTS REQUIRED

Quantity	Tektronix Part Number	Description
1 ea	308-0417-00	Resistor, WW, 5.1Ω 1/2W 2%

INSTALLATION

Replace R542 with a 5.1Ω wirewound resistor (308-0417-00). Refer to the illustration for the proper location.



BE:ls

1-10-68



MODIFICATION INSTRUCTIONS

MI - 10800

Type 422 Oscilloscope
Serial numbers 100-3346

WIRING CHANGED ON CHANNEL 2 CIRCUIT BOARD TO PREVENT POSSIBLE SHORT CIRCUIT

A short circuit possibility exists because of the proximity of the tab on the INVERT switch actuator mechanism to an etched run on the bottom of the CHANNEL 2 circuit board. The run on the circuit board, which carries -12V, becomes shorted to ground when enough misalignment occurs to allow the tab to touch the run. An interim method of alleviating this problem until the circuit board runs can be re-adjusted, is to cut the run carrying the -12V, as shown, and install a short piece of #22 insulated wire on the top side of the board in its place.

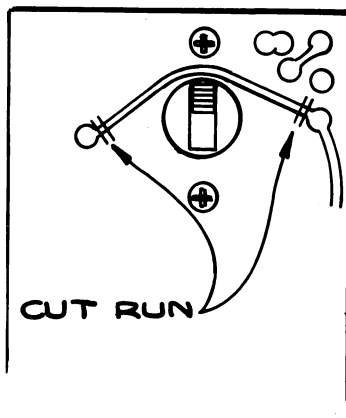
PARTS REQUIRED

Quantity	Tektronix Part Number	Description
2-1/2 in.	175-0522-00	Wire, #22 solid, insulated, white-red

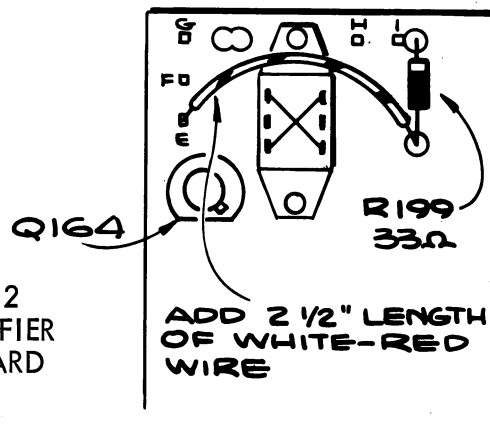
INSTALLATION

- 1) Remove the three 4-40 screws and their washers which secure the CH 2 INPUT AMPLIFIER circuit board to the instrument. SAVE.
- 2) Carefully lift up the circuit board so the bottom side is readily accessible.
- 3) Carefully cut and remove the circuit board conductor as shown in the "BOTTOM VIEW" drawing.
- 4) Install a 2-1/2" piece of #22 insulated white-red wire as shown in the "TOP VIEW" drawing.
- 5) Reinstall the circuit board and its hardware as it was removed in steps 1 and 2.

BOTTOM VIEW



TOP VIEW



CHANNEL 2
INPUT AMPLIFIER
CIRCUIT BOARD

BE:ls





MODIFICATION INSTRUCTIONS

MI - 10808

Type 422 AC-DC Power Supply

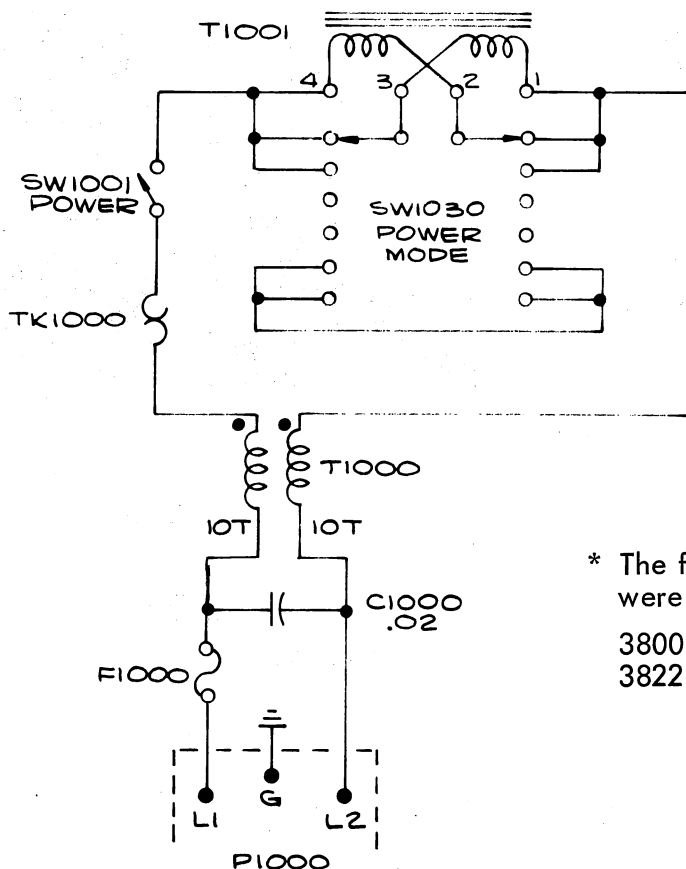
Serial numbers 100-3911*

WIRING CHANGED TO PLACE ALL SWITCHING IN "HOT" SIDE OF POWER LINE

Reduced shock hazard and increased protection against accidental circuit damage can be obtained by rewiring the power input circuitry to place all switching (On-Off switch, fuse, and thermal cutouts) in the "hot" side of the power line. With the present wiring method, it is possible for the transformer to remain "hot" after the fuse has blown.

PARTS REQUIRED

Quantity	Tektronix Part Number	Description
1 ea	175-0523-00	Wire, insulated, #22 stranded, bk 2"
1 ea	175-0524-00	Wire, insulated, #22 stranded, y-bn-gn-bn 6"



* The following serial numbered instruments were modified at the factory:

3800	3827	3849	3879	3890
3822	3842	3874	3887	3900

continued

INSTALLATION

Refer to Figs. 1 and 2 and perform steps 1 through 6.

- 1) Remove the AC-DC POWER SUPPLY from the power supply housing.
- 2) Remove the 4" yellow wire, located between fuse F100 (end connection) and thermo cutout TK1039 (inboard connection), from the cable.
- 3) Unsolder the yellow-brown-green-brown wire from the fuse holder F1000 (side terminal). Cut off where it enters the cable.
- 4) Relocate the yellow-brown-red-brown wire from the AC line plug P1000 (terminal 12), to fuse F1000 (side terminal).
- 5) Relocate the yellow-brown-brown-brown wire from the AC line plug P1000 (terminal L1) to terminal L2.
- 6) Add a 2" length of #22 stranded black wire between P1000 (terminal L1) and F1000 (end terminal).

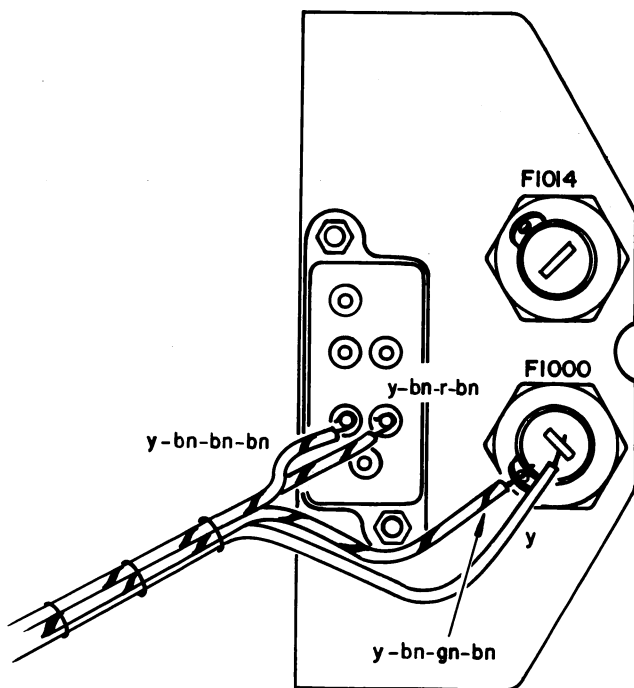
**BEFORE**

FIG. 1

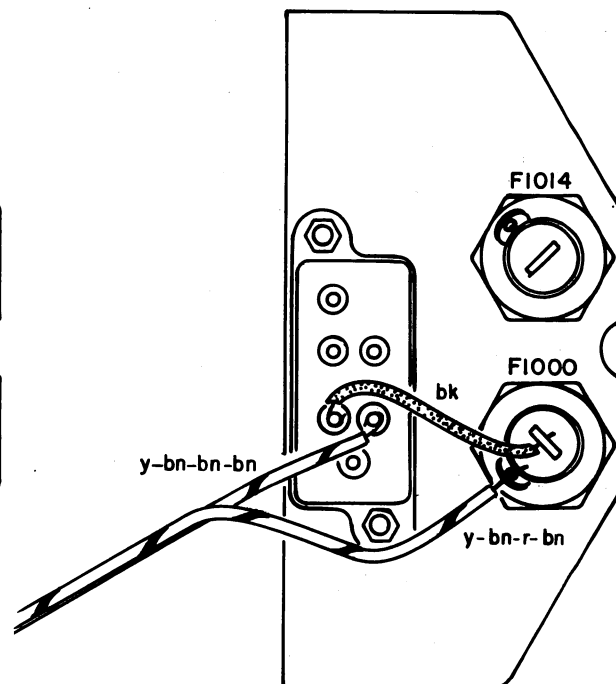
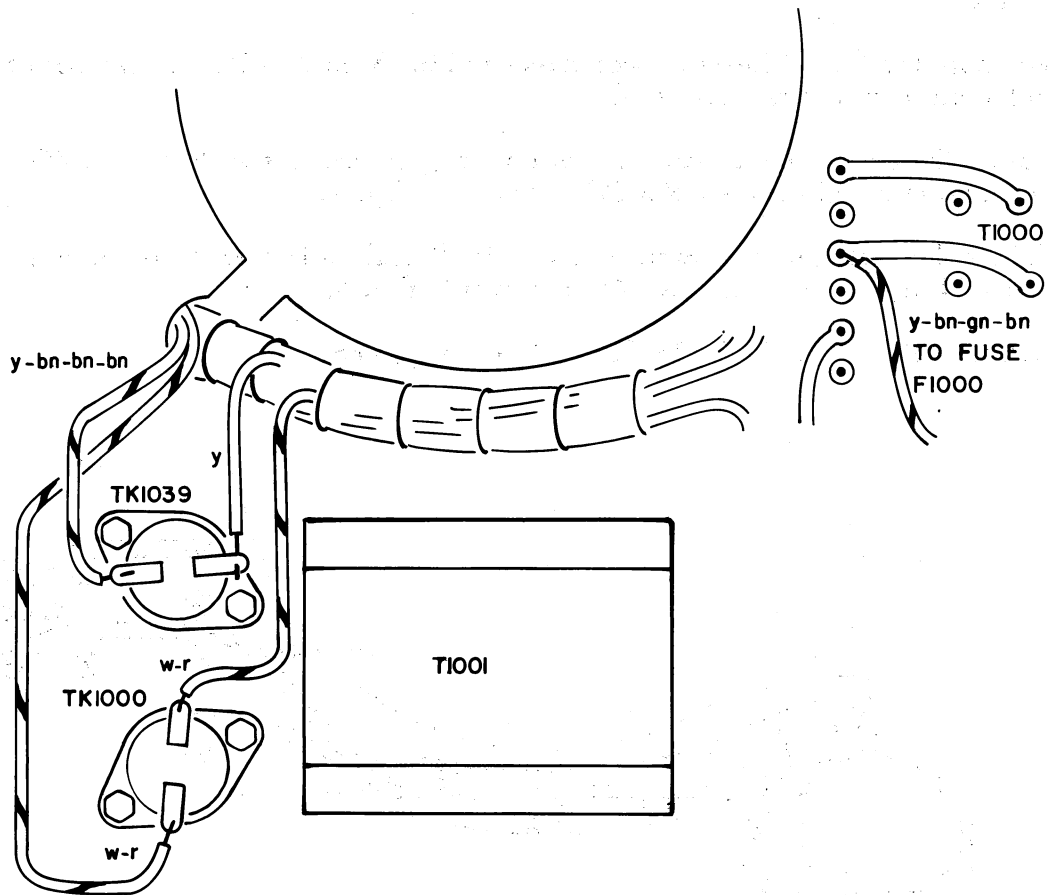
**AFTER**

FIG. 2

continued

- 7) Refer to Fig. 3 and remove the yellow-brown-green-brown wire connecting to T1000, from the circuit board. Cut off where it enters the cable.



BEFORE

FIG. 3

continued

- 8) Install a new 6" piece of yellow-brown-green-brown wire and dress along the existing cable above transformer T1001 as shown in Fig. 4.
- 9) Unsolder the yellow-brown-brown-brown wire connected to thermo cutout TK1039.
- 10) Relocate the two white-red wires connected to TK1000 to TK1039 (inboard and outboard terminals respectively).
- 11) Solder the yellow-brown-brown-brown wire (removed in step 9) to TK1000 (inboard terminal nearest TK1039) as shown in Fig. 4.
- 12) Solder the yellow-brown-green-brown wire (installed in step 8) to the outboard terminal of thermo cutout TK1000 as shown in Fig. 4.
- 13) Reinstall the AC-DC POWER SUPPLY in the housing.

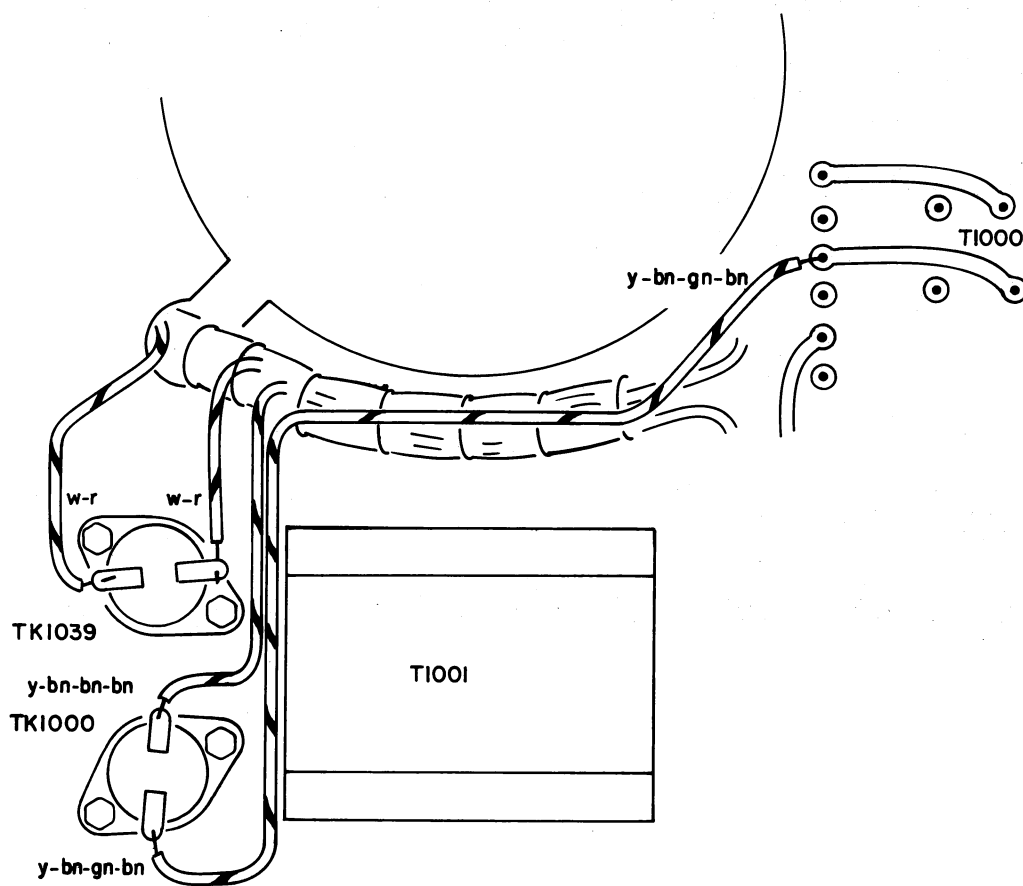
AFTER

FIG. 4

BE:ls



MODIFICATION INSTRUCTIONS

MI - 11387

Type 422 AC-DC Power Supply

Serial numbers 100-6989

Q1194 CHANGED TO IMPROVE POWER SUPPLY RELIABILITY

The reliability of the Power Supply can be improved by changing the transistor type used for Q1194 to a 2N4036. Occasionally at turn on, the breakdown voltage of the type presently used can be exceeded, resulting in secondary breakdown which causes the supply to go out of regulation.

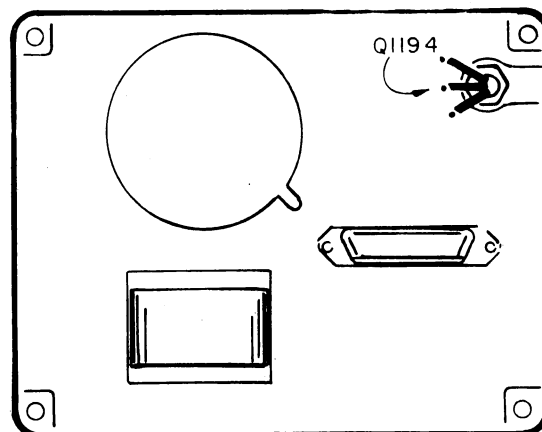
In Type 422's below serial number 3195, a mica washer should be added between Q1194 and the circuit board.

PARTS REQUIRED

Quantity	Tektronix Part Number	Description
1 ea	151-0208-00	Transistor, silicon, 2N4036 PNP T0-5
SN 100-3194 ONLY		
1 ea	210-0909-00	Washer, mica

INSTALLATION

Replace Q1194 with a 2N4036 transistor. In instruments below serial number 3195 add a mica washer between the circuit board and the flat washer on the Q1194 heat sink.



BE:ls

2-10-68



MODIFICATION INSTRUCTIONS

MI - 11427-2

Type 422 Oscilloscope

Serial numbers 100-8579

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 occasionally 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 kit.
To perform steps 3 and 4, a set of two chassis punches, part number 003-0506-00, is required.
- () 3 Using the smaller chassis 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.
- () 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.

continued

BE:fb

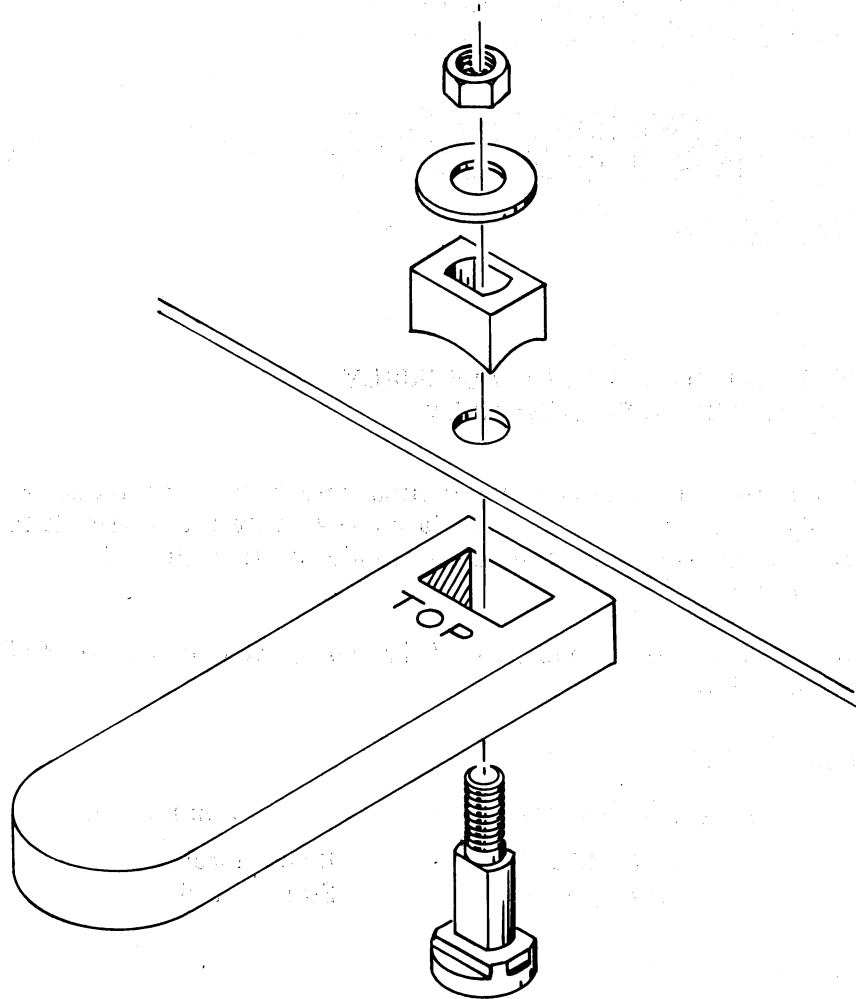


FIG. 1

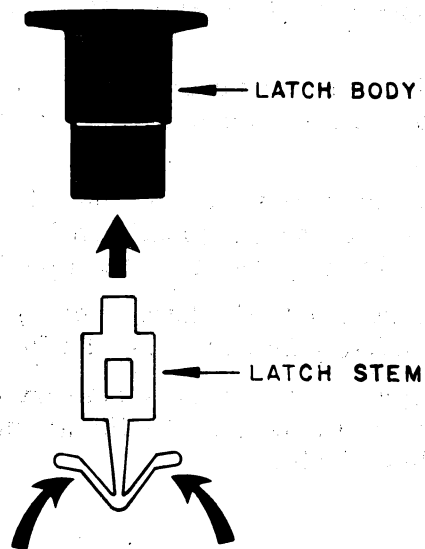


FIG. 2



MODIFICATION INSTRUCTIONS

MI - 12509

Type 422 Oscilloscope

Serial numbers 100-8761 *

-81V POWER SUPPLY REGULATION IMPROVED TO REDUCE TIMING SHIFT AT TURN-ON

This modification installs a capacitor in parallel with D735 to assure adequate ignition current for VR tube, V739, when power is applied to the instrument. Also, to prevent exceeding the BV_{cer} rating of Q737, it was changed to a type with a higher BV_{cer} .

These changes assure that the -81V supply will reference to the same voltage every time power is turned on.

PARTS REQUIRED

Quantity	Tektronix Part Number	Description
1 ea	151-0208-00	Transistor, 2N4036
1 ea	283-0068-00	Capacitor, ceramic, 0.01 μ F 500V

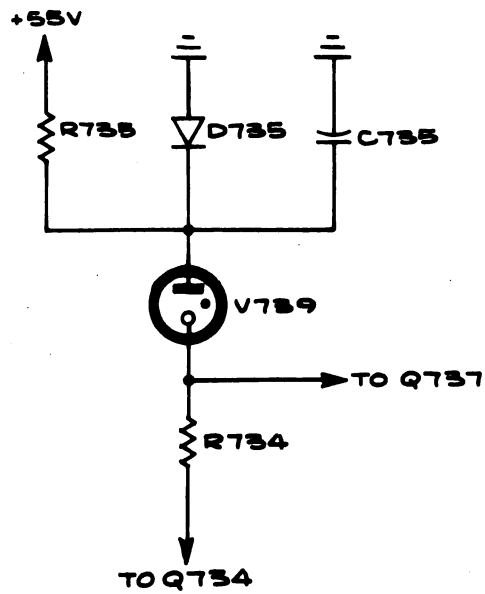
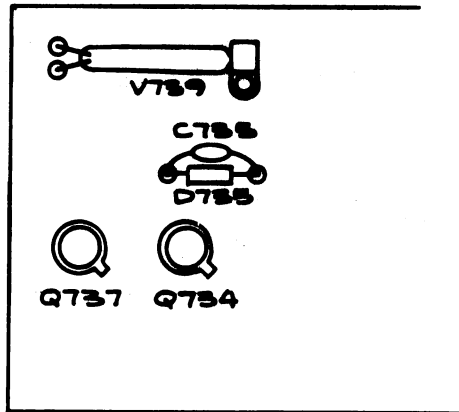
INSTALLATION

- 1) Replace Q737 with a 2N4036 (151-0208-00) transistor. See drawing for location.
- 2) Install C737 (0.01 μ F 500V capacitor) in parallel with D735. See drawing.

* The following serial numbered instruments were modified at the factory:

4983	7728	8541	8629	8684	8713
5364	7746	8583	8651	8687	8717-8
6638	8036-7	8597	8654-5	8693-4	8722
7348	8045	8600-1	8660	8697	8725-6
7455	8123	8606	8666	8700	8728-30
7546	8136	8609	8675	8702-5	8733-6
7603	8453	8624	8678	8707-8	8738
7717	8471	8626	8680	8711	8740-59

continued





modification instructions

MI - 13831

Types 422, R422
422-125B

HORIZONTAL AMPLIFIER STABILITY IMPROVED

Tektronix Type 422, R422, 422-125B
Serial Numbers 100-11709

Q543, a 2N3251 transistor, has been improved in bandpass capability during the past few months. If this transistor needs to be replaced, and one of the newer 2N3251 transistors is used, the horizontal amplifier may oscillate. These oscillations can be suppressed by relocating L535.

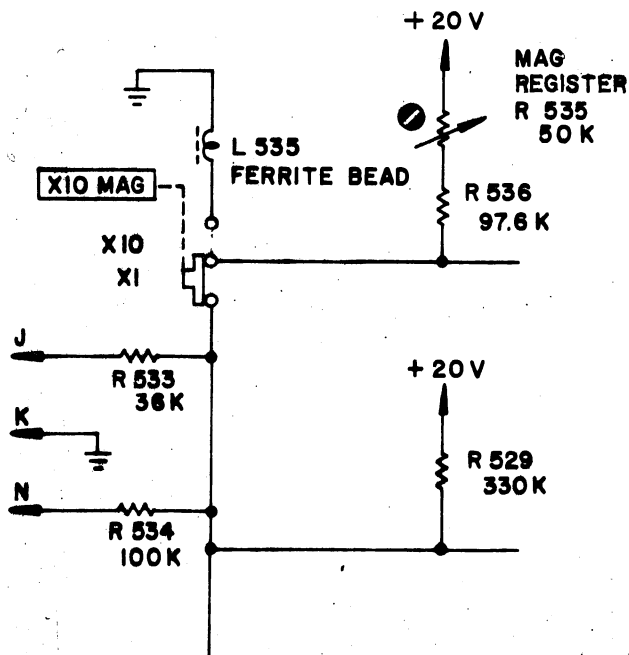
The modification consists of relocating ferrite bead L535 from the end strap to the center strap on the same side of X10 MAG switch SW 535.

PARTS REQUIRED

None

INSTALLATION

- 1) Separate the front section of the oscilloscope from the rear. Remove front section cover (see Instruction Manual). Locate X10 MAG switch SW535.
- 2) The ferrite bead, L535, is the black donut shaped disc around the end wire connecting SW535 to the circuit board. Unsolder this wire from the switch. Unsolder the wire connecting the center of the switch to the circuit board.
- 3) Transfer L535 to the center wire.
- 4) Resolder the wires to their original positions on the switch.
- 5) Reinstall the instrument cover and rear section.



THIS COMPLETES THE INSTALLATION.

Correct the Horizontal Amplifier schematic in your Instruction Manual.

BD:ls

