



Wizards Workshop

* ALL SERVICE QUESTIONS FROM EUROPE, MIDDLE EAST, *
* AND AFRICA SHOULD BE ADDRESSED TO THE EUROPEAN *
* MARKETING CENTER SERVICE GROUP IN THE NETHERLANDS. *

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TABLE OF CONTENTS

PERSONNEL CHANGES 1-3

GENERAL

STOLEN INSTRUMENTS (INTERNATIONAL) 4

WALKER ROAD PRODUCT UPDATE STATUS 4

ADMINISTRATIVE SUPPORT

BLANKET REPAIR PURCHASE ORDERS 5

LABORATORY INSTRUMENT DIVISION

TM500

AF501 MAINTENANCE NOTES 6

CG551AP SHIPPING 7

PG501 MAINTENANCE NOTES 8

PG502 MAINTENANCE NOTES 9

RG501 MAINTENANCE NOTES 12

SG502 MAINTENANCE NOTES 13

TABLE OF CONTENTS (CONTINUED)

7000 SERIES

7000 SERIES, CRT WRITING SPEED CHANGES	14
--	----

COMMUNICATIONS DIVISION

MEDICAL

413 EMI IMPROVEMENT	15
-------------------------------	----

TELEVISION PRODUCTS

TSG6/CABLE HARNESS FROM FRONT PANEL FREQUENCY CONTROL MAY BE CUT . . .	15
147A/148M/149A UNRELIABLE CAPACITOR, P/N 283-0192-00 (CORRECTION) . .	16
1430, 1440, 1441, 1460, 1461 - MISSING WASHER ON POWER SUPPLY BOARD, PART NUMBER CORRECTION	17-19
1481/1485 OPTION 08 INTERMITTENT SINGLE FRAME RECOGNITION	20-22

SERVICE INSTRUMENT DIVISION

LOGIC ANALYZERS

7D01 SOCKET UPDATE CODE 18 TERMINATION PLAN	23
---	----

PORTABLES

464, 466 VERTICAL OSCILLATIONS	24-26
465B RISETIME AT 5 VOLTS/DIV IMPROVED	27

INFORMATION DISPLAY DIVISION

634: TORX TOOLS AVAILABLE	28
4025/27 FIRMWARE ERROR	28
405X, 4923, 4924, 4081 TAPE DRIVE MAINTENANCE	29
4663, MEASURING PLATEN ELECTROSTATIC VOLTAGE	30
4907 GENERAL INFORMATION AND CALIBRATION (Reference Pull-Out)	A-1 thru A-8

TABLE OF CONTENTS (CONTINUED)

LABORATORY INSTRUMENT DIVISION

MICROCOMPUTER DEVELOPMENT PRODUCTS

8001 FIRMWARE UPDATE	31
--------------------------------	----

SEMICONDUCTOR TEST SYSTEMS

S-3200: D70 T.I.M.E. OPTION SKEWS	32
S-3200: BLANK PANELS FOR THE RACK ARE ORDERABLE	32
S-3200: DC SUBSYSTEM MODIFICATION #M40301	33
S-3200: S-3280 SAMPLING RACKS	34

SIGNAL PROCESSING SYSTEMS

IEEE CHECKOUT SOFTWARE	35
7612D: INCORRECT NUMBER OF DATA BYTES, CAUSING CKSUM ERRORS	36-38
7912AD: ADDED PROTECTION FOR THE CRT AND IMPROVED RELIABILITY	39
7912AD FIRMWARE UPDATE	39
7912AD: IMPROVED RELIABILITY FOR THE HI VOLTAGE OSCILLATOR	40-41

REFERENCE PULL-OUT

INFORMATION DISPLAY DIVISION

4907 GENERAL INFORMATION AND CALIBRATION	A-1 thru A-8
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PERSONNEL CHANGES

NEW HIRES

Welcome to Tektronix and the Service Team.

RICHARD SHUE
MDP Specialist
Rockville

Dick came to Tek from ITT-DTS in Atlanta where he was a system Support Supervisor.

RICK GIGLIOTTI
Field Service Specialists II for MDP in Pittsburgh, Dayton and Cleveland areas.
Rockville

Rick recently transferred to Systems after spending two years in T&M in Rockville.

ED CHENOWETH
Systems Team
Orlando

Ed recently transferred from the Orlando T&M team to Systems. He is now responsible for the STS product line in Orlando.

ROBERT HALLAN
Electronic Technician II
Concord

Bob comes to Tek from the USAF Metrology field.

JOHN KINGSTON
Electronic Technician II
Mobile Service Laboratory at
Livermore, California

John comes to Tek from the USAF Metrology Field.

JIM SMITH
Field Clerk/Driver
Concord

Jim has several years experience in shipping/receiving that will be well utilized in Concord.

NEW HIRES (CONTINUED)

TOM TOUGH

Electronic Technician I
Orlando

Tom has just left the Air Force after six years, the last two as a PMEL Technician.

BRIAN SHUMAKER

Field Service Specialist II supporting the SPS product line throughout the San Francisco Bay Area.
Santa Clara
Brian was previously employed with Shasta Business Systems, formerly Phillips Business Systems.

SHARRON MARTINEZ

Field Service Specialist I supporting MDL products throughout the Northern California Service area.
Santa Clara

Sharron comes to Tek from the U.S. Navy where her last position was an E-6 Aviation Electronic Technician.

STEVE DURBIN

Field Service Specialist II covering the San Francisco East Bay Area and working out of the Mobile Lab in Livermore, California.
Santa Clara

Steve comes to Tek from Ore-Ida Foods, Inc., Ontario, Oregon. His duties consisted of developing and maintaining analog, digital and microprocessing control systems for food processing.

WELCOME ONE AND ALL AND WE WISH YOU SUCCESS WITH TEKTRONIX SERVICE!

(continued on following page)

PROMOTIONS

Congratulations!

AUSTIN OLMSTED

Systems Field Service Specialist III
Syracuse

DON MASSELLI

Systems Field Service Specialist III
Detroit

COLIN HOLMES

Electronic Technician III
Concord

MICHELLE ISAACS

Electronic Technician II
Concord

WARREN SNYDER

Field Service Specialist III
Baltimore

KEN TALLEY

Field Service Specialist II
Baltimore

PAUL JAEGER

Field Service Specialist II
Rockville

CONGRATULATIONS TO ALL AND KEEP UP THE GOOD WORK!

--Editor
56-037, Ext. 8939MR

GENERAL

STOLEN INSTRUMENTS (INTERNATIONAL)

The following instruments have been reported by EMC as missing.

<u>PRODUCT</u>	<u>SERIAL NUMBER</u>	<u>LOCATION MISSING FROM</u>
466 DM44	701259	Tektronix Norge A/S
466 DM44	702836	Tektronix Norge A/S

If either of these instruments appear in your service area or you have any information regarding them, please contact the Service Support group in EMC.

--Editor

WALKER ROAD PRODUCT UPDATE STATUS

The following is a synopsis of the status of Walker Road Update Programs (U.S. Code 18) to date. Periodically, a status update sheet will be published in the Wizard's Workshop.

PRODUCT	DESCRIPTION	PART NUMBER	SCHEDULE COMPLETION DATE	PUBLICATION
Active:				
634	High Voltage	045-0015-00	Mar. 1981	SOB, Mar. 10, '80 Wizard Pending
851	OHM Mod	045-0003-00	Jan. 1981	SOB, Jun. 29, '79
7D01	C-95 Sockets Memory Bd., Output Bd.	670-4284-02 670-4285-01	Sept. 1981	SOB, Dec. '78 Wizard, Dec. '78
7912AD	Firmware Update and MPU Mod	046-0001-00	Oct. 1980	Code 18 Service Plan, Apr. 14, '80 IOC, Aug. 12, '80 Wizard, May 1980 Wizard, Sept. 1980
Inactive/Terminated:				
8001	System Memory V1.7 to V2.0 Update	040-0902-01 040-0903-00 040-0904-00 040-0905-00 040-0906-00 040-0907-00	Indefinite	Wizard, Sept. '78 Wizard, Sept. '80
TM500	Socket Rework	Sent to Beaverton	Sept. 1, '80	Wizard, Jun., '80

--Dean Hager
92-236, Ext. 1284
September 19, 1980
Issue 10-19

ADMINISTRATIVE SUPPORT

BLANKET REPAIR PURCHASE ORDERS

The advantage of the Blanket Repair Purchase Order is that the customer does not have to write a purchase order for each request for repair service. It is a convenience for the customer, especially the multiple location customer who uses it as a blanket authorization for his individual facilities to use when requesting service. The customer will often ask that all invoices be sent to one location for payment. The Blanket Repair Purchase Order is not intended to include extra considerations such as

- 1) faster turnaround time than normally offered (as in a Maintenance Agreement);
- 2) rates that are frozen for the term of the purchase order (as in a Maintenance Agreement);
- 3) accounting service to furnish the customer with instrument repair costs; i.e., when a purchase order has a total \$ limitation that Tektronix is asked to monitor.

Invoicing is on an individual job basis, Code 01.

A number of Purchase Orders are being received for national accounts stipulating an hourly rate to be effective for the full term of the BPO. A statement should always be included indicating that stated hourly rates are subject to change with 30 days notice given to the customer.

See Section 702 of the FRM for detailed information on BPO's.

For further clarification of questions contact Jean Hickok, Service Administrative Support, M/S 56-037, Extension 8935 Merlo Road.

--Bill Duerden
56-037, Ext. 8938 MR

LABORATORY INSTRUMENT DIVISION

TM500

AF501 MAINTENANCE NOTES

Low Amplitude Out

Suspect Q168

Low Or Intermittent Output

Suspect dirty switch contacts

No Trig Output

Suspect Q302

Ripple On Output Causing Display Of Signal To Be Defocused

Verify that the positive ends of C278 and C250 are connected to the correct points.

Spikes On Waveform When Set For 20 x 100 On Dial

Suspect unit is mis-calibrated, place in power module to see if problem disappears.

U110 Driven To One Side

Suspect CR110 and CR112 are not the same Mfg.

Submitted by--
Rich Andrusco

Inserted by--
Terry Turner
92-236, Ext. 1288

CG551AP SHIPPING

Several CG551APs have been received in Beaverton damaged due to being shipped in the mainframe. CG551APs should not be shipped via common carrier in any mainframe.

If the original packing material has not been retained, a new shipping carton and appropriate packing (P/N 065-0282-00) can be ordered. Please alert your shipping and receiving personnel of the hazards of shipping CG551APs in mainframes.

--Terry Turner
92-236, Ext. 1288

PG501 MAINTENANCE NOTES

Power Supply Dies After Warm-Up -

1. Verify that C172 and C226 are not in backwards.

Positive Output Cannot Get 5 Volts Out -

1. Verify that R140 and R142 are soldered together.

Positive Output Will Not Meet Rise or Fall Time Specs -

1. Change Q140.

Positive Output Has Aberrations

1. Suspect Q130 or Q136.

Negative Output Will Not Meet Rise or Fall Time Specs -

1. Suspect Q170 or Q176.

Output Problems -

1. Suspect open coils or zener diodes out of tolerance.

Submitted by--
Rich Andrusco

Inserted by--
Terry Turner
92-236, Ext. 1288

PG502 MAINTENANCE NOTES

No Output When In External Trigger -

1. Check the Base of Q125:

A-If 0 Volts suspect Q125 and Q130 or associated circuitry.

B-If not 0 Volts suspect the Main Trigger Circuits.

Cannot Set .1 Millisec Range -

Suspect R162 is out of tolerance.

100 MHz Cannot Be Adjusted -

Suspect R166 is out of tolerance.

50 μ sec Duration Check Cannot Be Set For 52 μ sec -

Suspect U260 - May need to be selected.

Cannot Get Duration From 2 μ sec Down -

Suspect U260 - May need to be selected.

250 MHz Adjust Won't Make Range When Varying Variable Down to 95 -

1. Suspect U150
2. Select R149, down to bring range up (Usually 10 Ω to 18 Ω).

Aberrations And Risetime Out Of Specs -

1. Verify R438 and R439 are 47 ohms.
2. Verify ferrite bead is installed on R442.
3. Suspect U400, may need selecting.
4. Verify R416 and R477 are 82 ohms (usually), lower improves Aberrations.
5. Add C418, C420, and C422 if not installed. (Helps one out of ten units).
6. Changing U360 usually helps Risetime.
7. Changing L416, L417, L435, or L436 helps Aberrations and Risetime.
8. Select R433 by using a 10K potentiometer, 2 nanosec duration is worst range. Trade off between Falltime and Aberrations.

External Trigger Drops Out -

Suspect U150 and U180.

High Frequency Output Amplitude Drops Out At 100 MHz or Any Frequency At 10 Nanosec Position

Suspect Q210 or Q220 to prove pull both out.

Selection of R248 - (Precaution)

If you increase R248 to get Duration circuit to work properly, make sure Ext. Trig. was not affected.

At 250 MHz and R300 (Duration Variable) Set Fully CCW, The Pulse Width Jumps When Just Turning R300 -

Suspect R300.

When High and Low Level Output Dials Are Both Fully CW or CCW You See A Small Squarewave Instead Of A Straight Line -

Suspect R487 and R489, Selection may be necessary.

Ringing -

1. Suspect R446, may need selecting (150-300 Ω).
2. Suspect coils.

Drift In 2 Nanosec Duration Position -

Suspect U260.

250 MHz Period - Not Enough Range or Stops Running Near X10 -

Adding another 18 Ω Resistor in parallel with R149 usually helps.

Minimum Output Level > .5 Volts

Suspect VR480 is shorted or leaky.

Minimum Output Level Shows Pulses For Short Time Then Decay

Suspect VR480 is open.

Loss Of Output Amplitude And DC Levels Track Together -

Suspect Q390 through Q470.

Flat Line With No DC Level Shift

Suspect Q390 through Q470.

Output At Maximum With No Control -

Suspect Q470.

Positive Or Negative Pulse Has Low Amplitude And Spiked -

Suspect VR449.

Both Positive And Negative Pulses Spiked And Distorted -

Suspect CR445, CR446, CR448, and CR449.

Output Overshoot When Back Terminated -

Suspect L443 - may need selection, more inductance produces more overshoot.

Glitch In Risetime -

Addition of ferrite bead (L443) to R443 sometimes helps.

Output Has Exaggerated Rounding And Low Output -

Suspect Q430.

All Supplies Near Ground -

Overvoltage Protection fires, Q626, to isolate area of fault remove Q620 and Q632.

Submitted by--
Rich Andrusco

Inserted by--
Terry Turner
92-236, Ext. 1288

RG501 MAINTENANCE NOTES

Line Trig OK But In Other Trig. Modes Supplies Load Down

Suspect Q15 is installed incorrectly because of different case styles.

Submitted by--
Rich Andrusco

Inserted by--
Terry Turner
92-236, Ext. 1288

SG502 MAINTENANCE NOTES

Isolation of Defective Ckt. When Unit Is Inop -

1. Observe voltage at the junction of R82 and R88, normally @ $-.4V$.
2. If $-.4$ Volts is present but oscillator isn't running suspect AGC Ckts.
3. If $-.4$ Volts is not present suspect Oscillator Ckts.
4. If junction of R82 and R88 reads 15 volts isolate circuits by disconnecting R120, R330, and R350. If $-.4$ Volts is now present, suspect Q150 and Q154. If $-.4$ Volts is still missing suspect the Oscillator and AGC circuits.

Distortion -

1. Verify that RF Output Voltage is about 2.6 Volts.
2. Verify that power supply is between 20 - 21 Volts.
3. Suspect Q110, C110, or C112.
4. Distortion at High End or start of Low End, suspect Q110 and Loop Ckts.
5. If Distortion is still bad, disconnect R120 and check distortion on R120 with an Analyzer and probe. Distortion should be within specifications, if not suspect circuits prior to R120, if within specifications suspect output circuits.

Frequency Hertz X 1 Breaks Into Oscillations -

1. Suspect C160.

Submitted by--
Rich Andrusco

Inserted by--
Terry Turner
92-236, Ext. 1288

7000 SERIES

7000 SERIES, CRT WRITING SPEED CHANGES

In the past we have always set specifications for CRT writing speeds with the assumption that the ASA rating of the film was very close to its advertised specifications. Due to changes in 3000 ASA film, which Polaroid will not hold to a specific ASA rating specification, it is necessary to revise writing speeds of several 7000 Series mainframes. Different batch numbers of film may have varying ASA ratings, some as low as 1800, which will greatly reduce the apparent writing speed.

So to simplify the performance checking procedures, writing speed is now being checked with a C-51 Series Camera, preferably the C-51P, and only being specified with P-11 phosphor. In typical camera applications, P-31 phosphor has about one-half the writing speed of P-11. All specifications are considered without film fogging, which is a technique for increasing the maximum sensitivity of photographic film by giving it a short exposure to dim, diffused light. The only exception to the above procedure is the 7104, which has sufficient speed to allow the C-53 camera to be used. For specific CRT writing speeds, refer to the microfiche, Sales and Service Section, for the new writing speed changes.

--John Eaton
58/511, Ext. 6902

COMMUNICATIONS DIVISION

MEDICAL

413 EMI IMPROVEMENT

Reference: All Serial Numbers

Electro-Magnetic Interference (EMI) from nearby motors, SCR controllers, communication systems and radio transmitters may trigger the Pacer Detector circuit to inhibit QRS output.

The modification kit, P/N 040-0962-00, reduces the sensitivity of the Pacer Detector circuit by changing R379 from a 1.2M Ω to a 120K Ω and C379 from 180pF to 0.0015pF.

All instructions are included with the kit.

--Dave McKinney
58/511, Ext. 7072

TELEVISION PRODUCTS

TSG6/CABLE HARNESS FROM FRONT PANEL FREQUENCY CONTROL MAY BE CUT

Reference: TSG6 Manual, P/N 070-2528-00

The 3-wire ribbon connector that runs from R156, frequency control pot on the front panel, to P159 on A60 (multiburst logic board) is normally dressed down between the A60 board and the right side (looking from the front) of the 1410 chassis. However, if the A60 board is put on an extender for troubleshooting or calibration, this cable is pulled up and out of the instrument. When the A60 board is returned to its normal position, take care to redress the wire well down in the instrument. There have been several instances where this cable has had one or more wires severed by the top cover or the twist-lock latch on the top cover.

Thanks to John Holme of the Woodbridge Service Center for bringing this to our attention.

--Steve Schmelzer
58-511, Ext. 6507

147A/148M/149A UNRELIABLE CAPACITOR, P/N 283-0192-00 (CORRECTION)

The following article appeared in Issue 10-15, with the part number for the new capacitor incorrect. The article is reprinted below with the correct part number. Thanks to Paul Hogan of the Atlanta Service Center for catching this error.

The 0.47 μ F, 3 V ceramic capacitors are experiencing a high failure rate. Symptoms exhibited are intermittent loss of chroma or low chrome amplitude.

The part is used in the following locations:

<u>Instrument</u>	<u>Circuit Number</u>	<u>Part Number</u>	<u>Change To</u>
147A/149A	C5245	283-0192-00	283-0203-00
147A/149A	C5435	283-0192-00	283-0203-00
148/148M	C5244	283-0192-00	283-0203-00
148/148M	C5434	283-0192-00	283-0203-00

Please check any units within the serial number range that come in for service for these parts and replace. Not all units within the serial number range have an 283-0192-00 installed. The 283-0192-00 is a 3 V rated capacitor, and the new part is rated at 50 V so it is easy to determine if the capacitor should be replaced.

Affected serial numbers:

147A	B162576 - B162585
149A	B112558 - B112560
148	B092332 - B092423
148M	B030212 - B030214

Instruments prior to the starting serial number also used the 283-0192-00, but these are from a lot that have caused no problems and should not be replaced unless failed. In the future, use only P/N 283-0203-00 to replace failed parts.

--Steve Schmelzer
58-511, Ext. 6507

1430, 1440, 1441, 1460, 1461 - MISSING WASHER ON POWER SUPPLY BOARD,
PART NUMBER CORRECTION

Reference: 1430 Manual, P/N 070-1455-00 1460 Manual, P/N 070-1803-00
 1440 Manual, P/N 070-1498-02 1461 Manual, P/N 070-1929-00
 1441 Manual, P/N 070-1499-00

The following article appeared in a previous W² issue. The part number for the washer is incorrect. The article is reprinted with the correct number.

The Manufacturing line had been installing a washer (P/N 210-1171-00) under the metal washer on the board mounting screw that is near R9803 (see the following board layout of power supply board, 670-1473-XX). This washer was to prevent R9803 from being shorted to ground due to close spacing of the circuit board pads. An unknown number of instruments have been shipped without this washer. It is possible that any slippage of the circuit board could cause R9803 to contact the mounting screw. When R9803 is grounded, the +5 volt supply will increase to approximately 9 volts. The power supply is normally not damaged, but other components in the instrument may be.

Please check all 1430, 1440, 1441, 1460, and 1461 instruments that come in for service and insure that a nylon washer is installed and that the power supply mounting screws have remained tight.

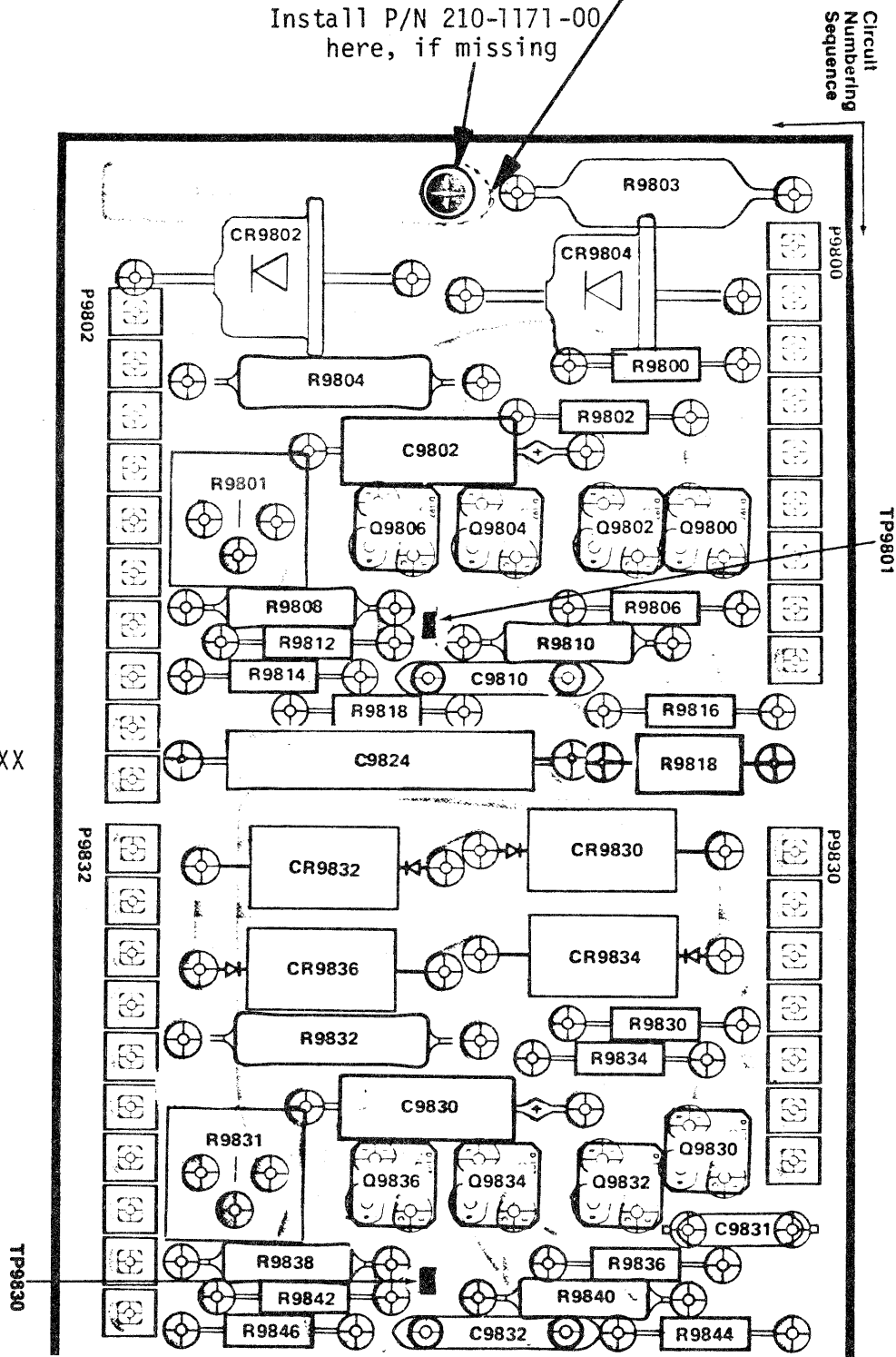
(schematics for this article are on the following two pages)

1430, 1440, 1441, 1460, 1461 - MISSING WASHER ON POWER SUPPLY BOARD,
PART NUMBER CORRECTION (CONTINUED)

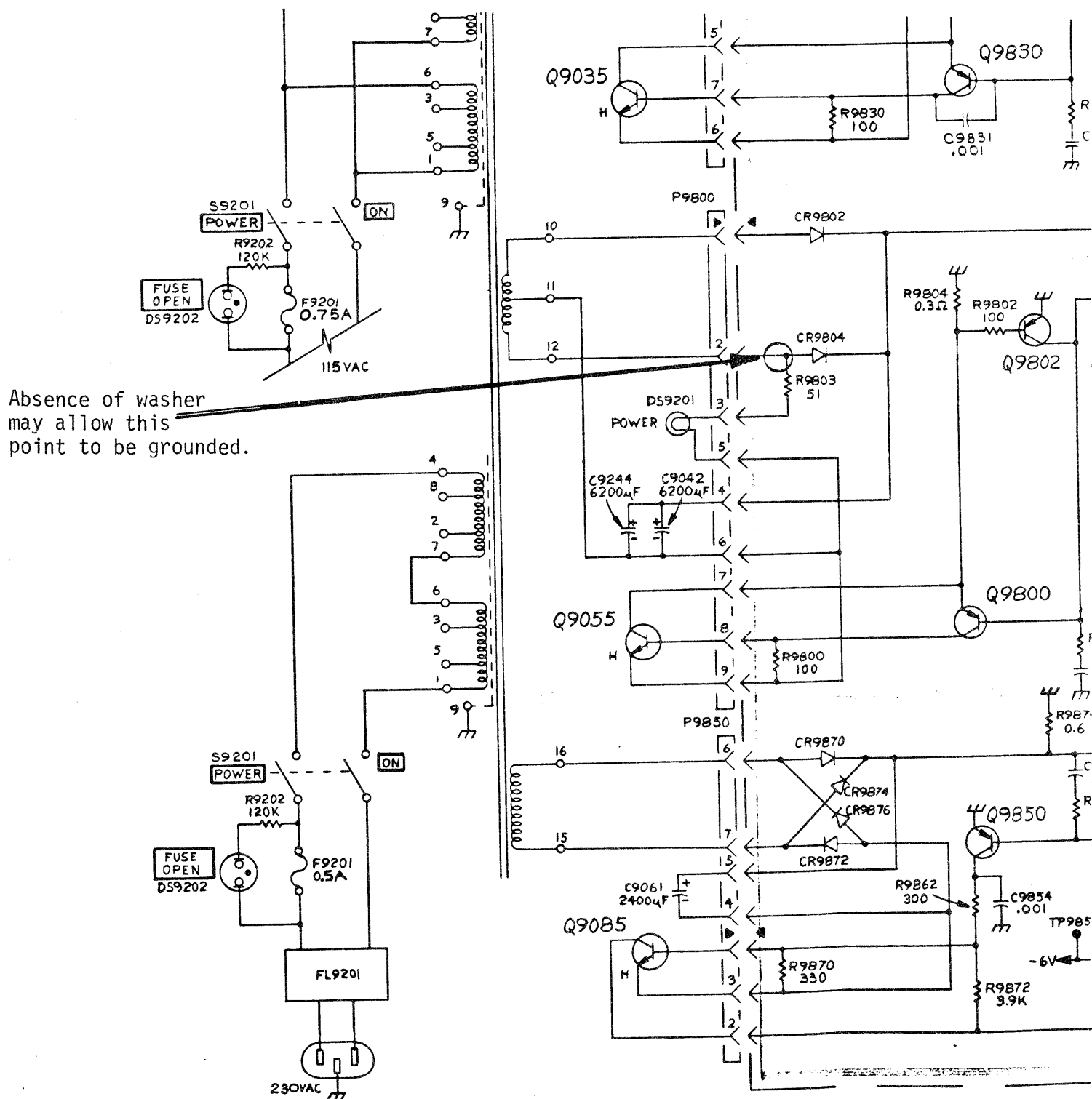
If board slips,
short could occur here.

Install P/N 210-1171-00
here, if missing

670-1473-XX



1430, 1440, 1441, 1460, 1461 - MISSING WASHER ON POWER SUPPLY BOARD
PART NUMBER CORRECTION (CONTINUED)



(A)

--Steve Schmelzer
58/511, Ext. 6507

1481/1485 OPTION 08 INTERMITTENT SINGLE FRAME RECOGNITION

Single frame recognition is interrupted and/or intermittent in the NTSC/PAL mode when a SECAM field one frame pulse is present on J9034. Horizontal jitter will occur on the first serration pulse of field one with horizontal controls set as follows:

DISPLAY - 2 field
MAGNIFIER - X50
FIELD - Button 4 pushed

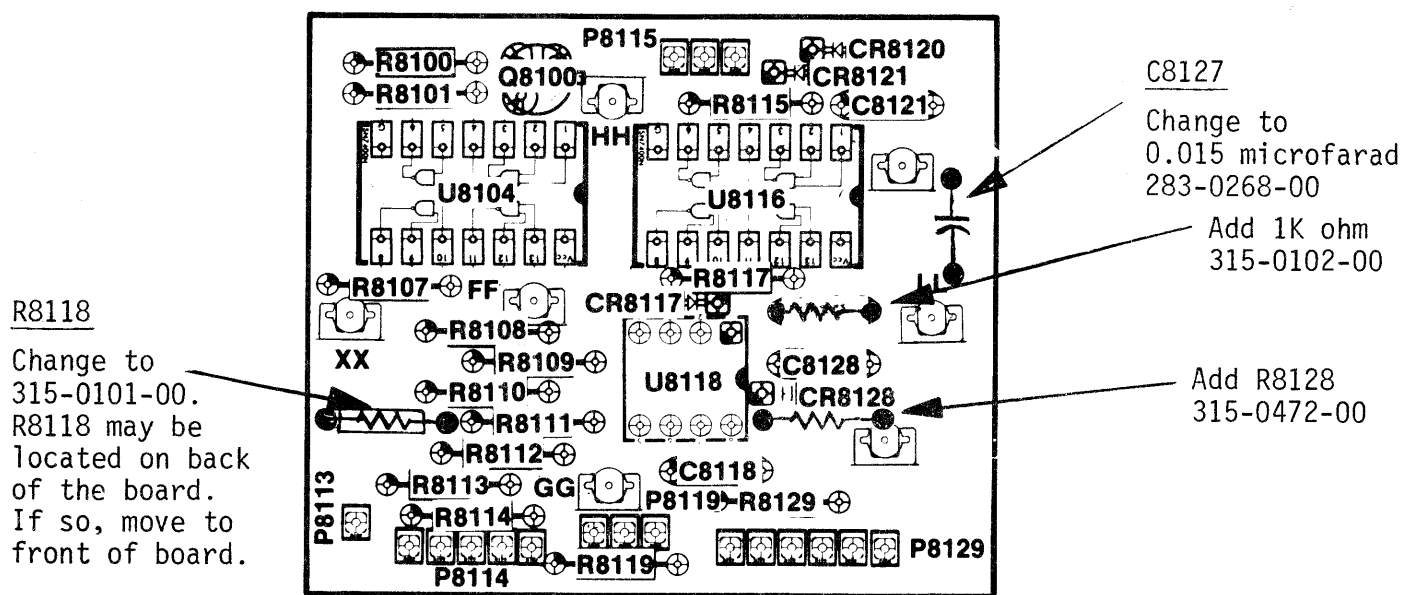
To correct these malfunctions, make the following changes on the SECAM Field Recognition Board (P/N 670-5367-00):

1. Change C8127 from 0.005 microfarad (P/N 283-0001-00) to 0.015 microfarad (P/N 283-0268-00).
2. Add a 1K ohm resistor (P/N 315-0102-00) at R8127.
3. Add a 4.7K ohm resistor (P/N 315-0472-00) at R8128.
4. Change R8118 from 1/8 watt, 100 ohm resistor (P/N 317-0101-00) to a 1/4 watt, 100 ohm resistor (P/N 315-0101-00).

See the following schematic and parts layout for locations of changes.

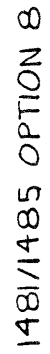
(schematics to complete this article are on the following two pages)

1481/1485 OPTION 8



A16 SECAM FIELD RECOGNITION

(continued on following page)



-22-

SERVICE INSTRUMENT DIVISION

LOGIC ANALYZERS

7D01 SOCKET UPDATE CODE 18 TERMINATION PLAN


The 7D01 Logic Analyzer Code 18 Rework Program will be discontinued on September 30, 1980. The rework program consisted of replacement of 670-4285-01 and 670-4284-02 which contained defective C95 sockets. The 7D01 Logic Analyzer serial number range was 74450 to 75930. Any 7D01 within that serial number range requiring rework after September 30, 1980 will be handled by the service center via normal billing process. The customer will be charged for all parts and labor unless the instrument is still under warranty.

Our data indicates that 70% of the instrument base was completed under this rework program. A job well done is extended to all service centers.

--Doug Comstock
92-236, Ext. 1611

PORTABLES

464,466 VERTICAL OSCILLATIONS

Serial Numbers: 464 B145328 and Below
466 B150755 and Below
Reference: Vertical output Schematic 

Due to a process change to U464, P/N 155-0115-00 the vertical may oscillate. If U464 is replaced the following modifications must be made:

Remove--

L483 230nH
L486 230nH
R482 10ohm
R485 10ohm

Change-- Old New

LR482 from 97nH to 195nH P/N 108-0729-00
LR484 from 97nH to 195nH P/N 108-0729-00

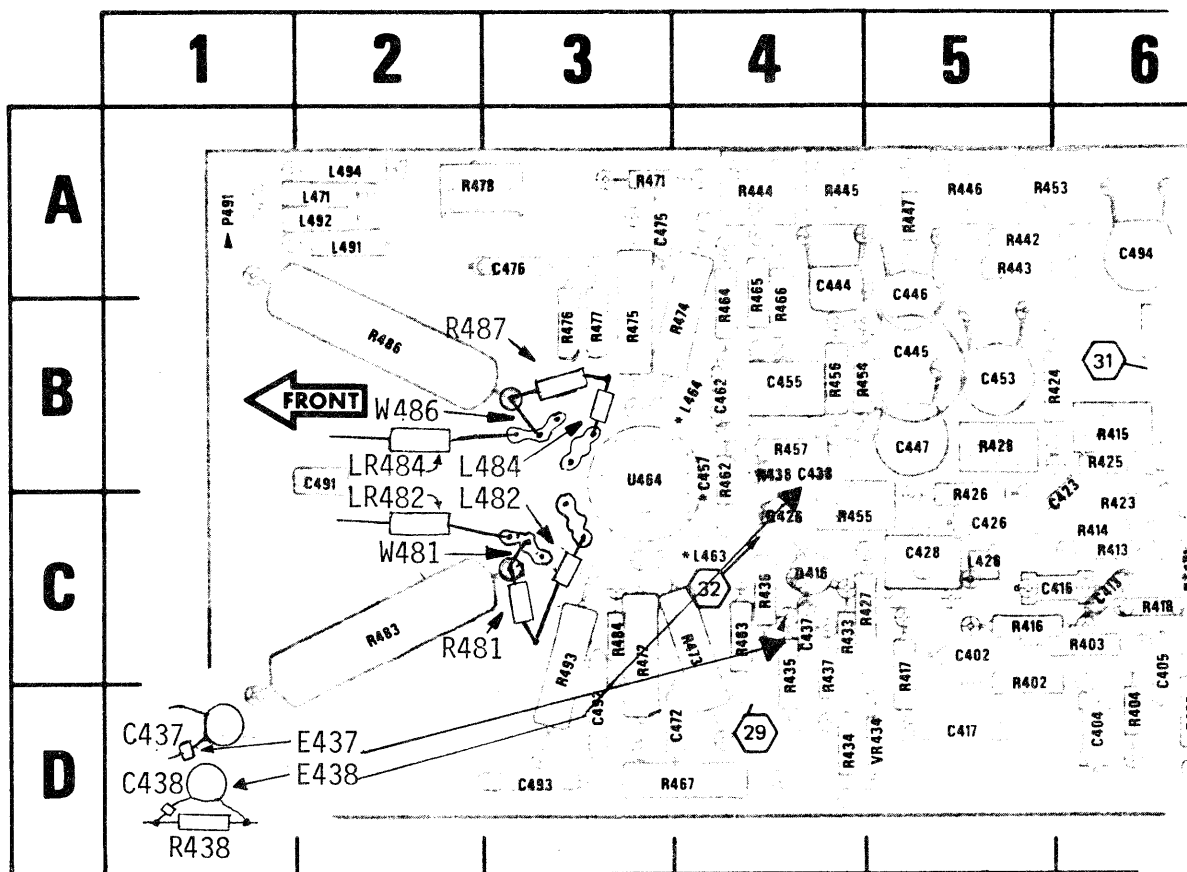
Add--

L482 (L484) 37nH, P/N 108-0606-00 is placed in the series with R481 (R487) 18 ohm, P/N 315-0180-00. R481 (R487) is connected in series with R483 (R486). L482 (L484) is connected in series with Pin 12 (9) of U464. A wire strap W481 (W486) is located from the junction of R481 (R487) and R483 (R486) to LR482 (LR484).

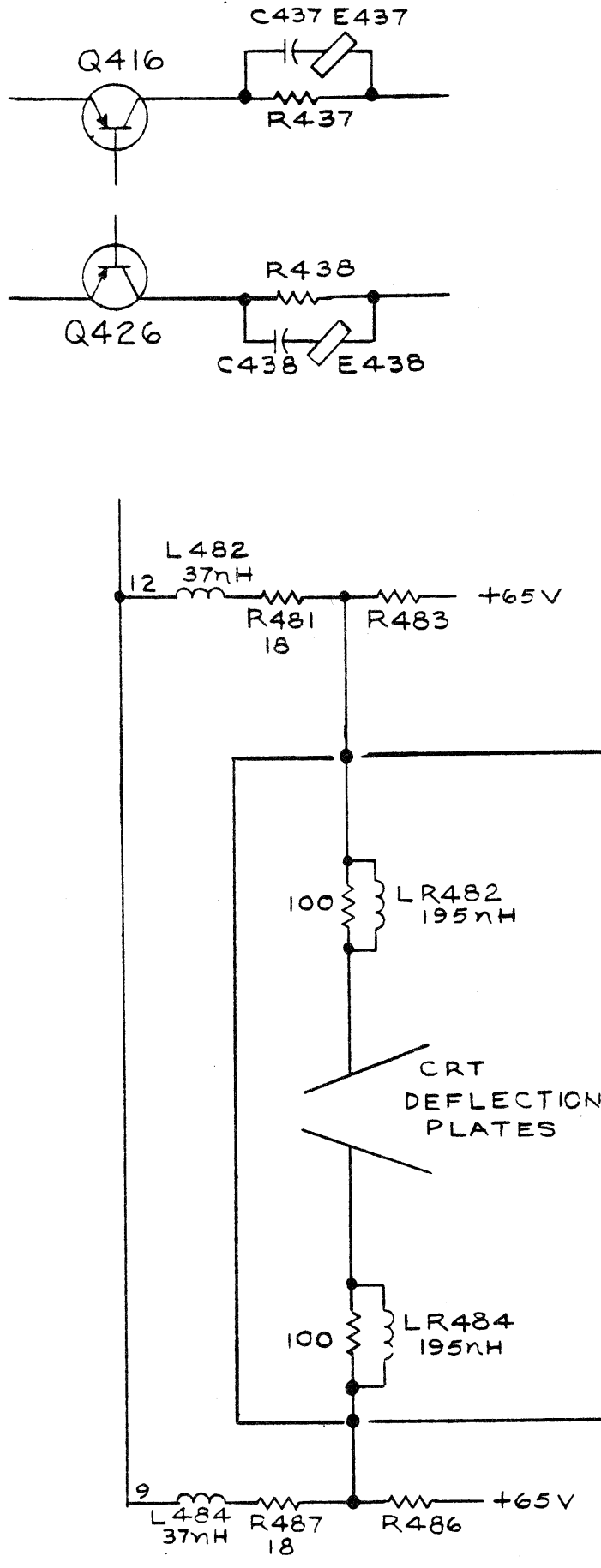
Add E437 (E438) 37 HN P/N 276-0543-00 (shield bead) to C437 (C438), the parts location diagram shows the physical location of the beads. The schematic shows the circuit after the changes have been made.

(schematics to complete this article are on the following two pages)

464, 466 VERTICAL OSCILLATIONS (CONTINUED)



464, 466 VERTICAL OSCILLATIONS (CONTINUED)



--Mike Laurens
58-511, Ext. 6246
September 19, 1980
Issue 10-19

465B RISETIME AT 5 VOLTS/DIV IMPROVED

Serial Numbers: B040600 and below
Reference: 465B Manual, P/N 070-2757-00

The 5 Volts/Div position on CH 1 and CH 2 vertical preamps may not meet risetime specifications. In order to improve grounding of the attenuator shield, which will improve the risetime to meet specifications, a ground clip is added to the top of the shield (see illustration for location).

The parts added are:	2 ea	P/N 131-1428-00	Ground clip
	2 ea	P/N 166-0030-00	Spacer
	2 ea	P/N 211-0012-00	Screw

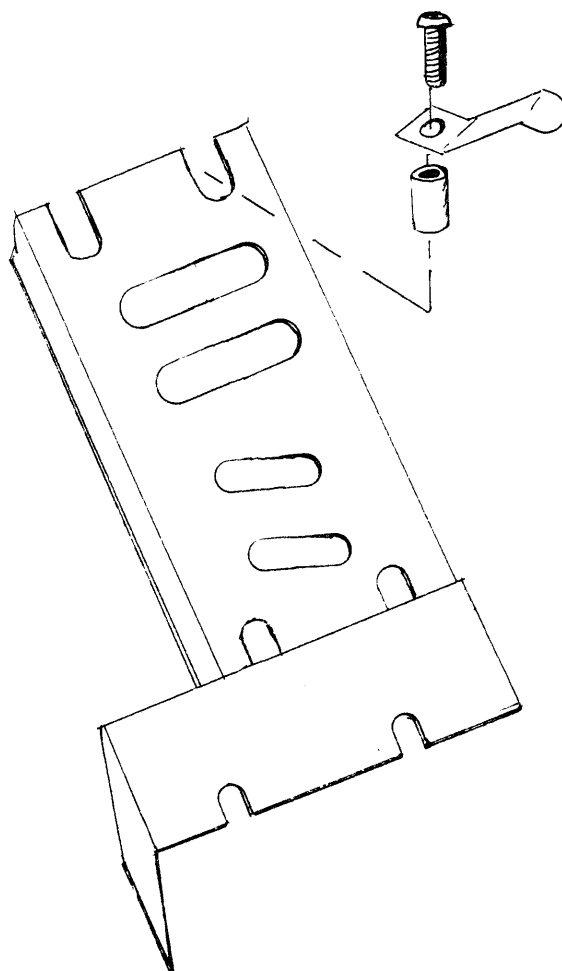


Illustration 1

--Mike Laurens
58-511, Ext. 6246

INFORMATION DISPLAY DIVISON

634: TORX TOOLS AVAILABLE

The 634 monitor uses eight T20 type torx-head screws in the frame assembly. To remove and replace these screws, the 003-0866-00 bit and a $\frac{1}{4}$ " drive magnetic screwdriver handle are required. To date, the 003-0866-00 is the only part numbered tool available for use with these screws.

Smaller torx-head bits (type T10) are available under part numbers 003-0814-00 (one inch shank) and 003-0815-00 (two inch shank). A complete tool for this size is orderable under part number 003-0816-00. The T10 size has found application in television products.

--George Kusiowski
63/503, ext. 3928

4025/27 FIRMWARE ERROR

A firmware error has been detected in the recently released firmware on the ROM Expansion Board, Version 1.6 in the 4025 and Version 1.2 in the 4027. The firmware error concerns only 4025's and 4027's which are connected to a 4662/63 Plotter via GPIB. During a copy from HOST to Plotter using the "/P" switch ("/P" converts english commands to moves and draws) when a continuation character ampersand "&" is used an incomplete plot will occur. The continuation character is used, so long command strings can be broken up into several strings. With version 1.6 4025 and Version 1.2 4027, any data transfer from terminal to plotter will stop after the first continuation character, and not continue until the next command character. This causes incomplete plots on the 4662/63 Plotters. The continuation character string "& ()" can be used in place of the continuation character "&" with no data loss to plotter.

050-1113-03
050-1140-02
050-1378-00
050-1380-00
050-1381-00

Shipment of five 050 kits used to upgrade firmware on the ROM Expansion for the 4025 and 4027 have been stopped. Shipment of these kits will resume when new part numbers are assigned and all existing firmware parts are re-worked to correct the firmware error.

Manufacturing is now shipping the new version of firmware on the ROM Expansion Board Version 1.7 4025 and Version 1.3 4027. The instrument serial number break for the new firmware is B054350 for the 4025 and B021263 for the 4027.

Do not install the Version R1.6 4025 firmware or Version R1.2 4027 firmware into instruments with the GPIB Option. The new firmware level will be available shortly and will be announced by another Service Organization Bulletin.

--Marty DeVall
63/503, ext. 3927

405X, 4923, 4924, 4081 TAPE DRIVE MAINTENANCE

In order to insure reliable operation of Tape Drives (especially compatibility between products) in the field, a few procedures should be followed:

1. Calibration - The importance of proper Tape Drive calibration cannot be overemphasized. All Tape Drives MUST be fully calibrated, on installation, when a drive is repaired, and when a defective drive is exchanged with a replacement drive. Tape Drive calibration should be routinely checked whenever the equipment is being serviced for other than Tape Drive problems. Tape Drives should only be exchanged when defective; a drive requiring an alignment and head cleaning is not considered defective.
2. Calibration Tape Handling - It is essential that the calibration tape be handled with care. It should be wrapped in foam for protection against vibration and shock. Prior to use, it should be allowed to adjust to ambient temperature and be "restacked" by cycling it in the Tape Drive. Occasionally your calibration tape should be compared to an office "standard" calibration tape. A new alignment tape (P/N 067-0781-02) has been set up. Changes are mechanical to the package to improve reliability. It is suggested these new tapes be used instead of the old style.
3. Cleaning - The Read/Write heads should be periodically cleaned with isopropyl alcohol. This is a must to avoid buildup of contaminants which can cause Read/Write errors.
4. Media - If other than Tektronix tapes are being used, insure they are certified media. Tapes should also be "restacked" before initial use, and then from time to time, to insure correct tape alignment and tension within the cartridge. The method to perform this restacking on a 4051 has been documented in Techniques Vol. 1 #7 and Vol. 2 #5.
5. Test Equipment - Recommended test equipment should be used when performing a tape alignment. Insure, also, that the test equipment is properly calibrated; this is especially necessary for accurate tape speed adjustment.
6. Tape Alignment Kit - A tape alignment kit (P/N 006-3396-00) has been set up which includes an alignment tape, a manual and a small test fixture. The alignment tape has some physical changes in the mechanical package to provide better reliability. The test fixture will allow easier and more accurate head skew and height alignments. The manual (070-3385-00) describes procedures for alignment of 405X, 4081, 4923, 4924 tape drives.

--Frank Lees
63-503, Ext. 3929

4663, MEASURING PLATEN ELECTROSTATIC VOLTAGE

The following procedure enables an accurate check of the 4663 Platen Electrostatic Voltages.

WARNING

Dangerous voltages are measured in this procedure. In these measurements, make sure that you are not touching the voltmeter probe tip and that the probe tip does not touch other components or the Plotter chassis. In addition, use only one hand to hold the voltmeter probe and make sure that no part of your body is touching the Plotter chassis.

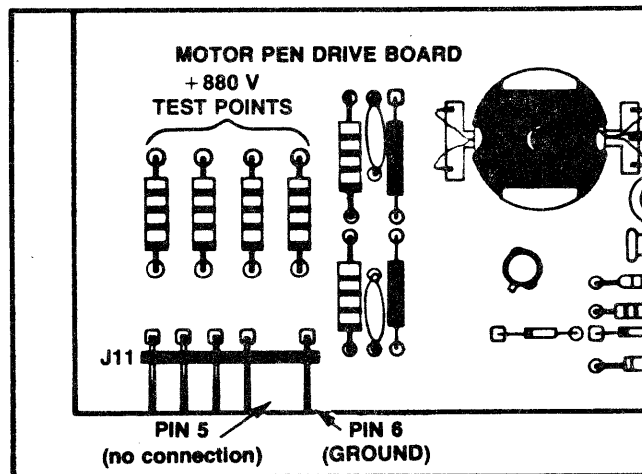
1. Place the Plotter in SHEET mode (if not already). To do this, pull the Parameter Entry card out to the Media Form line and press the switch over SHEET. Then press the MEDIA CHANGE front panel switch twice.
2. Set the voltmeter to read the +1000 Vdc scale.
3. Attach the negative voltmeter lead to Pin 6 of J11 on the Motor pen Drive circuit card (see illustration below).
4. Carefully attach or touch the positive voltmeter lead (probe) to each of the four load resistors directly behind J11 as shown in Figure 2-11. A reading of +880 Vdc $\pm 10\%$ should be measured at each resistor.

NOTE

If an attempt is made to measure this voltage on Pins 1-4 of J11, the input impedance of even a 10M ohm voltmeter will place a sizeable load on the High Voltage Platen Power Supply. This will lower the voltmeter reading and provide an inaccurate check.

--Larry North
63-503, ext. 3926

LN:jk
8/20/80



LABORATORY INSTRUMENT DIVISION

MICROCOMPUTER DEVELOPMENT PRODUCTS

8001 FIRMWARE UPDATE

A Version 1.7 to Version 2.0 Update for the 8001 System Memory Board has been in effect for approximately two years.

Parts shortages on the front end of the program is the reason for running the program for two years.

This Activity Code 18 Program is now terminated.

040 Kits involved with the Update were:

TEK OPS	V2.0 (7 ROM)	040-0902-01
8080	(2 PROM)	040-0903-00
6800	"	040-0904-00
Z80	"	040-0905-00
9900	"	040-0906-00
8085	"	040-0907-00

The above kits are still orderable as replacement parts for on-going support.

--Vern Johnson
92-236, Ext. 1289

SEMICONDUCTOR TEST SYSTEMS

S3200: D70 T.I.M.E. OPTION SKEWS

The installation of new D70 Sector Cards may result in frequent T.I.M.E. Option correction table failures.

Burn-In for D70 sector cards may require several weeks. Because of normal skew drift, re-entering of T.I.M.E. correction tables is recommended once a week until the skew stabilizes on new sector cards.

Prior to running T.I.M.E. a 12 hour burn-in is recommended for new D70 sector cards. If skew drift is excessive, Recal may be necessary with particular attention to comparators and risetimes.

Information by Craig Wasson, Service Support.

Inserted by--
Ron Lang
92-236, Ext. 1015

S-3200: BLANK PANELS FOR THE RACK ARE ORDERABLE

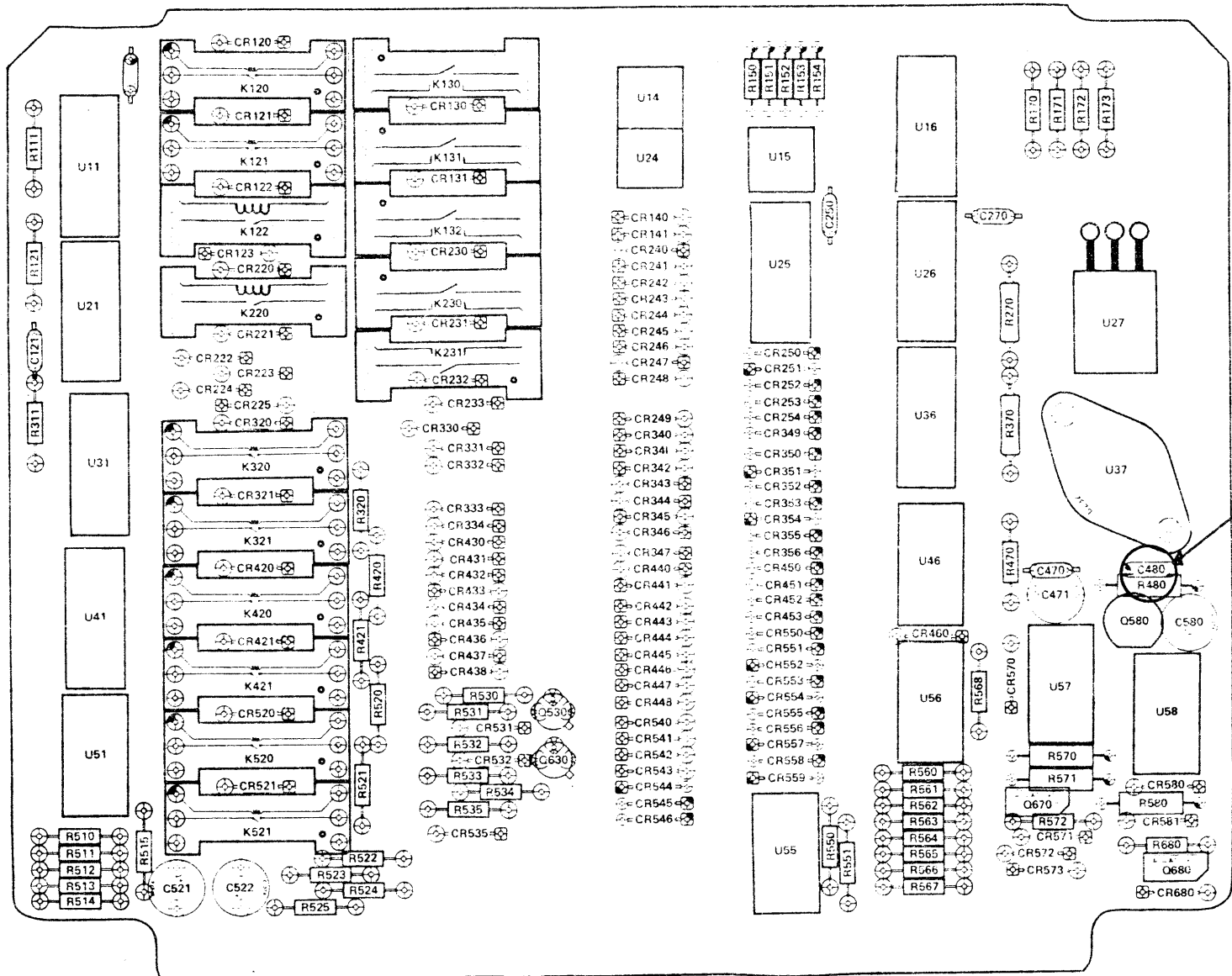
The need arises for blank panels when the system rack configuration is changed or when a rack is added to the system and all the extra space is not occupied by instruments. The size and part numbers follow.

1 -3/4 inch	333-1351-00
3 -1/2 inch	333-0997-00
5 -1/4 inch	333-0999-00
7 inch	333-1352-00
8 -3/4 inch	333-0998-00
10 -1/2 inch	333-0996-00

--Jim Stubbs
92-236, Ext. 1287

S3200: DC SUBSYSTEM MODIFICATION #M40301

It has been determined in some cases there is an oscillation on the +7V regulator which is coupled to the 15V supply. This oscillation may cause a false initialize signal to be generated. Mod #40301 calls for replacing C480 on the DC Sub-System Logic circuit board. Remove the .001 micro farad capacitor (283-0065-00). Install a one micro farad capacitor (283-0177-00). The assembly number for the DC Subsystem Logic board will change from 670-2828-03 to 670-2828-04. This mod applies to all test tables 1803, 1804 and 1805. See the attached parts placement diagram for the logic Board.



3331-51

Figure 7-43. DCSS Logic Card (A28) Component Locations

Information provided by Carl Baker, STS Manufacturing

--Jim Stubbs
92-236, Ext. 1287

S3200: S-3280 SAMPLING RACKS

New part numbers have now been established for the single bay S-3280 Sampling Racks. These racks contain the R288 Master Mux Unit, the R287 Mux Unit, the 286 Head Mux and S-1 Sampling Heads.

All S-3280's and S-3270's with Dual Stations which have an 1805 Test Station will have these racks.

The new part numbers are for the racks, the fans located in the top of the rack, and the power plug mold strips located in the right rear.

Export Rack: 437-0249-02

Domestic Rack: 437-0248-02

2 ea. 119-0828-01 Fan, 115V
1 ea. 131-1938-01 Plug Mold, 115V

Note: Export racks require one of the following power transformers:

015-0357-00 French Power Isolation
015-0377-00 Japan Line Volt Auto XFMR 100V
015-0378-00 Japan Line Volt Auto XFMR 200V

--Ron Lang
92-236, Ext. 1015

SIGNAL PROCESSING SYSTEMS

IEEE CHECKOUT SOFTWARE

The Dma Transfer Test in the CP56507 checkout software made some incorrect assumptions about the 18 bit addressing in V02XM-02. The attached patch will fix that problem.

CP56507 Patch

1. COPY "DTR.CKP" TO "DTR.BAK"
2. OLD in the file DTR.CK0
3. Enter the following lines:

```
CHANGE 2740, '"20000"', '"20000"'
CHANGE "BC,'20000'", "BC,'20000' GOSUB 5500"
CHANGE ",AR", ",AR\GOSUB 5500"
CHANGE "BA,Y", "BA,Y\GOSUB 5600"
CHANGE 2460, ",D", ",D\GOSUB 5600"
CHANGE 4590, ",D", ",D\GOSUB 5600"
5500 REM *** Routine to store Extended Memory Address bits ***
5510 OSET X1="200000"\REM X1 is mask for Ext Mem bits in AR
5520 OSET X2="004000" REM X2 is offset for Ext Mem bits in BCR
5530 X3=ITP(AR/X1)\REM X3 is Ext Mem bits pattern
5540 BITSET BC,X3*X2\REM Set X3 pattern into BCR bits 11 & 12
5540 RETURN
5560 REM *** Routine to recall Extended Memory bits
5610 GETLOC BC,X3,11,12\REM Get bits 11 & 12 of BCR
5620 D=D+(X3*X1)\REM Add bit pattern to D
5630 Y=Y+(X3*X1)\REM Add bit pattern to Y
5640 RETURN
```

4. REPLACE the file DTR.CK0

--Dean Hager
92-236, Ext. 1565

7612D: INCORRECT NUMBER OF DATA BYTES. CAUSING CKSUM ERRORS

References: Manual: 061-2248-00 (Schematic Diagram 5)

Modification #: M40670

Symptom: An intermittent CKSUM error will be generated when sending waveform data to the computer. An incorrect number of data bytes are generated from the translator board.

Solution: Add a dual D flip-flop (156-0388-02), and a 1K Ω resistor (315-0102-00) on the front side of the translator board (670-4952-00) as shown in diagram 'A'.

Cut a run between Pin 5 of U930 and a feedthrough hole adjacent to Pin 6 of U930 as shown in diagram 'B', on the backside of the translator board.

On the backside of the IEEE interface board (670-5773-00), remove C136 capacitor between Pin 7 and Pin 9 of U132.

Adding this mod will synchronize the data transfer handshake with the 7612D internal clock.

This mod changes the translator board 670-4952-00 to a 670-4952-01 and the IEEE interface board 670-5773-00 to a 670-5773-02.

The schematic representation is shown in diagram 'C'.

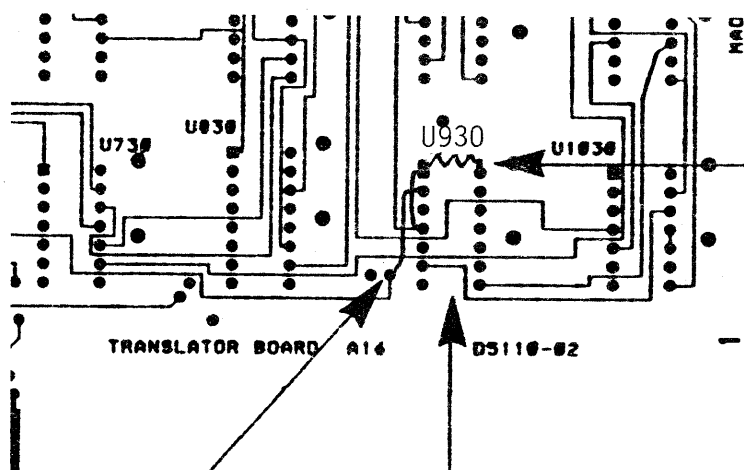
This mod is incorporated in B03XXXX and higher serial numbered instruments.

(drawings to complete this article are on the following two pages)

DIAGRAM 'A'

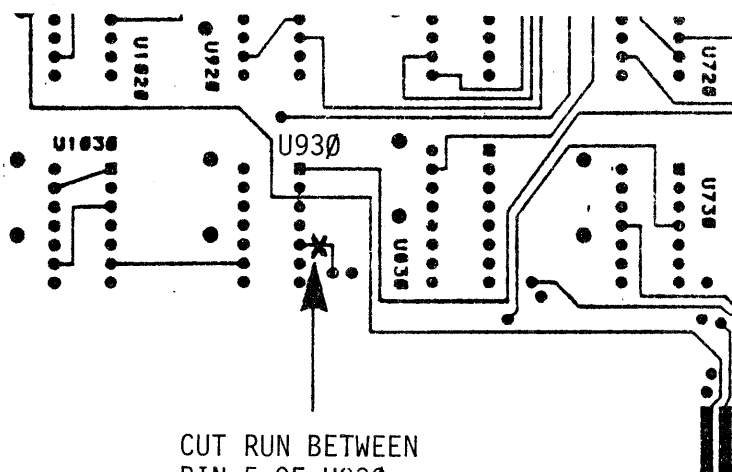
PARTIAL FRONTSIDE VIEW OF
THE TRANSLATOR CIRCUIT BOARD

670-4952-00



1. ADD U935 (156-0388-02) ON TOP OF U930 (PIGGY-BACK). LIFT PINS 1,4,6,8,9,10,11,12, AND 13. TRIM BACK THESE PINS, FOR THEY WON'T BE USED. SOLDER PINS 3,5,7, AND 14 TO CORRESPONDING PINS ON U930.
2. SLIGHTLY LIFT PIN 2 OF U935 AND STRAP TO FEEDTHROUGH HOLE ADJACENT TO PIN 6 & 7 OF U930.
3. ADD R930 (315-0102-00) TO PIN 14 OF U935. TAKE THE OTHER END AND ATTACH IT TO PINS 1 AND 4 OF U935, ENSURING THERE IS AN INSULATED SLEEVING BETWEEN PIN 1 AND PIN 4.

DIAGRAM 'B'



PARTIAL BACKSIDE VIEW
OF TRANSLATOR CIRCUIT
BOARD 670-4952-00.

CUT RUN BETWEEN
PIN 5 OF U930
AND FEEDTHROUGH
HOLE ADJACENT TO
PIN 6 OF U930.

7612D: INCORRECT NUMBER OF DATA BYTES, CAUSING CKSUM ERRORS (CONTINUED)

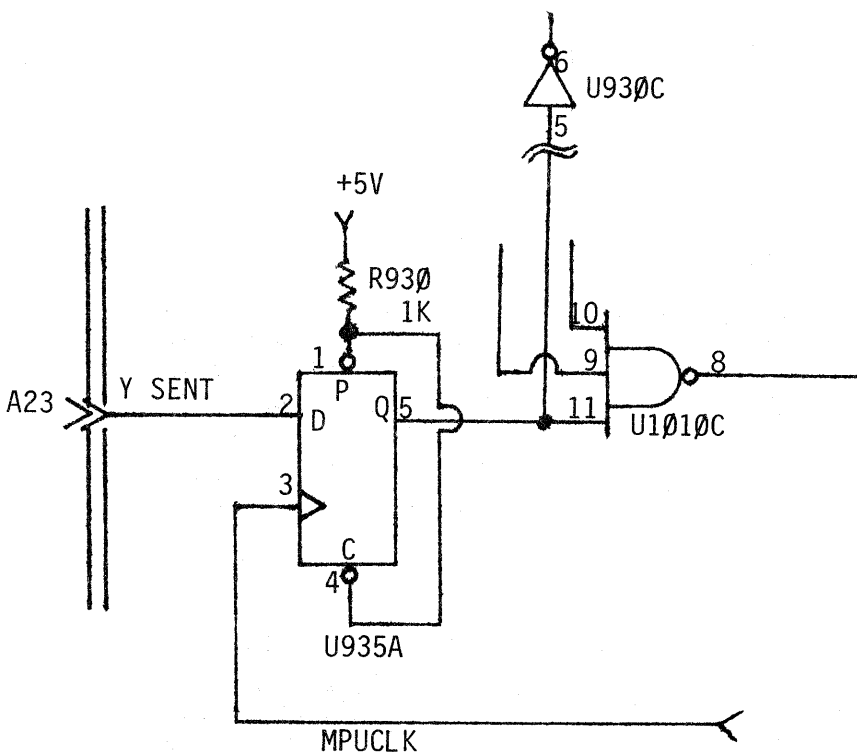
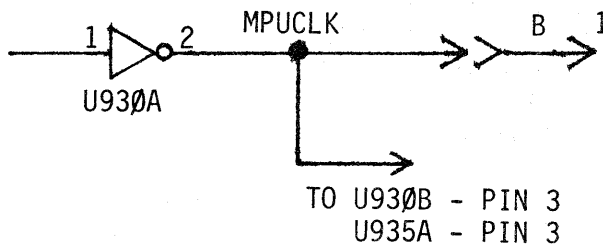


DIAGRAM 'C'

PARTIAL VIEW OF TIMEBASE CONTROL 5



--Randy Newton
92-236, Ext. 1635

7912AD: ADDED PROTECTION FOR THE CRT AND IMPROVED RELIABILITY

References: Manual 070-2385-00
Modification #M38395

SYMPTOMS:

- 1a). When a power supply failure occurs the CRT target may get burned. The reason for this is: the deflection amps will stop operating, but the positive and negative 17 volt power supplies will continue to provide hi voltage operation.
- 1b). Turning the instrument off and then on (while the filaments are still warm) causes a burst of beam current which could cause damage to the CRT.
2. During calibration of the 2-ns timing adjustment, A40C108, an oscillation may occur causing verticle trace jitter. (070-2385-00, Pg. 5-73 and 74, Paragraph 50).
3. The Cal In/Out and the Vert In/Out (running from the rear panel to the front panel) will occasionally short out against the horizontal and Z-Axis amplifier circuit board (670-5144-01).

SOLUTION: To repair any of the symptoms listed, the mod kit 040-0959-00 should be ordered. This kit will fix all the symptoms listed.

If a new Hi Voltage Oscillator Board (670-5155-01) is required in an instrument that doesn't already have this mod, order the 050-1362-00 Parts Replaceable kit instead of the board.

If a new horizontal and Z-Axis Board (670-5144-01) is required in an instrument that doesn't already have this mod, order the 050-1363-00 parts replacement kit instead of the board.

This modification is incorporated in Serial Numbers B040522 and above.

--Randy Newton
92-236, Ext. 1635

7912AD FIRMWARE UPDATE

The Activity Code 18 Update now in progress will terminate October 31, 1980. Orders for 046-0001-00 kits will not be accepted beyond that date. Orders placed prior to October 31, but not filled due to shortages or manufacturing capability, will be filled as kits become available. A reminder that beyond the cut off date it will be very costly for a customer who was missed and requires a repair in the affected areas.

--Dean Hager
92-236, Ext. 1284

7912AD: IMPROVED RELIABILITY FOR THE HI VOLTAGE OSCILLATOR

References: Manual 070-2385-00 Circuit Schematic 7
Modification #M39556

Symptom: If a failure occurs in the filament supply the majority of the active components on the Hi Voltage Oscillator Circuit Board will be destroyed. This mod adds protection to the circuit to prevent this type of catastrophic failure.

Solution: On the front side of the Hi Voltage Oscillator Circuit Board 670-5155-01, add two heat sinks (214-0269-00), one to Q016 and one to Q018. Remove VR016 and replace with Part Number 152-0304-00.

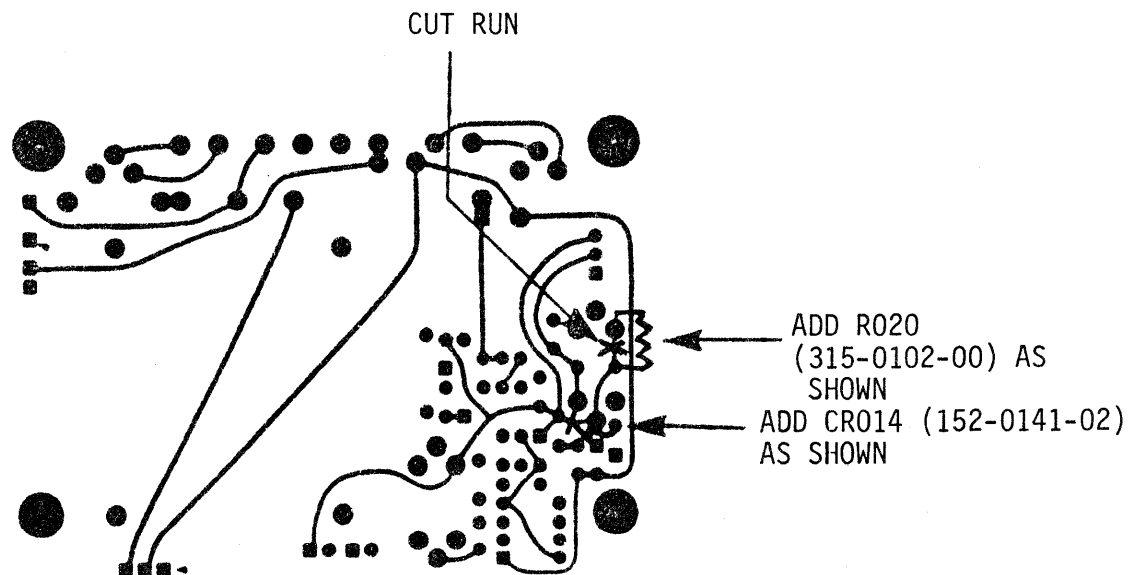
As shown in diagram 'A' cut a run, add R020 (315-0102-00) between collector of Q012 and the base of Q014 and add CR014 (152-0141-02) between the emitters of Q014 and Q002.

Diagram 'B' is the schematic equivalent of this modification.

This modification changes the Hi Voltage Oscillator Board from a 670-5155-01 to a 670-5155-02.

DIAGRAM 'A'

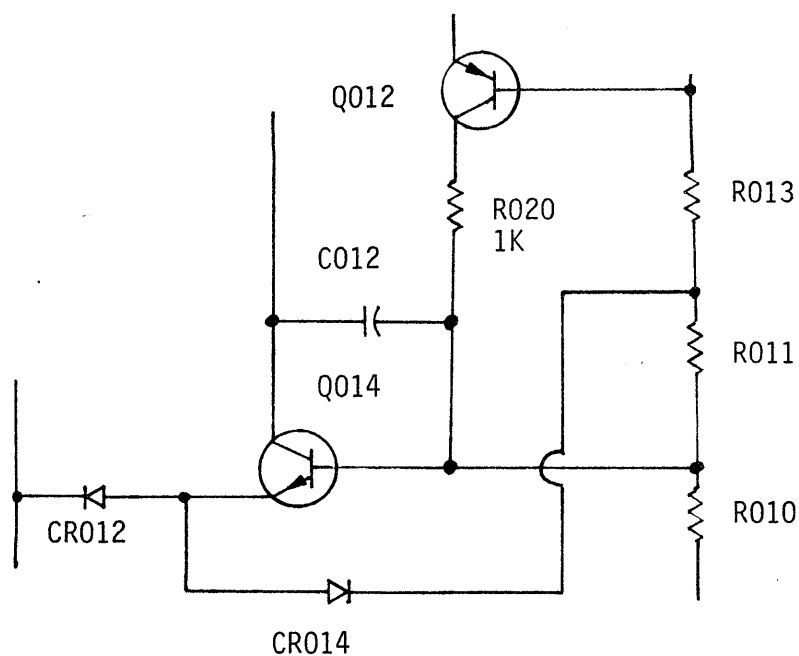
THE BACKSIDE VIEW OF THE HIGH VOLTAGE OSCILLATOR CIRCUIT BOARD
670-5155-01



(diagram to complete this article is on the following page)

DIAGRAM 'B'

PARTIAL VIEW OF THE Z-AXIS/HIGH VOLTAGE CIRCUIT SCHEMATIC 7



--Randy Newton
92-236, Ext. 1635

REFERENCE PULL-OUT

INFORMATION DISPLAY DIVISION

4907 GENERAL INFORMATION AND CALIBRATION

Reference: Pull-Out

The following information is provided to answer some frequently asked questions about the 4907 File Manager.

1. Strapping:

A) Control Board:

a. Address Switches - All off (for address 0) with 405X series.

- Strap to desired GPIB address with 401X Option 5 GPIB Interface.

b. RAM Address Select-J13 pins 2 & 3 (normal operation)

-J13 pins 1 & 2 (using system test fixture 067-0746-00)

B) Power Supply:

a. Cont Strap - in on Main cabinet
out on Auxiliary cabinet

C) Disk Drive Boards:

All Disk Drive Boards have straps present in the following positions:

T2, DS, C, DC, A, B, 801, L

Drive 0 should have a strap present on DS1

Drive 1 should have a strap present on DS2

Drive 2 should have a strap present on DS3

Terminator Straps: T1, T3, T4, T5, T6 should be present in the electrically furthest Disk Drive from the controller.

In a single drive configuration the terminator straps will be present in drive 0.

In a dual drive configuration the terminator straps will be present in drive 1 (Aux cabinet right side).

In a triple drive configuration the terminator straps will be present in drive 1 (Aux cabinet left drive).

4907 GENERAL INFORMATION AND CALIBRATION (CONTINUED)

There is a 3-wire cable added to the Disk Drive Boards, which connects from:

1. Pin 2 (edge connector J1) to Z strap pin 1.
2. Pin 4 (edge connector J1) to IC4E pin 11.
3. Pin 6 (edge connector J1) to eyelet hole between pins 5 & 6 of IC3D, which runs to IC3C pin 9.

2. Firmware:

Current firmware shipped in the 4907 is version 1.2. Serial number breaks for firmware levels are:

B010100 to B010487 - Level 1.0
B010488 to B010810 - Level 1.1
B010811 to present - Level 1.2

To identify firmware level 1.2, locate the patch ROM and FPLA, the part number should be:

U631: 156-0960-08 U541: 156-0940-14

To upgrade from level 1.0 to 1.2 order 050-1160-01. To upgrade from level 1.1 to 1.2 order 156-0960-08.

3. Configuration:

- A) A 4051 used with the 4907 must have firmware level 5 or higher.
- B) The 4051 File Manager ROMpak must be in backpack slot 41 (left slot). The 4052/4054 File Manager ROMpak must be in backpack slot 41 (left slot).
- C) The power up sequence should be:
 - a. 4907 Auxiliary Cabinet (if present)
 - b. 4907 Main Cabinet
 - c. 405X Terminal
 - d. Greater than 50% of the devices connected on the GPIB must be powered on.
- D) If a 4662 Plotter is used with the 4907, the plotter must have firmware level 3 or higher.
- E) If a 4051 Printer Interface is used with the 4907, the Printer Interface should contain a modification. Refer to Wizards Workshop issue 8-4 February 17, 1978 page 11 and issue 8-33 December 8, 1978 page 9.
- F) If a 4051 E01 (ROM Expander) or a 4051 C01 (Synchronous Interface) is being used with the 4907, the E01 and C01 should contain a modification. Refer to Wizards Workshop issue 8-8 March 24, 1978 page 6.

4907 GENERAL INFORMATION AND CALIBRATION (CONTINUED)

- G) Shielded GPIB cables should be used between the 4907 and 405X. The part numbers for these cables are:

012-0630-03 - 2 meter

012-0630-04 - 4 meter

- H) A File Manager experiencing intermittent problems that can be attributed to line voltage transients should have Corporate Mod #40319 installed. Refer to Wizards Workshop issue 10-14 July 11, 1980 pages 22, 23.

4907 CALIBRATION PROCEDURE

When installing or repairing a 4907 File Manager the Disk Drive calibration must be checked. If the drive is not properly calibrated, problems will occur where a disk created on one drive will not be read on another drive. A recommended calibration procedure is as follows:

References: 4907 Service Manual, P/N 070-2405-00
119-0977-00 Flexible Disk Drive Service Manual P/N 070-2504-00

Equipment needed:

1 Dysan #2405 Alignment Disk P/N 119-0896-00

1 blank Formatted Disk P/N 119-1011-01 (box of 10)

SC504 Oscilloscope or equivalent

405X "FDCAL" Program (4907 Service Manual (070-2405-00) Appendix E)

1. Load the "FDCAL" Program into a 405X Series terminal. Make the following changes to the "FDCAL" Program to insure it will operate properly with a 4051, 4052 and 4054:

Line 630 FOR S=1 to 400 to 630 FOR S=1 to F

Line 800 CREATE "F0", "A"; F0, 0 to 800 CREATE "F0", "A"; F0 + 0, 0

Line 820 CREATE "F1", "A"; F1, 0 to 820 CREATE "F1", "A"; F1 + 0, 0

Line 460 T=0 to 460 READ A, B, T, L, W

Line 470 L=0 to 470 DATA 0, 0, 0, 0, 0

Delete line 480 -

Add line 605 - F=((RND (0) and 1)*10+1) *400

2. Head radial adjustment

- a. Insert the alignment disk into the drive.
- b. Set scope as follows:
 - CHAN 1 - AC 100 mv/div Probe on TP1
 - CHAN 2 - AC 100 mv/div Probe on TP2
 - Trigger - external negative 20 ms/div Probe on TP10
 - Display - 1-2
- c. Step to track 38 (UDK #6)
- d. Two cat eyes will be displayed on the scope, they should be within 70% amplitude of each other. (figure 1)
- e. If the cat eyes are not within 70% amplitude of each other, carefully loosen the two screws holding the stepper motor mounting plate. NOTE: Do not loosen the screws coated with glyptol.
- f. Rotate the stepper motor until the cat eyes are within 70% amplitude of each other and tighten the screws holding the stepper motor mounting plate.
- g. Step out a few tracks (UDK #2) then step back to track 38 (UDK #6) and insure the cat eyes are within 70% amplitude of each other. Readjust the stepper motor as necessary (Step e).
- h. Step in a few tracks (UDK #3) then step back to track 38 (UDK #6) and insure the cat eyes are within 70% amplitude of each other. readjust the stepper motor as necessary (Step e).
- i. Repeat steps c through h to insure the cat eyes are within 70% amplitude of each other.

3. Index pulse adjustment

- a. Insert the alignment disk into the drive.
- b. Set scope as follows:
 - CHAN 1: DC 2 v/div Probe on TP12
 - TRIGGER: Auto internal negative .2 ms/div
 - DISPLAY: Chan 1
- c. The index pulse will be displayed on the scope, it should have a pulse width of $1.7 \text{ ms} \pm .5 \text{ ms}$. (Figure 2)
- d. If the index pulse is not within tolerance adjust the index sector potentiometer for a pulse width of $1.7 \text{ ms} \pm .5 \text{ ms}$.
- e. Put glyptol or equivalent coating (loctite, enamel) on the index sector potentiometer.

4907 GENERAL INFORMATION AND CALIBRATION (CONTINUED)

4. Index to data timing

a. Insert the alignment disk into the drive.

b. Set scope as follows:

CHAN 1: AC 200 mv/div Probe on TP1

CHAN 2: AC 200 mv/div Probe on TP2

TRIGGER: External negative 50 μ s/div Probe on TP10

DISPLAY: 1-2

c. Step to track 1 (UDK #5).

d. Observe the timing from the start of the sweep to the beginning of the data burst; it should be 200 μ s \pm 50 μ s. (Figure 3)

e. If the timing is not within tolerance, loosen the index sector transducer until the transducer is just able to be moved. Adjust the transducer so 200 μ s \pm 50 μ s is observed from the start of the sweep to the beginning of the data burst.

f. Step out to track 76 (UDK #8).

g. Redo steps d & e to insure timing from the start of the sweep to the beginning of the data burst 200 μ s \pm 50 μ s.

h. Insure timing is correct at track 1 and track 76 readjust as necessary.

5. Head load activator timing

a. Insert the alignment disk into the drive.

b. Set scope as follows:

CHAN 1: AC 100 mv/div Probe on TP1

CHAN 2: AC 100 mv/div Probe on TP2

TRIGGER: External positive 10 ms/div Probe on TP11

DISPLAY: 1-2

c. Load and unload the head on track 75 (UDK #15).

d. When the head loads, the signal on the scope should be 50% of full amplitude within 35 ms (Figure 4). Trigger slope must be adjusted carefully to obtain proper timing.

e. If the timing is not met, adjust the downstop screw clockwise until the signal is 50% of full amplitude within 35 ms. (DO NOT ADJUST THE DOWNSTOP SCREW MORE THAN $\frac{1}{4}$ TURN).

4907 GENERAL INFORMATION AND CALIBRATION (CONTINUED)

6. Head amplitude

- a. Insert a blank formatted disk into the drive.
- b. Set scope as follows:
 - CHAN 1: AC 50 mv/div - Do not connect probe until track 76 is being read.
 - CHAN 2: AC 50 mv/div - Do not connect probe until track 76 is being read.
 - TRIGGER: External negative 1 ms/div TP12
 - DISPLAY: 1-2
- c. The scope probes for CHAN 1 & CHAN 2 must not be connected to the board until after the 2 F data pattern has been written to track 76.
- d. Enable write mode (UDK #11).
- e. Step to track 76 and write a 2 F pattern to it (UDK #12).
- f. When the message "READING TRACK 76" appears on the terminal CRT hook the CHAN 1 scope probe to TP1 and the CHAN 2 scope probe to TP2.
- g. The signal on the scope should be greater than 110 mv peak to peak. Typically on a new drive it is 170 mv peak to peak or greater.

7. Track 00 flag adjust

- a. Insert a blank formatted disk into the drive.
- b. Set scope as follows:
 - CHAN 1: DC 1 volt/div Probe on TP26
 - TRIGGER: Auto internal any continuous sweep
 - DISPLAY: CHAN 1
- c. Step to track 1 (UDK #5).
- d. TP 26 should be high (+ 5v).
- e. If TP26 is not high (+ 5v), loosen the setscrew on the track 00 flag and move the flag until TP26 goes high. (+ 5v)
- f. Step to track 2 (UDK #2).
- g. TP26 should be low (0v).

4907 GENERAL INFORMATION AND CALIBRATION (CONTINUED)

- h. If TP26 is not low (0v), loosen the set screw on the track 00 flag and move the flag until TP26 goes low (0v).
 - i. Redo steps c through h and insure TP26 is high (+ 5v) while the head is on track 1 and TP26 is low (0v) while the head is on track 2.
8. Write protect detector
- a. Insert a blank formatted disk into the drive with the write protect hole open.
 - b. Set scope as follows:
 - CHAN 1: DC 2 v/div Probe on TP25
 - TRIGGER: Auto internal any continuous sweep
 - DISPLAY: CHAN 1
 - c. Loosen the screw on the write protect assembly and position it for maximum output at TP25 (+ 5v).
 - d. Once maximum output is obtained, tighten the screw on the write protect assembly.

--Frank Lees
63-503, ext. 3929

NOTE: DRAWINGS TO COMPLETE THIS ARTICLE ARE ON THE FOLLOWING PAGE.

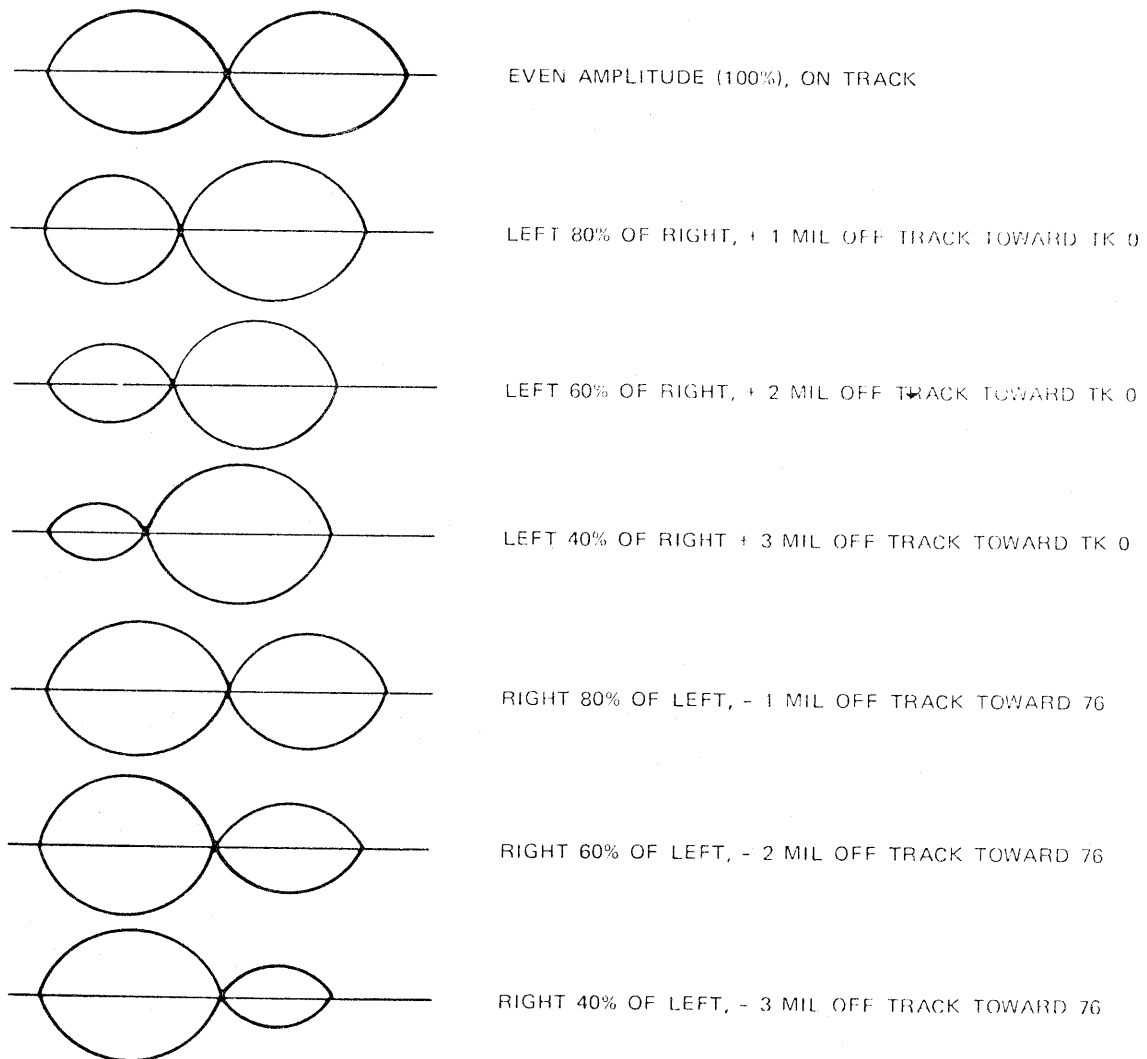


FIGURE 1 Head Radial Adjustment

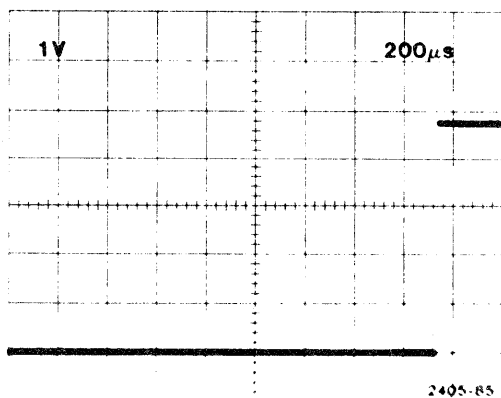


FIGURE 2 INDEX PULSE ADJUSTMENT

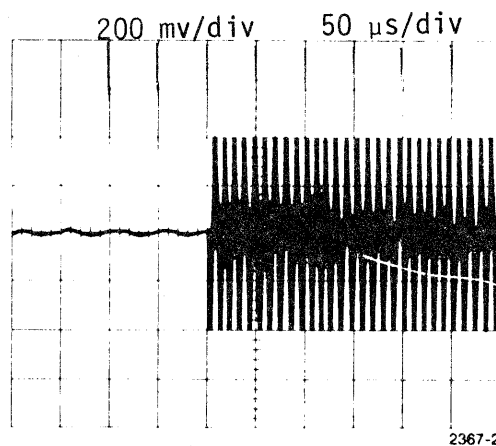


FIGURE 3 Index to Data Timing

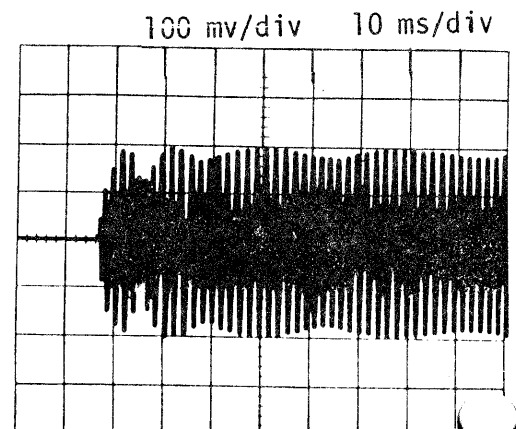


FIGURE 4 Head Load Activator Timing