



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

TEKTRONIX INTERNAL USE ONLY

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GENERAL

DIGITAL CONCEPTS VIDEOTAPE (CORRECTION)

There is an error in the "Digital Concepts Quizzes" booklet that accompanies the Digital Concepts Videotape. On page 22, an invert symbol should appear on the T input of flip-flop B (question 52). Without this symbol, the answer in the key appears incorrect.

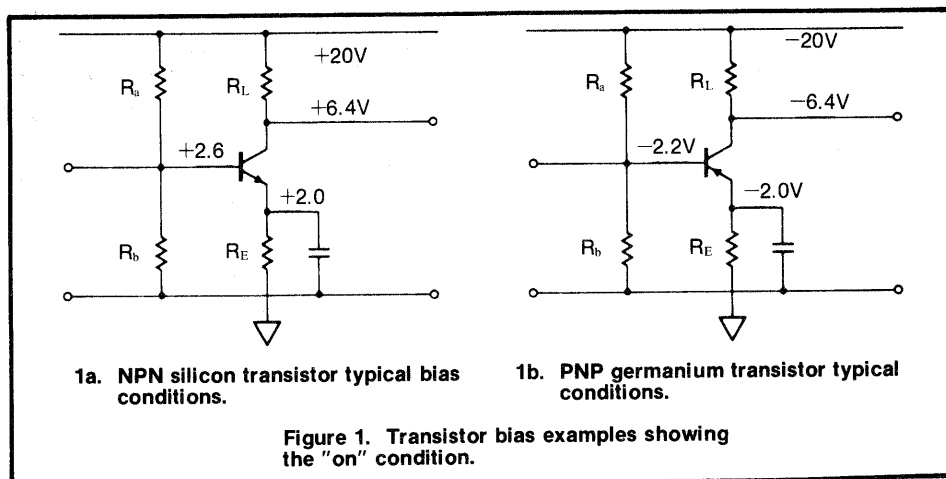
Submitted by--
Steve Gentis
Maintenance Training

This article is the first in a series of five. It was submitted for publication by Dick Hornicak, Maintenance Training. Look for the other four articles in upcoming editions of Wizards Workshop.

FUNDAMENTAL CHARACTERISTICS OF TRANSISTORS

Before describing specific troubleshooting tips, let's take a moment and review several important transistor characteristics.

Conventional PNP or NPN transistors are basically "off" devices and must be biased "on" to their operating point. This is done by forward biasing the base-emitter diode to make the transistor conduct. Refer to Figure 1 for examples of forward bias on NPN/PNP silicon and germanium transistors.



As shown in Figure 1, an NPN transistor must have its base more positive than the emitter in order for current to flow.

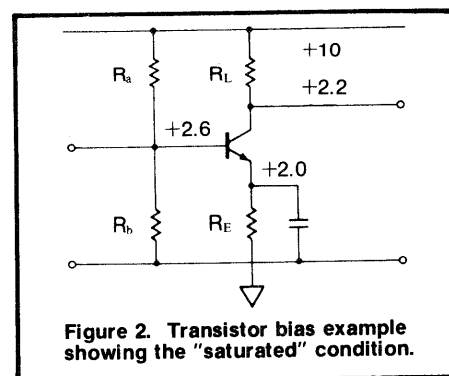
In a PNP transistor, the base must be more negative than the emitter in order for current to flow.

So "on" bias voltages for a transistor can be summed up by referring to Figure 1 and the following two rules:

- For a PNP, the base is negative, the emitter is not quite as negative, and the collector is far more negative.
- For an NPN, the base is positive, the emitter is not quite as positive, and the collector is far more positive.

There is a distinct difference between a transistor being turned "on" and being "saturated." When a transistor is saturated, it's generally thought of as being almost a short, that is, the IR drop across the emitter and collector resistors equals the supply voltage as shown in Figure 2. Naturally this means that there is practically no voltage drop between the collector and emitter of the transistor. In this condition, both the base-emitter and base-collector diodes are forward biased (where in the "on" condition only the base-emitter is forward biased — the base-collector is reverse biased). A saturated germanium transistor may have as low as 0.05 volts between its emitter and collector, while a saturated silicon transistor may have 0.5 volts or less between these leads.

"Saturated" or "off" are the usual conditions found in digital circuits. In ac circuits where transistors are used as amplifiers instead of switches, the amount the transistor is turned on depends upon current gain (beta) of the transistor, the resistors in series with the collector and emitter, and the supply voltage.



NEW SERVICE ACTION REQUEST FORMS AVAILABLE

The Service Action Request (SAR) form has been revised. The form has been part numbered (000-5999-00) and is now available from stock. Directions for completion and distribution are printed on the back of the Field Office copy of the SAR.

Any Technician or Specialist can initiate an SAR with the approval of the service center/field service supervisor. The SAR can be used to document problems such as troubleshooting, parts, reliability, and general product related information. It is not intended to replace currently used procedures, e.g., Manual Correction Forms and software problem reports. However, if in doubt as to whether an SAR would be appropriate, it is recommended that an SAR be used, so as to ensure documentation of problems.

For identification purposes, the SARs are numbered in sequence. List only one problem per SAR; if sending additional documentation, place the SAR on top of all other paperwork. Also, if additional space is needed, use plain paper, not another SAR.

The new SAR is a three-part form. The distribution is explained on the back of the Field Office copy. In all cases the white copy should be sent to the appropriate Service Support Group (Beaverton, Walker Road, or Wilsonville). Product responsibilities for each Service Support group are outlined on the back of the form.

Service Support will respond to the originator within five working days after receipt, with either a solution or status of the SAR.

--Debbie Zukerman
92-236, Ext. 1291

PROBE SUPPORT

Eilene Dickey, formerly of Factory Service, has joined Service Support as a PAE supporting probes and accessories, and reporting to Roy Lindley. She has in the past, and is still, receiving a large number of calls from customers in your Field Office areas seeking application, parts, and technical support.

As with all other products, the intent of the Service Organization is to ensure the customer works with his local Field Office sales and service personnel for problems relating to his Tek product. Please do not refer the customer with probe/accessory questions to Beaverton Service Support or Factory Service. The local sales and service organization should be the responding party to the customer. Service Support will provide technical support to the Service Center, if you are unable to provide the information.

--Todd Paulus
53/108, Ext. 8685

NOTICE

OUR SUPPLY OF THE WARRANTIES SECTION HAS TEMPORARILY
BEEN DEPLETED. WHEN THE NEW SUPPLY HAS BEEN PRINTED
ISABEL VAN LOM WILL FORWARD YOUR COPY TO COMPLETE
THIS SQI. AT THAT TIME PLEASE FILE BEHIND "YELLOW"
WARRANTIES TAB. OUR APOLOGIES FOR THE DELAY.

Sharon Huetson

ADMINISTRATIVE SUPPORT

INFORMATION SYSTEMS

The importance of complete, accurate data reporting cannot be over emphasized.

The warranty period failure information and associated defective components are important facets of this data.

Component failure patterns are determined through analysis of Service Record data by Reliability Engineers. This analysis requires accurate, timely data to be successful.

Component failure analysis is not done entirely on paper, however, and thus the second part of warranty failure reporting comes into play. The defective component, forwarded to Reliability Engineering within a week after instrument repair, is carefully analyzed. Some of the information determined is: who made the component and when? was there a structural defect? was defective or contaminated material used in making the component? None of this information can be learned without the component.

Let's keep those warranty failed components rolling in.

--Bill Duerden
56-037, Ext. 8939 MR

WIZARDS WORKSHOP BY PRODUCT MICROFICHE

The By-Product microfiche has now been completed, excluding General articles. Distribution procedures are being set up at this time. A great deal of time and effort has gone into making this a very useful tool for all technicians. So polish your microfiche screens and get ready - - it will be distributed shortly.

--Sharon Huetson
Editor

INFORMATION DISPLAY DIVISION

634: YOKE DRIVER BOARD MODIFICATION #36631

A number of changes have been made to the 634 yoke driver boards to improve reliability and performance. The new part numbers of the boards are 670-5594-03 for the standard product and 670-6122-02 for the 634 Option 15.

To improve geometry, an ORTHOGONALITY adjustment is added to both boards. However, the values of the added components differ between the two boards. Refer to Figure 1 for the values of the new parts. Those values in parentheses are for the Option 15 board. The new ORTHO control is best adjusted after step D5.h of the manual calibration procedure; that is, after the horizontal linearity adjustment.

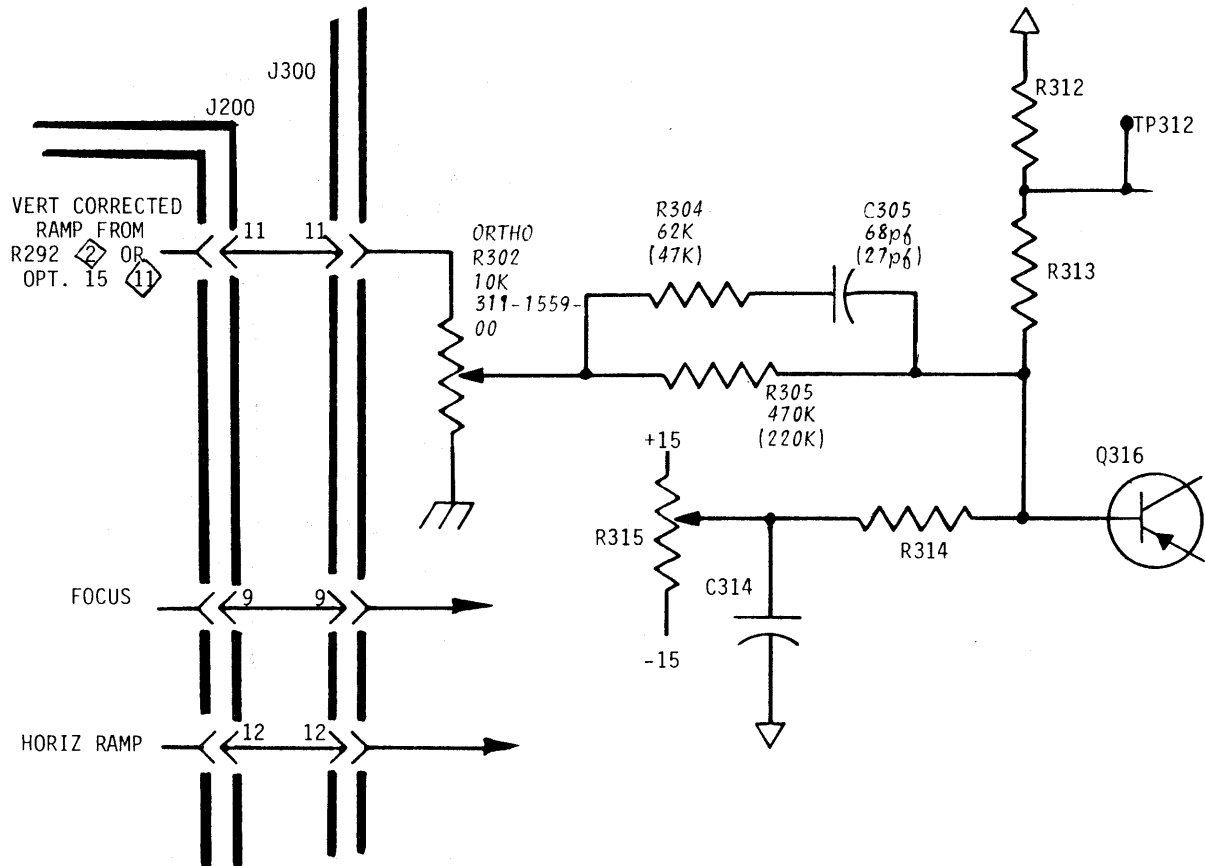
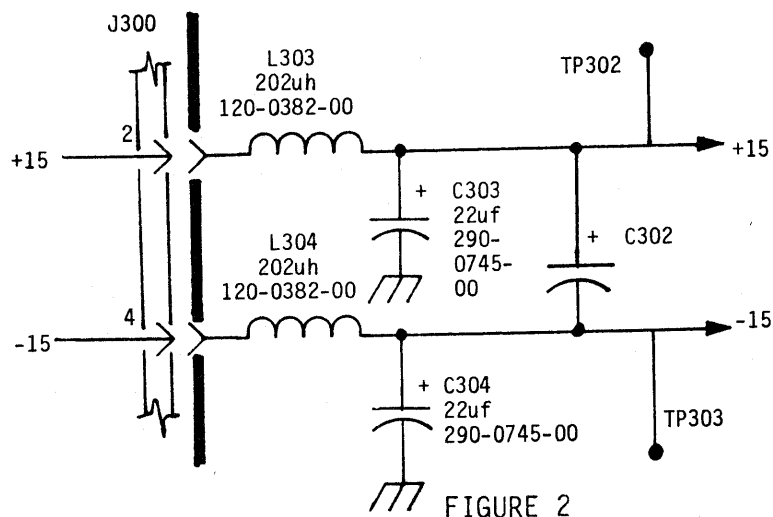


FIGURE 1

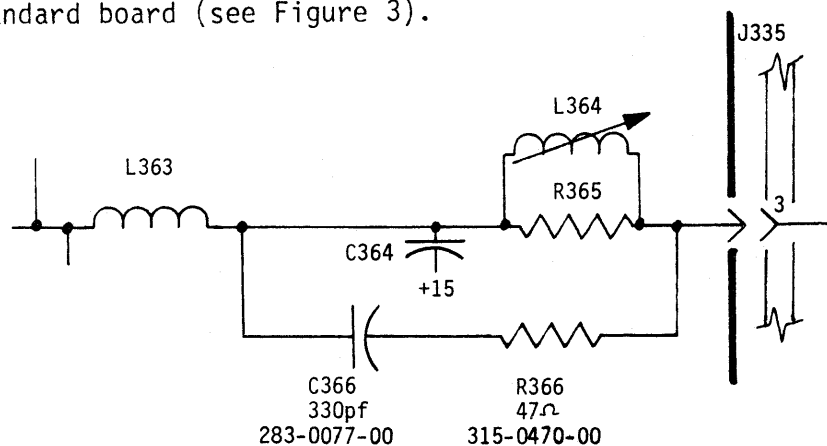
(continued)

634: YOKE DRIVER BOARD MODIFICATION #36631 (CONTINUED)

The new standard yoke driver board includes the filtering components C303, C304, L303, and L304 needed for the Option 20 product. As a result, the 670-7004-00 will no longer be produced.



Several other changes are made to the standard yoke driver board. Resistor R380 is reduced in value and R386 is increased (see Table I). These values are changed to prevent an overcurrent condition. Resistor R352 is changed to an Allen-Bradley type component to prevent board damage in the event of an overcurrent failure. Capacitor C324 is changed from P.N. 283-0204-00 to 283-0003-00 to provide commonality between the standard and Option 15 boards. The damping network previously used on the Option 15 is now added to the standard board (see Figure 3).



On the Option 15 board, the values of R380 and R386 have changed as described above (see Table II). In addition, the value of R357 has been changed from 680 ohm to 1.2K ohm. This has been done to increase the range of the horizontal position control.

Both boards receive a new circuit pattern layout. As a result, it is not recommended that earlier yoke driver boards be upgraded to the 670-5594-03 or the 670-6122-02. This article is for your information only.

(continued)

634: YOKE DRIVER BOARD MODIFICATION #36631 (CONTINUED)

TABLE I

Changes to Standard Yoke Driver Board

<u>Circuit No.</u>	<u>Old Value</u>	<u>New Value</u>	<u>New Part Number</u>
C303		22 μ F, 25V	290-0745-00
C304		22 μ F, 25V	290-0745-00
C305		68pF, 100V	281-0785-00
C324	.01 μ F, 50V	.01 μ F, 150V	283-0003-00
C366		300pF, 500V	283-0077-00
L303		202 μ H	120-0382-00
L304		202 μ H	120-0382-00
R302		10K Ω	311-1559-00
R304		62K Ω	315-0623-00
R305		470K Ω	315-0474-00
R352	12 Ω	12 Ω	315-0120-01
R366		47 Ω	315-0470-00
R380	2.4K Ω	2.0K Ω	315-0202-00
R386	10 Ω	100 Ω	315-0101-00

TABLE II

Changes to Option 15 Yoke Driver Board

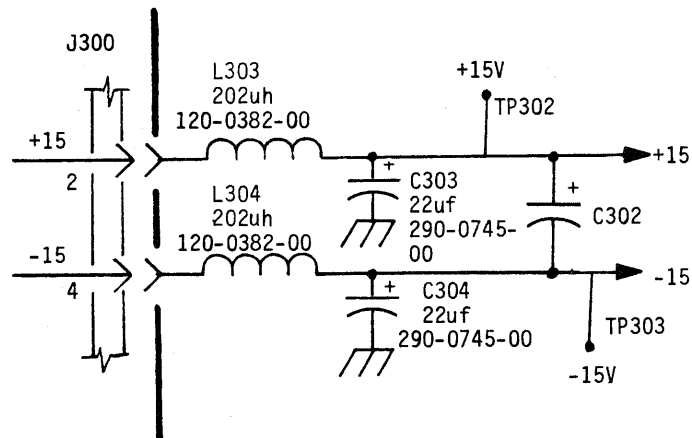
<u>Circuit No.</u>	<u>Old Value</u>	<u>New Value</u>	<u>New Part Number</u>
C305		27pF, 100V	281-0762-00
R302		10K Ω	311-1559-00
R304		47K Ω	315-0473-00
R305		220K Ω	315-0224-00
R357	680 Ω	1.2K Ω	315-0122-00
R380	2.4K Ω	2.0K Ω	315-0202-00
R386	10 Ω	100 Ω	315-0101-00

--George Kusiowski
63/503; ext 3928

634 YOKE DRIVER BOARD MODIFICATION 39769

The 634 Option 20 was known to transmit noise and horizontal line rate interference down the customers' power supply lines. To correct this, filtering was necessary on the +15V and -15V supply inputs.

Modification 39769 solved the problem by establishing the 670-7004-00 yoke driver circuit board assembly. This board is identical to the standard 670-5594-02 except that line filtering is effected by the addition of two toroidal coils and two electrolytic capacitors.



This modification has been superseded by corporate modification #36631 (written up elsewhere in this issue). This article is for your information, only.

--George Kusiowski
63-503, ext. 3928 (WI)

LABORATORY INSTRUMENT DIVISION

TM 500

CG551AP CALIBRATION VOLTMETER AND TERMINATION RECOMMENDATIONS

Reference: CG551AP Programmable Calibration Generator
Vol. 2 with Options Manual, Part Number 070-2815-00, Page 5-1,
Table 5-1, list of test equipment, Items 3 and 13.

Affected Serial Numbers: All

For calibration of the CG551AP, the Fluke 8502A is the recommended voltmeter. If another voltmeter is used it should be checked to assure that its measurements are within 0.02% at 100mv and above. The other parameters given in Table 5-1 should be considered, as well as the \pm digit count and the temperature coefficients.

At the request of a Field Service Center, the Fluke 8350A was tested and was found not to have necessary accuracy.

The termination (Part Number 011-0129-00) called out in Table 5-1, Item 13 is, at present, the only device known to have the temperature stability required for accurate calibration. Therefore no other termination should be used unless degraded performance is acceptable.

--Stan Uffner
92-336, Ext. 1564

DC509 MAINTENANCE INFORMATION UPDATE

The following is a sample report of calibration and certification for the DC509.

--Terry Turner
92-236, Ext. 1288

REPORT OF CALIBRATION AND CERTIFICATION

INSTRUMENT TYPE DC509	CAL. DATE	CALIBRATION STANDARDS USED		
SERIAL NUMBER	DUE DATE	Type	Serial Number	Cal Due
TEKTRONIX JOB #	TEMP.			
CALIBRATED BY	HUMIDITY			
NBS NO.				

INSTRUCTIONS

Procedures used to calibrate this instrument is documented in the current Tektronix Service Manual. Policies and procedures followed by this facility is in compliance with MIL-C-45662A.

1. Before any adjustments are made to the instrument, record "Pre-cal Value".
2. Circle in red all "Out-of-Specification" measurements.
3. After all adjustments, measure and record the "Corrected Value".

CALIBRATION DATA

Step No.	Function Tested	Minimum	Pre-Cal Value	Corrected Value	Maximum
1	Oscillator Frequency				
	Standard Time Base	999.99399kHz			1.0000061MHz
	(Sufficient for 6 months of operation)				
2	Oscillator Frequency				
	Option 01 Time Base	999.99879kHz			1.0000013MHz
	(Sufficient for 6 months of operation)				
3	Trigger Level Range	≤ -3.2V			≥ +3.2V
4	Trigger Level Output Accuracy				
	+10MV of internal DC Trigger				
	Level Chan. A	-10MV			+10MV
5	Chan. B	-10MV			+10MV
6	Input Sensitivity, XI Attenuation				
	DC Coupled; 56.6 MV PPT0 ≤ 100MHz	Check			
7	Auto Trigger Sensitivity				
	≤ 125MV P-P Times Attenuator				
	≥ 100MHz	Check			
8	Input Sensitivity: X1/X5	Check			
	Attenuation, DC and AC Coupled				
	113MV to 135 MHz				

DC509 UNIVERSAL COUNTER/TIMER INTER-CHANNEL CROSSTALK

Reference: DC509 Manual, Part Number 070-3464-00
Foldouts 1 & 2
A12 Analog Board
Change Reference C2/581

Affected Serial Numbers: B010195 and up.

Several instances of inter-channel crosstalk have occurred. A typical situation and symptom would be when driving Channels A and B with a 100MHz, 100mV signal there would be a loss of trigger on either channel.

Change reference C2/581, Pilot Instrument Change #24, corrects this problem by decoupling the +12V supply by adding 0.01 UF capacitors. Implementation for Channel A accomplished by adding C1120 (Part Number 281-0773-00) between the cathode of CR1122 and the ground at C1122. For Channel B, C1130 (Part Number 281-0773-00) is added between the cathode of CR1132 and the ground at C1133.

--Stan Uffner
92-236, Ext. 1564

PG505 PULSE GENERATOR - FALSE TRIGGER SPIKE AND PULSE DURATION OUT OF SPEC

Reference: PG505 Manual, Part Number 070-1583-01
Foldout 1
A1 Main Board
Mod Number 42676

Effective Serial Number: B023190

An extraneous spike on the leading edge of the trigger pulse might cause a false trigger when the pulse is to be used for external triggering. Also in some instruments the 5 μ s pulse spec is not being met.

The following changes (Mod Number 42676) correct these problems:

Change To:	<u>NEW P/N</u>	<u>NEW DESCRIPTION</u>
A1	670-2927-02	CKT BOARD ASSY:MAIN
C180	290-0297-00	CAP.,FXD,ELCTLT:39UF,10%,10V
C182	285-1068-00	CAP.,FXD,PLSTC:5UF,1%,200V
C184	285-1067-00	CAP.,FXD,PLSTC:0.5UF,1%,200V
C186	285-1066-00	CAP.,FXD,PLSTC:0.05UF,1%,200V
C188	283-0695-00	CAP.,FXD,MICA D:4440PF,1%,300V
R180	311-1562-00	RES.,VAR,NONWIR:2K OHM,20%,0.5W
R185	311-0580-00	RES.,VAR,NONWIR:50K OHM,20%,0.5W
R186	321-0210-00	RES.,FXD,FILM:1.5K OHM,1%,0.125W

Add:

C181	290-0830-00	CAP.,FXD,ELCTLT:10UF,5%,20V
C187	283-0646-00	CAP.,FXD,MICA D:170PF,1%,100V

The above parts are located on the MAIN circuit board and are shown on Diagram 1. C181 is added in parallel with C180. C187 is added in parallel with C188.

--Stan Uffner
92-236, Ext. 1564

5000 SERIES

5223, NEW MEMORY BOARD SHIELD

Reference: 5223 Instruction Manual
Wizard's Workshop, Issue 11-7

In the above mentioned Wizard article, it was stated that when a new shield was ready, it would be announced to the field. The new shield is ready and orderable and is part numbered 337-2777-01. A new insulator is needed when installing the new shield, its P/N is 342-0513-01. It is recommended that the shield only be replaced when it is necessary to troubleshoot the memory board on the extenders.

--John Eaton
53/108, Ext. 8689 (MR)

7000 SERIES

7854, ROM BOARD

Reference: 7854 Instruction Manual P/N 070-2874-01

29 Read Only Memory

In the manual schematics and the electrical parts list, one gets the impression that U300 and U310 should be in the instrument. At the present time this is not true as these two I.C.'s are used as "patches" along with U400 and U410. Until such time as U300 and U310 are needed, only U400 and U410 will be installed. The absence of U300 and U310 do not effect overall operation of the instrument.

--John Eaton
58/511, Ext. 1237



COMMUNICATIONS DIVISION

MEDICAL

VITATEK SUPPORT

Effective July 15, 1981, Vitatek will provide technical support (instead of Factory Service) for all PPM's (except 410). Please direct your inquiries to Vitatek 800-547-8805 and ask for Steve Schmelzer, Ext. 209.

--Todd Paulus
53/108, Ext. 8685

SPECTRUM ANALYZERS

492/492P SERVICE MANUAL VOLUME #2--MANUAL CHANGE INFORMATION TO OFFSET MIXER
AREA (REPRINT)

Due to a bad copy some of the first page of this article in the June 5, 1981 edition did not print well. I am repeating the first part for your use. The spacing is the same so you can cut this out and paste over the top of the previous article. Sorry for the inconvenience.

Reference: Corporate Mod #M41234 & M42109
492/492P Service Manual #2, P/N 070-2852-02

492 EFF SN B010740-up
492P EFF SN B011036-up

REFPLACEABLE ELECTRICAL PARTS AND SCHEMATIC DIAGRAM CHANGES

CHANGE TO:

A50A2	670-5520-01	CKT BOARD ASSY: STROBE DRIVER
A50A2C1032	-----	SELECTED
A50A2C2105	-----	SELECTED

The above parts are located on the A50A2 STROBE DRIVER circuit board assembly and shown on the CONTROLLED OSCILLATOR, OFFSET MIXER & STROBE DRIVER diagram 42.

CHANGE TO:

A50A3	670-5522-01	CKT BOARD ASSY: OFFSET MIXER
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--Editor



SERVICE INSTRUMENT DIVISION

ACCESSORIES

AM503 SWITCH CONTACTS

Reference: M42786
AM503 Manual P/N 070-2052-01
S-200 A & B M.P.L. #99

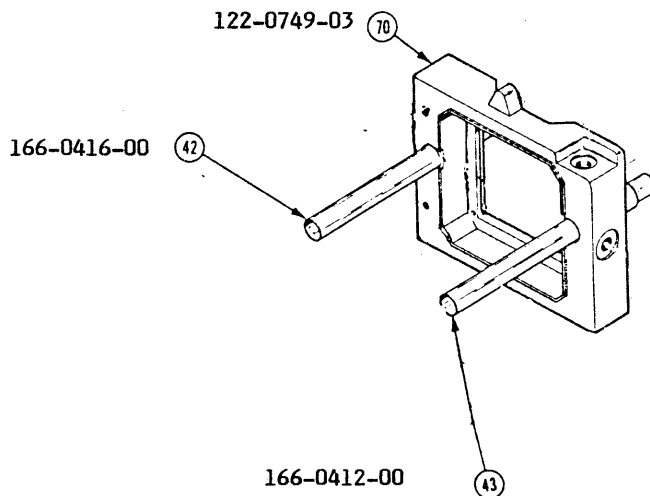
The Cam Switch Contact Assembly, P/N 131-1030-00, has been changed to P/N 131-1030-01 to help resolve the contact closure problems. When replacing contacts, all 13 should now be the "01's".

--Eilene Dickey
53/108, Ext. 8692

C-30B & C-31B REAR FRAME ASSEMBLY

Because of the difficulty in replacing P/N 122-0749-03 (rear frame), P/N 166-0412-00 and P/N 166-0416 (guide tubes) in the field, it is recommended that the assembly (P/N 426-0570-01) be used to replace any of the individual parts. This assembly is not listed in the manuals, but is currently available. A manual correction has been submitted.

Thanks to Steve Turner of Tek Australia for his input.



--Eilene Dickey
53/108, Ext. 8692

C-51 & C-53 CURRENT SURGE MODIFICATION

Reference: M42782

C-50 Series Manual, P/N 070-1011-03

C-51 cameras above B094628 and C53's above B095609 have C-92 100uf (290-0215-00) removed from the shutter control board (P/N 670-1135-00). This was done to stop excessive current drains at turn-on, that caused erasure of stored waveforms on the 7000 Series storage scopes. C-51 and C-53 cameras known to be used with 7000 Series storage should have C-92 removed.

--Eilene Dickey
53/108, Ext. 8692

P6042 - P/N 156-0014-00 (M-18) REPLACEMENTS

Because of the temporary unavailability of P/N 156-0014-00, all P6042 current probes that are suspected of having M-18 failures should be returned to Beaverton Factory Service for repair. Product Life Support has a very limited amount of parts, which will be released only to Factory Service.

Probes needing other repairs or calibration should continue to be done at the local level. A new replacement part is about 5 to 6 months away. After it becomes available, all repair will revert back to the local level.

--Eilene Dickey
53/108, Ext. 8692

P6120 SERVICE MAINTENANCE INFORMATION

Description: P6120 is a miniature 10X, DC to 60MHz Modular Probe (previously designated as non-repairable). The P6120 probe package and the new IC Grabber Tip, P/N 013-0191-00, will be standard accessories with the 2213/2215 Series Oscilloscopes. It can be compensated for other Tektronix scopes but may limit bandwidth.

Attenuation 10X \pm 2%
Compensation 23pf - 51pf
Input R/C 10M Ω /14pf
Risetime <5.9ns.
Cable Length 1.5 meters (4.9ft.)

Ordering Information:

Probe Only 010-6120-00
Probe Package 101-6120-01
Optional Tip 013-0191-00
(IC Grabber)

Replacement Parts:

Probe Head 206-0253-00
Probe Cable 175-3217-00
Compensator Box 206-0274-00

Standard Accessories:

1 - Instruction Sheet 070-3392-00
1 - Pouch, Accessory 016-0521-00
1 - Tip, Retractable 013-0107-04
1 - Sleeve, Insulating 166-0404-01
2 - Band, Markers 334-2794-02
(silver/gray)
1 - Ground Lead, 25cm 195-0950-00

Warranty:

The standard version Warranty #2 applies.

SQI Information:

P6120 does not qualify for Maintenance Agreements and is not on Probe Exchange. Customers should be encouraged to perform their own module replacement. However, if a customer sends his P6120 to the Service Center for repair, he shall incur a minimum of 0.25 hours labor charge plus the NPR cost of the replacement module. P6120 can be serviced at all domestic and international Tektronix Service Centers.

--Eilene Dickey
53/108, Ext. 8692

P6201 PERFORMANCE IMPROVEMENT

Reference: P6201 Manual P/N 070-1306-00

P6210's are recommended for return to Beaverton for repair. But for information, the following changes have been made to ensure performance specifications remain intact.

BELOW B060000

C3, 2.5pF (283-0310-00)
X10 Probe Head CRT Board
(670-2211-01)
- - - - -
Q300 & 320 (151-0475-00)
Hi Frequency Output Amp Board
(670-2296-00)
C220 7-45pF (281-0158-00)
Low Frequency Output Board
(670-2297-00)
Remove R100 and Change R120
(307-0240-00)
Probe Circuit Board
(670-2210-00)

Changed To

Changed To

Add

Changed To

Changed To

Changed To

Changed To

To

Changed To

ABOVE B060000

4.7pF, (283-0311-00)

(02)

C302, 1pF, (283-0320-00)

(151-0475-01) 100% Screened

(01)

(281-0158-01)

(01)

27 ohm (307-0514-00)

(01)

See schematic for location for changes.

--Eilene Dickey
53-108, Ext. 8692

SCHEMATIC TO COMPLETE ARTICLE IS ON THE FOLLOWING PAGE.

HI FREQ. OUTPUT AMPL.
670-2296-01.



Electrical components shown on the diagrams are in the following units unless noted otherwise:

Capacitors =	Values one or greater are in picofarads (pF). Values less than one are in microfarads (μF).
Resistors =	Ohms (Ω)

P6201 PROBE

REV. C, FEB 1978

283-0311-00 (4.7pF)

June 19, 1981
Issue 11-11

COMMUNICATION DIVISION

834 USED TO SERVICE OTHER DATA COMMUNICATION TESTERS

Reference: 834 Operator's Manual, Part Number 070-3400-01
834 Instruction Manual, Part Number 070-3399-00

Designated Service Centers have received 834s for use in servicing other Data Communication Testers. Some questions have come up concerning the "how-to" of this type of application. There is now a new edition of the Operator's Manual (Part Number 070-3400-01) which has expanded explanations of this use for the 834.

Valuable simulation descriptions are also available in the Instruction Manual (Part Number 070-3399-00).

Both of these books are on microfiche.

--Stan Uffner
92-236, Ext. 1564

851 - THRESHOLD SWITCHES HAVING REVERSED CONTACTS

Reference: 851 Switch R164 A,B (S164), Part Number 311-1941-00

851 Instruction Manual, Part Number 070-2192-01, Pullout 6

The vendor for the threshold switch, Part Number 311-1941-00, found it necessary to invert the switch's body. All electrical functions remained the same, but there were some alterations made to the pin configuration which will affect the wiring. However, the part number remained the same for both versions.

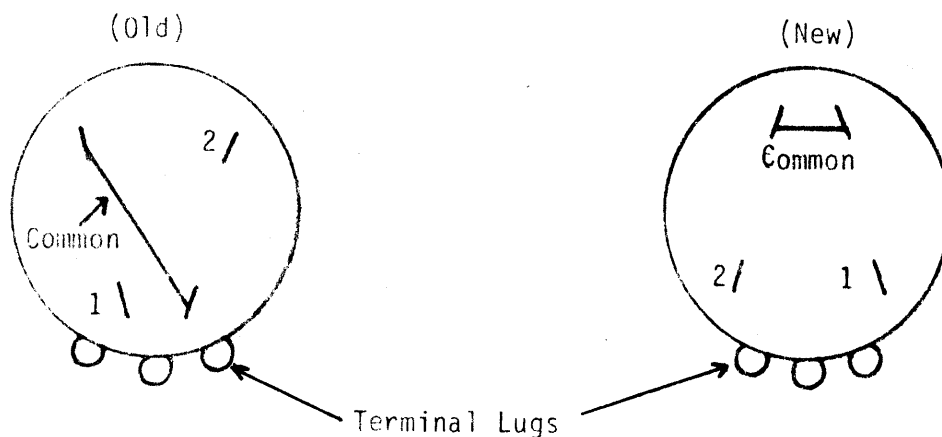
This change was effective in LOT Dates 79XX and later.

The following diagrams will illustrate the differences between these two pin configurations.

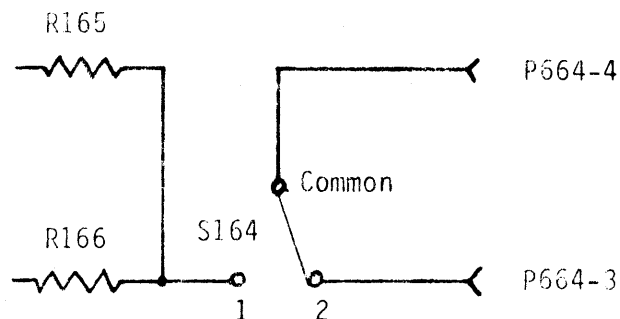
If you have any questions, please call.

311-1941-00

Bottom View

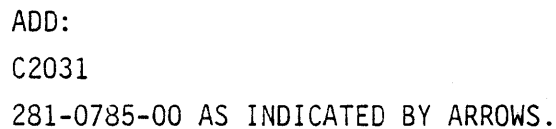


6



--Pat Wolfram
92-236, Ext. 1582

The diagrams below show the schematic change and part locations.



PORTABLES

2213, 2215 FAILURE OR PROBLEM INFORMATION

Due to the high volume of products shipped per week, it is especially important that Service provides immediate feedback to Manufacturing on any failures, problems, concerns or customer complaints on the new 2200 Series scopes. Please send the information to Mike Laurens or myself via Service Action Request (SAR), speedmail, telex or phone as appropriate for each occurrence. Any information you can provide will be greatly appreciated.

--Roy Lindley
53/108, Ext. 8687

2213, 2215 MAINTENANCE INFORMATION

The 2213 is a dual trace oscilloscope with a delayed mono time base. The 2215 is also a dual trace oscilloscope with a delayed, alternate dual time base.

Vertical channel sensitivity ranges from 2mV/div to 10V/div. Both scopes have a DC to 60 MHz bandwidth with main time base sweep ranges from 0.5 sec/div to 50 nsec/div. A variable magnifier (1X to 10X) will extend the maximum sweep rate to 5 nsec/div. The 2215 "B" sweeps at a rate of 50 msec/div to 50 nsec/div.

Carrying weight with panel cover, pouch, and accessories is 16.8 lbs.

The following are normal operation modes:

- 1) Upon initial turn-on of the instrument, the trace will have a bright dot at the start of the sweep, even with the intensity control fully off. The auto intensity causes this dot. After a period of warm-up (about 20 minutes) this dot will disappear. This is normal operation.
- 2) The trace shift caused by rotating the variable Volts/div Control, can be up to 2.5 divisions.
- 3) The trace shift caused by rotating the attenuator position can be up to 1.0 divisions.

The following are troubleshooting hints:

1) Fuse Blown - Main Power

Check FET Q938. This part is very static sensitive.

Check Zener VR 938. If this 45v zener is shorted there could also be other problems in the primary side of the power supply. VR938 is used for over voltage protection.

2) Power Supplies Low

Check VR938 for 45v, if the reading is about 20v, then there could be a loading problem on the secondary side.

3) Full Intensity - No Control

Check DC restorer diodes, CR867 and CR868. This circuit uses 152-0242-00 diodes.

(CONTINUED)

2213, 2215 MAINTENANCE INFORMATION (CONTINUED)

4) Vertical Trace-Off Screen

Check the ground wire soldered to the case of R148 and R248 (Var/volts). The wire is located on the back of the pot.

5) 100 HZ Roll Off

Check R139 or R239 from pin 2 to pin 4 with an ohm meter (out of circuit). This measurement should be 5.00K Ω .

6) HF Roll Off

Check the vertical leads to the CRT for good electrical connection.
Check C175 and C185 or C275 and C285.

7) Poor Bandwidth on Both Channels

Check Q331, 341.

8) Poor Trigger Sensitivity

Check TP444 for 0vdc reference with at least a 30mv/div trigger signal.
Check VR483 for 5.0V. Voltages greater than 5.1v will reduce trigger sensitivity.

9) 5NS Sweep Non-Linear

Check for corrosion on CRT pins.

10) Long or Short Sweep Lengths

Check Q630 A/B (A sweep) or Q680 A/B (B sweep).

11) Auto Intensity Dims When Reducing Sweep Speeds

Check adjustment on grid bias (be sure to use a 50 Ω termination on the external Z-Axis in).

1) Troubleshooting the P-P Auto Trigger

U507 should have 0vdc at pin 1 and 7 with no signal applied. In normal trigger Pin 1 should read +.6v and pin 7 should read -.6v.

2) Troubleshooting U145 and U245, Vertical Preamp

If the trace is locked off screen, short pin 9 (U145 or U245) to ground. This should center the trace if the problem is before the device. By pulling P1010 or P2010 and adding a 2.49K Ω resistor between pin 1 and pin 2, and between pin 3 and pin 4 (on P1010 or P2010), this will simulate the hybrid and the vertical should now center. Pin 1 on the device should also read 0V.

--Mike Laurens
53/108, Ext. 8688

TYPOGRAPHICAL ERROR - 4016/GMA125 CRT RETURNS

Your editor apologizes for the typographical error in this article in the June 5, 1981 edition. The last line in the first paragraph should read "CRT faceplate packed pointing down".

--Sharon Huetson
Editor

634: YOKE DRIVER BOARD MODIFICATION #36631

A number of changes have been made to the 634 yoke driver boards to improve reliability and performance. The new part numbers of the boards are 670-5594-03 for the standard product and 670-6122-02 for the 634 Option 15.

To improve geometry, an ORTHOGONALITY adjustment is added to both boards. However, the values of the added components differ between the two boards. Refer to Figure 1 for the values of the new parts. Those values in parentheses are for the Option 15 board. The new ORTHO control is best adjusted after step D5.h of the manual calibration procedure; that is, after the horizontal linearity adjustment.

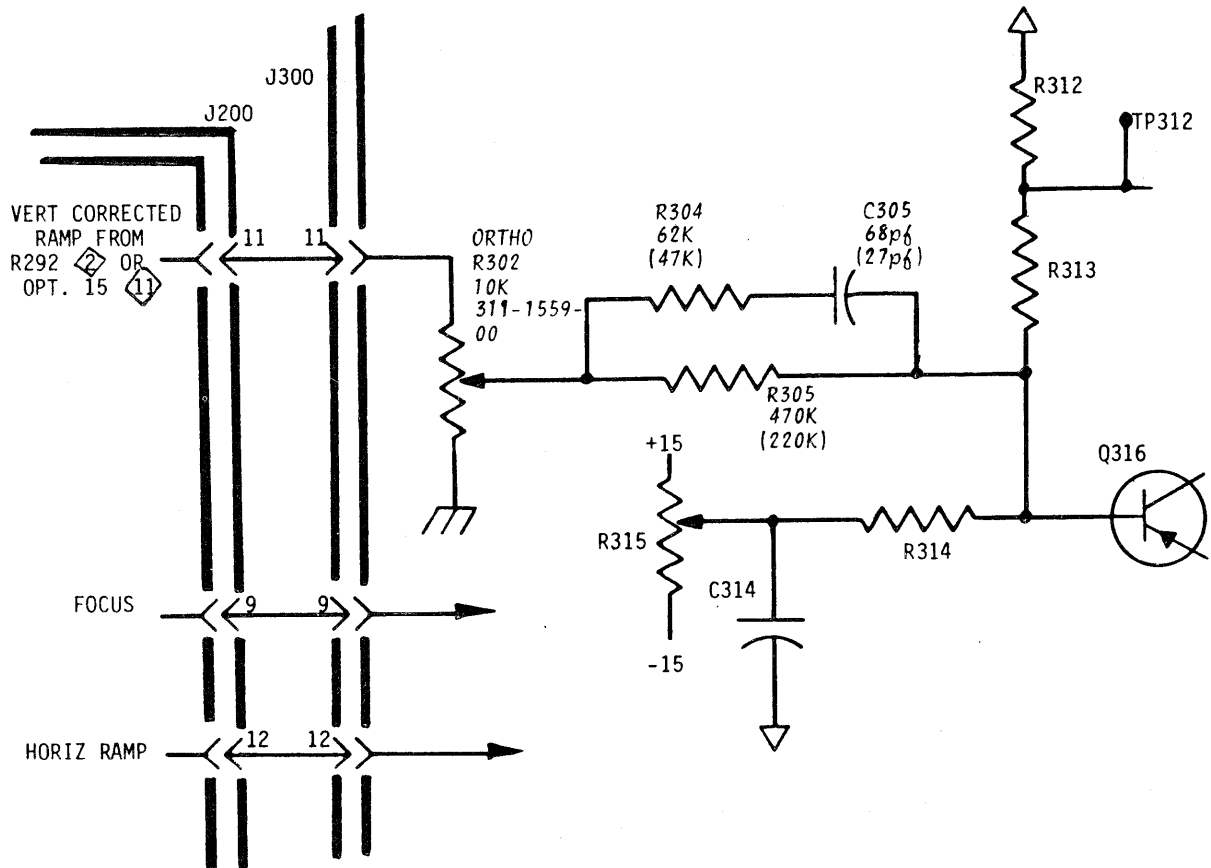


FIGURE 1'

The new standard yoke driver board includes the filtering components C303, C304, L303, and L304 needed for the Option 20 product. As a result, the 670-7004-00 will no longer be produced.

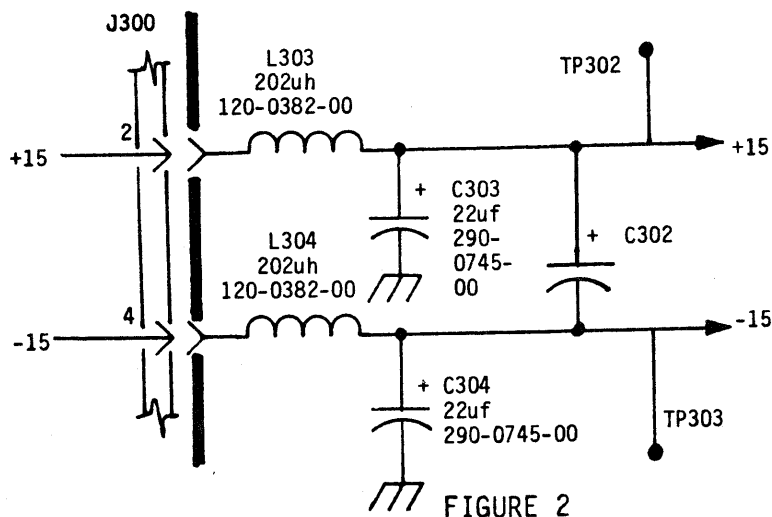


FIGURE 2

Several other changes are made to the standard yoke driver board. Resistor R380 is reduced in value and R386 is increased (see Table I). These values are changed to prevent an overcurrent condition. Resistor R352 is changed to an Allen-Bradley type component to prevent board damage in the event of an overcurrent failure. Capacitor C324 is changed from P.N. 283-0204-00 to 283-0003-00 to provide commonality between the standard and Option 15 boards. The damping network previously used on the Option 15 is now added to the standard board (see Figure 3).

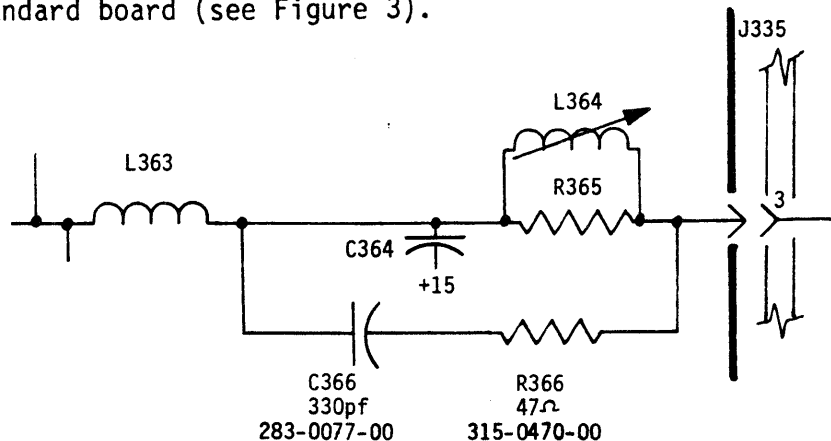


FIGURE 3

On the Option 15 board, the values of R380 and R386 have changed as described above (see Table II). In addition, the value of R357 has been changed from 680 ohm to 1.2K ohm. This has been done to increase the range of the horizontal position control.

Both boards receive a new circuit pattern layout. As a result, it is not recommended that earlier yoke driver boards be upgraded to the 670-5594-03 or the 670-6122-02. This article is for your information only.

634: YOKE DRIVER BOARD MODIFICATION #36631 (CONTINUED)

TABLE I

Changes to Standard Yoke Driver Board

<u>Circuit No.</u>	<u>Old Value</u>	<u>New Value</u>	<u>New Part Number</u>
C303		22 μ F, 25V	290-0745-00
C304		22 μ F, 25V	290-0745-00
C305		68pF, 100V	281-0785-00
C324	.01 μ F, 50V	.01 μ F, 150V	283-0003-00
C366		300pF, 500V	283-0077-00
L303		202 μ H	120-0382-00
L304		202 μ H	120-0382-00
R302		10K Ω	311-1559-00
R304		62K Ω	315-0623-00
R305		470K Ω	315-0474-00
R352	12 Ω	12 Ω	315-0120-01
R366		47 Ω	315-0470-00
R380	2.4K Ω	2.0K Ω	315-0202-00
R386	10 Ω	100 Ω	315-0101-00

TABLE II

Changes to Option 15 Yoke Driver Board

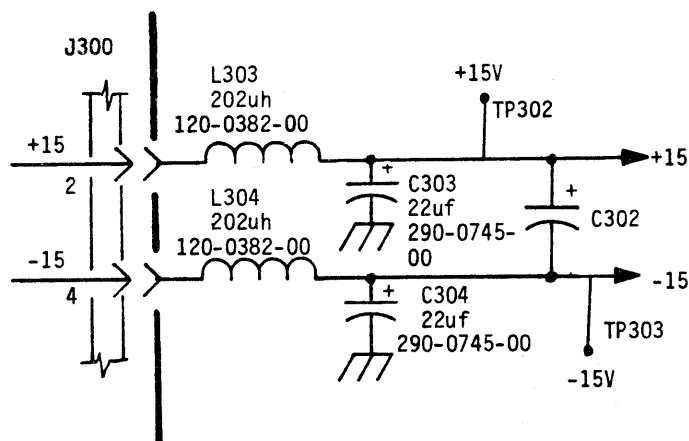
<u>Circuit No.</u>	<u>Old Value</u>	<u>New Value</u>	<u>New Part Number</u>
C305		27pF, 100V	281-0762-00
R302		10K Ω	311-1559-00
R304		47K Ω	315-0473-00
R305		220K Ω	315-0224-00
R357	680 Ω	1.2K Ω	315-0122-00
R380	2.4K Ω	2.0K Ω	315-0202-00
R386	10 Ω	100 Ω	315-0101-00

--George Kusiowski
63/503; ext 3928

634 YOKE DRIVER BOARD MODIFICATION 39769

The 634 Option 20 was known to transmit noise and horizontal line rate interference down the customers' power supply lines. To correct this, filtering was necessary on the +15V and -15V supply inputs.

Modification 39769 solved the problem by establishing the 670-7004-00 yoke driver circuit board assembly. This board is identical to the standard 670-5594-02 except that line filtering is effected by the addition of two toroidal coils and two electrolytic capacitors.



This modification has been superseded by corporate modification #36631 (written up elsewhere in this issue). This article is for your information, only.

--George Kusiowski
63-503, ext. 3928 (WI)

4052, 4051, AND 4006-1 DISPLAY BOARD, MOD #M37210

Two variable resistors, R496 and R385, have been added to 672-0537-09 and 672-0546-09 Display Boards. (Circuitry for 672-0537-09 and 672-0546-09 boards are the same.) These added resistors allow for adjustments to be made to U485 to compensate for undesired operation characteristics. The new part number for these boards are 672-0537-10 and 672-0546-10. The locations of these adjustments are illustrated in Figure 1. Schematic changes are illustrated in Figure 2.

The procedure for adjusting R496 and R385 is as follows:

R496 Adjustment Procedure:

1. Set scope to .5 volts per division.
2. Connect scope probe to pin 15 of U485.
3. While the curser is in the home position, adjust R496 so that pin 15 of U485 is at 0 volts per division.

R385 Adjustment Procedure:

1. Load the following program in by keyboard or tape.

```
100 Del ALL
110 Page
120 Move 0,0
130 Draw 130,0
140 Draw 130,100
150 Draw 0,100
160 Draw 0,0
170 Move 65,0
180 Draw 65,100
190 Move 0,50
200 Draw 130,50
210 Go to 120
```

2. Now type in RUN; you should see a rectangle divided into four equal, smaller rectangles displayed on your 4051 or 4052.
3. Adjust R385 until the rectangles corners are at right angles.

--Darrell McGiverin
63/503, ext. 3786 (WI)

(SCHEMATIC TO COMPLETE ARTICLE IS ON THE FOLLOWING PAGE.)

4052, 4051, AND 4006-1 DISPLAY BOARD, MOD #M37210





4054 OPTION 30 SCRATCH PAD RAM

There has been a problem with the 4054 when Option 30 is installed. The most common symptom is the 4054 will "hang up" on power-up or after operating for a period of time. The problem may be on the Option 30 board in the Scratch Pad RAM. The component location for the Scratch Pad RAM is U230 and U430 on the Option 30 (670-6201-01). The Texas Instrument RAM (Tek part number 156-1189-00) used on the Option 30 board for the 4054 has had problems meeting specification. We have purged all stock of the Texas Instrument RAM (156-1189-00) and replaced them with AMD RAM. The part number for the AMD RAM is the same as the Texas Instrument RAM, 156-1189-00. All Option 30 boards (670-6201-01) being returned to Factory Service that have the Texas Instrument RAM are being replaced with AMD RAMs.

If any of the above symptoms or other random failures are encountered with a 4054 Option 30, it is recommended to check U230 and U430 of Option 30 for Texas Instrument RAMs. If any one or both of these two locations do have Texas Instrument RAMs, please change them with AMD RAMs or replace the Option 30 board with an Option 30 that has AMD RAM.

--Darrell McGiverin
63/503, ext. 3786 (WI)

4054 VECTOR GENERATOR MODIFICATION #40319

The early level Vector Generator Board 670-5667-01 had a problem with centering the Y-axis. The variable resistor R715 had insufficient range. The correction for the insufficient range was to replace R715 311-1245-00 (Variable Resistor, 10K) with a 311-1198-00 (Variable Resistor, 20K). Also R716 315-0623-00 (Fixed Resistor, 62K) was replaced with a 315-0563-00 (Fixed Resistor 56K). Mod #M40379 rolled the Vector Generator Board 670-5667-01 to 670-5667-02.

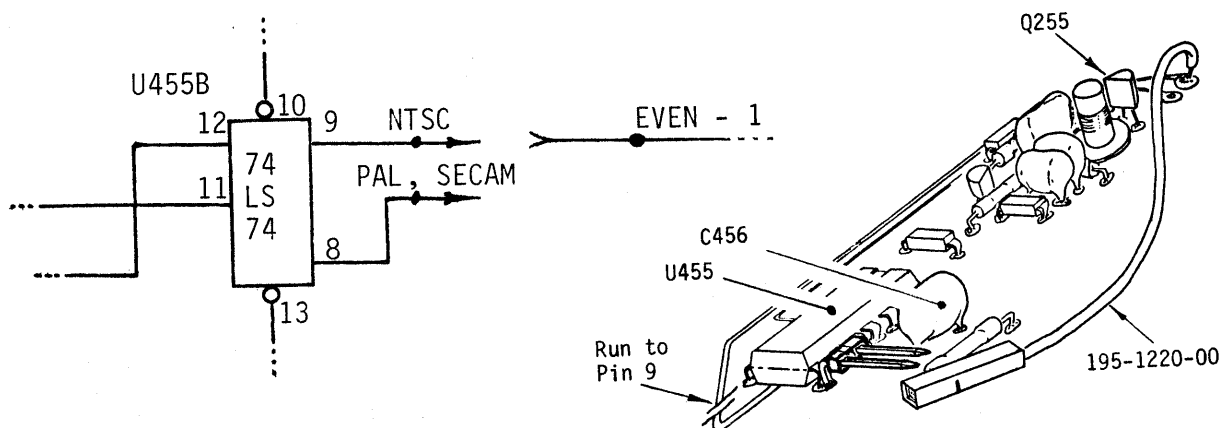
--Darrell McGiverin
63-503 EXT. 3786

4612: PILOT CHANGE TO SUIT PAL AND SECAM VIDEO

Early 4612 hardcopiers have produced garbled copies when interfaced with PAL or SECAM video sources. This occurs because some European video systems confuse the odd-even line decoder in the 4612.

To accomodate either set of standards, the following modification may be made to the video interface board:

- Cut the run leading to U455 pin 9 close to the body of the I.C.
- Solder two pins of a right-angle 36 square pin connector (P/N 131-1426-00) onto pins 8 and 9 of U455. If necessary, reposition C456 to accomodate the pins.
- Solder a one-connector jumper (P/N 195-1220-00) onto the severed run at the through hole above Q255.
- Position the jumper on pin 9 for an NTSC system or pin 8 for a PAL or SECAM system.



Installation of this modification rolls the level of the 670-6297-01 video interface board to -02. This mod should be installed whenever an early 4612 is interfaced with a PAL or SECAM source.

--George Kusiowski
63/503, ext. 3928 (WI)

LABORATORY INSTRUMENT DIVISION

MICROCOMPUTER DEVELOPMENT PRODUCTS (MDP)

8550 MAPPING, WRITE ACCESSES TO PROTECTED MEMORY

The MAP function of the 8550 operating system has the ability to write protect program memory. When the write protect function is invoked, a user's program will be unable to write to the protected memory. The write access to the protected memory will also cause a break to occur in program execution. The break may not occur on the write instruction; it may, however, occur several instructions after the write. A break caused by a write to protected program memory will give the following indication.

Address <BREAK MEMWR>

Only program memory can be write protected. User or portotype memory cannot be write protected. In Mode 0 and Mode 1 mapped to program memory a break in program execution will occur when a write to protected memory is attempted. In Mode 1 mapped to user memory and in mode 2 protected memory can be written to and program execution will not be stopped.

We would like to thank Less Aeder for bringing this feature to our attention.

--Kevin King, Brad Griffin
92-236, Ext. 1636, 1608

SEMICONDUCTOR TEST SYSTEMS

S-3200: SOFTWARE, EH1501 INTERFACE ADDRESSES

Reference: Software Change Notices 840 Through 844

The following software programs were written with 'SETBUS' commands. Problems arise when the EH1501 interface is placed in a location different from that called for by the SETBUS.

The GETADR subroutine was added so that the SETBUS will function correctly, regardless of the interface address. GETADR retrieves the interface address from the EH1501 driver subroutine EH1501.FNC.

SCN#840, EHRLY1.EDT:LIB, 3260	NEW VERSION V01.01, 3260
SCN#841, EHRLY2.EDT:LIB, 3260	NEW VERSION V01.01, 3260
SCN#842, EHCAL1.EDT:RCL, 3260	OLD VERSION V02.20 NEW VERSION V02.21, 3260
SCN#843, EHCAL2.EDT:RCL, 3260	OLD VERSION V02.20 NEW VERSION V02.21, 3260
SCN#844, EHGEN.EDT:VDT, 3260	OLD VERSION 3260 V02.30 NEW VERSION V02.31, 3260

Information, originator: Mike Deal, Production Engineering.

--Ron Lang
92-236, Ext. 1015

S-3200: SOFTWARE, GPIB.EDT:VDT (SCN#837)

Reference: Software Change Notice #837
OLD VERSION V02.30, NEW VERSION V02.31

Problem 1: F296 has one failure intermittently with Version 4.00 Operating System. This was caused by the faster execution time of floating point conversions.

Solution 1: A 100 μ s wait was added after a SETBUS to the A side of the interface. This corresponds to a hardware time out while the IFC bit is asserted.

Problem 2: F296 would not indicate any totalized errors if no print was selected, even if the interface was not installed in the system.

Solution 2: The print routine was changed to increment TOTERR for every error, whether printing or not.

All customer and field software should be updated with this software change.

Information, originator: Tom Blackerby, Production Engineering.

--Ron Lang
92-236, Ext. 1015

S-3200 SOFTWARE, REDUCE.RUN(SCN#845),LOG.RUN(SCN#846)

Changes in versions V03.01 and V03.02 were not included in Version X04.00.

New Version V04.01 have added codes to FILES.MAC and ALOCAT.MAC to include all features of versions prior to X04.00.

Software Change Notice #845

REDUCE.RUN	OLD VERSION X04.00, NEW VERSION V04.01
REDUC0.OVR	OLD VERSION X04.00, NEW VERSION V04.01
REDUC1.OVR	OLD VERSION X04.00, NEW VERSION V04.01
REDUC2.OVR	OLD VERSION X04.00, NEW VERSION V04.01

Software Change Notice #846

LOG.RUN:SYS	OLD VERSION X04.00, NEW VERSION V04.01
LOGOV.OVR:SYS	OLD VERSION X04.00, NEW VERSION V04.01

Field Specialists should check updated disks for latest versions of the above software programs. All requests for software updates should be directed to Liz Nutter; STS Software/Documentation Support, 94-512.

Information, originator: Tom Blackerby; Production Engineering.

--Ron Lang
92-236, Ext. 1015

S-3200 SERIES: MC-3 SELECTABLE RESISTORS

When changing the MC-3 Card Nest card (current voltage monitor), check the value of the power supply selectable resistors. There is a correct value for each Power Supply. If not used, current sensing will not be correct. Refer to the Option Master for the 3200 LSI.

Also, note in the Option Master Manual, Section MC-3/1140A #2, Table A3, Power Supply Option No. PS-2 on VS8 the correct Power Supply value is 100V at .125A, not 40V at .5A. The correct resistor value is 800m ohms, not 200m ohms. Tektronix part numbers for the selectable resistors can be found in Table A4.

Written by--
Greg Richardson

Submitted by--
Jim Stubbs
92-236, Ext. 1287

S-3200: 2943 CLOCK LINE MOD NO. M39965

The signal at the output of U61 Pin 2 on the cycle length board is received distorted by loads along the signal path. High speed signals need to be terminated at the end of the signal path or the remaining line will cause reflections and/or distortions. This mod eliminates the problem by putting two drivers in parallel from U61 giving the clock output more drive, which reduces distortion from overloading. The mod also changes the termination location on the output of U61. The above changes more closely match termination impedance to microstrip characteristic impedance and slightly raises the termination voltage.

The above changes are on the cycle length circuit board assembly, 670-5383-02. The part number changes to 670-5383-04 subpart of the 2943. If your 2943 requires this mod order Part Number 040-0973-00. This kit includes installation instructions, parts and placement diagrams.

Written by--
Greg Richardson

Submitted by--
Jim Stubbs
92-236, Ext. 1287

S-3200 2943 CYCLE LENGTH M#42466

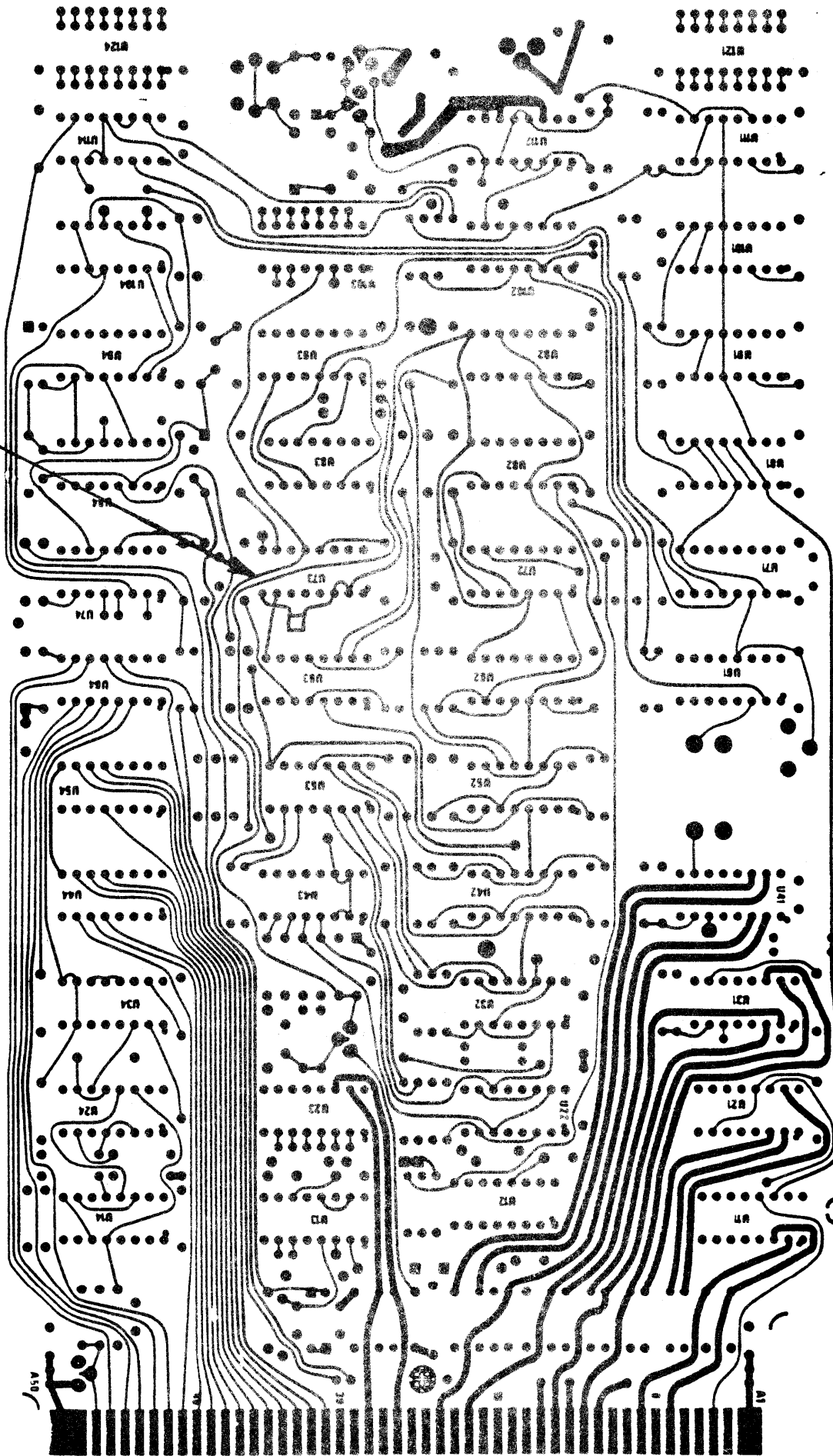
Cycle length counter bits may toggle prematurely due to a negative glitch in the "Inhibit" signal. This premature count may cause cycle length errors. The signal is enhanced by adding a 51pf, 5% 200V capacitor (283-0107-00). Component designation will be C173. Connect C173 from U73 pin 3 to pin 8. The leads of the capacitor should be insulated with sleeving (162-0581-00). Add the capacitor on the back of the board as shown in the diagram. The assembly number of the cycle length card will change from 670-5383-03 to 670-5383-04.

--Jim Stubbs
92-236, Ext. 1287

·(SCHEMATIC TO COMPLETE THE ARTICLE IS ON THE FOLLOWING PAGE.)

ADD C173 51PF 5% 200V

283-0107-00 FROM U73 PIN 3 TO 8.



S-3200: 2942, DATA GENERATOR CIRCUIT BOARD (MECHANICAL)

Replacement of nylon screws (211-0685-00) with metal screw assemblies (211-0180-00). This change will secure the Data Generator Modules' 670-3922-08 and 670-3922-09, preventing the possibility of shorting against the Address Boards in the 2942 Pattern Generator.

Remove:

211-0685-00 screw, mach. 2-56x0.312, RH nylon, black

4 each	from	670-3922-08
8 each	from	670-3922-09

Add:

211-0180-00 screw, assy. washer, 2-56x0.250, double sems, POZ

4 each	to	670-3922-08
8 each	to	670-3922-09

--Ron Lang
92-236, Ext. 1015

SIGNAL PROCESSING SYSTEM

CP115 WIRING ERROR

Some CP115's in the field may have a wiring error. The black wire and the white wire are interchanged at the line filter on the IEC connector. Inspect any CP115 in any SPS system on your next service call. The wiring must conform to the drawings S/2151-1, S/2153-X, and AS/2137 in the CP115 Instruction Manual, 070-2432-00. Please let me know when any are found and corrected and what the Data System Design Serial Number is.

Our thanks to Mike Tranchemontagne, Boston, for bringing this to our attention.

--Dean Hager
92-236, Ext. 1284

BEAVERTON SERVICE SUPPORT
PRODUCT RESPONSIBILITY LIST

D/S 53-108

PRODUCT	DESCRIPTION	Technical Questions Repair/Troubleshoot PAE	Service Plans Business SPS
MAJOR BUSINESS UNITS:			
	Television	Bill Bean	Roger Ring
	FDI	Rich Kuhns	Rich Andrusco
	Portables/T900	Mike Laurens	Roy Lindley
	5000 Series	John Eaton	Dick Freshour
	7000 Series	Lynn Sperley	Dick Freshour
	Accessories	Eilene Dickey	Roy Lindley
	Metrology	---	Tom Fox
	Operations & Int'l. Coordinator	---	Roy Lindley
<hr/>			
A6701	Word Recognizer	Eilene Dickey	Roy Lindley
AM503	Current Probe Amplifier	Eilene Dickey	Roy Lindley
AM511	CATV Preamplifier	Factory Service	Roger Ring
AN/USM-281C	Ruggedized Oscilloscope	Lynn Sperley	Dick Freshour
C-28	Oscilloscope Camera	Eilene Dickey	Roy Lindley
C-30 Series	Oscilloscope Camera	Eilene Dickey	Roy Lindley
C-50 Series	Oscilloscope Camera	Eilene Dickey	Roy Lindley
C-5C	Oscilloscope Camera	Eilene Dickey	Roy Lindley
CT-1,2,3,5	Current Transformer	Eilene Dickey	Roy Lindley
DM40, DM43	Digital Multimeter	Factory Service	Roy Lindley
DM44	Digital Multimeter	Mike Laurens	Roy Lindley
J16	Digital Photometer	Eilene Dickey	Roy Lindley
J65XX	J16 Probe	Eilene Dickey	Roy Lindley
<hr/>			
L1,L2,L3	Spectrum Analyzer Plug-In	Rich Kuhns	Rich Andrusco
M1	Multi-Function Module	Factory Service	Dick Freshour
M2	Sample/Hold Module	Lynn Sperley	Dick Freshour
M3	RMS Volts Module	Factory Service	Dick Freshour
P6XXX	Probe	Eilene Dickey	Roy Lindley
Scope Cart	Model 3, Model 200 Series	Eilene Dickey	Roy Lindley
SPG 1,2	1410 Module	Bill Bean	Roger Ring
SW503	Sweep Generator	Factory Service	Rich Andrusco
TDC, TDC1, TDC2	Television Down Converter	Rich Kuhns	Roger Ring

PRODUCT	DESCRIPTION	PAE	SPS
TR501	Tracking Generator	Factory Service	Rich Andrusco
TR502	Tracking Generator	Rich Kuhns	Rich Andrusco
TR503	Tracking Generator	Rich Kuhns	Rich Andrusco
TSG 1,2,3,5,6	1410 Module	Bill Bean	Roger Ring
TSP 1	1410 Module	Bill Bean	Roger Ring
T912,T921, T922, T922R	Oscilloscope	Factory Service	Roy Lindley
T932A, T935A			
5A13N	Differ, Comparator Analyzer	John Eaton	Dick Freshour
5A14N	1 MHz Four-Trace Amplifier	John Eaton	Dick Freshour
5A15N	2 MHz Amplifier	John Eaton	Dick Freshour
5A18N	2 MHz Dual Trace Amp.	John Eaton	Dick Freshour
5A19N	Differential Amplifier	John Eaton	Dick Freshour
5A20N	Differential Amplifier	Factory Service	Dick Freshour
5A21N	Dif.Amp/Current Probe Input	John Eaton	Dick Freshour
5A22N	Differential Amplifier	John Eaton	Dick Freshour
5A23N	1.5 MHz Amplifier	Factory Service	Dick Freshour
5A24N	Single Trace Amplifier	John Eaton	Dick Freshour
5A26	Dual Differential Amp.	John Eaton	Dick Freshour
5A38	Dual Trace Amplifier	John Eaton	Dick Freshour
5A45	60 MHz Amplifier	John Eaton	Dick Freshour
5A48	Dual Trace Amplifier	John Eaton	Dick Freshour
5B10N, 5B12N	Dual Delayed Time Base	John Eaton	Dick Freshour
5B13N	Time Base	Factory Service	Dick Freshour
5B25N	Time Base	John Eaton	Dick Freshour
5B31	Digital Delayed Time Base	Factory Service	Dick Freshour
5B40	Time Base	John Eaton	Dick Freshour
5B42	Delaying Time Base	John Eaton	Dick Freshour
5B44	Dual Time Base	Factory Service	Dick Freshour
5CT1N	Curve Tracer	Factory Service	Gary Ellsworth
5L4N	Spectrum Analyzer	Factory Service	Rich Andrusco
7A11	Single Trace Amplifier	Lynn Sperley	Dick Freshour
7A12	Dual Trace Amplifier	Factory Service	Dick Freshour
7A13	Differ.Comparator Amplifier	Lynn Sperley	Dick Freshour
7A14	Current Probe Amplifier	Factory Service	Dick Freshour
7A15, 7A15N	Single Trace Amplifier	Factory Service	Dick Freshour
7A15A	Single Trace Amplifier	Lynn Sperley	Dick Freshour

PRODUCT	DESCRIPTION	PAE	SPS
7A15AN Opt 11	Single Trace Amplifier	Lynn Sperley	Dick Freshour
7A16A	Single Trace Amplifier	Lynn Sperley	Dick Freshour
7A17	Single Trace Amplifier	Factory Service	Dick Freshour
7A18	Dual Trace Amplifier	Lynn Sperley	Dick Freshour
7A18N,7A18-950A	Dual Trace Amplifier	Factory Service	Dick Freshour
7A19	Single Trace Amplifier	Lynn Sperley	Dick Freshour
7A21N	Direct Access Unit	Factory Service	Dick Freshour
7A22	Differential Amplifier	Lynn Sperley	Dick Freshour
7A24	Dual Trace Amplifier	Lynn Sperley	Dick Freshour
7A26	Dual Trace Amplifier	Lynn Sperley	Dick Freshour
7A29	Single Trace Amplifier	Lynn Sperley	Dick Freshour
7B10	Time Base	Lynn Sperley	Dick Freshour
7B15	Delaying Time Base	Lynn Sperley	Dick Freshour
7B50	Time Base	Factory Service	Dick Freshour
7B50A	Time Base	Lynn Sperley	Dick Freshour
7B51,52	Time Base	Factory Service	Dick Freshour
7B53A	Dual Time Base	Lynn Sperley	Dick Freshour
7B53AN, 7B53N	Dual Time Base	Factory Service	Dick Freshour
7B70, 7B71	Time Base	Factory Service	Dick Freshour
7B80	Time Base	Lynn Sperley	Dick Freshour
7B85	Delaying Time Base	Lynn Sperley	Dick Freshour
7B87	Time Base	Lynn Sperley	Dick Freshour
7B92	Dual Time Base	Factory Service	Dick Freshour
7B92A	Dual Time Base	Lynn Sperley	Dick Freshour
7CT1N	Curver Tracer	Factory Service	Gary Ellsworth
7D10	Digital Events Delay	Factory Service	Dick Freshour
7D11	Digital Delay	Lynn Sperley	Dick Freshour
7D12	A/D Converter	Lynn Sperley	Dick Freshour
7D13	Digital Multimeter	Factory Service	Dick Freshour
7D13A	Digital Multimeter	Lynn Sperley	Dick Freshour
7D14	Digital Counter	Factory Service	Dick Freshour
7D15	Universal Counter/Timer	Lynn Sperley	Dick Freshour
7L5 to 7L18	Spectrum Analyzer	Rich Kuhns	Rich Andrusco
7M11	Dual Delay Line	Factory Service	Dick Freshour
7M13	Readout Unit	Lynn Sperley	Dick Freshour

PRODUCT	DESCRIPTION	PAE	SPS
140, 141	TV Generator	Factory Service	Roger Ring
144, 145, 146	TV Generator	Factory Service	Roger Ring
147A, 149A	TV Generator	Bill Bean	Roger Ring
305	Oscilloscope	Mike Laurens	Roy Lindley
308	Data Analyzer	Pat Wolfram	Gary Ellsworth
314	Oscilloscope	Mike Laurens	Roy Lindley
321, 321A	Oscilloscope	Factory Service	None
323, 324, 326	Oscilloscope	Factory Service	Roy Lindley
335	Oscilloscope	Mike Laurens	Roy Lindley
432	Oscilloscope	Factory Service	Roy Lindley
434	Oscilloscope	Mike Laurens	Roy Lindley
442	Oscilloscope	Factory Service	Roy Lindley
455	Oscilloscope	Factory Service	Roy Lindley
464	Oscilloscope	Mike Laurens	Roy Lindley
465/R	Oscilloscope	Factory Service	Roy Lindley
465B	Oscilloscope	Mike Laurens	Roy Lindley
465M	Oscilloscope	Mike Laurens	Roy Lindley
466	Oscilloscope	Mike Laurens	Roy Lindley
468	Digital Storage	Mike Laurens	Roy Lindley
475/A	Oscilloscope	Mike Laurens	Roy Lindley
485	Oscilloscope	Mike Laurens	Roy Lindley
491	Spectrum Analyzer	Factory Service	Rich Andrusco
492/P	Spectrum Analyzer	Rich Kuhns	Rich Andrusco
520A	Vectorscope	Factory Service	Roger Ring
524	Television Monitor	Factory Service	Roger Ring
526, 527	Vectorscope	Factory Service	Roger Ring
632	TV Color Monitor	Factory Service	Roger Ring
650A Series	TV Color Monitor	Factory Service	Roger Ring
651A	TV Color Monitor	Factory Service	Roger Ring
653A	TV Color Monitor	Factory Service	Roger Ring

PRODUCT	DESCRIPTION	PAE	SPS
655A	TV Color Monitor	Factory Service	Roger Ring
656A	TV Color Monitor	Factory Service	Roger Ring
1105, 1106	Power Supply	Mike Laurens	Roy Lindley
1401, 1401A	Spectrum Analyzer	Factory Service	Rich Andrusco
1405	Sideband Analyzer	Rich Kuhns	Rich Andrusco
1410,1411,1412	TV Generator	Bill Bean	Roger Ring
1420	Vectorscope	Factory Service	Roger Ring
1450,1450-1,1450-2	Television Demodulator	Bill Bean	Roger Ring
1501	Cable Tester	Factory Service	Rich Andrusco
1502, 1503	Cable Tester	Rich Kuhns	Rich Andrusco
1900	Television Generator	Bill Bean	Roger Ring
1980	Television Measurement Set	Bill Bean	Roger Ring
5030	Oscilloscope	Factory Service	Dick Freshour
5031	Oscilloscope	Factory Service	Dick Freshour
5110, R5110	Single Beam Oscilloscope	John Eaton	Dick Freshour
5111, R5111	Single Beam Storage Oscill.	John Eaton	Dick Freshour
5112, R5112	Dual Beam Oscilloscope	Factory Service	Dick Freshour
5113, R5113	Dual Beam Storage Oscill.	John Eaton	Dick Freshour
5115, R5115	Single Beam Storage Oscill.	John Eaton	Dick Freshour
5223, R5223	Digitizing Oscilloscope	John Eaton	Dick Freshour
5440, R5440	Single Beam Oscilloscope	John Eaton	Dick Freshour
5441, R5441	Var. Persistence Storage Osc.	John Eaton	Dick Freshour
5444, R5444	Dual Beam Oscilloscope	Factory Service	Dick Freshour
7104	1 GHz Real Time Oscill.	Lynn Sperley	Dick Freshour
7313, R7313	Bistable Storage Oscilloscope	Factory Service	Dick Freshour
7403N	Oscilloscope	Factory Service	Dick Freshour
R7403, 708P	Oscilloscope	Factory Service	Dick Freshour
7503,7504,7514	Oscilloscope	Factory Service	Dick Freshour
7603, R7603	Oscilloscope	Lynn Sperley	Dick Freshour
7613, R7613	Var. Persistence Storage Osc.	Lynn Sperley	Dick Freshour
7623, R7623	Transfer Storage Oscilloscope	Factory Service	Dick Freshour
7623A, R7623A	Multimode Storage Osc.	Lynn Sperley	Dick Freshour
7633, 7633A	Multimode Storage Osc.	Lynn Sperley	Dick Freshour

PRODUCT	DESCRIPTION	PAE	SPS
7704	Oscilloscope	Factory Service	Dick Freshour
R7704	Oscilloscope	Lynn Sperley	Dick Freshour
7704A	Oscilloscope	Lynn Sperley	Dick Freshour
7834	Fast Storage Oscilloscope	Lynn Sperley	Dick Freshour
7844, R7844	Dual Beam Oscilloscope	Lynn Sperley	Dick Freshour
7854	Waveform Processing Osc.	John Eaton	Dick Freshour
R7903	Oscilloscope	Lynn Sperley	Dick Freshour
7904	Oscilloscope	Lynn Sperley	Dick Freshour

PRODUCT RESPONSIBILITY LIST FOR WALKER ROAD SERVICE SUPPORT

Includes: S-3000 Series, SPS Products, 8000 Series, TM500, BST,
Logic Analyzers, TM500, 800 Series, Telequipment, Sampling

STS PRODUCTS

<u>Product</u>	<u>Description</u>	Technical Questions	Service Plan
		Repair/Troubleshoot	Business
		<u>Perf. Assur. Eng.</u>	<u>Serv. Prog. Spec.</u>
S-3000	Series Test Systems	STS Staff	Frank Codanti
S-3100	Series Test Systems	STS Staff	Frank Codanti
S-3200	Series Test Systems	Jim Stubbs/Ron Lang	Frank Codanti
S-3455	Test System	Joe Lipska	Frank Codanti

BST PRODUCTS

172	Programmable Test Fixture	Factory Service	Gary Ellsworth
176	High Current Fixture	Factory Service	Gary Ellsworth
177	Standard Test Fixture	Factory Service	Gary Ellsworth
178	Linear IC Test Fixture	Factory Service	Gary Ellsworth
576	Curve Tracer	Factory Service	Gary Ellsworth
577D1	Storage Curve Tracer	Factory Service	Gary Ellsworth
577D2	Nonstorage Curve Tracer	Factory Service	Gary Ellsworth

MICROCOMPUTER DEVELOPMENT PRODUCTS

8001/8002	Microcomputer	Brad Griffin/Kevin King	Vern Johnson
8002A	Development Products		
CT8101	Printer/Terminal	Brad Griffin/Kevin King	Vern Johnson
CT8100	TEK 4023-CRT Terminal	Brad Griffin/Kevin King	Vern Johnson
LP8200	DEC Line Printer	Brad Griffin/Kevin King	Vern Johnson
8301	Microcomputer Development Unit	Brad Griffin/Kevin King	Vern Johnson
8501	Data Management Unit	Brad Griffin/Kevin King	Vern Johnson
CT8500	CRT Terminal	Brad Griffin/Kevin King	Vern Johnson
Microlab	067-0892-OX	Brad Griffin/Kevin King	Vern Johnson
8000	Series Options	Brad Griffin/Kevin King	Vern Johnson

SIGNAL PROCESSING SYSTEMS PRODUCTS

<u>Product</u>	<u>Description</u>	Technical Questions	Service Plan
		Repair/Troubleshoot	Business
		<u>Perf. Assur. Eng.</u>	<u>Serv. Prog. Spec.</u>
P7001	Digitizer	Randy Newton	Dean Hager
P7912	Digitizer	Factory Service	Dean Hager
R7912R	Digitizer	Factory Service	Dean Hager
7612D	Digitizer	Randy Newton	Dean Hager
7912AD	Digitizer	Randy Newton	Dean Hager
7A16P	Programmable Vertical Plug-in	Randy Newton	Dean Hager
7B90P	Programmable Hori- zontal Plug-in	Randy Newton	Dean Hager
CP4165	Controller	Randy Newton	Dean Hager
1350	DDC	Factory Service	Dean Hager
016-0397-00	TV MUX (Custom)	Randy Newton	Dean Hager
021-XXXX-XX	Interfaces	Randy Newton	Dean Hager
CP112	DEC Floppy	Randy Newton	Dean Hager
CP115	Data Systems Floppy	Randy Newton	Dean Hager
WP1000	Series - DPO System	Randy Newton	Dean Hager
WP2000	Series - Transient Digitizer System	Randy Newton	Dean Hager
WP3XXX	Dual Channel Digitizer Systems	Randy Newton	Dean Hager
WP11000AC	Custom Product	Randy Newton	Dean Hager
WP1000AF	Mod Product	Randy Newton	Dean Hager
All previous WPXXX			

LOGIC ANALYZER PRODUCTS

7D01	Logic Analyzer	Factory Service	Gary Ellsworth
7D01-DF1	Logic Analyzer	Factory Service	Gary Ellsworth
7D02	Logic Analyzer	Pat Wolfram/S. Uffner	Gary Ellsworth
PM1XX	Personality Module Series	Stan Uffner/P. Wolfram	Gary Ellsworth
DF1	Logic Analyzer	Factory Service	Gary Ellsworth
DF2	Logic Analyzer	Factory Service	Gary Ellsworth
DL2	Logic Analyzer	Factory Service	Gary Ellsworth
DL502	Logic Analyzer	Factory Service	Gary Ellsworth
LA501	Logic Analyzer	Factory Service	Gary Ellsworth
WR501	Logic Analyzer	Factory Service	Gary Ellsworth
308	Data Analyzer	Pat Wolfram/S. Uffner	Gary Ellsworth

DATA COMMUNICATION ANALYZERS

<u>Product</u>	<u>Description</u>	Technical Questions	Service Plan
		Repair/Troubleshoot	Business
		<u>Perf. Assur. Eng.</u>	<u>Serv. Prog. Spec.</u>
821	Word Recognizer	Factory Service	Gary Ellsworth
832	Data Comm Tester	Stan Uffner/P. Wolfram	Gary Ellsworth
833	Data Comm Tester	Stan Uffner/P. Wolfram	Gary Ellsworth
834/834RXX	Programmable Data Comm Tester	Stan Uffner/P. Wolfram	Gary Ellsworth
851	Digital Tester	Stan Uffner	Gary Ellsworth

TM500 PRODUCTS

AA501	Distortion Analyzer	Terry Turner/S. Uffner	Frank Tucker
AF/AM5XX ¹	Amplifiers	Terry Turner/S. Uffner	Frank Tucker
CG551AP	Calibration Generator	Terry Turner/S. Uffner	
DD501	Digital Delay	Terry Turner/S. Uffner	Frank Tucker
DM5XX	Digital Multimeters	Terry Turner/S. Uffner	Frank Tucker
MR5XX	X-Y Display Monitor	Terry Turner/S. Uffner	Frank Tucker
PS5XX	Power Supplies	Terry Turner/S. Uffner	Frank Tucker
RG5XX	Ramp Generator	Terry Turner/S. Uffner	Frank Tucker
FG5XX	Function Generator	Stan Uffner/T. Turner	Frank Tucker
SG5XX	Sine-wave Generators	Stan Uffner/T. Turner	Frank Tucker
TG5XX	Time Mark Generators	Stan Uffner/T. Turner	Frank Tucker
SC5XX	Oscilloscopes	Terry Turner/S. Uffner	Frank Tucker
TM5XX	Power Modules	Terry Turner/S. Uffner	Frank Tucker
PG5XX	Pulse Generators	Terry Turner/S. Uffner	Frank Tucker
DC5XX	Digital Counters	Terry Turner/S. Uffner	Frank Tucker

¹Except AM503 and AM511 (T & M, Beaverton Service Support)

Other products not covered: DL502 and LA501,W (Factory Service)

SW503 and TR501,502 (Beaverton Service Support)

TELEQUIPMENT PRODUCTS

All Service related calls should be referred to Tom Herd,
Factory Service.

SAMPLING

<u>Product</u>	<u>Description</u>	Technical Questions	Service Plan
		Repair/Troubleshoot	Business
		<u>Perf. Assur. Eng.</u>	<u>Serv. Prog. Spec.</u>
S Series	Sampling Head	Factory Service	Dean Hager
S50,S52	Pulse Head	Factory Service	Dean Hager
S51	Trigger Count Down	Factory Service	Dean Hager
S53	Trigger Recognizer	Factory Service	Dean Hager
S54	Pulse Head	Factory Service	Dean Hager
284	Pulse Generator	Factory Service	Dean Hager
5S14	Two Channel Sampler	Factory Service	Dean Hager
7K Series	Sampling	Factory Service	Dean Hager

PRODUCT RESPONSIBILITY LIST FOR SERVICE SUPPORT

PRODUCT	DESCRIPTION	TECHNICAL QUESTIONS	SERVICE PLAN
		REPAIR/TROUBLESHOOT PERF. ASSUR. ENG.	BUSINESS SER. PROG. SPEC.
	MODIFIED PROD., OEM ACCOUNTS, INTERNATIONAL		JIM TIANO
	REMOTE DIAGNOSTIC CENTER	DUANE MOORE	
	DATA COMMUNICATIONS	FRANK LEES	
	REMOTE DIAGNOSTICS	MARTY DEVAL	
	INTERNAL DIAGNOSTICS	ED SAWICKI	
E31	LOW COST TEK 31	FACTORY SERVICE	DEL MOORE
FEM181	4081 & PERIPHERALS & S/W PACKAGE	BILL HATCH	DENNIS MCGARY
GMA101A	19" STORAGE DISPLAY MONITOR	DENNIS PAINTER	DENNIS MCGARY
GMA102A	19" STORAGE DISPLAY MONITOR	DENNIS PAINTER	DENNIS MCGARY
GMA125	25" STORAGE DISPLAY MONITOR	DENNIS PAINTER	KENT BARNARD
MEG121	MECHANICAL ENGINEERING WORK ST.	BILL HATCH	DENNIS MCGARY
MEG121/ 131	OPT. 35 FUNCTION KEYBOARD	BILL HATCH	DENNIS MCGARY
MEG121/ 131	OPT. 36, 25" DISPLAY	BILL HATCH	DENNIS MCGARY
MEG131	MECHANICAL ENGINEERING DEVELOPMENT STATION (INCLUDES PDP 11/34)	BILL HATCH	DENNIS MCGARY
AE4012	RUGGEDIZED MIL SPEC RACK MT. 4012	FACTORY SERVICE	KENT BARNARD
SURVEY 31	SURVEYING CALCULATOR	FACTORY SERVICE	JIM TIANO
T4002	11" CRT STORAGE TERMINAL	FACTORY SERVICE	KENT BARNARD
TEK 21	LOW COST CALCULATOR (DESK TOP)	FACTORY SERVICE	DEL MOORE
TEK 31	DESK TOP CALCULATOR	FACTORY SERVICE	DEL MOORE
152	TEK 31 INTERFACE	FACTORY SERVICE	DEL MOORE
153	TEK 31 INTERFACE TO TM503	FACTORY SERVICE	DEL MOORE
154	TEK 31 INTERFACE	FACTORY SERVICE	DEL MOORE
3110	TEK 31 & 4010 TERMINAL	FACTORY SERVICE	DEL MOORE
3153	TEK 31 & 153 INTERFACE	FACTORY SERVICE	DEL MOORE
4002A	11" STORAGE TERMINAL	FACTORY SERVICE	KENT BARNARD
4006	11" STORAGE TERMINAL-LOW COST	DENNIS PAINTER	KENT BARNARD
4010	11" STORAGE TERMINAL-PEDESTAL	FACTORY SERVICE	KENT BARNARD
4012	11" STORAGE TERMINAL-PEDESTAL	FACTORY SERVICE	KENT BARNARD
4013	4012 WITH APL CHARACTER SET	FACTORY SERVICE	KENT BARNARD
4014	19" DVST TERMINAL	FACTORY SERVICE	KENT BARNARD
4015	19" DVST TERMINAL & APL CHARACTER SET	FACTORY SERVICE	KENT BARNARD
4016	25" STORAGE TERMINAL-PEDESTAL	DENNIS PAINTER	KENT BARNARD
4023	RASTER SCAN TERMINAL	FACTORY SERVICE	KENT BARNARD
4024	RASTER SCAN TERMINAL	MARTY DEVAL	KENT BARNARD
4025	RASTER SCAN TERMINAL	MARTY DEVAL	KENT BARNARD
4027	COLOR RASTER SCAN TERMINAL	MARTY DEVAL	KENT BARNARD
4051	11" CRT GRAPHIC COMPUTING SYSTEM	DARRELL MCGIVERIN	DEL MOORE
4051C01	SYNC. INTERFACE	DARRELL MCGIVERIN	DEL MOORE
4051E01	ROM EXPANDER BACK PACK	DARRELL MCGIVERIN	DEL MOORE
4051ROX	ROM PACKS	DARRELL MCGIVERIN	DEL MOORE

PRODUCT	DESCRIPTION	TECHNICAL QUESTIONS	SERVICE PLAN
		REPAIR/TROUBLESHOOT	BUSINESS
		PERF. ASSUR. ENG.	SER. PROG. SPEC.
4052	GRAPHIC COMPUTING SYSTEM	DARRELL MCGIVERIN	DEL MOORE
4052ROX	ROM PACKS	DARRELL MCGIVERIN	DEL MOORE
4054	GRAPHIC COMPUTING SYSTEM	DARRELL MCGIVERIN	DEL MOORE
4054ROX	ROM PACKS	DARRELL MCGIVERIN	DEL MOORE
4081	MINI-COMPUTER SYSTEM	BILL HATCH	DENNIS MCGARY
4112	COMPUTER DISPLAY TERMINAL	BILL HATCH	DENNIS MCGARY
4114	COMPUTER DISPLAY TERMINAL	BILL HATCH	DENNIS MCGARY
4501	SCAN CONVERTER	FACTORY SERVICE	HANK PIATEK
4551	LIGHT PEN FOR VIDEO TERMINAL	FACTORY SERVICE	HANK PIATEK
4601	HARD COPY (611 AND 4002)	FACTORY SERVICE	HANK PIATEK
4602	VIDEO HARD COPY	FACTORY SERVICE	HANK PIATEK
4610	HARD COPY TO 4010 FAMILY	FACTORY SERVICE	HANK PIATEK
4611	LOW COST HARD COPY UNIT	GEORGE KUSIOWSKI	STEVE PRUNTY
4612	LOW COST VIDEO HARD COPY UNIT	GEORGE KUSIOWSKI	STEVE PRUNTY
4620	DIGITAL VIDEO HARD COPY	FACTORY SERVICE	HANK PIATEK
4623	VIDEO HARD COPY	FACTORY SERVICE	HANK PIATEK
4631	HARD COPY TO 4010 FAMILY	FACTORY SERVICE	HANK PIATEK
4632	VIDEO HARD COPY	FACTORY SERVICE	HANK PIATEK
4633	CONTINUOUS RECORDER	GEORGE KUSIOWSKI	HANK PIATEK
4633A	CONTINUOUS RECORDER	GEORGE KUSIOWSKI	HANK PIATEK
4634	IMAGE FORMING MODULE	GEORGE KUSIOWSKI	HANK PIATEK
4641	LINE PRINTER (DEC LA180)	LARRY NORTH	HANK PIATEK
4642	LINE PRINTER (CENTRONICS)	LARRY NORTH	HANK PIATEK
4661	PLOTTER "B" SIZE	FACTORY SERVICE	STEVE PRUNTY
4662	PLOTTER "B" SIZE	LARRY NORTH	STEVE PRUNTY
4663	PLOTTER "C" SIZE	LARRY NORTH	STEVE PRUNTY
4701	8 CHANNEL ANALOG MUX	FACTORY SERVICE	KENT BARNARD
4801	INTERFACE FOR T4002	FACTORY SERVICE	KENT BARNARD
4802	INTERFACE FOR T4002	FACTORY SERVICE	KENT BARNARD
4803	INTERFACE FOR T4002	FACTORY SERVICE	KENT BARNARD
4804	INTERFACE FOR T4002	FACTORY SERVICE	KENT BARNARD
4901	INTERFACE FOR 4002A	FACTORY SERVICE	KENT BARNARD
4902	INTERFACE FOR 4002A	FACTORY SERVICE	KENT BARNARD
4903	INTERFACE FOR 4002A	FACTORY SERVICE	KENT BARNARD
4905	MASS STORAGE MODULE	BILL HATCH	DENNIS MCGARY
4907	FLOPPY DISC STORAGE MODULE	DARRELL MCGIVERIN	DAN HARRIS
4911	REMEX READER PUNCH FOR 4010 FAMILY	FACTORY SERVICE	KENT BARNARD
4912	CASSETTE RECORDER (DIGITAL) (SYKES) FOR 4010 FAMILY	FACTORY SERVICE	KENT BARNARD
4921	SINGLE FLOPPY DISC TO 4010 FAMILY	FACTORY SERVICE	KENT BARNARD
4922	DUAL F.D. TO 4010 FAMILY	FACTORY SERVICE	KENT BARNARD
4923	CASSETTE TAPE RS-232, 401X BUS	DARRELL MCGIVERIN	DAN HARRIS
4924	CASSETTE TAPE GPIB	DARRELL MCGIVERIN	DAN HARRIS
4931	MODEM FOR 4010 FAMILY	FRANK LEES	KENT BARNARD
4951	JOY STICK FOR 4002A	FACTORY SERVICE	KENT BARNARD
4952	JOY STICK FOR 4010 FAMILY AND 4051	DARRELL MCGIVERIN	KENT BARNARD
4953	SUMMAGRAPHS GRAPHIC TABLET 11"X11"	MARTY DEVAL	KENT BARNARD
4954	SUMMAGRAPHS GRAPHIC TABLET 40"X30"	MARTY DEVAL	KENT BARNARD
4956	SUMMAGRAPHS GRAPHIC TABLET GPIB INTERFACE TO 4051 20"X20"	DARRELL MCGIVERIN	KENT BARNARD
601	DISPLAY MONITOR	FACTORY SERVICE	KENT BARNARD
602	8X10 CM DISPLAY MONITOR	FACTORY SERVICE	KENT BARNARD
603	10.2X12.7 CM STORAGE DISPLAY MONITOR	FACTORY SERVICE	KENT BARNARD
603A	10.2X12.7 CM STORAGE DISPLAY MONITOR	FACTORY SERVICE	KENT BARNARD

PRODUCT	DESCRIPTION	TECHNICAL QUESTIONS	SERVICE PLAN
		REPAIR/TROUBLESHOOT	BUSINESS
		PERF. ASSUR. ENG.	SER. PROG. SPEC.
604	10.2X12.7 CM DISPLAY MONITOR	FACTORY SERVICE	KENT BARNARD
604A	10.2X12.7 CM DISPLAY MONITOR	FACTORY SERVICE	KENT BARNARD
605	7.2X9 CM STORAGE DISPLAY MONITOR	FACTORY SERVICE	KENT BARNARD
606	8X10 CM DISPLAY MONITOR	FACTORY SERVICE	KENT BARNARD
606A	8X10 CM HIGH RESOLUTION DISPLAY MON.	FACTORY SERVICE	KENT BARNARD
606B	8X10 CM HIGH RESOLUTION DISPLAY MON.	FACTORY SERVICE	KENT BARNARD
607	7.2X9 CM VARIABLE PERSISTENCE DISPLAY MONITOR	FACTORY SERVICE	KENT BARNARD
607A	7.2X9 CM VARIABLE PERSISTENCE DISPLAY MONITOR	FACTORY SERVICE	KENT BARNARD
608	9.8X12.2 CM HIGH BRIGHTNESS DIS. MON.	GEORGE KUSIOWSKI	KENT BARNARD
611	11" DISPLAY	FACTORY SERVICE	KENT BARNARD
613	11" HIGH CONTRAST DISPLAY	FACTORY SERVICE	KENT BARNARD
618	19" STORAGE DISPLAY	DENNIS PAINTER	DENNIS MCGARY
619	19" STORAGE DISPLAY	DENNIS PAINTER	DENNIS MCGARY
620	10X12 CM DISPLAY MONITOR	GEORGE KUSIOWSKI	KENT BARNARD
624	9.8X12.2 CM DISPLAY MONITOR	GEORGE KUSIOWSKI	KENT BARNARD
634	9X12 CM RASTER SCAN DISPLAY MONITOR	GEORGE KUSIOWSKI	KENT BARNARD

