TECHNICAL MANUAL

GENERAL SUPPORT MAINTENANCE MANUAL
FOR
OPTICAL FIBER TEST SET
TS-4320(P)/G
(NSN 6625-01-355-4087)
(EIC: N/A)

HEADQUARTERS, DEPARTMENT OF THE ARMY
1 MAY 1995

5 SAFETY STEPS TO FOLLOW IF SOMEONE IS THE VICTIM OF ELECTRICAL SHOCK

1. DO NOT TRY TO PULL OR GRAB THE INDIVIDUAL

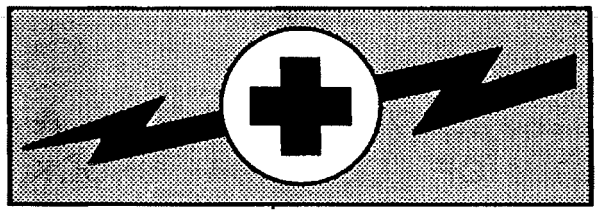
2. IF POSSIBLE, TURN OFF THE ELECTRICAL POWER

3. IF YOU CANNOT TURN OFF THE ELECTRICAL POWER, PULL, PUSH, OR LIFT THE PERSON TO SAFETY USING A WOODEN POLE OR A ROPE OR SOME OTHER INSULATING MATERIAL

4. SEND FOR HELP AS SOON AS POSSIBLE

5. AFTER THE INJURED PERSON IS FREE OF CONTACT WITH THE SOURCE OF ELECTRICAL SHOCK, MOVE THE PERSON A SHORT DISTANCE AWAY AND IMMEDIATELY START ARTIFICIAL RESUSCITATION

W A R N I N G



HIGH VOLTAGE

is used in the operation of this equipment

D E A T H ON C O N T A C T

may result if personnel fail to observe safety precautions

Never work on electronic equipment unless there is another person nearby who is familiar with the operation and hazards of the equipment and who is competent in administering first aid. When technicians are aided by operators, they must warn them about dangerous areas.

Whenever possible, the power supply to the equipment must be shut off before beginning work on the equipment. Take particular care to ground every capacitor likely to hold a dangerous potential. When working inside the equipment, after the power has been turned off, always ground every part before touching it.

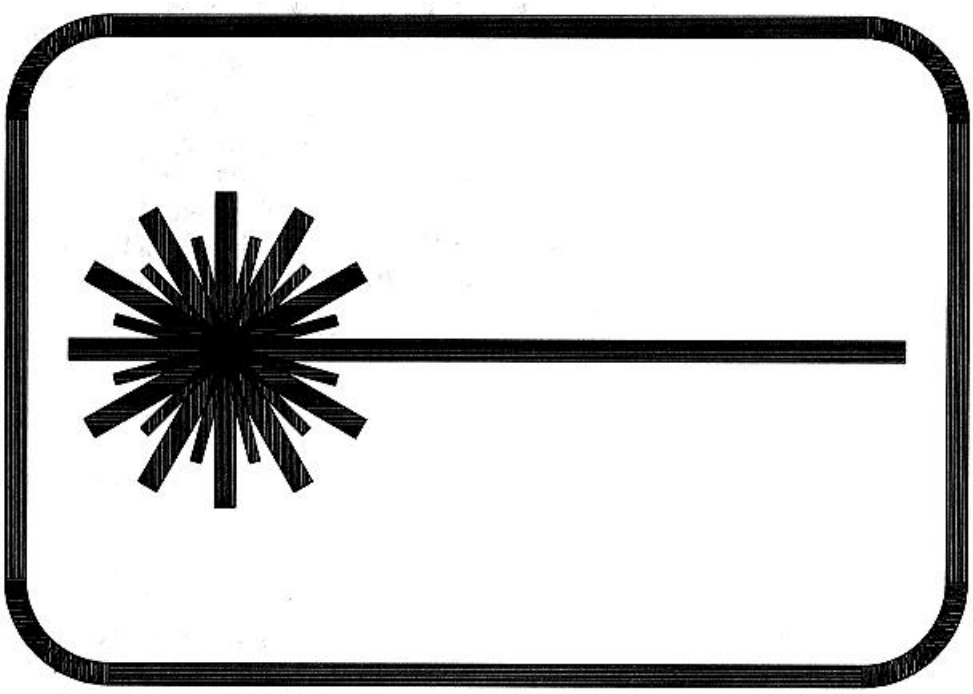
Be careful not to contact high-voltage connections of 115-volt ac input when installing or operating this equipment.

Whenever the nature of the operation permits, keep one hand away from the equipment to reduce the hazard of current flowing through vital organs of the body.

WARNING

Do not be misled by the term "LOW VOLTAGE". Potentials as low as 50 volts may cause death under adverse conditions.

For Artificial Respiration refer to FM 4-25.11.



WARNING

LASER RADIATION

Infrared radiation is produced at the fiber connection port on the right side of the front cover and at the end of unterminated optical fibers that are attached to this port. Avoid long, direct exposure to the light that comes from these sources.

CAUTION

THIS EQUIPMENT CONTAINS PARTS AND ASSSEMBLIES SENSITIVE TO DAMAGE BY ELECTROSTATIC DISCHARGE (ESD).
USE ESD PRECAUTIONARY PROCEDURES WHEN TOUCHING, REMOVING OR INSERTING CIRCUIT CARD ASSEMBLIES.

ESD
CLASS 1

NOTE

The symbol for static sensitive devices in military inventory is as depicted in the caution box above.

GENERAL HANDLING PROCEDURES FOR ESDS ITEMS

- USE WRIST GROUND STRAPS OR MANUAL GROUNDING PROCEDURES.
- KEEP ESDS ITEMS IN PROTECTIVE COVERING WHEN NOT IN USE.
- GROUND ALL ELECTRICAL TOOLS AND TEST EQUIPMENT.
- PERIODICALLY CHECK CONTINUITY AND RESISTANCE OF GROUNDING SYSTEM.
- USE ONLY METALIZED SOLDER SUCKERS.
- HANDLE ESDS ITEMS ONLY IN PROTECTED AREAS.

MANUAL GROUNDING PROCEDURES

- MAKE CERTAIN EQUIPMENTIS POWERED DOWN.
- TOUCH GROUND PRIOR TO REMOVING ESDS ITEMS.
- TOUCH PACKAGE OF REPLACEMENT ESDS ITEM TO GROUND BEFORE OPENING.
- TOUCH GROUND PRIOR TO INSERTING REPLACEMENT ESDS ITEMS.

ESD PROTECTIVE PACKAGING AND LABELING

- INTIMATE COVERING OF ANTISTATIC MATERIAL WITH AN OUTER WRAP OF EITHER TYPE 1 ALUMINIZED MATERIAL OR CONDUCTIVE PLASTIC FILM OR HYBRID LAMINATE BAGS HAVING AN INTERIOR OR ANTISTATIC MATERIAL WITH AN OUTER METALIZED LAYER.
- LABEL WITH SENSITIVE ELECTRONIC SYMBOL AND CAUTION NOTE.

CAUTION

Devices such as CMOS, MNOS, NMOS, VMOS, HMOS, thin-film resistors PMOS, and MOSFET used in many equipments can be damaged by static voltages present in most repair facilities. Most of the components contain internal gate protection circuits that are partially effective, but sound maintenance practice and the cost of equipment failure in time and money dictate careful handling of all electrostatic sensitive components.

The following precautions should be observed when handling all electrostatic sensitive components and units containing such components.

CAUTION

Failure to observe all of these precautions can cause permanent damage to the electrostatic sensitive device. This damage can cause the device to fail immediately or at a later date when exposed to an adverse environment.

STEP 1. Turn off and/or disconnect all power and signal source and loads used with the unit.

STEP 2. Place the unit on grounded conductive work surfaces.

STEP 3. Ground the repair operator using a conductive wrist strap or other device using a 1-M series resistor to protect the operator.

STEP 4. Ground any tools (including soldering equipment) that will contact the unit. Contact with the operator's hand provides a sufficient ground for tools that are otherwise electrically isolated.

STEP 5. All electrostatic sensitive replacement components are shipped in conductive foam or tubes and must be stored in the original shipping container until installed.

STEP 6. When these devices and assemblies are removed from the unit, they should be placed in the conductive work surface or in conductive containers.

STEP 7. When not being worked on, wrap disconnected circuit boards in aluminum foil or in plastic bags that have been coated or impregnated with a conductive material.

STEP 8. Do not handle these devices unnecessarily or remove from their packages until actually used or tested.

INSERT LATEST CHANGED PAGES. DESTROY SUPERSEDED PAGES.

LIST OF EFFECTIVE PAGES

NOTE

ON CHANGED PAGES, THE PORTION OF THE TEXT AFFECTED BY THE LATEST CHANGE IS INDICATED BY A VERTICAL LINE OR OTHER CHANGE SYMBOL IN THE OUTER MARGIN OF THE PAGE.

Date of issue for original and changed pages are:

Original	0	1 May 1995
Change	1	13 January 2006

Total number of pages in this publication is 220 consisting of the following:

Page No.	*Change No.
Cover	1
A	0
B	1
C thru E / (F blank)	0
G / (H blank)	1
i	1
ii, iii	0
1-0	0
1-1, 1-2	1
1-3 thru 1-23 / (1-24 blank)	0
2-1 thru 2-139 / (2-140 blank)	0
A-1 / (A-2 blank)	1
B-1	0
B-2	1
C-1 thru C-13 / (C-14 blank)	0
INDEX-1 thru 8	0
FP-1 / (FP-2 blank)	0
FP-3 / (FP-4 blank)	0
FP-5 / (FP-6 blank)	0
FP-7 / (FP-8 blank)	0
FP-9 / (FP-10 blank)	0
FP-11 / (FP-12 blank)	0
FP-13 / (FP-14 blank)	0
FP-15 / (FP-16 blank)	0
FP-17 / (FP-18 blank)	0
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FP-39 / (FP-40blank)	0

* Zero in this column indicates an original page.

CHANGE
No. 1

Headquarters
Department of the Army
Washington, D.C., 13 January 2006

GENERAL SUPPORT MAINTENANCE MANUAL FOR OPTICAL FIBER TEST SET TS-4320(P)/G (NSN 6625-01-355-4087) (EIC: N/A)

HAZARDOUS MATERIAL INFORMATION – This document has been reviewed for the presence of solvents used as cleaning solutions containing hazardous materials defined by the EPCRA 302 and 313 lists by the AMCOM G-4 (Logistics) Environmental Division. As of the base document, dated 1 May 1995, all references to solvents containing hazardous materials have been removed from this document by substitution with non-hazardous or less hazardous materials where possible.

OZONE DEPLETING CHEMICAL INFORMATION – This document has been reviewed for the presence of Class I ozone depleting chemicals by AMCOM G-4 (Logistics) Environmental Division. As of the base document, dated 1 May 1995, all references to Class I ozone depleting chemicals have been removed from this document by substitution with chemicals that do not cause atmospheric ozone depletion.

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TM 11-6625-3271-40 dated 1 May 1995, is changed as follows:

1. Remove old pages and insert new pages as indicated below. New or changed material is indicated by a vertical bar in the outer margin of the page.

Remove Pages	Insert Pages
A and B	A and B
-----	G/(H Blank)
i and ii	i and ii
1-1 and 1-2	1-1 and 1-2
A-1/(A-2 blank)	A-1/(A-2 blank)
B-1 and B-2	B-1 and B-2
DA Forms 2028-2	DA Forms 2028
Cover	Cover

2. File this change sheet in front of the publication for reference purposes.

By Order of the Secretary of the Army:

PETER J. SCHOOMAKER
General, United States Army
Chief of Staff

Official:

SANDRA R. RILEY
Administrative Assistant to the
Secretary of the Army
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Technical Manual

No. 11-6625-3271-40

Headquarters
Department of the Army
Washington, D.C., 1 May 1995

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REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms) directly to: Commander, U. S. Army Aviation and Missile Command, AMSAM-MMC-MA-NP, Redstone Arsenal, AL 35898-5000. A reply will be furnished to you. You may also provide DA Form 2028 information to AMCOM via email, fax or the World Wide Web. Our fax number is: DSN 788-6546 or Commercial 256-842-6546. Our email address is: 2028@redstone.army.mil. Instructions for sending an electronic 2028 may be found at the back of this manual immediately preceding the hardcopy 2028. For the World Wide Web use: https://amcom2028.redstone.army.mil.

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TABLE OF CONTENTS

HOW TO USE THIS MANUAL

This manual is divided into three parts. These are: Equipment Description principles of operation, Troubleshooting location of faults that result in symptoms, and Maintenance Procedures replacement of failed parts.

If using this manual for Troubleshooting, perform the Preliminary Service and Adjustment of Equipment (para 2-5). This will lead to the SYMPTOM INDEX. If using this manual for repair or replacement of failed parts, go to the Chapter Index located at the beginning of Chapter 2 to locate the correct procedure.

When first receiving the TS-4320(P)/G, start at the front of the manual and go all the way through to the back. Become familiar with every part of the manual and the TS-4320(P)/G.

This manual has an edge index which will help find specific information in a hurry. Simply spread the pages on the right edge of the manual until the printed blocks can be seen. Open the manual where the block on the edge of the page lines up with the selected topic printed on the front cover block.

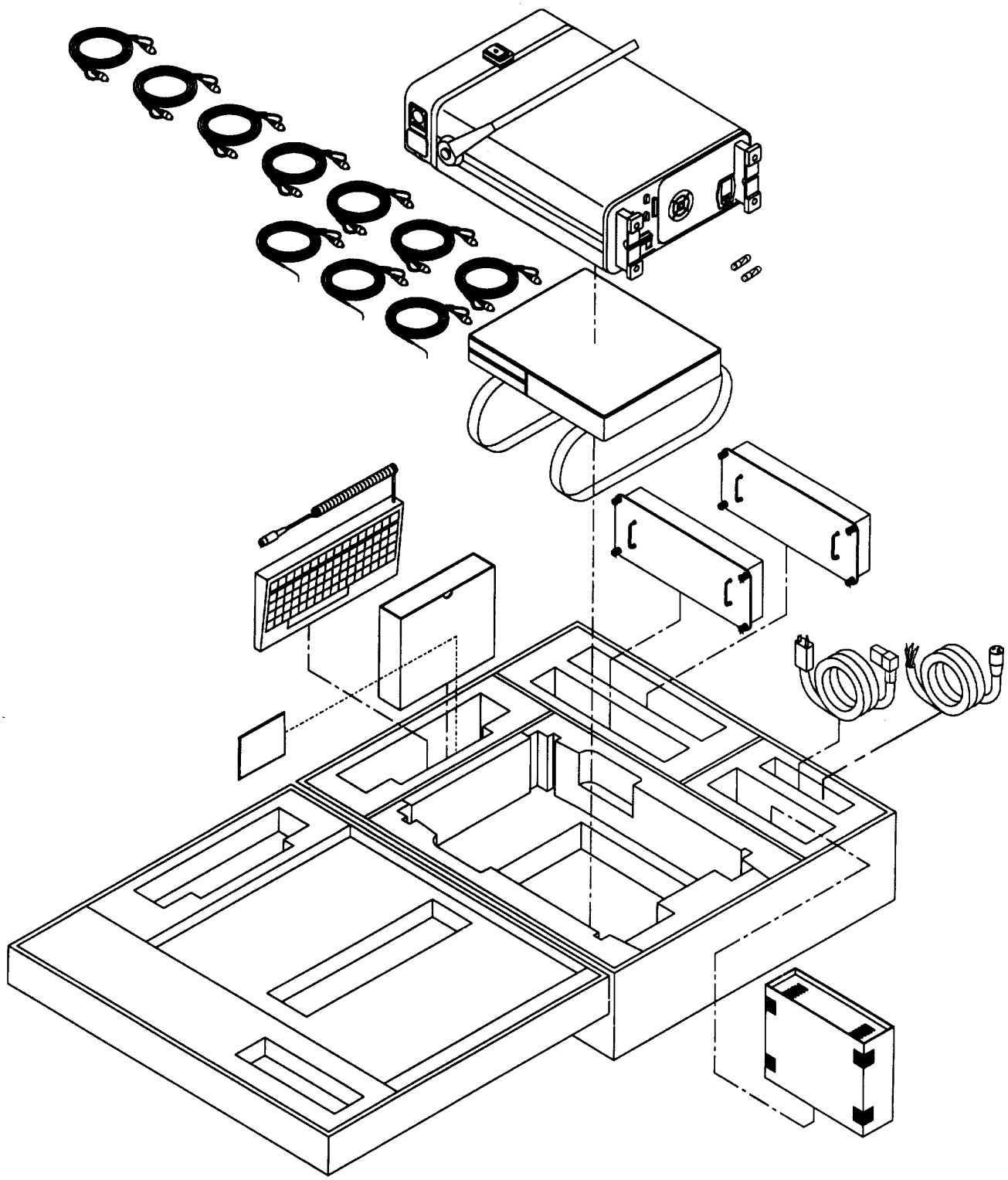


Figure 1-1. Optical Fiber Test Set TS-4320(P)/G.

CHAPTER 1
INTRODUCTION

Section I. GENERAL INFORMATION

1-1. SCOPE.

a. *Type of Manual*: General Support Maintenance Manual.

b. *Equipment Name and Model Number*: Optical Fiber Test Set TS-4320(P)/G (fig. 1-1).

c. *Purpose of Equipment*: The TS-4320(P)/G is to test and troubleshoot fiber optic cable.

1-2. CONSOLIDATED INDEX OF ARMY PUBLICATIONS AND BLANK FORMS.

Refer to the latest issue of DA Pam 25-30 to determine whether there are new editions, changes, or additional publications pertaining to the equipment.

1-3. MAINTENANCE FORMS, RECORDS, AND REPORTS.

a. Reports of Maintenance and Unsatisfactory Equipment. Department of the Army forms and procedures used for equipment maintenance will be those prescribed by DA Pam 750-8 as contained in the Maintenance Management Update.

b. Report of Item and Packaging Deficiencies. Fill out and forward SF 364 (Report of Discrepancy) (ROD) as prescribed in AR 735-11-2/DLAR 4140.55/SECNAVINST 4355.18/AFR400-54/MCO 4430.3J.

c. Transportation Discrepancy Report (TDR)(SF 361). Fill out and forward Transportation Discrepancy Report (TDR)(SF 361) as prescribed in DA Pam 25-30/NAVSUPINST 4610.33C/AFR 75-18/MCO P4610.19D DLAR 4500.15.

1-4. DESTRUCTION OF ARMY MATERIEL TO PREVENT ENEMY USE.

Destruction of Army materiel to prevent enemy use is described in TM 750-244-2.

1-5. NOMENCLATURE CROSS-REFERENCE LIST.

Common names will be used when the Optical Fiber Test Set TS-4320(P)/G is mentioned in this manual.

Common Name	*Official Nomenclature*
Optical Time Domain Reflectometer (OTDR)	Optical Fiber Test Set TS-4320(P)/G
TS-4320(P)/G	Optical Fiber Test Set TS-4320(P)/G
TS-4320	Optical Fiber Test Set TS-4320(P)/G
Optical Module	Light Signal Receiver-Transmitter Subassembly

1-6. REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIR).

If your TS-4320(P)/G needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design or performance. Put it on an SF 368 (Product Quality Deficiency Report). Mail it to us at: Commander, U.S. Army Aviation and Missile Command, ANSAM-MMC-MA-NM, Redstone Arsenal, AL. 35898-5000. We'll send you a reply.

1-7. WARRANTY INFORMATION

The TS-4320(P)/G is warranted by Laser Precision for two years. Warranty starts on the date of shipment to the original buyer. Report all defects in material or workmanship to your supervisor, who will take appropriate action.

Section II. EQUIPMENT DESCRIPTION AND DATA

1-8. EQUIPMENT CHARACTERISTICS, CAPABILITIES, AND FEATURES

a. CHARACTERISTICS

- CRT for information display.
- Visual characteristic of fiber under test.
- Single Mode or Multi Mode operation.
- Softkey control allows for easy operation of equipment.
- LED indicators on front panel for constant equipment status.
- Interactive HELP display.
- Programmable interface for remote operation.
- Programmed interface for printer operation.
- Keyboard for entering header data.
- Image storage to RAM Card.
- Self test confirms operational status.
- Error messages define incorrect operating procedures.
- Designed for bench top use.

b. CAPABILITIES AND FEATURES.

- Operates on AC or DC power.
- Distance from origin measurement.
- Distance between points measurements.
- Loss between points measurements.
- Average loss measurement.
- Splice loss measurements.
- Reflectance measurements.
- Fiber trace storage.
- Fiber trace retrieval.
- Fiber trace printout.
- Fiber trace overlay.

1-9. EQUIPMENT DATA.

WEIGHTS AND DIMENSIONS

TS-4320(P)/G

Weight	32.5 lbs (14.74 Kg)
Length	22.15 in (56.26 cm)
Width	16.3 in (41.40 cm)
Height	6.5 in (16.51 cm)
Inverter	
Weight	12.0 lbs (5.44 Kg)
Length	8.0 in (20.32 cm)
Width	10.0 in (25.4 cm)
Height	3.0 in (7.62 cm)
Transit Case with all items	
Weight	104.0 lbs (47.164 Kg)
Length	33.0 in (83.82 cm)
Width	29.0 in (41.40 cm)
Height	12.0 in (30.48 cm)

POWER REQUIREMENTS

Voltage:	
100 Vac operation	90 to 110 Vac
120 Vac operation	103 to 127 Vac
220 Vac operation	193 to 237 Vac
240 Vac operation	207 to 253 Vac
Frequency	50, 60 or 400 Hz
Power	95 VA maximum

POWER REQUIREMENTS - Continued.

Fuse Rating:

100/120 Vac operation	2.0 amp, SLO-BLO, 250 volt
220/240 Vac operation	1.5 amp, SLO-BLO, 250 volt

POWER REQUIREMENTS (INVERTER)

Voltage:

12 Vdc operation	10 to 15 Vdc
24 Vdc operation	20 to 28 Vdc
28 Vdc operation	28 to 32 Vdc

Recommended Minimum Load	25 VA
Overload and Reverse Polarity	Protected

Fuse Rating:

Input	30 amp
Output	3 amp SLO-BLO

ENVIRONMENTAL

Operating temperature range	+14°F to +131°F (-10°C to +550C)
Storage temperature range	+14°F to +131°F (-100C to +550C)

Relative humidity:

86°F (30°C)	95% maximum
104°F (40°C)	75% maximum
122°F (50°C)	45% maximum

Operating altitude	0 to 15,000 ft (4,570 m)
Storage altitude	0 to 15,000 ft (4,570 m)
Vibration	3 g
Shock	40 g

PERFORMANCE

Resolution

Readout Resolution	0.1 m
Display Resolution	0.01 dB
Refractive Index	Five significant digits, with range 1.0001 to 1.9999 digital entry, values retained in nonvolatile memory for each optical module.
Distance Accuracy	0.01% ± Distance Sampling i Index uncertainty

TD260C, Multimode, Wavelength 850 +20 nm

Pulse Width	Short
Dynamic Range	10 dB
Attenuation Dead Zone	4 m
Spatial Resolution	3 m
Pulse Width	Medium
Dynamic Range	18 dB
Attenuation Dead Zone	20 m
Spatial Resolution	18 m
Pulse Width	Long
Dynamic Range	22 dB
Attenuation Dead Zone	290 m
Spatial Resolution	270 m

TD261C, Multimode, Wavelength 1300 +20 nm

Pulse Width	Short
Dynamic Range	5 dB
Attenuation Dead Zone	30 m
Spatial Resolution	3 m
Pulse Width	Medium
Dynamic Range	14 dB
Attenuation Dead Zone	30 m
Spatial Resolution	18 m
Pulse Width	Long
Dynamic Range	22 dB
Attenuation Dead Zone	290 m
Spatial Resolution	270 m

PERFORMANCE - Continued

TD285C, Singlemode, Wavelength 1310 +20 nm

Pulse Width (Short)	Short
Dynamic Range	10 dB
Attenuation Dead Zone	18 m
Spatial Resolution	13 m
Pulse Width	Medium
Dynamic Range	18 dB
Attenuation Dead Zone	120 m
Spatial Resolution	110 m
Pulse Width	Long
Dynamic Range	26 dB
Attenuation Dead Zone	1200 m
Spatial Resolution	1180 m

TD285C, Singlemode, Wavelength 1550 ±30 nm

Pulse Width	Short
Dynamic Range	10 dB
Attenuation Dead Zone	18 m
Spatial Resolution	11 m
Pulse Width	Medium
Dynamic Range	16 dB
Attenuation Dead Zone	130 m
Spatial Resolution	120 m
Pulse Width	Long
Dynamic Range	23 dB
Attenuation Dead Zone	1200 m
Spatial Resolution	1180 m

1-10. SAFETY, CARE AND HANDLING.

Observe all WARNINGS, CAUTIONS, and NOTES in this manual. This equipment can be extremely dangerous if these instructions are not followed.

Section III. PRINCIPLES OF OPERATION

1-11. GENERAL FUNCTIONAL DESCRIPTION.

The Functional Block Diagram (fig. FO-1) gives the basic organization of the TS-4320(P)/G.

(1) A laser in the optical module is pulsed to send a burst of energy down the fiber under test. Rayleigh backscatter light and reflections from imperfections and joints are recorded as a function of time. By observing the amplitude of light which is reflected back toward the detector, and knowing at what time the reflected light is received with respect to when the pulse was sent, a determination can be made as to the amount of power loss in the line and where the losses occur.

Rayleigh backscatter is caused by intrinsic spatial variations in the index of refraction of the fiber and fluctuations in the dopant material. It is inversely proportional to the fourth power of the wavelength used. It accounts for most of the power loss in the fiber. Other types of scatter loss include loss from microbending, core-cladding interface scattering, and fiber imperfections.

Anywhere a fiber is joined to another fiber there is a loss of power. The better the splice, the less loss that will be incurred. Most mechanical splices create a reflection of part of the power passing through the splice. These reflections can be identified on the instrument as large positive spikes in the data displayed.

The laser and detector are coupled to the fiber to be tested by an optical directional coupler. Light passed into the coupler by any of the leads is distributed evenly among the remaining leads.

A Photo Diode Detector is used to sense the amount of light returning from the laser pulse. The detector acts as a light controlled current source. The output current is amplified, at the Pre-Amp stage, before passing to the Analog-to-Digital (A/D) Converter.

(2) The 1A2A8 A/D Converter CCA digitizes the Detector output and feeds it to a 16K x 24 bit Accumulator on the 1A2A4 Data Acquisition System CCA (DAS). The A/D Converter is also controlled by the DAS.

(3) Timing is critical, as the pulse of light sent down a fiber must have enough time to travel the full length of the fiber and back before the laser is fired again. Furthermore, the laser must be fired as many times in a second as possible, to maximize the number of times the data points will be averaged to create a display. Averaging reduces displayed noise so that a clear, detailed image of the fiber profile is achieved. The Accumulator produces a running average of the Detector output after the laser has fired. This data is then available to the 1A2A3 Central Processor Unit CCA (CPU).

The function of the 1A2A4 Data Acquisition System CCA is to:

- Provide main timebase in the TS-4320(P)/G
- Contain 16K x 24 bit Accumulator
- Control pulsing of the laser
- Sample A/D Converter
-

In turn, the DAS is controlled by the CPU, which commands the DAS as to when to start a laser fire/data acquisition cycle.

(4) All activity in the TS-4320(P)/G is coordinated by the CPU, which is based on an 8088 microprocessor. The I/O Interfaces, Display Control, Data Acquisition, RAMCARD Interface and other sections of the instrument communicate through the CPU.

(5) The 1A2A5 Special Input/Output CCA (SIO) acts as a medium through which the 1A2A1 Front Control Panel CCA (FCPI) Interfaces to the CPU. The FCPI interacts directly with the user. The SIO interface contains non-volatile memory used for storing various system parameters.

(6) Also governed by the CPU are the 1A2A2 Bit Mapped Graphic Adapter CCA and 1A2A7 Color Graphics Adapter CCA (CGA) which passes video and timing signals through the Video Multiplexer, to the Electron Tube Driver, to the CRT.

(7) Backup program loading and trace image output are provided through the 1A2A12 RAMCARD Interface, under control of the CPU. Should the system software be destroyed the software can be reloaded from the PROGRAM ROMCARD. When required, a trace can be stored in a RAMCARD for later evaluation.

(8) The CPU connects to IEEE-488 and RS-232C interfaces, via the 1A2A6 General Input/Output CCA (GIO) interface, available from ports at the rear of the unit.

(9) 1A2PS1 Power is supplied to the TS-4320(P)/G by a 90-135/180 260 Volt, single phase, 47 63 and 400 Hz Nominal, power supply. In addition, a A209 DC/AC inverter connected to a +12, +24, +28, Volt DC source will supply the 120 Volt AC input to the power supply.

1-12. DETAILED FUNCTIONAL DESCRIPTION.

The following is a detailed functional description of key TS-4320(P)/G assemblies.

a. ***1A2A8 Analog to Digital Converter (A/D Converter) CCA.*** This CCA (fig. 1-2) is the main link between the Optical Module and the Mainframe. Fiber signature data generated at the optical module is converted to digital data and presented to the 1A2A4 DAS CCA for acquisition, averaging, processing, and analysis.

- ***Analog to Digital Converter.*** A pair of MC10319s (8-bit, high speed analog to digital flash converters), are stacked to provide 9-bit conversion. Internally the flash converter has comparitors which are attached to a precision resistor ladder network that divides the difference between the reference voltages applied to the top and bottom of the ladder into equal intervals. (The span of the reference voltage is the Rail Voltage Adjust.) The analog input is distributed to all of the comparitors, and the comparitor outputs drive a priority encoder and

latch. For any given analog input level between the two reference levels, comparitors which are referenced below the level will trip, those above the level will not. The priority encoder determines the highest one which is above its threshold and outputs the appropriate binary value. This data can then be held stable in the latch for access by the digital circuitry.

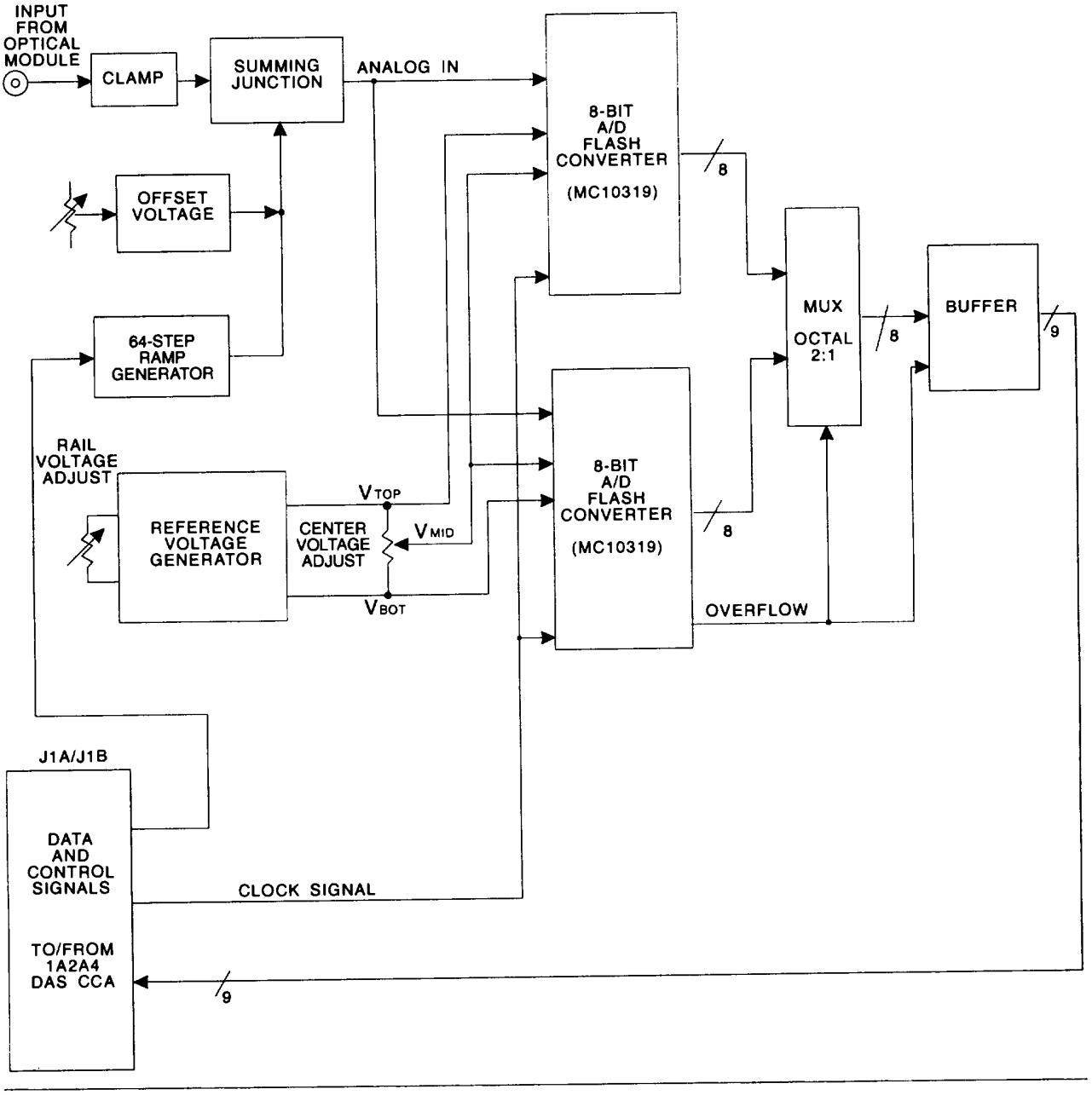


Figure 1-2. 1A2A8 A/D Converter CCA Functional Block Diagram

To generate 9-bit data, the two 8-bit converters are stacked so that the upper converters lower voltage reference and the lower converters upper voltage reference are equal (Center Voltage Adjust,VMID). The overflow bit from the lower converter controls the octal 2: 1 multiplexer.

- ***Octal 2: 1 Multiplexer.*** Selects between the upper and lower converters 8-bit outputs. These 8-bits become the lower 8-bits of the 9-bit output; the overflow bit becomes the most significant bit.
- ***Clamp and Summing Junction.*** Analog fiber signature data is received via coax from the optical module and is terminated and clamped prior to feeding the summing junction of a high speed buffer amplifier which drives the MC10319 inputs. The buffer amplifier runs near unity gain for improved band width and sums the analog input with the offset and ramp signals.
- ***Offset Adjust.*** Used to balance the DC component of the analog input.
- ***Ramp Signal.*** The 64-step digital ramp generator is controlled by the 1A2A4 DAS CCA. This signal randomizes the otherwise periodic quantization noise of the analog to digital system.

b. ***1A2A4 Data Acquisition System (DAS) CCA.*** This CCA (fig. 1-3) is the most complex board in the unit. It is the function of this CCA to control the operation of the Optical Module and the Analog to Digital Conversion so that the fiber signature data can be collected and averaged for improved signal to noise ratio by Gaussian noise reduction.

- ***First In First Out (FIFO).*** At the heart of the DAS CCA is a 16k by 24-bit high speed accumulating FIFO into which the fiber signature data is averaged in base time intervals of 80ns. The implementation of the FIFO uses discrete memory devices coupled with an address generator instead of monolithic FIFO buffer devices, for greater flexibility and functionality. To simplify programming, the FIFO memory appears to the CPU as 32-bit data with the bytes being arranged in Intel Double-Word Order as follows:
-

Lo Word, Lo Byte	FIFO Data Bits 7..0
Lo Word, Hi Byte	FIFO Data Bits 15..8
Hi Word, Lo Byte	FIFO Data Bite 23..16
Hi Word, Hi Byte	Always Reads Zero

- ***Address Generator/Buffer.*** The address inputs to the memories are fed from a synchronous counter which generates sequential addresses from a parallel loaded base address. The address generator can also transparently pass barrel shifted addresses from the CPU for processor access to FIFO memory. The lower two bits of system address are not barrel shifted and are used to control the output multiplexer which selects which of the 3 bytes of FIFO data will be gated onto the system data bus.
-

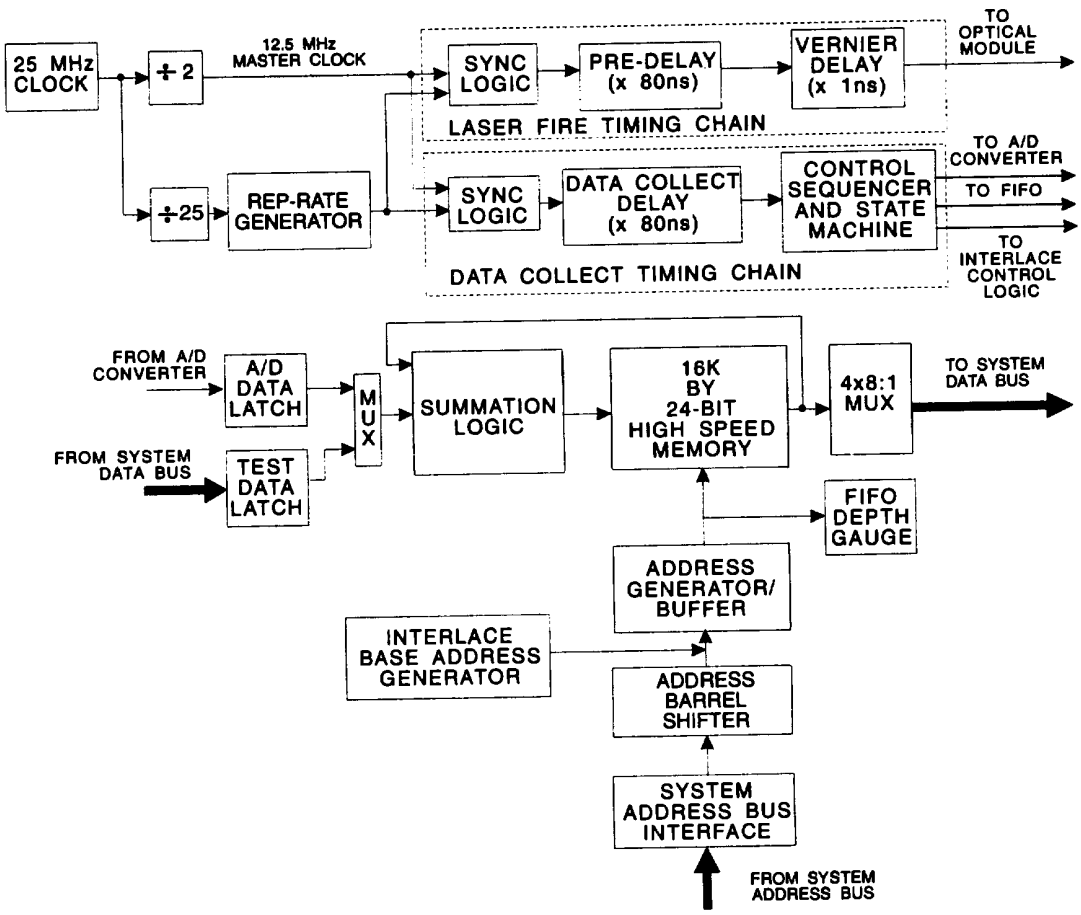


Figure 1-3. 1A2A4 DAS CCA Functional Block Diagram.

- ***Summation Logic.*** The data inputs to the memories are fed from a 24-bit high speed binary adder which has been pipelined to improve efficiency. The adder inputs come from the FIFO data outputs and from the input data multiplexer which switches between the Analog to Digital converter outputs and the static test data latch under processor control. As both of these sources are 16-bit, the upper eight bits are padded with zeros. Further, since the A/D converter is limited to 10-bits, the upper six bits of the A/D Data are also padded with zeros.
- ***25 MHz Master Clock.*** Timing, control, and sense elements are present throughout the averager and interconnect directly with the Time Base Generator and Control Sequencer. The primary time base is 12.5 MHz which is generated by dividing a 25.00 MHz + .005% crystal clock oscillator by two to insure symmetry. The 12.5 MHz Master Clock is prescaled by 25 and fed to a programmable counter/timer to generate the Laser Repetition Rate (RepRate) Clock. This clock, which is typically 750 Hz to 3 KHz, is used to start each of the averaged fiber samples by feeding two timing paths; the Data Collect Timing Chain and the Laser Fire Timing Chain.

- ***Laser Fire Timing Chain.*** The Laser Fire Chain runs continuously (unless disabled by program control) and synchronizes the RepRate Clock to the 12.5 MHz Master Clock, which is delayed by an integral number of 80ns periods. This, in turn, is delayed by an integral number of ins periods and buffered prior to driving the optical module. This timing chain permits the actual laser fire to be calibrated to any ins delta from the synchronized RepRate Clock. For the purposes of discussion, these two delays are the Laser Fire PreDelay and the Laser Fire Vernier Delay respectively.
- ***Data Collect Timing Chain.*** The Data Collect Timing Chain also synchronizes the RepRate Clock to the Master Clock which is then delayed in 80ns increments (the Data Collect Delay) prior to initiating the actual data acquisition. To take a single sample, the A/D Converter is told to convert the incoming fiber data which is then added to the data currently stored at a given FIFO address. The sum replaces the data in the FIFO, and the FIFO address is incremented. This sequence occurs every 80ns and is repeated until the FIFO Depth Gauge indicates that enough samples have been taken for this laser fire cycle. The Address Generator is reloaded from the Interlace Base Address Generator as determined by the Interlace Control Logic, preparing the averager for the next laser fire. This continues until the Laser Fire Counter signals that the requested number of laser fire cycles have been accumulated by shutting down the Data Collect Timing Chain Synchronizer.
- ***Data Collect Delay and Laser Fire Vernier Delay.*** The propagation delays within the asynchronous elements of the overall system (specifically the optical module) will vary from unit to unit and must be compensated for to insure that the launch point of the fiber signature is reported at zero distance. By careful setting of the three delays, data can be sampled and the delays adjusted under program control to place the launch point at the beginning of the FIFO memory. This is accomplished using the Data Collect Delay and Laser Fire Vernier Delay. The Laser Fire Pre-Delay allows the placement of the launch point at a specific point in the FIFO memory so that the incoming data immediately prior to the launch can be sampled. This data is analyzed to generate values used in the logarithmic conversion of the fiber data.
- ***Interlace Control Logic.*** As stated, the accumulating FIFO is capable of sampling the fiber data every 80ns which represents 8 meters of light travel through a vacuum. As this is not fine enough granularity for high resolution applications, the Interlace Control Logic is used to achieve data sampling intervals as small as 5ns.

Assume that data has been sampled at 8 meter intervals starting at the launch. The following data points have been taken:

..... 0m, 8m, 16m, 24m, 32m .....

The vernier is now altered to subtract 40ns of delay from the laser fire chain. Since the laser will now fire 40ns earlier, the first data point will be taken not at the launch, but 40ns after the launch. As a result, the following data points can be taken:

.....4m, 12m, 20m, 28m.....

These two sets of data can now be assembled to create a fiber signature with 4 meter granularity:

0m, 4m, 8m, 12m, 16m, 20m, 24m, 28m, 32m.....

The Interlace Control Logic can support 8m, 4m, 2m,1 m, and 0.5m data collect intervals which relates to 1, 2, 4, 8, and 16 data points per 80ns period. During an interlaced scan, the 16k of FIFO memory is broken into equal blocks as given by the number of data points per 80ns period, and the Interlace Base Address Generator outputs the appropriate value to point to the beginning of a particular memory block based on which interlace step is currently being sampled. Thus, at the completion of an interlaced scan, the FIFO memory does not contain data in Fiber Sequence Order (i.e.: 0m, 4m, 8m, 12m, 16m, 20m, 24m, 28m, 32m, ...) but instead contains separate blocks of data where all of data points in a given block are 8m apart but each block has a different launch offset. This is referred to as Time Sequence Order since the blocks of data are arranged in offset time order:

0m, 8m, 16m, 24m, 32m, 4m, 12m, 20m 28m

Data Block Zero Data Block One

The address barrel shifter alters the system address so that the FIFO memory appears to the processor as if it were in Fiber Sequence Order.

c. ***1A2A3 Microprocessor CCA.*** This CCA (fig. 1-4) is the main controlling element of the TS-4320 mainframe. It is based on the Intel 8088 MPU and uses a VLSI device to provide peripheral support compatible with the IBM PC/XT architecture.

- ***ISA/8 Core Logic.*** This logic provides 8 levels of priority interrupts, 4 channels of DMA, numeric coprocessor support, dual clocking, and support of up to 2.5 megabytes of DRAM. It also generates operator alert tone and the interface of the QWERTY keyboard.
- ***Read Only Memory (ROM).*** The BIOS ROM provides power up self testing, system initialization, basic peripheral device control, and the load and execution of the application code.

d. ***1A2A5 Specialized Input/Output (SIO) CCA.*** This CCA (fig. 1-5) provides interface and device control for internal devices, (specifically the front panel), as well as up to 1 Megabyte of non-volatile memory for program and data storage. Other functions include a DIP switch configuration register and Optical Module laser fire condition control.

- ***Front Panel Interface.*** The unit's front panel is comprised of momentary contact switches and LEDs. To minimize the number of interconnections between the Front Panel and the SIO CCA, both the input data from the switches and the output data to the LEDs is serialized. Under program control, the SIO CCA can signal the front panel as to the direction of data transmission. The program then manually clocks each bit between the SIO CCA and the Front Panel to read all of the switches or set all of the LEDs. A signal is provided to the SIO CCA from the front panel to indicate that a key is currently being pressed so that it is not necessary to continuously read the switches to determine if operator actions have taken place.

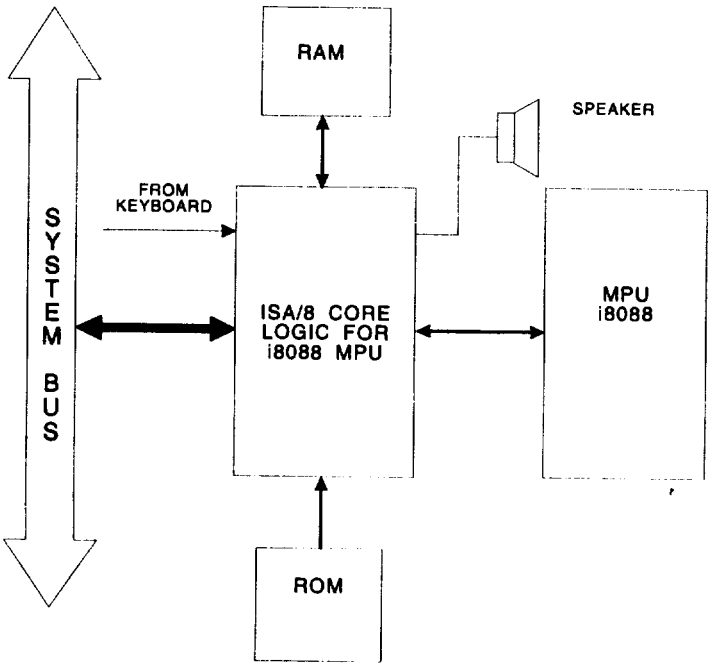


Figure 1-4. 1A2A3 Processor CCA Functional Block Diagram.

The front panel also has two continuous rotation optical encoders which are used for cursor control. Each of these encoders generate two clocks, the phasing of which is used to determine clockwise versus counter-clockwise rotation. These rotation detection clocks drive up/down counters which accumulate cursor rotation 'ticks' for processor access.

- ***Non-Volatile Memory SubSystem.*** Static RAMs are used to supply up to 1 Megabyte of memory which is battery protected to prevent data loss during instrument off periods. This memory is fully isolated from the system bus and is I/O mapped for access by means of address and data registers. Since most accesses will be sequential, the address register is self-incrementing with each data register access to minimize I/O operations and improve performance.
  Battery power for the RAMs comes from the power supply when the TS-4320 is powered ON, and the internal batteries when power is OFF. However, when the CCA is removed from the mainframe, power is supplied from a high capacity, low leakage capacitor on the CCA, which can preserve the memory for several minutes.

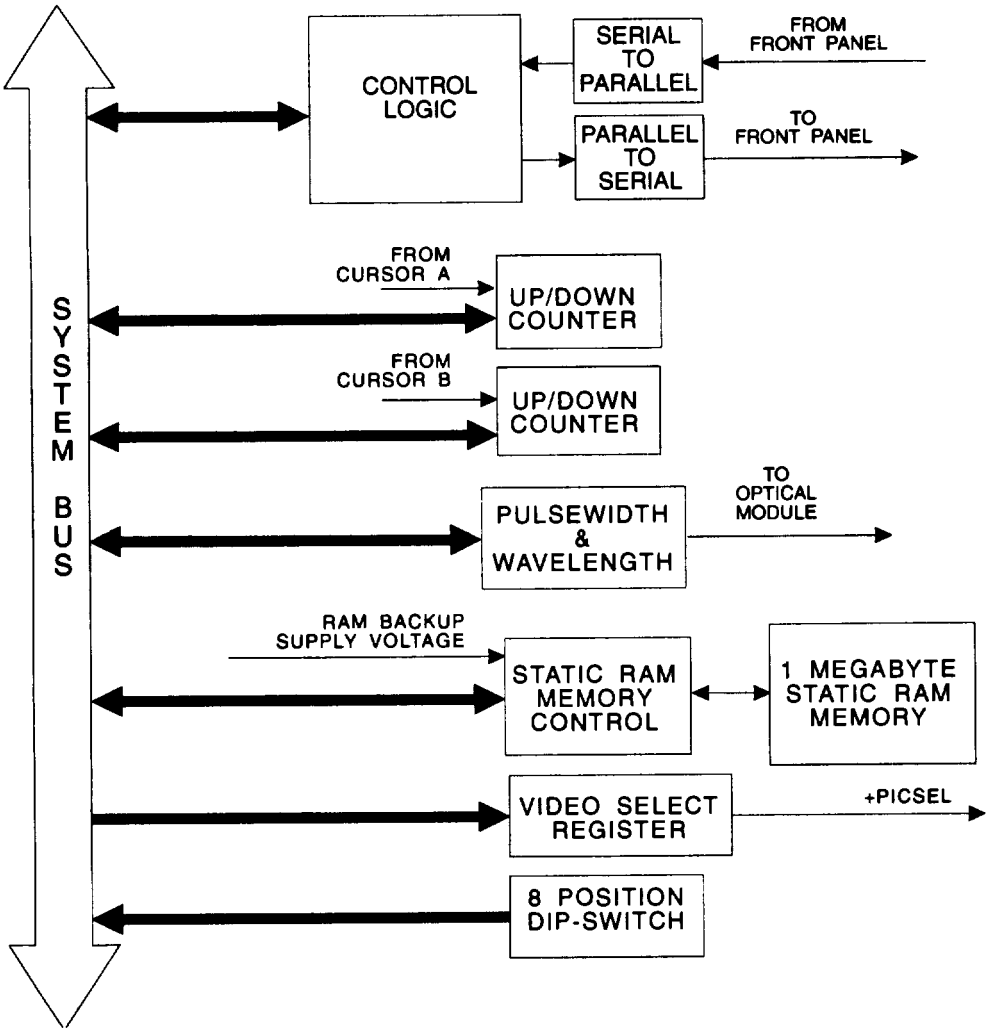


Figure 1-5. 1A2A5 SIO CCA Functional Block Diagram.

- ***Optical Module Laser Fire Condition Control.*** Several static bits link the SIO CCA with the optical module and are used to select the laser pulse width and the wavelength of the dual wavelength 285C module. These open collector outputs are pulled high locally through 47k ohm resistors. Input signals from the optical module which are used for identification are also pulled high via 47k ohm resistors.
- ***Video Select Register.*** This program controlled register generates the "+PICSEL" signal that selects the source of the video signal to drive the CRT Display. At the Backplane CCA, either 1A2A2 Bit Mapped Graphic Adapter video output or 1A2A6 Color Graphic Adapter video output is selected.

- ***Dip Switch Configuration Register.*** An eight position dip-switch is located on the SIO CCA and is readable by the processor to identify installed options and features. These switches are factory set and should not be altered in the field, except as directed by maintenance procedures.

e. ***1A2A1 Front Panel CCA.*** This CCA (fig. 1-6) provides mounting and electrical connection for the user controls and LEDs. Seventeen normally open momentary contact switches form the keyboard matrix. In addition to these 17 inputs, five phantom switches and two jumpers feed the inputs to a 24-bit parallel to serial converter which, under program control, feeds data to the 1A2A5 SIO CCA. Similarly, 24-bit serial data is received from the SIO and is used to drive the 14 visible, 5 unused, and 5 phantom LEDs. Unused inputs to the serializer are locally pulled high through 47k ohm resistors. Unused outputs are left open, although sufficient current limiting resistors are present in local resistor packs if required.

A 24-bit wide logical OR gate sense the condition of all switches and provides a constant indication to the 1A2A3 Processor CCA CPU (via the SIO CCA) if any key is pressed. The software must then upload the entire 24-bit stream to determine which key is pressed. The hardware does not prevent multiple key actuations, nor does it provide for key debounce. Key debounce is provided in software.

- ***Cursor A, Cursor B.*** These two continuous rotation optical encoders are mounted to and powered from the front panel CCA and are used for cursor control. The outputs from the encoders are phase altered pulse trains dependent on the direction of rotation. These signals are interpreted by the SIO board.

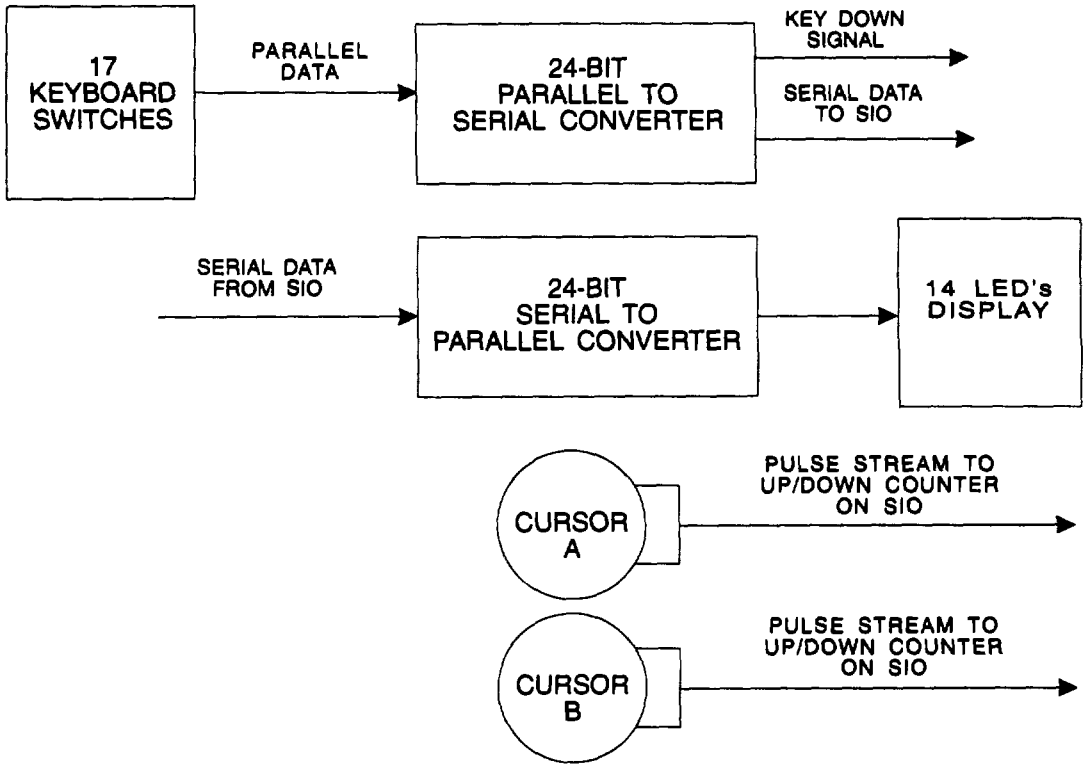


Figure 1-6. 1A2A1 Front Panel CCA Functional Block Diagram.

f. ***1A2A2 Bit Mapped Graphics Adapter CCA.*** This CCA (fig. 1-7) is one of two display controllers in the TS-4320 and provides high speed, high resolution graphics modes for trace display.

- ***Microprocessor.*** This independent Z80B microprocessor runs at 6 MHz to off load graphics function overhead from the 1A2A3 Processor CPU. Scalable character information is available to the Z80B, which translates incoming character strings into bit mapped graphics information.
- ***Read Only Memory (ROM).*** Contains the microprocessor Z80B operational program code.
- ***Random Access Memory (RAM).*** Used by the microprocessor Z80B as a scratch-pad memory.
- ***CRT Controller.*** This 6845 CRT timing controller is used to generate timing and synchronization and to manage the 128kbytes video display memory. As this is truly a graphics display controller, there is no character generator.
- ***Video Display Memory.*** The video display memory is logically organized to create four single bit planes of 512h by 512v pixels. The data from this memory is qualified by the dot clock and routed (in parallel) to the color mapping registers.

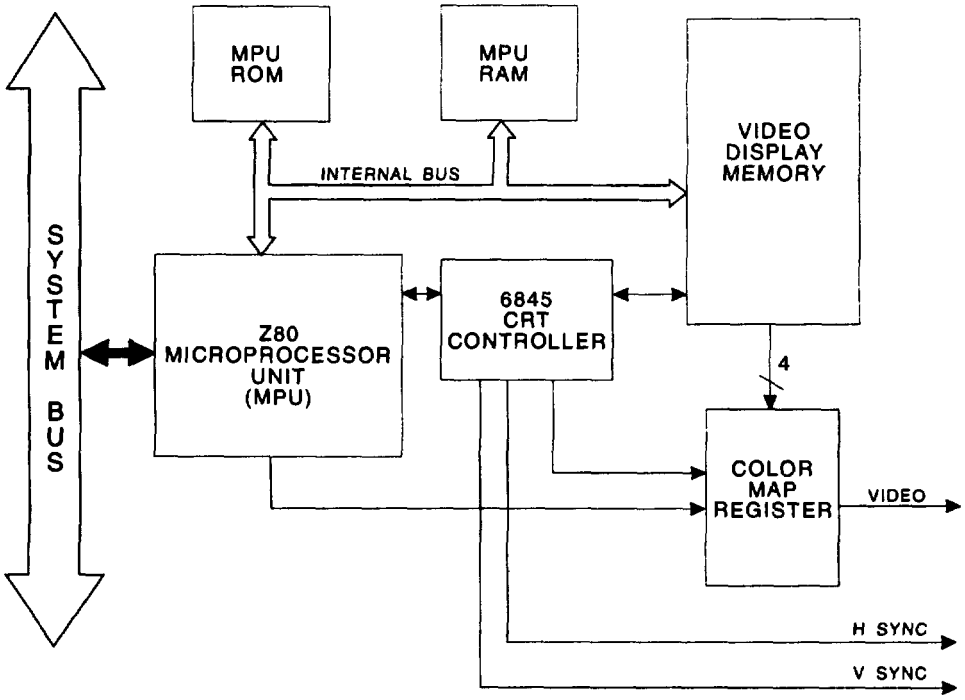


Figure 1-7. 1A2A2 Bit Mapped Graphics Adapter Functional Block Diagram.

- ***Color Mapping Register.*** Translates each 4-bit pixel into three 4-bit signals which are then passed to high speed digital to analog converters (DACs) to generate analog Red, Green, and Blue outputs. Since the internal display is not color, and since there is no need for a 4096 color palette on an instrument of this nature, the three 4-bit outputs are used differently.
  The video output is used to drive the internal monochrome monitor in 16 grayscales. All video outputs are passed through the video multiplexer, located on 1A2A11 Backplane CCA, which selects the active display source between these signals and the 1A2A7 Color Graphic Adapter CCA counterparts.

g. ***1A2A7 Color Graphics Adapter CCA.*** This CCA (fig. 1-8) is one of two display controllers in the TS-4320, and provides standard IBM PC compatible video modes at a hardware level. Based on the 6845 CRT timing controller, the CGA CCA contains the video memory which holds the information to be displayed, the character generator which is used to generate dot information in character modes, and all necessary timing and sync generation for display control.
  The board can also be placed into two different graphic display modes: 320h by 200v four-color pixels or 640h by 200v two-color pixels. (It should be noted that black is considered a color and that the two-color mode generates dots which are either on or off.)

- ***Video Display Memory.*** In character display modes, the display memory can be organized into four 80 character by 25 line display pages or eight pages that are 40 characters by 25 lines. In these modes, two bytes are used for each character; one byte for the character data and one byte for attribute information (i.e.: foreground/background colors and blanking).
- ***Attribute Control.*** The video output is fed to a video multiplexer, on 1A2A11 Backplane CCA, which is used to select which of the two display controllers is used to drive the CRT.

h. ***lA2A12 RAMCARD Interface CCA and 1A2A13 RAMCARD Driver CCA.*** These CCA's (fig. 1-9) make up the RAMCARD Subsystem. This subsystem provides the interface between the ROM/RAMCARD and the System Bus.
  The RAMCARD Driver provides the actual support circuitry for the RAMCARDs in a manner almost identical to the non-volatile Memory Subsystem on the 1A2A5 SIO CCA.

- ***RAMCARD Interface CCA.*** Although it does minimal address decoding, the CCA may best be thought of as an Extended Bus. It extends the system address, data, and control bus across the ribbon cable (1A2W7) to the 1A213 RAMCARD Driver CCA through the use of standard TTL buffers and transceivers. The minimal address decoding is done locally to minimize the number of signals which need to be carried between the two CCA's.
- ***RAM/ROMCARD Memory.*** This memory is fully isolated from the system bus and is I/O mapped for access by means of address and data registers.

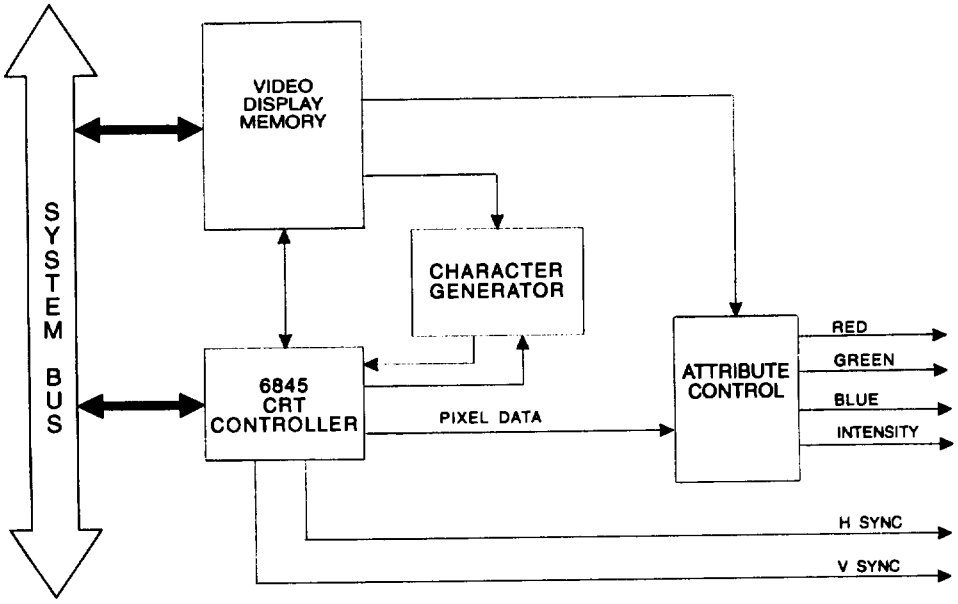


Figure 1-8. 1A2A7 Color Graphics Adapter CCA Functional Block Diagram.

- ***Address Generator.*** Twenty-two bits of address are used to support RAM/ROMCARD's up to 4 Megabytes (4 Meg by 8-bit). Since most accesses will be sequential, the lower 16-bits of the address register are self-incrementing with each data register access to minimize 1/O operations and improve performance.
- ***Red/Green LED.*** Indicates no light if the RAM/ROMCARD is not installed, Green if the RAM/ROMCARD is installed but not being accessed, and Red if the RAM/ROMCARD is being accessed (and should not be removed).
- ***RAMCARD Battery Low LED.*** Indicates the RAMCARD internal battery is low. The RAMCARD Driver provides power to the RAMCARD when the RAMCARD is installed. When a RAMCARD is removed, internal batteries preserve the contents of the RAM. When a RAMCARD is inserted into the TS-4320 and power is switched on, the TS-4320 supplies power to the RAMCARD. The RAMCARDs contain their own voltage monitors and its output is made available, via the Status Register, for read by the 1A2A3 Processor CCA.
- ***Internal Battery Low LED.*** The RAMCARD Driver monitors the condition of the TS-4320 Internal (non-volatile Memory) Battery Pack and indicates the low battery condition. It is important to note that this LED is only illuminated if the Internal Battery Pack is in a low voltage condition and the TS-4320 power is switched on. The Internal Low Battery signal is made available, via the Status Register, for read by the 1A2A3 Processor CCA.

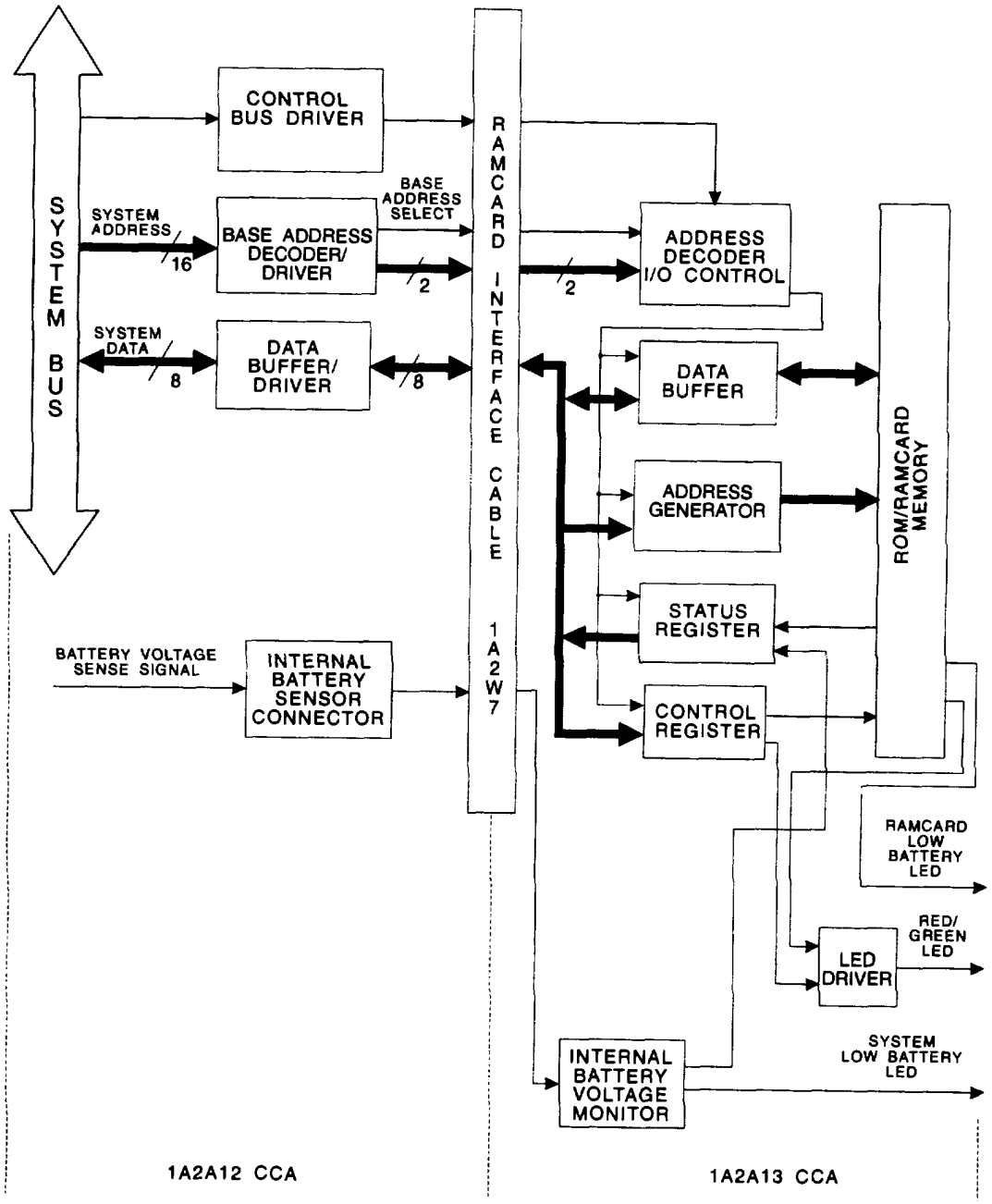


Figure 1-9. 1A2A12 RANCARD Interface CCA and 1A2A13 RAMCARD Driver CCA Functional Block Diagram.

i. ***1A2A6 General Input/Output (GIO) CCA.*** This CCA (fig. 1-10) provides five main functions:

- Floppy Disk Control for the Optional (Diagnostic) External Floppy Disk
- General Purpose Interface Bus (IEEE-488) Interface
- Serial (RS-232C) Interface
- Parallel (Centronics) Interface
- Real Time Clock

The floppy disk controller, serial interface, and parallel interface conform to the IBM PC/XT specification for such devices. There is no IBM or industry wide specification for GPIB interfaces or real time clocks. Each of these functional blocks is outlined below.

- ***Floppy Disk Control.*** Support for up to two floppy disk drives is provided by the WD37C65 (or equivalent) floppy disk controller (FDC). This interface is available at the back panel for connection to the Diagnostic Floppy Disk Drive. A VLSI device, the WD37C65, integrates the functionality of the CIPD765 floppy disk controller with all necessary support logic and transceivers to implement a dual floppy disk controller for IBM PC/XT use. The FDC utilizes system interrupt 6 and DMA channel 2.
- ***General Purpose Interface Bus (IEEE-488) Interface.*** An IEEE-488 GPIB interface is provided by a TMS-9914A (or equivalent). Connection to the IEEE488 Bus is buffered by 75160 and 75162 transceivers. The GPIB interface utilizes system interrupt channel 5 and does not use DMA.
- ***Serial (RS-232C) Interface.*** As specified by RS-232C, Data Terminal Equipment compatibility is provided by a WD8250B (or equivalent). Translation to RS-232 voltage levels is provided by a MAX-239 (or equivalent). The serial interface uses system interrupt channel 4 and does not use DMA. This serial port is equivalent to IBM PC/XT physical communications port 0, most typically referred to by its logical name COM1.
- ***Parallel (Centronics) Interface.*** A Standard IBM PC/XT style parallel interface is implemented using standard 74xxx logic devices. Logically identified as LPT1, this port utilizes interrupt channel 7.
- ***Real Time Clock.*** Clock and calendar functions are provided in software by the operating system but are seeded from a hardware Real Time Clock on the GIO CCA. This timekeeper, implemented by a DS1216E, has a self-contained battery with ten year life expectancy.

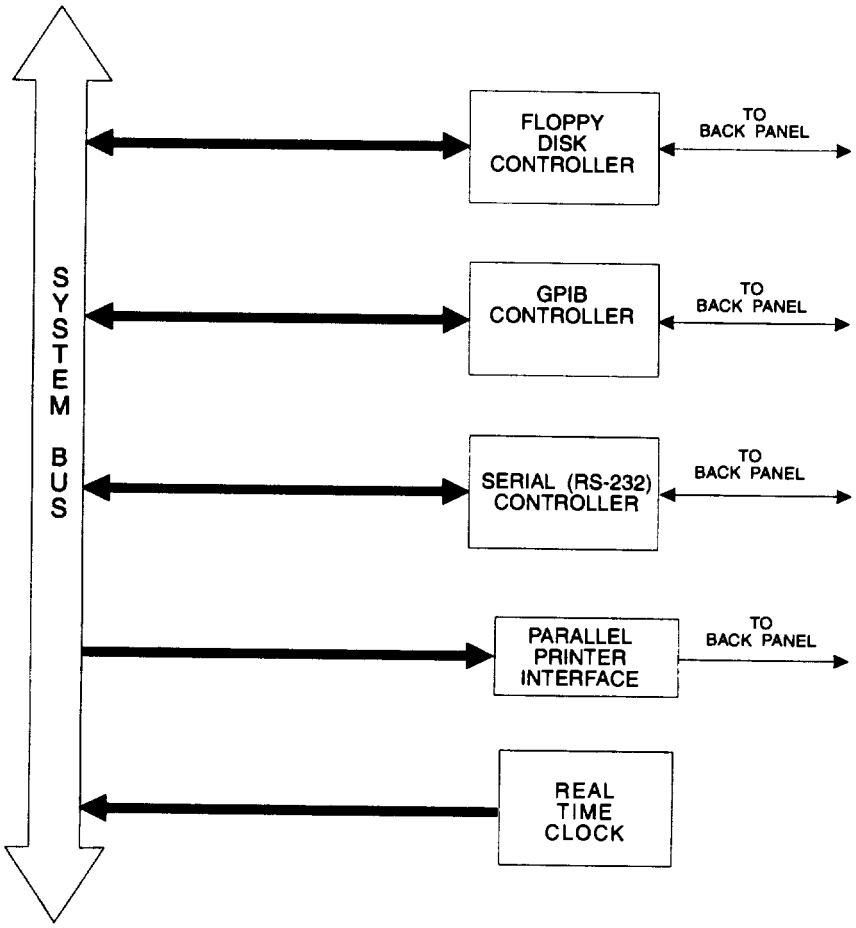


Figure 1-10. 1A2A6 GIO CCA Functional Block Diagram.

j. ***1A2A11 Backplane CCA.*** This CCA (fig. 1-11) is also referred to as the Motherboard, provides distribution of the system address, data, and control bus between the 1A2A2 Bit Mapped Graphic Adapter, 1A2A3 Processor, 1A2A4 Data Acquisition System, 1A2A5 Special Input/Output, 1A2A6 General Input/Output, 1A2A7 Color Graphics Adapter, and 1A2A12 RAMCARD Interface CCAs. Additionally, all interconnection between the assorted boards and the front and back panels are routed via the Motherboard. In fact, the Rear Panel CCA is an extension of the Motherboard which holds the instrument's rear panel connectors. The signals on the schematics of the Motherboard referring to 1A2A2 Bit Mapped Graphics Adapter are prefixed VSC for (Vectorscan).

- Digital/Analog Converter. The analog monochrome signal (Red, Green, Blue, and Intensity) from the 1A2A7 CGA is synthesized by a 4-bit DAC.

- ***Video Multiplexer.*** Determines which of the two video sources (CGA or VSC) is active (i.e.: being displayed). The VSC board provides three styles of output: composite video, TTL RGBI, and analog monochrome, which are used for the external composite video output connector, the external 9-pin monitor connector, and the internal monochrome monitor respectively. In the TS-4320, only the internal monochrome monitor video signal is used. The corresponding signals from each source are then multiplexed, the digital signals via a TTL mux and the analog signals via relays, and routed to their appropriate destinations. The control signal for the multiplexer (+PICSEL) is under processor control and originates on the SIO CCA.
- ***Battery Standby Power Control.*** Internal RAM Backup Supply Voltage has two sources, +12V Power Supply or Internal Battery Supply. When TS-4320 power is ON the +12V Power Supply is selected, when power is OFF the Internal Battery Supply is selected. In the TS4320 the Battery Charge logic has been removed.

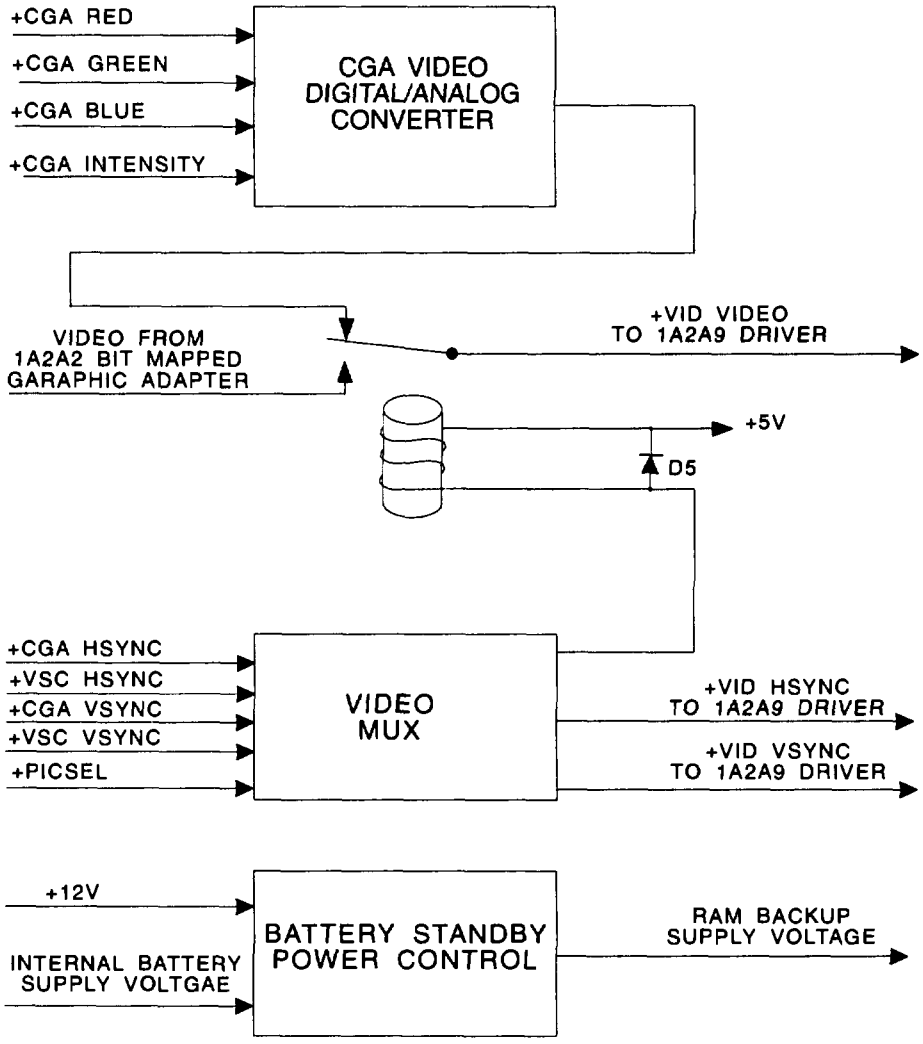


Figure 1-11. Backpanel CCA Functional Block Diagram.

CHAPTER 2
MAINTENANCE INSTRUCTIONS

Section I. REPAIR PARTS, SPECIAL TOOLS, TMDE AND SUPPORT EQUIPMENT

2-1. COMMON TOOLS AND EQUIPMENT.

Common tools and equipment required for general support maintenance of TS-4320(P)/G are listed in the Maintenance Allocation Chart (MAC), TM 11-6625-3271-12, Appendix B.

2-2. SPECIAL TOOLS, TMDE, AND SUPPORT EQUIPMENT.

Special tools, TMDE, and support equipment required for general support maintenance are listed in the Maintenance Allocation Chart (MAC), TM 11-6625-3271-12, Appendix B. Special tools are listed and illustrated in Repair Parts and Special Tools List (RPSTL), TM 11-6625-3271-24P.

2-3. REPAIR PARTS.

Repair parts are listed and illustrated in the Repair Parts and Special Tools List, TM 11-6625-3271-24P.

Section II. SERVICE UPON RECEIPT

2-4. SERVICE UPON RECEIPT OF MATERIAL.

a. Unpacking. Transit case provides maximum protection for TS-4320(P)/G. Avoid damaging transit case and inside material during equipment unpacking. Use the following steps for unpacking TS-4320(P)/G.

- Release latches and open transit case.
- Grasp Optical Time Domain Reflectometer (OTDR) firmly and lift vertically.
- Remove remaining items.
- Return transit case to supply system.

b. Check Unpacked Equipment.

- Inspect the equipment for damage incurred during shipment. If equipment has been damaged, report damage on SF 364, Report of Discrepancy (ROD).
- Check the equipment against packing slip to see if the shipment is complete. Report all discrepancies in accordance with the instructions of DA Pam 738750.
-

2-5. PRELIMINARY SERVICE AND ADJUSTMENT OF EQUIPMENT.

a. Verify Calibration Dates.

b. TS-4320(P)/G Initial Functional Checkout.

(1) Attach the external keyboard (para 2-29, TM 11-6625-3271-12).

(2) Refer to FO-2. Install Module Simulator CCA (tool 20, Appendix B, TM 11-6625-3271-12) onto Connector JM1.

(3) Perform Turn-on Procedure (para 2-7, TM 11-6625-3271-12).

- Turn POWER OFF.

2-5. PRELIMINARY SERVICE AND ADJUSTMENT OF EQUIPMENT - Continued.

(4) Set switches on the Module Simulator CCA as follows:

SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8
O	X	0	0	0	X	0	
O=Switch Open, X=Swltch Closed, *=don't care							

(5) Turn POWER ON and observe initialization sequence as follows:

(a) One or more front panel LEDs will light.

(b) Fan will turn on

- If the fan does not turn on, and/or no LEDs light, refer to items 27 through 29 in the Symptom Index.

(c) Display will come on and should display a self test message. (It may be necessary to adjust the brightness and contrast controls on the front panel.)

(d) At the completion of the self test (approx 10 seconds), the unit will beep.

- If the display does not illuminate, but the fan is running and one or more front panel LEDs are lit, listen carefully for the short beep after about 10 seconds. If no sounds are heard, refer to item 9 in Symptom Index. Most probable cause of failure is the 1A2A3 Processor CCA.

(e) After sounding the self test completion beep, the display should change to show that the unit is "Loading".

- If the self test does not complete and displays an error message, refer to items 3 through 5 in the Symptom Index.
- If the message "Stand-alone ROM Version not supported" is displayed, refer to para 2-7, TM 11-6625-3271-12.

(f) When loading is complete, the screen changes to read "TS-4320 OTDR Starting".

- If any condition other than TS-4320 OTDR Starting occurs, refer to items 6 through 17 in the Symptom Index.

2-5. PRELIMINARY SERVICE AND ADJUSTMENT OF EQUIPMENT - Continued.

(g) After the TS-4320 code initializes, the screen changes to the Instrument Configuration Screen, para 2-7, TM 11-6625-3271-12. Moments after the Optical Module is identified, the unit pauses, beeps twice, and displays the rest of the screen. The last line reads: "Press any main panel key to begin".

- If the Instrument Configuration Screen does not appear within 30 seconds, refer to items 14 and 16 in the Symptom Index.
- If the line "Press any main panel key to begin" fails to appear within 30 seconds after the Instrument Configuration Screen appears, or any other condition occurs, refer to items 18 through 26 in the Symptom Index.

(6) Verify that the Configuration screen reports that the TD-285C Optical Module is attached.

- If TD-285C is not identified as the attached module, refer to item 24 in the Symptom Index.

(7) Press any key on the main panel.

(a) The unit emits a short beep when the key is pressed and the display changes to the Trace Display Screen, para 2-7, step 11, TM 11-6625-3271-12.

- If nothing happens when the key is pressed, try a different key. If none or only some keys work, refer to items 36 through 37 in the Symptom Index.

(8) Set the distance range to 128km and the resolution to 8 meters, para 2-27, TM 11-6625-3271-12.

(9) Set the pulse width to LONG, and press the REAL TIME key.

(a) The LASER ON indication will light and the unit should begin to display a trace similar to that shown in step 18 of para 2-42,

- If no trace is displayed, or the trace does not resemble the illustration, refer to item 34 in the Symptom Index.

(10) Press the FAST SCAN key and wait for the scan to complete.

(a) The LASER ON indicator will show the averages that are accumulating, followed by the WORKING indicator, which extinguishes after several seconds.

2-5. PRELIMINARY SERVICE AND ADJUSTMENT OF EQUIPMENT - Continued.

(11) Verify the operation of the two cursor knobs.

(a) Cursor movement should be smooth; the cursors should track the knob movements, although they will lag slightly from knob activity.

- If the cursors do not move smoothly and track the motion of the knobs, refer to item 40 in the Symptom Index.

(12) Verify the operation of the remaining front panel keys by pressing keys and insuring that the appropriate action is taken.

- It is not important to note the different loss values; only that the Loss Mode cycles when the key is pressed.

(13) Format a blank (or erasable) RAMCARD (Appendix B, item 4), para 2-23, TM 11-6625-3271-12.

- If the format fails, refer to item 30 in the Symptom Index.

(14) Save the trace image to the RAMCARD, para 2-16, TM 11-6625-3271-12. The filename will be used again in step 16.

- If the external keyboard does not allow entry of the filename, or the data is entered incorrectly, refer to item 39 in the Symptom Index.

- If the save fails, refer to item 30 in the Symptom Index.

(15) Remove the RAMCARD and cycle the unit's power to restart the instrument.

(16) Insert the RAMCARD and recall the trace you saved in step 14, para 2-17, TM 11-6625-3271-12.

(a) The recalled trace should look identical to the trace saved earlier.

- If the trace fails to recall, or is different than the trace stored, refer to item 30 in the Symptom Index.
-

c. The basic functions of the TS-4320 have now been verified. If no trouble has been found to this point, refer to the unit's DA 2402 or DA 2407 to establish if the problem involves any of the following:

- Can't print or plot to serial printer/plotter (Symptom 32).
- Can't print or plot to parallel printer/plotter (Symptom 31).
- Can't print or plot to GPIB Device (Symptom 31).
- Real Time Clock/Calendar (Time-of-day Clock) incorrect (Symptom 41).

d. Complete Performance Tests (para 2-56).

Section III. TROUBLESHOOTING

SYMPTOM INDEX

TS-4320(P)/G Page
Symptom

SYMPTOM INDEX - Continued.

TS-4320(P)/G Page
Symptom

SYMPTOM INDEX - Continued.

TS-4320(P)/G Page
Symptom

2-6. GENERAL.

Troubleshooting at the general support maintenance level requires you to locate any malfunction as quickly as possible. The amount of troubleshooting you can do is defined by the Maintenance Allocation Chart. Because of this, the only trouble symptoms you will find here are those that could be caused by faulty items you can repair.

NOTE

- **Before using the troubleshooting table, check your work order and talk to unit maintenance, if possible, for a description of the symptoms and the steps that have been taken to correct them.**

- **Check all forms attached to, or accompanying, the equipment to determine the reason for removal from service.**

2-7. TROUBLESHOOTING GUIDELINES.

The following is a list of aids that you can use when troubleshooting the TS-4320(P)/G:

a. The TS-4320(P)/G has built-in self tests and diagnostics that are used in troubleshooting. A self-test is automatically initiated at power-up and can be initiated manually from the Data Entry Keyboard by pressing Ctrl/Alt/Del.

2-7. TROUBLESHOOTING GUIDELINES - Continued.

b. Refer to the principles of operation, Chapter 1, Section III as required. This provides circuit theory of the section you are troubleshooting with references to the functional block diagrams and schematic diagrams. The TS-4320 Functional Block Diagram is located on figure FO-1. The TS-4320 Assembly and Cable Locator Diagram is located on figure FO-2. Assembly component locator diagrams and schematic diagrams for repairable assemblies are located on figures FO-3 through FO-15.

c. OTDRs that have been in service for a while may display problems caused by corrosion. Sometimes removing and reseating the affected plug-in assembly or cable will correct a malfunction. Cleaning connector pins with alcohol (Appendix B, item 1) will repair many types of malfunctions.

d. For microcircuit and connector orientation, pin one is identified on a printed circuit card by a "1" or a square solder pad. For cable connectors, an arrow identifies pin one.

e. Perform Turn-on Procedure (para 2-7, TM 11-6625-3271-12).

2-8. EQUIPMENT INSPECTION.

The following inspection procedures shall be used to locate obvious malfunctions with the TS-4320(P)/G.

a. Inspect all external surfaces of the TS-4320(P)/G for physical damage, breakage, loose or dirty contacts, and missing components.

WARNING

Hazardous voltages are present when covers are removed.

Where maintenance can be performed without having power applied, power should be removed.

WARNING

Lethal, charged-CRT voltages may be present on the CRT Anode for some time after power is removed.

CAUTION

Do not disconnect or remove any CCA in the TS-4320(P)/G unless the instrument is turned to OFF. Some CCAs contain devices that can be damaged if the CCA is removed when the power is ON. Several components, including MOS devices, can be damaged by electrostatic discharge. Always use conductive foam and grounding straps when servicing the TS-4320(P)/G.

2-8. EQUIPMENT INSPECTION - Continued.

b. Remove top cover (para 2-63) to gain access to components.
c. Inspect CCA surfaces for discoloration, cracks, breaks, and warping.
d. Inspect CCA runs for breaks, cracks, cuts, erosion, or looseness.
e. Inspect all CCAs for burnt or loose components.
f. Inspect all chassis-mounted components for looseness, breakage, loose contacts or conductors.
g. Inspect TS-4320(P)/G for disconnected, broken, or frayed cables or wires.

2-9. ERROR MESSAGE.

The TS-4320(P)/G uses error messages to indicate system faults. The SELF TEST software routines that generate error messages are initiated at instrument turn-on or can be initiated manually from the Data Entry Keyboard by pressing Ctrl/Alt/Del. If multiple error messages appear, troubleshoot them in a logical sequence.

2-10. TROUBLESHOOTING TABLE.

Table 2-1 lists common malfunctions which may be found during operation or maintenance of the TS-4320(P)/G. Perform the TEST OR INSPECTION steps under a MALFUNCTION in the order listed. After replacing/repairing an assembly during a test procedure or CORRECTIVE ACTION, verify malfunction is cleared and perform Performance Test (para 2-56).

NOTE

- **Perform adjustments after replacing 1A2A8 or 1A2A9 CCA (table 2-2).**
- **TTL low logic level is 0.0 to +0.8 VDC; TTL high logic level is +2.0 to +7.0 VDC.**

Table 2-1. Troubleshooting.

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
1. UNABLE TO BOOTLOAD FROM INTERNAL CMOS RAM. The following error message is displayed: **Stand-alone ROM version not supported.** Loading Failed!! Insert TS-4320 System Card. Step 1. Check INTERNAL BATTERY indicator beneath the RAMCARD insertion slot. If ON: • Replace internal batteries, TM 11-6625-3271-12 (para 3-12). • If still ON, go to Malfunction 21.

Table 2-1. Troubleshooting - Continued.

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

1. UNABLE TO BOOTLOAD FROM INTERNAL CMOS RAM - Continued.

   Step 2. Perform Initial Loading of Operating Software, TM 11-6625-3271-12 (para 3-5.c).

   Step 3. After TS-4320 loads, remove PROGRAMMED ROMCARD, set POWER switch to OFF and wait for 60 minutes.

   Step 4. If after 60 minutes TS-4320 does not load from internal CMOS RAM, go to step 5.

   - If loading is complete, TS-4320 is functional.

   Step 5. Perform System Backup Battery Test (para 2-14).
   Step 6. Perform 1A2W9 Storage Battery Lead Test (para 2-15).
   Step 7. Perform Storage Battery Voltage Test at 1A2A5 (para 2-16).
   Step 8. Perform ROM/RAMCARD Test Setup (para 2-18).
   Step 9. Perform ROM/RAMCARD Light/Status Test (para 2-19).
   Step 10. Perform ROM Data and Address Test (para 2-20).
   Step 11. Perform RAMCARD CCA Test (para 2-21).
   Step 12. Perform 1A2A5 SIO CCA Test (para 2-51).

2. UNABLE TO BOOTLOAD FROM PROGRAMMED ROMCARD.

   The following error message is displayed:

   Stand-alone ROM version not supported.
   Loading Failed!!
   Insert TS-4320 System Card.

   Step 1. Insert ROM Card Diagnostic CCA (tool 23, Appendix B, TM 11-6625-3271-12) and retry bootload.

   - If Diagnostic ROMCARD loads, replace PROGRAMMED ROMCARD.

   Step 2. Perform ROM/RAMCARD Test Setup (para 2-18).
   Step 3. Perform ROM/RAMCARD Light/Status Test (para 2-19).
   Step 4. Perform ROM Data and Address Test (para 2-20).
   Step 5. Perform RAMCARD CCA Test (para 2-21).
   Step 6. Perform 1A2A5 SIO CCA Test (para 2-51).

3. ERROR MESSAGE "MEMORY SIZE ERROR".

   - Replace 1A2A3 Processor CCA (para 2-67).

4. ERROR MESSAGE "BAD CHECKSUM".

   - Replace 1A2A3 Processor CCA (para 2-67).

5. ERROR MESSAGE "BAD ADDRESS LINE".

   - Replace 1A2A3 Processor CCA (para 2-67).

Table 2-1. Troubleshooting - Continued.

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

6. BLANK SCREEN.
   - Step 1. If nothing is displayed, rotate Brightness and Intensity Knobs full clockwise.
     - If same symptom occurs, go to step 2.
     - If symptom changes, go to Symptom Index.
   - Step 2. Remove 1A2A2, 1A2A4 (para 2-66), 1A2A6 (para 2-65), 1A2A8 (para 2-64), and 1A2A12 (para 2-68) CCAs.
   - Step 3. Power up.
     - Verify Raster - adjust R165 clockwise. (FO-11)
     - If Power-On Self Test is displayed, go to step 4.
     - If raster does not appear, go to step 5.
     - If raster appears, go to step 6.
   - Step 4. Power down and reinstall each of the removed CCAs (1A2A2, 1A2A4, 1A2A6, 1A2A8, and 1A2A12) in turn, and power up to see if the Blank Screen malfunction returns. Power down before reinstalling the next CCA. Replace faulty CCA.
   - Step 5. Perform 1A2A9 CRT Driver CCA 12 Volt DC Test (para 2-54).
   - Step 6. Perform 1A2A9 CRT Driver CCA Test. (para 2-32).
     - If signals are as shown in the test, go to step 8.
     - If signals are not as shown, go to step 7.
   - Step 7. Refer to FO-13, sheet 1 of 6. Disconnect P35 from 1A2A11 CCA and perform 1A2A9 CRT Driver CCA Test again, but observe signals at J35.
     - If signals are as shown in the test, replace 1A2A9 Electron Tube Assembly (para 2-72).
     - If signals are bad, go to step 9.
   - Step 8. Check for raster on the screen.
     - If present, replace 1A2A9 Electron Tube Assembly (para 2-72).
     - If not present, go to step 11.
   - Step 9. Perform 1A2A7 Color Graphics Adapter CCA Test (para 2-34).
     - If OK, replace 1A2A11 CCA (para 2-80).
     - If "PICSEL" is the only failing signal, go to step 10.
   - Step 10. Perform 1A2A2 Bit Mapped Graphics Adapter CCA Test (para 2-35).
     - If signals are as shown, replace 1A2A11 CCA (para 2-80).
     - If signals are not as shown, replace 1A2A2 CCA (para 2-66).
   - Step 11. Perform Video Select Enable Test (para 2-36).
     - If meter reads less than than 2 ohms, replace 1A2A5 CCA (para 2-65).
     - If meter reads 2 ohms or more, replace 1A2A11 CCA (para 2-80).

Table 2-1. Troubleshooting - Continued.

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

6. BLANK SCREEN - Continued.
   Step 12. Perform Brightness Control Test (para 2-53).
   - If resistances are within tolerance, replace 1A2A9 Electron Tube Assembly (para 2-72).
   - If not within tolerance, replace Display Brightness Control (para 2-70).
7. GREEN SCREEN WITH RASTER, FLYBACK LINES, FOLLOWED BY LOGO AND INSTRUMENT CONFIGURATION SCREEN.
   Perform 1A2A7 Color Graphics Adapter CCA Test (para 2-34).
   - If no fault is found, replace 1A2A11 CCA (para 2-80).
8. GARBLED TEXT, VERTICAL LINES, THEN LOGO AND PROPER INSTRUMENT CONFIGURATION SCREEN.
   Perform 1A2A7 Color Graphics Adapter CCA Test (para 2-34).
   - If no fault is found, replace 1A2A11 CCA (para 2-80).
9. STOPS WITH ONLY COPYRIGHT TEST, "Power-on Self Test" AND LINE GRAPH DISPLAYED.
   - Replace 1A2A3 Processor CCA (para 2-67).
10. STOPS LOAD FROM CMOS RAM AFTER DISPLAYING "Power-on Self Test", LINE GRAPH, AND "LOADING"; BEEPER SOUNDS.
    - Replace 1A2A5 CCA (para. 2-65)
11. LOADS FROM PROGRAMMED ROM CARD; RAMCARD STATUS READY/IN USE LED NOT OPERATIVE.
    - Replace 1A2A13 RAMCARD Driver (para 2-74).
12. STOPS LOAD FROM PROGRAMMED ROMCARD AFTER DISPLAYING "Power-on Self Test", LINE GRAPH, AND "LOADING"; BEEPER SOUNDS.
    Step 1. Perform ROM/RAMCARD Test Setup (para 2-18).
    Step 2. Perform ROM/RAMCARD Light/Status Test (para 2-19).
    Step 3. Perform ROM Data and Address Test (para 2-20).
    Step 4. Perform RAMCARD CCA Test (para 2-21).
    Step 5. Perform 1A2A5 SIO CCA Test (para 2-51).
13. STOPS LOAD FROM PROGRAMMED DISK AFTER DISPLAYING "Power-On Self Test", LINE GRAPH, AND "Loading"; BEEPER SOUNDS.
    Perform 1A2A6 General Input/ Output CCA to 1A2A11 CCA Test (para 2-37).

Table 2-1. Troubleshooting - Continued.

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

14. LOAD STOPS WITH "TS-4320 OTDR STARTING Please Wait" DISPLAYED.
    Step 1. Perform 1A2A2 Bit Mapped Graphics Adapter CCA Test (para 2-35).
    - If signals are not as shown, replace 1A2A2 CCA (para 2-66).

    Step 2. Perform 1A2A5 SIO CCA Test (para 2-51).

15. LOAD STOPS WITH LOGO DISPLAYED.
    - Replace 1A2A2 CCA (para 2-66).

16. LOGO NOT DISPLAYED AFTER "TS-4320 OTDR STARTING" MESSAGE.
    Perform 1A2A2 Bit Mapped Graphics Adapter CCA Test (para 2-35).

17. SYSTEM BEEPER DOES NOT SOUND.
    Perform 1A2A3 Processor CCA Beeper Driver and Beeper Test (para 2-45).

18. SYSTEM BOARD SELF-TEST FAILS.
    - Replace 1A2A5 CCA (para 2-65).

19. LASER MODULE INTERFACE SELF-TEST FAILS.
    - Replace 1A2A5 CCA (para 2-65).

20. EXPANSION INTERFACE SELF-TEST FAILS.
    - Replace 1A2A5 CCA (para 2-65).

21. "System Battery Status: LOW".
    Check "INTERN BATT LOW" indicator.
    - If OFF, perform System Backup Battery Test (para 2-14).
    - Replace internal batteries, TM 11-6625-3271-12 (para 3-12).

22. "No Optical Module Attached" AND CONSTANT BEEPER.
    - Install Optical Module.

23. LOAD STOPS WITH NO MODULE IDENTIFIED.
    Step 1. Remove Top Cover (para 2-63).
    Step 2. Refer to FO-6. Turn TS-4320(P)/G ON and observe the following sequence in lighting of LEDs D1 - D4.

D1	D2	D3	D4
ON	OFF	OFF	OFF
OFF	OFF	OFF	OFF
OFF	ON	ON	ON
OFF	OFF	ON	OFF

    - If sequence differs, replace 1A2A4 CCA (para 2-66).

Table 2-1. Troubleshooting - Continued.

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

24. INCORRECT MODULE IDENTIFIED.
    - Reseat optical module.
    - Replace optical module.

    Perform 1A2A5 Special Input/Output Module CCA Interface Test (para 2-38).

25. "TD-488 GPIB Interface" NOT LISTED AS ATTACHMENT.

    Replace 1A2A6 CCA (para 2-65).

26. "Press Any Main Panel Key To Begin" IS NOT DISPLAYED ON LAST LINE.

    If no indication, perform 1A2A4 Data Acquisition System CCA test (para 2-40).
    - If faulty, replace 1A2A4 CCA (para 2-66).

27. FAN INOPERATIVE.
    - Replace 1A2APS1 Power Supply Assembly (para 2-71).

28. FAN INOPERATIVE AND FRONT PANEL LEDs DO NOT LIGHT.

    Step 1. Set POWER switch to OFF and verify AC Line voltage and rear panel fuse.
    - Select correct AC Line voltage and/or replace rear panel fuse as required.

    Step 2. Set POWER switch to ON.
    - If rear panel fuse opens a second time, replace 1A2PS1 Power Supply Assembly (para 2-71).
    - If rear panel fuse is OK, go to step 3.

    Step 3. Perform 1A2APS1 Power Supply Test With Supply Disconnected (para 2-12).
    - If voltages are present but incorrect, replace 1A2PS1 Power Supply (para 2-71).
    - If voltages are proper, go to step 4.
    - If voltages are missing, go to step 12.

    Step 4. Refer to FO-2. Disconnect 1A2W1 from 1A2A1 and the cable from J101 on 1A2A9

    Step 5. Remove from 1A2A11 Backplane Assembly:

    1A2A2 and 1A2A4 - para 2-66
    1A2A5 and 1A2A6 - para 2-65
    1A2A3 - para 2-67
    1A2A12 - para 2-68
    1A2A7 - para 2-69
    1A2A10 - para 2-75

    Step 6. Perform 1A2PS1 Power Supply Test With Supply Installed (para 2-11).
    - If bad, go to step 11.

Table 2-1. Troubleshooting - Continued.

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

28. FAN INOPERATIVE AND FRONT PANEL LEDs DO NOT LIGHT - Continued.
    - Step 7. Set POWER switch to OFF.
    - Step 8. Reinstall the CCAs removed from 1A2A11 in step 5 one at a time in reverse order. Set POWER switch to ON and check corrective actions after installing each CCA.
        - If fan stops running, replace CCA that was just installed.
        - If fan runs with all boards installed, set POWER to OFF and go to step 9.
        - If fan continues running, set POWER to OFF and install next CCA.
    - Step 9. Reconnect the cable removed from J101 on 1A2A9 Driver CCA in step 4 and set POWER to ON.
        - If fan does not run, replace 1A2A9 (para 2-72).
    - Step 10. Set POWER to OFF and connect 1A2W1 to 1A2A1. Then set POWER to ON.
        - If fan does not run, replace 1A2A1 (para 2-76).
    - Step 11. With the CCA's still removed, perform 1A2A11 Backplane Assembly Voltage Resistance Test (para 2-13).
    - Step 12. Perform 1A2W5 Power Switch Test (para 2-52).
        - If good, replace 1A2PS1 Power Supply (para 2-71).

29. TS-4320(P)/G NOT OPERATING WHEN CONNECTED TO DC/AC INVERTER.
    - Step 1. On TS-4320, check fuse and verify voltage selection wheel set for 120 VAC.
        - Adjust voltage selection wheel if required, TM 11-6625-3271-12 (para 3-7).
    - Step 2. On TS-4320, verify AC cable connection.
        - Make necessary connections.
    - Step 3. On DC/AC Inverter, check to see if fuses are blown or broken.
        - Replace faulty fuses, TM 11-6625-3271-12 (para 3-8).
    - Step 4. On DC/AC Inverter, verify DC Power Cable connection.
        - Install DC cable correctly.
        - If correct, perform Inverter Static Power Test Procedure (para 2-55).

30. ERROR MESSAGE "Media Error" WHEN ACCESSING RAMCARD.
    - Step 1. Remove RAMCARD and replace with another.
        - If fault persists, go to step 2.
    - Step 2. Perform ROM/RAMCARD Test Setup (para 2-18).
    - Step 3. Perform ROM/RAMCARD Light/Status Test (para 2-19).
    - Step 4. Perform ROM Data and Address Test (para 2-20).
    - Step 5. Perform RAMCARD CCA Test (para 2-21).

Table 2-1. Troubleshooting - Continued.

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

31. GPIB NOT FUNCTIONAL.
    - Step 1. Perform GPIB Interface Test (para 2-49).
    - Step 2. Perform 1A2A6 General Input/Output CCA to 1A2All CCA Test (para 2-37).
    - Step 3. Perform GPIB Circuit At 1A2A10 Rear Panel Assembly Test (para 2-47).
        - If test passes, replace 1A2A6 (para 2-65).

32. RS-232 PORT DOES NOT FUNCTION.
    - Step 1. Perform RS-232 Interface Test (para 2-50).
        - If test passes, check RS-232 equipment.
    - Step 2. Perform 1A2A11 Backplane CCA Assembly, Serial I/O Test (para 2-48).
        - If test passes, replace 1A2A6 (para 2-65).

33. CANNOT LOAD DIAGNOSTIC SOFTWARE WITH DISK DRIVE UNIT (tool 18, Appendix B, TM 11-6625-3271-12) CONNECTED TO EXT DISK PORT.
    Perform 1A2A6 General Input/Output CCA to 1A2A11 CCA Test (para 2-37).
        - If test passes, replace 1A2A10 Rear Panel Assembly (para 2-75).

34. BAD TRACE
    - Step 1. Install an alternate optical module from the same system.
        - If the alternate optical module produces a good trace, send original optical module to next higher level of maintenance.
    - Step 2. Perform Analog Interface Module Test (para 2-42).
    - Step 3. Perform 1A2A4 Data Acquisition System CCA Test (para 2-40).
    - Step 4. Perform 1A2A4 Data Acquisition System CCA Module Interface Test (para 2-41).
    - Step 5. Perform Adjust 1A2A8 A/D CCA Chip Rail Voltage (para 2-59).
    - Step 6. Perform Adjust 1A2A8 A/D CCA Center Voltage (para 2-60).
    - Step 7. Perform Adjust 1A2A8 A/D CCA Offset Voltage (para 2-61).

35. DISPLAYED TRACE IS IRREGULAR (NON-LINEAR).
    - Step 1. Perform 1A2A4 Data Acquisition System CCA Test (para 2-40).
    - Step 2. Perform 1A2A4 Data Acquisition System CCA Module Interface Test (para 2-41).
    - Step 3. Perform Analog Interface Module Test (para 2-42).
    - Step 4. Perform 1A2A4 DAS CCA to 1A2A8 A/D Converter CCA Interconnect Test (para 2-43).

36. MULTIPLE OR PARTIAL FIBER SCAN TRACES ON DISPLAY.
    Perform Analog Interface Module Test (para 2-42).

Table 2-1. Troubleshooting - Continued.

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

37. INACCURATE DISTANCE MEASUREMENT BETWEEN TWO FEATURES.
    Perform 1A2A4 Data Acquisition System Oscillator Test (para 2-39).
    - If test passes, notify next level of maintenance.

38. UNABLE TO SAVE OR RECALL TRACES FROM RAMCARD.
    Step 1. Perform ROM/RAMCARD Test Setup (para 2-18).
    Step 2. Perform ROM/RAMCARD Light/Status Test (para 2-19).
    Step 3. Perform ROM Data and Address Test (para 2-20).
    Step 4. Perform RAMCARD CCA Test (para 2-21).

39. KEYBOARD DATA ENTRY ERRORS.
    Step 1. Set POWER to OFF.
    Step 2. Insert ROM Card Diagnostic CCA (tool 23, Appendix B, TM 11-6625-3271-12).
    Step 3. Set POWER to ON.
    Step 4. Press 7 on the keyboard to select Keyboard Test.
    Step 5. Press keys and verify proper character is displayed.
    - Replace keyboard if errors are found.

    Step 6. Perform Keyboard Entry Data Line Test (para 2-46).
    - If all checks are good, replace keyboard.

40. INOPERATIVE FRONT PANEL KEY.
    Step 1. Perform 1A2A1 Front Panel CCA Key Test (para 2-28).
    Step 2. Perform Front Panel Diagnostic Setup (para 2-29).
    Step 3. Perform 1A2A1 Front Panel CCA Key Signals Test (para 2-30).
    Step 4. Perform 1A2A1 Front Panel CCA Serial Signals Test (para 2-31).

41. UNABLE TO SET INTERNAL CLOCK.
    - Replace 1A2A6 CCA (para 2-65).

42. SOME, BUT NOT ALL FRONT PANEL INDICATORS LIGHT.
    Perform 1A2A1 Front Panel CCA LED Test (para 2-27).
    - If all LEDs are not cycled ON and OFF, replace 1A2A1 Front Panel CCA (para 2-76).

43. NO FRONT PANEL INDICATORS LIGHT.
    Step 1. Perform 1A2A1 Front Panel CCA Voltage Test (para 2-24).
    - If voltage is correct, go to step 2.
    - If voltage is incorrect, go to step 3.

Table 2-1. Troubleshooting - Continued.

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

43. NO FRONT PANEL INDICATORS LIGHT - Continued.
    Step 2. Perform 1A2A1 Front Panel CCA LEDSET Signal Test (para 2-25).
    - If all Front Panel LEDs do not light and pulse is not present, replace 1A2A5 CCA (para 2-65).

    Step 3. Perform 1A2W1 Front Panel Cable Assembly Test (para 2-26).
    - If continuity test fails, replace Cable Assembly 1A2W1.

    Step 4. Perform Front Panel Diagnostic Setup (para 2-29).
    Step 5. Perform 1A2A1 Front Panel CCA Key Signals Test (para 2-30).
    Step 6. Perform 1A2A1 Front Panel CCA Serial Signals Test (para 2-31).

2-11. 1A2PS1 POWER SUPPLY TEST WITH SUPPLY INSTALLED.

DESCRIPTION

This test is used to measure the +5, -5, and +12 voltages with power supply installed.

1. On TS-4320:
   - Set POWER to OFF.
   - Remove top cover (para 2-63).
2. Refer to FO-2. Connect the ground lead of the oscilloscope to wire ground strap.
3. Set POWER to ON.
4. Refer to FO-13, sheet 1 of 6. Using an oscilloscope, verify the following supply voltages:

SUPPLY VOLTAGE	OSCILLOSCOPE (+) LEAD	READING
+5 V	+ lead of C5	+4.75 to +5.25 V with < 100mv of ripple
+12 V	+ lead of C9	+11.50 to +12.50 V with < 120mv of ripple

   - If voltage is not as specified, the Power Supply must be replaced (para 2-71).
5. Remove power and disconnect test equipment.
6. On TS-4320:
   - Set POWER to OFF.
   - Reinstall top cover.

2-12. 1A2PS1 POWER SUPPLY TEST WITH SUPPLY DISCONNECTED.

DESCRIPTION

This test is used to measure the +5, -5, and +12 voltages with power supply disconnected.

1. On TS-4320:

   - Set POWER to OFF.
   - Remove top cover (para 2-63).
   - Loosen Power Supply to access P25 (para 2-71).
   - Refer to FO-13, sheet 1 of 6. Disconnect Power Supply connector P25 from backplane J25.
   - Set POWER to ON.

2. Using a Multimeter, verify the following supply voltages:

-METER LEAD	+ METER LEAD	VOLTAGE
P25-4	P25-7	+4.75 to +5.25
P25-11	P25-2	+11.05 to +12.5

   - If voltage is not as specified, the Power Supply must be replaced (para 2-71).

3. Remove power and disconnect test equipment.
4. On TS-4320:

   - Set POWER to OFF.
   - Reconnect Power Supply connector P25.
   - Reinstall top cover.

2-13. 1A2A11 BACKPLANE CCA ASSEMBLY RESISTANCE TEST.

DESCRIPTION

This test is used to measure the resistance of the backplane assembly voltage circuits.

1. On TS-4320:

   - Set POWER to OFF.
   - Remove top cover (para 2-63).
   - Refer to FO-13, sheet 1 of 6. Disconnect Power Supply connector P25 from backplane J25.

2-13. 1A2A11 BACKPLANE CCA ASSEMBLY RESISTANCE TEST - Continued.

2. Using a Multimeter, verify the following resistances:

NOTE
Allow 10 seconds for readings to stabilize

- METER LEAD	+ METER LEAD	RESISTANCE
J25-1	J25-7	> 200 Ω
J25-1	J25-2	<1 Ω
J25-1	J25-3	> 500 Ω

- If any measurement is not as specified, replace 1A2A11 Backplane Assembly(para 2-80).
- If all measurements are correct, replace 1A2PS1 Power Supply (para 2-71).

3. Disconnect test equipment.
4. On TS-4320:

- Reconnect Power Supply connector P25.
- Reinstall top cover.

2-14. SYSTEM BACKUP BATTERY TEST.

DESCRIPTION

This test is used to check the memory backup batteries voltage.

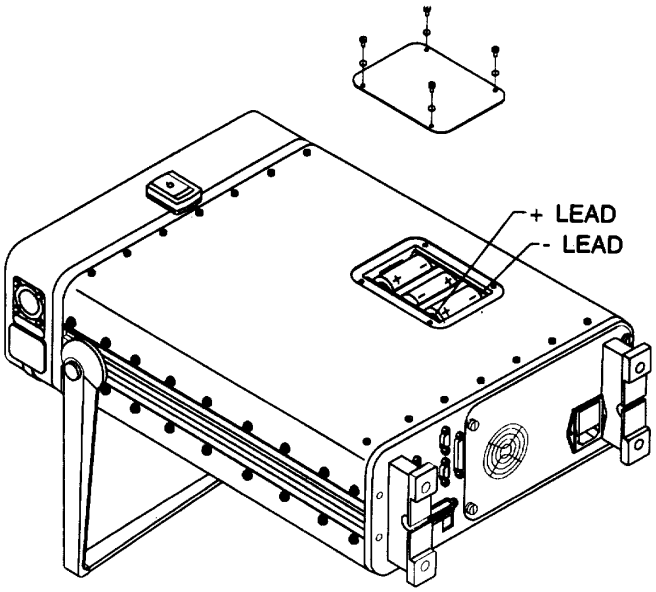
1. On TS-4320:

- Set POWER to OFF.
- Remove four screws, four washers, and lift BATTERY cover off.

2. Connect multimeter (tool 3, Appendix B, TM 11-6625-3271-12) to each battery as shown.

3. The multimeter should read greater than +0.9 VDC for each battery.

- If incorrect, replace batteries.



2-14. SYSTEM BACKUP BATTERY TEST - Continued.

4. Remove power and disconnect test equipment.

5. On TS-4320:

   - Replace BATTERY cover, four washers, and four screws.

2-15. 1A2W9 STORAGE BATTERY LEAD TEST.

DESCRIPTION

This test is used to check the electrical continuity of the 1A2W9 Storage Battery Lead.

1. On TS-4320:

   - Set POWER to OFF.
   - Remove top cover (para 2-63).

WARNING

Lethal, charged-CRT voltages may be present on the CRT Anode for some time after power is removed.

2. Refer to FO-2. Disconnect the 1A2W9 Storage Battery Lead from the battery holder in the top cover, from 1A2A11 CCA, and from 1A2A12 CCA.

3. Measure the resistances between the battery holder connector, P2 and BT1, as shown below.

+ METER LEAD	- METER LEAD	RESISTANCE
Battery Holder +	P2-1	<1 Ω
Battery Holder +	BTI-1	<1 Ω
Battery Holder -	P2-2	<1 Ω
Battery Holder -	BT1-6	<1 Ω

If any measurement is incorrect, replace 1A2W9.

4. Reconnect the 1A2W9 Storage Battery Lead to the battery holder in the top cover, to BT1 of 1A2A11 CCA, and to J2 of 1A2A12 CCA.

5. On TS-4320:

   - Reinstall top cover.

2-16. STORAGE BATTERY VOLTAGE AT 1A2A5 CCA TEST.

DESCRIPTION

This test is used to check voltage of the memory backup batteries at the 1A2A5 Special Input/Output CCA.

1. On TS-4320:

   - Set POWER to OFF.
   - Remove top cover (para 2-63) without disconnecting the 1A2W9 Storage Battery Lead.
   - Remove 1A2A5 SIO CCA (para 2-65).

2. Refer to FO-13, sheet 1 of 6. Measure the battery voltage at connector J26E-13. Observe a reading of greater than +2.2 volts DC.

   - If measurement is incorrect, replace 1A2A11 (para 2-80).
   - If measurement is correct, replace 1A2A5 CCA (para 2-65).

3. On TS-4320:

   - Reinstall top cover.

2-17. STORAGE BATTERY VOLTAGE AT 1A2A12 CCA AND 1A2A13 CCA TEST.

DESCRIPTION

This test checks the Storage Battery Voltage at 1A2A12 CCA and 1A2A13 CCA.

1. On TS-4320:

- Set POWER to OFF.
- Remove top cover (para 2-63) without disconnecting the 1A2W9 Storage Battery Lead.

2. Refer to FO-2. Disconnect 1A2W7 Cable Assembly from 1A2A12 CCA.
3. Refer to FO-14. Using a multimeter, measure voltage between J1-33 and J1-34 of 1A2A12 RAMCARD Interface CCA. Observe a reading of greater than 2.2 VDC.

2-17. STORAGE BATTERY VOLTAGE AT 1A2A12 CCA AND 1A2A13 CCA TEST - Continued.

4. If voltage in step 3 is correct, disconnect 1A2W7 Cable Assembly from 1A2A13 and check one-to-one electrical continuity of the cable.

   - If discontinuity is found, replace 1A2W7 Cable Assembly.
   - If no discontinuity, replace 1A2A13 RAMCARD Driver CCA (para 2-74).

5. On TS-4320:

   - Reinstall 1A2W7 Cable Assembly.
   - Reinstall top cover.

2-18. ROM/RAMCARD TEST SETUP.

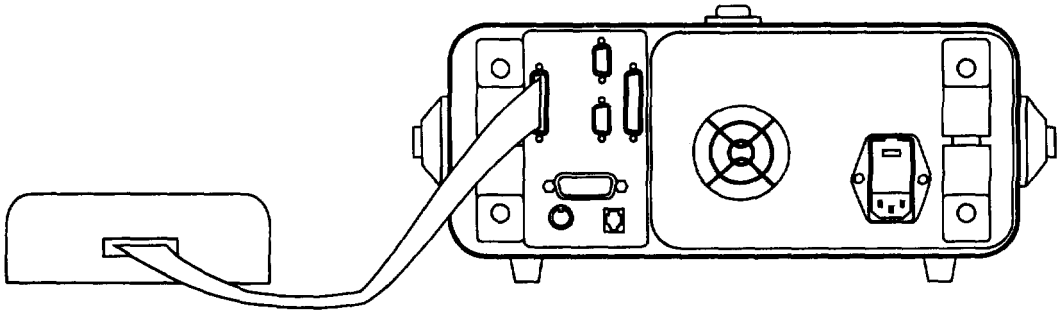
DESCRIPTION

This procedure prepares the TS-4320(P)/G to run the ROM/RAMCARD Tests which are part of the tests found on the Automatic Data Processing Disk Program (tool 19, Appendix B, TM 11-6625-3271-12).

1. On TS-4320:

   - Set POWER to OFF

2. Connect the Disk Drive Unit (tool 18, Appendix B, TM 11-6625-3271-12) to the TS-4320 "EXT. DISK" as shown.



DISK DRIVE UNIT TS-4320

REAR VIEW

3. On TS-4320:

   - Connect keyboard.
   - Remove top cover (para 2-63).
   - Set Power to ON.

2-18. ROM/RAMCARD TEST SETUP - Continued.

4. Insert the Program Disk (tool 19, Appendix B, TM 11-6625-3271-12) into the Disk Drive Unit.

NOTE

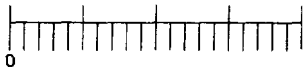
If there is no raster or image at this point, set the BRIGHTNESS and CONTRAST controls fully clockwise.

5. Observe that the following events occur:

- The Power-On Self Test runs and the screen displays the following:

TS-4320 SYSTEM BIOS V1.Ola 10/22/92
(c) 1991 Laser Precision Corporation
(C) Copyright 1989, 90 TEMPUSTECH, INC. - All Rights Reserved

Power-On Self Test

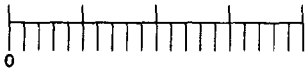


Loading

- The display screen then displays:

TS-4320 SYSTEM BIOS V1.Ola 10/22/92
(c) 1991 Laser Precision Corporation
(C) Copyright 1989, 90 TEMPUSTECH, INC. - All Rights Reserved

Power-On Self Test



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CECOM OTDR TEST FUNCTIONS PACKAGE
Enter number of Test to Execute:

1. ROM/RAMCARD Tests
2. DAS Timing Tests
3. DAS Memory Test (uses A/D Simulator Board)
4. GIO Board Test
5. SIO Board Test
6. FRONT PANEL Test
7. KEYBOARD Test
0. To Exit

Type a number from 1 to 7 (or 0 to quit):

6. Return to the malfunction number in table 2-1 that directed the ROM/RAMCARD Test Setup.

2-19. ROM/RAMCARD LIGHT/STATUS TEST.

DESCRIPTION

This test checks the ROM/RAMCARD status register and the "READY/IN USE" light on the front panel.

NOTE

Perform this procedure only when instructed from table 2-1 or another troubleshooting test. Do not perform this or any other troubleshooting test as a separate procedure unless otherwise instructed, as certain conditions have been established and/or tested prior to performing this test.

1. Insert the ROM Card Diagnostic CCA (tool 23, Appendix B, TM 11-6625-3271-12) into the ROM/RAMCARD drive.

2. Observe that the "READY/IN USE" light on the ROM/RAMCARD drive front panel is illuminated GREEN and that the other two lights are OFF.

   - If the "READY/IN USE" light is ON, go to step 5.
   - If the "READY/IN USE" light does not light, continue.

3. Refer to FO-14. Connect the positive multimeter lead to ICU5, pin 14 and the negative lead to ICU5, pin 7.

4. Observe a voltage greater than +4.74 Volts DC.

   - If the voltage is less than +4.74 perform 1A2W7 CABLE ASSEMBLY CONTINUITY TEST (para 2-23).

5. On the Keyboard, type 1.

   - The Diagnostic Test loads and the screen displays the RAM/ROM Card Test Function menu.

6. Type D on the keyboard to dump status port.

   - The Status Register data will be read back. The correct display results are:

```
RAM/ROMCARD STATUS DUMP:
Status Byte - f0 hex
CARD INSTALLED (data bit 3)...
WRITE DISABLED...
SYSTEM BATTERY OK...

Enter Command:
```

2-19. ROM/RAMCARD LIGHT/STATUS TEST - Continued.

7. Verify results.

   - If the results are correct, go to step 12.

8. Set the oscilloscope controls for both Probe 1 and Probe 2 as follows:

HORIZONTAL	VERTICAL	COUPLING	MODE	SLOPE	SOURCE
0.2 µs/Div	1 V/Div	DC	Normal	Negative	Ch 1

9. Refer to FO-14. Connect oscilloscope Probe 1 ground to ICU5, pin 7 and Probe 1 to ICU5 pin 6 on the RAMCARD Driver CCA.

10. On the Keyboard repeatedly press the D key.

    - For every press, the oscilloscope should show a negative pulse 350ns to 450ns in width. If there is no pulse, perform 1A2A13 RAMCARD Driver Status Port Test (para 2-22).

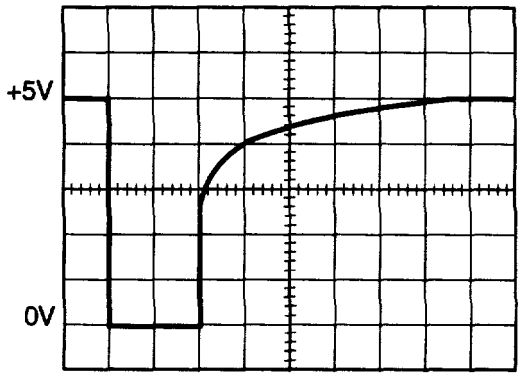
11. Use oscilloscope Probe 2 to check for HIGH (+2.0 to +7.0 VDC) or LOW (0 to +0.8 VDC) signals on ICU1. The signals should be as indicated below during the time that the signal on Probe 1 is LOW. Any other time is not significant.

ICU1 PIN	LEVEL
3 (DO)	LOW
4 (D1)	LOW
5 (D2)	LOW
6 (D3)	LOW
7 (D4)	HIGH
8 (D5)	HIGH
9 (D6)	HIGH
10 (D7)	HIGH

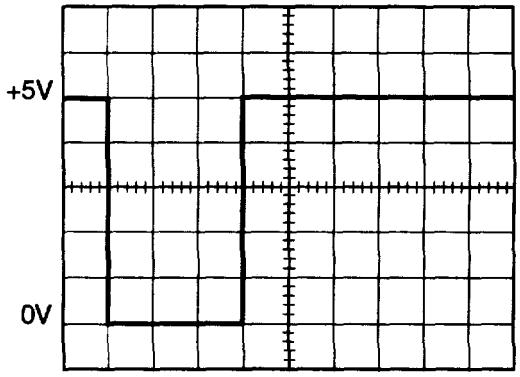
    - If the signals are not correct, replace the 1A2A13 RAMCARD Driver CCA (para 2-74).

12. On TS-4320:

    - Remove the ROM Card Diagnostic from the ROM/RAMCARD drive.
    - Remove power and disconnect test equipment.
    - Reinstall top cover.



0.2 µs/Div
Probe 1



0.2 µs/Div
Probe 2 LOW

2-20. ROM DATA AND ADDRESS TEST.

DESCRIPTION

This test checks the ROM/RAMCARD Data and Address logic.

NOTE

Perform this procedure only when instructed from table 2-1 or another troubleshooting test. Do not perform this or any other troubleshooting test as a separate procedure unless otherwise instructed, as certain conditions have been established and/or tested prior to performing this test.

1. Insert the ROM Card Diagnostic CCA (tool 23, Appendix B, TM 11-6625-3271-12) into the ROM/RAMCARD drive.

   - On the Keyboard, type 1.

2. On the Keyboard, type P.

   - The test will read the last 16 locations of the Diagnostic ROMCARD and compare them for correctness. The correct display results are:

     ROMCARD PATTERN MATCH TEST

     PATTERN MATCH OK...

     Enter Command:

3. Verify results.

   - If the results are correct, return to table 2-1.
   - If the results are incorrect, continue.

4. Set the oscilloscope controls as follows:

HORIZONTAL	VERTICAL	COUPLING	MODE	SLOPE	SOURCE
0.2 µs/Div	1 V/Div	DC	Normal	Negative	Ch 1

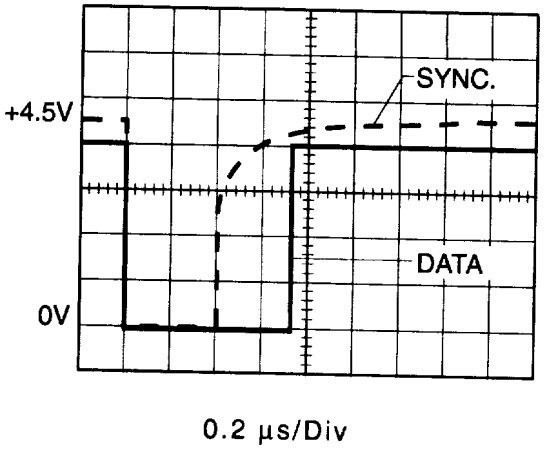
5. Refer to FO-14. Connect oscilloscope Probe 1 ground to ICU5, pin 7 and Probe 1 to ICU5, pin 3 on the 1A2A13 RAMCARD Driver CCA for a SYNC pulse.

6. On the Keyboard, type the following sequence:

TYPE	ACTION
X	Load output data
AA	Set output data pattern
C	Write to control register

2-20. ROM DATA AND ADDRESS TEST - Continued.

7. Use oscilloscope Probe 2 to check for HIGH (+2.0 to +7.0 VDC) or LOW (0 to +0.8 VDC) signals on ICU1. The DATA signals should be as indicated below during the time that the SYNC signal on Probe 1 is LOW. Any other time is not significant.



ICU1 PIN	LEVEL
3 (DO)	LOW
4 (D1)	HIGH
5 (D2)	LOW
6 (D3)	HIGH
7 (D4)	LOW
8 (D5)	HIGH
9 (D6)	LOW
10 (D7)	HIGH

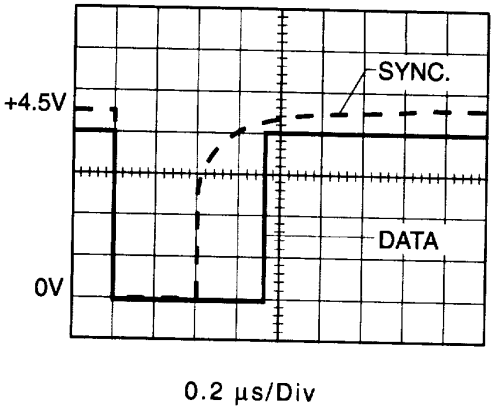
- If the signals are not correct go to 1A2W7 CABLE ASSEMBLY CONTINUITYTEST (para 2-23).
- If the signals are correct, continue.

8. On the Keyboard, type the following sequence:

TYPE	ACTION
SPACE BAR	Stop Write
X	Load output data
55	Set output data pattern
C	Write to control register

9. Refer to FO-14. Connect oscilloscope Probe 1 ground to ICU5, pin 7 and Probe 1 to ICU5, pin 3 on the RAMCARD Driver CCA for a SYNC pulse.

10. Use oscilloscope Probe 2 to check for HIGH (+2.0 to +7.0 VDC) or LOW (0 to +0.8 VDC) signals on ICU1. The DATA signals should be as indicated below during the time that the SYNC signal on Probe 1 is LOW. Any other time is not significant.



ICU1 PIN	LEVEL
3 (DO)	HIGH
4 (D1)	LOW
5 (D2)	HIGH
6 (D3)	LOW
7 (D4)	HIGH
8 (D5)	LOW
9 (D6)	HIGH
10 (D7)	LOW

2-20. ROM DATA AND ADDRESS TEST - Continued.

- If the signals are not correct, go to 1A2W7 CABLE ASSEMBLY CONTINUITY TEST (para 2-23).
- If the signals are correct, replace 1A2A13 RAMCARD Driver CCA (para 2-74).

11. On TS-4320:

- Remove the ROM Card Diagnostic from the ROM/RAMCARD drive.
- Remove power and disconnect test equipment.
- Reinstall top cover (para 2-63).

2-21. RAMCARD CCA TEST.

DESCRIPTION

This test checks the TS-4320(P)/G for low RAMCARD battery detection and RAMCARD data storage. A formatted RAMCARD is required for the test.

CAUTION
All data stored on the RAMCARD CCA used in this check will be lost.

NOTE
Perform this procedure only when instructed from table 2-1 or another troubleshooting test. Do not perform this or any other troubleshooting test as a separate procedure unless otherwise instructed because certain conditions have been established and/or tested prior to performing this test.

1. Remove the Diagnostic ROMCARD from the ROM/RAMCARD drive.

2. Insert a RAMCARD CCA into the ROM/RAMCARD drive.

3. Observe that the "READY/IN USE" light on the ROM/RAMCARD drive front panel is illuminated GREEN and the other two lights are OFF.

- If the "READY/IN USE" light is OFF, perform ROM/RAMCARD Light/status Test (para 2-19).
- If the "READY/IN USE" light is ON, continue.

2-21. RAMCARD CCA TEST - Continued.

4. On the Keyboard, type D.

- The Status Register data will be read back. The correct display results are:

RAM/ROMCARD STATUS DUMP:

Status Byte - eO hex
CARD INSTALLED (data bit 3)...
WRITE ENABLED...
RAMCARD BATTERY OK...
SYSTEM BATTERY OK...

Enter Command:

- If the results are correct, go to step 9.

5. Set the oscilloscope controls for both Probe 1 (use 1X probe) and Probe 2 (use 1OX probe) as follows:

HORIZONTAL	VERTICAL	COUPLING	MODE	SLOPE	SOURCE
0.2 µs/Div	1 V/Div	DC	Normal	Negative	Ch 1

6. Refer to FO-14. Connect oscilloscope Probe 1 ground to ICU5, pin 7 and Probe 1 to ICU5, pin 6 on the 1A3A13 RAMCARD Driver CCA.

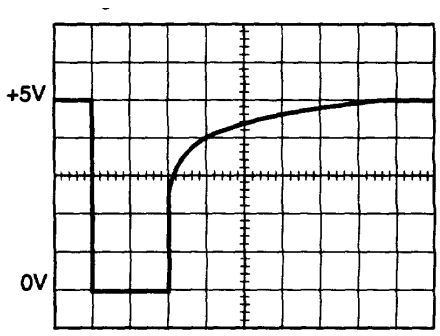
7. On the Keyboard repeatedly press the D key.

- For every press, the oscilloscope should show a negative pulse 350ns to 450ns in width. If there is no pulse, perform 1A2A13 RAMCARD Driver Status Port Test (para 2-22).

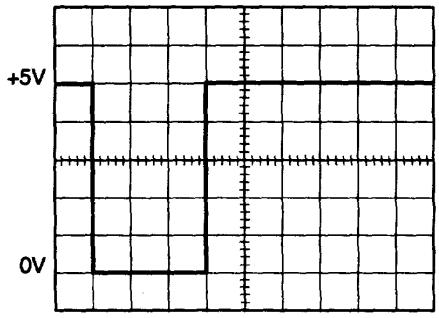
8. Use oscilloscope Probe 2 to check for HIGH (+2.0 to +7.0 VDC) or LOW (0 to +0.8 VDC) signals on ICU1. The signals should be as indicated below during the time that the signal on Probe 1 is LOW. Any other time is not significant.

ICU1 PIN	LEVEL
3 (DO)	LOW
4 (D1)	LOW
5 (D2)	LOW
6 (D3)	LOW
7 (D4)	LOW
8 (D5)	HIGH
9 (D6)	HIGH
10 (D7)	HIGH

- If the signals are not correct, replace the 1A2A13 RAMCARD Driver CCA (para 2-74).

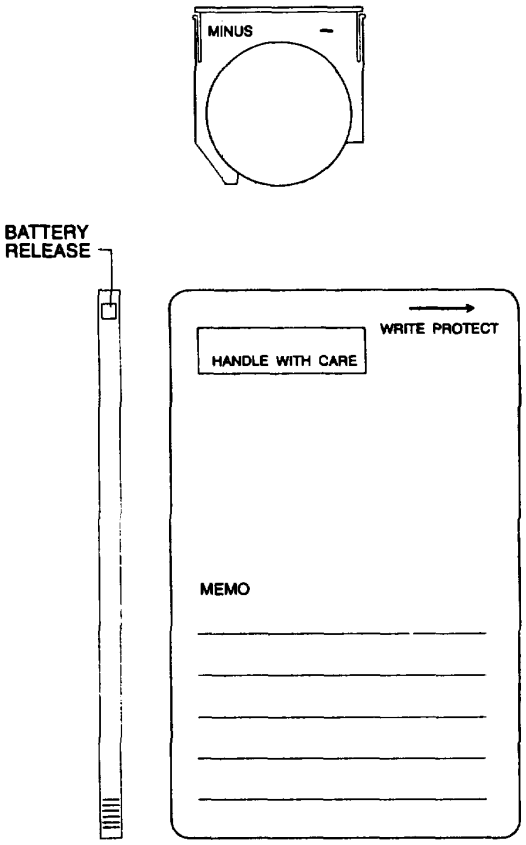


0.2 µs/Div
Probe 1



0.2 µs/Div
Probe 2 LOW

2-21. RAMCARD CCA TEST - Continued.



9. Remove the RAMCARD CCA from the ROM/RAMCARD drive.
10. There is a small hole on the back end side edge of the RAMCARD CCA opposite the connector. Insert a 0.050" Allen wrench into the hole and press to release the battery box latch.
11. While holding latch, remove the battery box and battery from the RAMCARD CCA.
12. Insert the RAMCARD CCA into the ROM/RAMCARD drive
13. Observe the following:
    - "READY/IN USE" light on the ROM/RAMCARD drive front panel is illuminated GREEN,
    - "BAT LOW" light is ON,
    - "INTERN BAT LOW" light is OFF.
14. If the "BAT LOW" does not light, the RAMCARD Driver CCA is defective.
    - Replace 1A2A13 CCA (para 2-74).
15. On the Keyboard, type D.

    - The Status Register data will be read back. The correct display results are:

      RAM/ROMCARD STATUS DUMP:

      Status Byte - 40 hex
      CARD INSTALLED (data bit 3)...
      WRITE ENABLED...
      RAM CARD BATTERY LOW...
      SYSTEM BATTERY OK...

      Enter Command:

    - If the results are correct, go to step 20.

16. Set the oscilloscope controls for both Probe 1 and Probe 2 as follows:

HORIZONTAL	VERTICAL	COUPLING	MODE	SLOPE	SOURCE
0.2 µs/Div	1 V/Div	DC	Normal	Negative	Ch 1

17. Refer to FO-14. Connect oscilloscope Probe 1 ground to ICU5, pin 7 and Probe 1 to ICU5, pin 6 on the 1A3A13 RAMCARD Driver CCA.

2-21. RAMCARD CCA TEST - Continued.

18. On the Keyboard repeatedly press the D key.

- For every press, the oscilloscope should show a negative pulse 350ns to 450ns in width. If there is no pulse, perform 1A2A13 RAMCARD Driver Status Port Test (para 2-22).

19. Use oscilloscope Probe 2 to check for HIGH (+2.0 to +7.0 VDC) or LOW (0 to +0.8 VDC) signals on ICU1. The signals should be as indicated below during the time that the signal on Probe 1 is LOW. Any other time is not significant.

ICU1 PIN	LEVEL
3 (DO)	LOW
4 (D1)	LOW
5 (D2)	LOW
6 (03)	LOW
7 (D4)	LOW
8 (D5)	LOW
9 (D6)	HIGH
10 (D7)	LOW

20. Replace battery box and battery in RAMCARD CCA
21. Insert the RAMCARD CCA into the ROM/RAMCARD drive.

22. On the Keyboard type the following sequence:

TYPE	ACTION
x	Load output data
40	Select memory bank 0
c	Write to control register
SPACE BAR	Stop Write
x	Load output data
ff	Select high order address
h	Write to high address register FFxxh
SPACE BAR	Stop Write
l	Write to low address register xxFFh
SPACE BAR	Stop Write
x	Load output data
aa	Data
w	Write to memory address 0FFFFh
SPACE BAR	Stop write

2-21. RAMCARD CCA TEST - Continued.

This sequence will write the Hex characters "aa" into RAMCARD memory bank 0, address FFFFh.

23. On the Keyboard type:

TYPE	ACTION
r	Read memory address FFFFh
SPACE BAR	Stop Read

- The screen will fill with the characters "aah". Scrolling will stop after a few seconds.

24. Repeat steps 22 and 23 but type "55" for Data, instead of "aa".

- In the repeat of step 23, the screen will fill with the characters "55h".

25. If either of the above results are incorrect, replace 1A2A13 (para 2-74).

26. On TS-4320:

- Remove the RAMCARD from the ROM/RAMCARD drive.
- Remove power and disconnect test equipment.
- Reinstall top cover (para 2-63).

2-22. 1A2A13 RAMCARD DRIVER STATUS PORT TEST.

DESCRIPTION

This test uses the oscilloscope to check the status byte residing in the 1A2A13 CCA Status Register as a result of actions previously performed in another test.

NOTE

Perform this procedure only when instructed from table 2-1 or another troubleshooting test. Do not perform this or any other troubleshooting test as a separate procedure unless otherwise instructed because certain conditions have been established and/or tested prior to performing this test.

1. Set the oscilloscope controls for both Probe 1 and Probe 2 as follows:

HORIZONTAL	VERTICAL	COUPLING	MODE	SLOPE	SOURCE
0.2 µs/Div	1 V/Div	DC	Normal	Negative	Ch 1

2. Refer to FO-14. Connect oscilloscope Probe 1 ground to ICU5, pin 7 and Probe 1 to ICU5, pin 5 on the 1A2A13 RAMCARD Driver CCA (SYSIORD pulse).

2-22. 1A2A13 RAMCARD DRIVER STATUS PORT TEST--Continued.

3. On the Keyboard repeatedly press the D key to observe a 350ns to 450ns negative pulse.

   - If no pulse, perform 1A2W7 Cable Assembly Continuity Test (para 2-23).

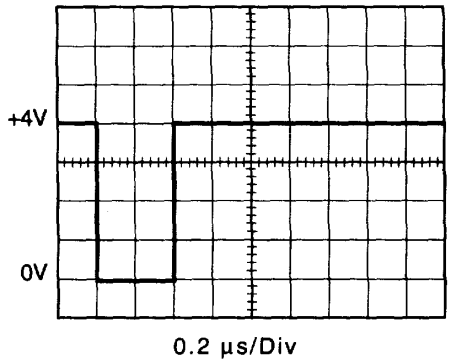
4. Connect oscilloscope Probe 2 to ICU5, pin 4 (MEMIOSEL pulse).

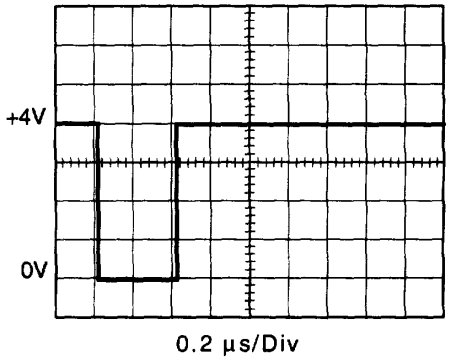
5. On the Keyboard, repeatedly press the D key to observe a negative pulse on Ch2 350ns to 450ns wide. The signal should be LOW when the signal on Probe 1 is LOW; any other time is not significant.

   - If this signal is not correct, perform 1A2W7 Cable Assembly Continuity Test (para 2-23).
   - If the signals do coincide, replace 1A2A13 RAMCARD Driver CCA (para 2-74).

6. On TS-4320:

   - Remove the RAMCARD from the ROM/RAM CARD drive.
   - Remove power and disconnect test equipment.
   - Reinstall top cover (para 2-63).





2-23. 1A2W7 CABLE ASSEMBLY CONTINUITY TEST.

DESCRIPTION

This test checks the electrical continuity of 1A2W7 Cable Assembly that connects 1A2A12 RAMCARD Interface CCA and 1A2A13 RAMCARD Driver CCA.

NOTE

Perform this procedure only when instructed from table 2-1 or another troubleshooting test. Do not perform this or any other troubleshooting test as a separate procedure unless otherwise instructed because certain conditions have been established and/or tested prior to performing this test.

1. Refer to FO-2. Remove 1A2W7 Cable Assembly.

2-23. 1A2W7 CABLE ASSEMBLY CONTINUITY TEST--Continued.

2. Use Multimeter to check the one-to-one continuity of 1A2W7 Cable Assembly.
   - If the cable checks are bad, replace 1A2W7 Cable Assembly.
   - If the cable checks are good, replace 1A2A12 RAMCARD INTERFACE CCA (para 2-68).
3. Remove ROMCARD Diagnostic CCA and store in protective envelope. The "READY/IN USE" light will go OFF.
4. Remove the Program Diskette from the Disk Drive Unit.
5. On TS-4320:

   - Set POWER to OFF.
   - Disconnect test equipment.
   - Reinstall top cover (para 2-63).

2-24. 1A2A1 FRONT PANEL CCA VOLTAGE TEST.

DESCRIPTION

This test is used to check the voltage present at the 1A2A1 Front Panel CCA.

1. On TS-4320:

   - Set POWER to OFF.
   - Remove top cover (para 2-63).
   - Remove 1A2A5 and 1A2A6 CCAs (para 2-65).
   - Set POWER to ON.

2. Refer to FO-3. Place the positive lead of the multimeter on ICU6, pin 14 and the negative lead on ICU6, pin 7.

3. Observe a reading of +4.75 to +5.25 VDC.

4. On TS-4320:

   - Set POWER to OFF.
   - Reinstall 1A2A5 and 1A2A6 CCAs.
   - Reinstall top cover (para 2-63).

2-25. 1A2A1 FRONT PANEL CCA LEDSET SIGNAL TEST.

DESCRIPTION

This test is used to check the 1A2A1 Front Panel CCA LEDSET signal at the 1A2A5 SIO CCA.

1. On TS-4320:

   - Set POWER to OFF.
   - Remove top cover (para 2-63).
   - Remove the 1A2A5 CCA (para 2-65).

2. Refer to FO-13. Insert two Extender Cards (tool 17, Appendix B, TM 11-6625-3271-12) into connectors J26 and J28. Insert Extender Card (tool 16, Appendix B, TM 11-6625-3271-12) into connector J27.

3. Plug 1A2A5 CCA into these Extender Cards.

4. Set the oscilloscope controls as follows:

HORIZONTAL	VERTICAL	COUPLING	MODE	SLOPE	SOURCE
2 ms/Div	2 V/Div	DC	Normal	Positive	Ch 1

5. Refer to FO-7. Connect oscilloscope probe ground to ICU16, pin 1 on the 1A2A5 CCA.

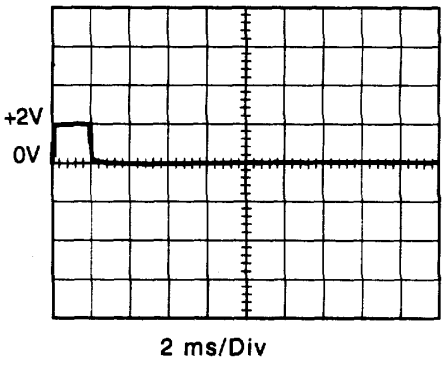
6. Refer to FO-13, sheet 1 of 6. Connect oscilloscope probe to pin 9 of J26E.

7. Set POWER to ON.

8. Press the LOSS MODE key and observe the Front Panel CCA +LEDSET signal as a single pulse as shown. The signal is generated each time the key is pressed.

9. On TS-4320:

   - Set POWER to OFF.
   - Disconnect test equipment.
   - Reinstall top cover (para 2-63).



2-26. 1A2W1 FRONT PANEL CABLE ASSEMBLY TEST.

DESCRIPTION

This test is used to check the integrity of the Front Panel Cable Assembly 1A2W1.

1. On TS-4320:

   - Set POWER to OFF.
   - Remove top cover (para 2-63).
   - Remove 1A2A5 and 1A2A6 CCAs (para 2-65).

2. Refer to FO-2. Disconnect Front Panel Cable Assembly 1A2W1 from the Backplane Assembly and from the Front Panel CCA (para 2-77).

3. Using the multimeter, measure the one-to-one continuity between P29 and P3 of Cable Assembly 1A2W1.

4. On TS-4320:

   - Reconnect Cable Assembly 1A2W1.
   - Reinstall 1A2A5 and 1A2A6 CCAs.
   - Reinstall top cover (para 2-63).

2-27. 1A2A1 FRONT PANEL CCA LED TEST.

DESCRIPTION

This procedure turns each of the front panel LEDs on and off in turn.

1. On TS-4320:

   - Set POWER to OFF.
   - Connect keyboard.
   - Insert ROM Card Diagnostic CCA (tool 23, Appendix B, TM 11-6625-3271-12) into the ROM/RAMCARD Drive.
   - Set POWER to ON.

2. When "CECOM OTDR TEST FUNCTIONS PACKAGE" is displayed, type 6 on the keyboard.

   - Observe that the "FRONT PANEL AUTOMATIC LED TEST" loads and the front panel LEDs cycle ON and OFF.

3. Press space bar on the keyboard twice to halt the LED test.

2-27. 1A2A1 FRONT PANEL CCA LED TEST - Continued.

4. On TS-4320:

- Remove Diagnostic ROMCARD from the ROM/RAMCARD Drive.
- Set POWER to OFF.
- Detach keyboard.

2-28. 1A2A1 FRONT PANEL CCA KEY TEST.

DESCRIPTION

This procedure displays the binary code of each front panel key as it is pressed.

1. On TS-4320:

- Set POWER to OFF.
- Connect keyboard.
- Insert ROM Card Diagnostic CCA (tool 23, Appendix B, TM 11-6625-3271-12) into the ROM/RAMCARD Drive.
- Set POWER to ON.

2. When "CECOM OTDR TEST FUNCTIONS PACKAGE" is displayed, type 6 on the keyboard.

- Observe that the "Panel display LED test" loads and the front panel LEDs cycle ON and OFF.

3. Press space bar on the keyboard to halt the LED test.

- Observe "FRONT PANEL MANUAL KEY/LED TEST" is displayed.

4. Press the inoperative front panel key or the key in the table below that corresponds to the inoperative LED.

- Observe the binary code and LED illumination and note if not correct.

KEY	CODE	LED
Soft #1	00011000	
Soft #2	00011111	
Soft #3	00010000	
Soft #4	00010111	
Soft #5	00010110	
VERT EXP	00011001	dB/km
HOR CONT	00011101	
HOR EXP	00011110	ON
VERT CONT	00011010	SPLICE

KEY	CODE	LED
N/LASER OFF	00010100	A
LOCK	00010011	SHORT
DISPLAY FROM	00001100	ORIGIN
LOSS MODE	00001111	2 POINT
PULSE WIDTH	00001010	LONG
REAL TIME	00001101	REAL TIME
FAST SCAN	00001110	FAST SCAN
SLOWSCAN	00001011	SLOWSCAN

2-28. 1A2A1 FRONT PANEL CCA KEY TEST - Continued.

5. On the keyboard, press the space bar to exit from the key test.
6. On TS-4320:

- Remove Diagnostic ROMCARD from the ROM/RAMCARD Drive.
- Set POWER to OFF.
- Detach keyboard.

2-29. FRONT PANEL DIAGNOSTIC SETUP.

DESCRIPTION

This procedure prepares the TS-4320(P)/G for testing of the front panel signals.

1. On TS-4320:

- Set POWER to OFF.
- Connect keyboard.
- Connect the Disk Drive Unit (tool 18, Appendix B, TM 11-6625-3271-12) to the "EXT. DISK" connector on the rear of the TS-4320.
- Remove top cover (para 2-63).
- Remove 1A2A5 CCA (para 2-65).
- Remove 1A2A12 CCA (para 2-68).

2. Refer to FO-13, sheet 1 of 6. Insert two Extender Cards (tool 17, Appendix B, TM 11-6625-3271-12) into connectors J26 and J28. Insert Extender Card (tool 16, Appendix B, TM 11-6625-3271-12) into connector J27.

3. Plug 1A2A5 CCA into these Extender Cards.

4. Refer to FO-7. Connect oscilloscope probe ground to pin 1 of ICU16 on the 1A2A5 CCA.

5. Insert the Program Disk (tool 19, Appendix B, TM 11-6625-3271-12) into the Disk Drive Unit.

6. Set POWER to ON.

7. Observe that the light on the Disk Drive illuminates and the Power-On Self Test runs.

8. When the CECOM OTDR TEST FUNCTIONS PACKAGE menu is displayed, type 6 on the keyboard.

9. Press the space bar on the keyboard to exit from the LED cycle test and select the FRONT PANEL MANUAL KEY/LED TEST.

10. Return to the malfunction number being tested in table 2-1.

2-30. 1A2A1 FRONT PANEL CCA KEY SIGNALS TEST.

DESCRIPTION

This test is used to check the 1A2A1 Front Panel CCA Key signals.

NOTE

Perform this procedure only when instructed from table 2-1 or another troubleshooting test. Do not perform this or any other troubleshooting test as a separate procedure unless otherwise instructed because certain conditions have been established and/or tested prior to performing this test.

1. Set the oscilloscope controls as follows:

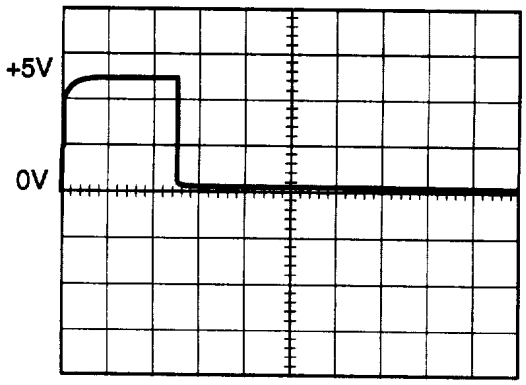
HORIZONTAL	VERTICAL	COUPLING	MODE	SLOPE	SOURCE
5 pls/Div	2 V/Div	DC	Normal	Positive	Ch 1

2. Refer to FO-13, sheet 1 of 6. Connect oscilloscope probe to pin 5 of J26E.

3. Repeatedly press and release the PULSE WIDTH key on the system Front Panel. Observe that the pulse width LEDs sequence on and off. The oscilloscope should display a continuous TTL active low level (approximately 0.0 VDC) when the button is depressed and a continuous TTL active high level (approximately +4.0 VDC) when the button is released.

   - If pulse width LEDs do not sequence on and off, go to step 4.
   - If results are as described, go to step 5.

4. Connect the oscilloscope probe to J26E, pin 7. Repeatedly press and release the PULSE WIDTH key on the system Front Panel. The LEDOUT waveform should appear as shown.



5 µs/Div
LEDOUT/KEYOUT

- If LEDOUT is not as shown, replace 1A2A5 CCA (para 2-65).
- If results are as shown, continue.

5. Connect the oscilloscope probe to J26E, pin 6. Repeatedly press and release the PULSE WIDTH key on the system Front Panel. The LONG pulse width LED should sequence on and off and the KEYOUT waveform should appear as shown.

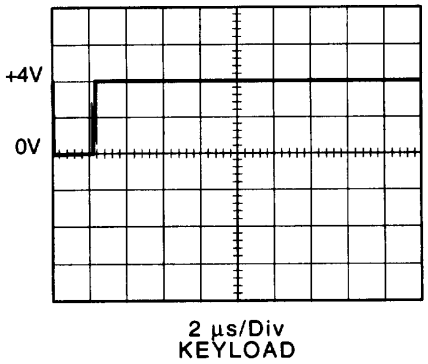
   - If KEYOUT is not as shown, replace 1A2A5 CCA (para 2-65).
   - If results are as shown, continue.

2-30. 1A2A1 FRONT PANEL CCA KEY SIGNALS TEST - Continued.

6. Set oscilloscope horizontal control to 2 lis/Div.

7. Connect oscilloscope probe to pin 10 of J26E and set trigger to negative.

8. Repeatedly press and release the PULSE WIDTH key on the system Front Panel. The KEYLOAD waveform should appear as shown.



- If results are as described above, return to table 2-1.
- If results are not as described above, continue.

9. Set POWER to OFF.

10. Remove 1A2A6 CCA (para 2-65).

11. Remove 1A2A5 from the extender cards and remove the extender cards.

12. Refer to FO-2. Disconnect 1A2W1 Cable Assembly from 1A2A11 CCA.

13. Refer to FO-13, sheet 1 of 6. Using the multimeter, check the electrical continuity between J29 and J26E and between J29 and J28B of the Backplane Assembly 1A2A11.

+ METER LEAD	- METER LEAD	+ METER LEAD	- METER LEAD
J29-1	J26E-1	J29-2	J28B-3
J29-3	J26E-2	J29-4	J28B-1
J29-5	J26E-3	J29-6	J28B-1
J29-7	J26E-4	J29-8	J28B-1
J29-9	J26E-5	J29-10	J28B-1
J29-11	J26E-6	J29-12	J28B-1
J29-13	J26E-7	J29-14	J28B-1
J29-15	J26E-8	J29-16	J28B-1
J29-17	J26E-9	J29-18	J28B-1
J29-19	J26E-10		

- If test passes, replace 1A2A1 (para 2-76).
- If test fails, replace 1A2A11 (para 2-80).

14. Remove power and disconnect test equipment.
15. On TS-4320:

- Reconnect 1A2W1 Cable Assembly.
- Reinstall 1A2A5, 1A2A6, and 1A2A12 CCAs.
- Reinstall top cover (para 2-63).

2-31. 1A2A1 FRONT PANEL CCA SERIAL SIGNALS TEST.

DESCRIPTION

This test is used to check the 1A2A1 Front Panel CCA Key signals.

NOTE

Perform this procedure only when instructed from table 2-1 or another troubleshooting test. Do not perform this or any other troubleshooting test as a separate procedure unless otherwise instructed because certain conditions have been established and/or tested prior to performing this test.

1. Set the oscilloscope controls as follows:

HORIZONTAL	VERTICAL	COUPLING	MODE	SLOPE	SOURCE
1 is/Div	2 V/Div	DC	Normal	Positive	Ch 1

2. Refer to FO-13, sheet 1 of 6. Observe the 1A2A5 CCA SERIAL CLOCK signal by connecting oscilloscope probe to pin 8 of J26E.

- If the signal appears as shown, continue.
- If the signal does not appear as shown, replace 1A2A5 SIO CCA (para 2-65).

3. Refer to FO-3. Observe the 1A2A1 CCA SERIAL CLOCK signal by connecting the oscilloscope probe to pin 2 of ICU3.

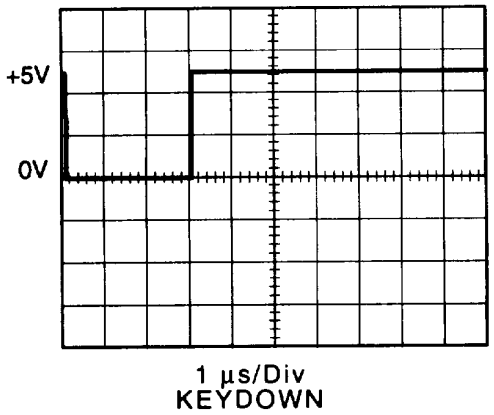
- If the signal appears as shown, continue.
- If the signal does not appear as shown, perform 1A2W1 Front Panel Cable Assembly Test (para 2-26).

4. Change the oscilloscope horizontal setting to 50 ms/Division.

5. Refer to FO-3. Connect the oscilloscope probe to pin 1 of ICU6.

2-31. 1A2A1 FRONT PANEL CCA SERIAL SIGNALS TEST --Continued.

6. Observe the 1A2A1 CCA KEYDOWN signal by pressing and releasing the REAL TIME key on the system Front Panel. The signal should be low when the key is pressed and high when the key is released.



- If the signal does not appear as shown, replace 1A2A1 Front Panel CCA (para 2-76).

7. Refer to FO-13, sheet 1 of 6. Connect the oscilloscope probe to pin 5 of J26E.

8. Observe the 1A2A5 CCA KEYDOWN signal by pressing and releasing the REAL TIME key on the system Front Panel.

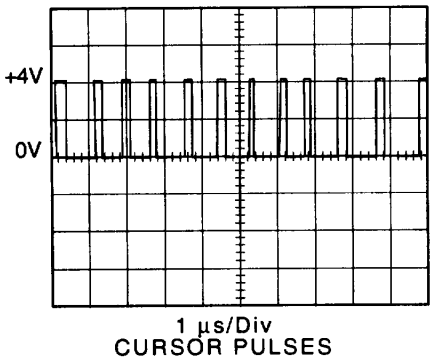
- If the signal appears as shown, continue.
- If the signal does not appear as shown, perform 1A2W1 Front Panel Cable Assembly Test (para 2-26).

9. Change the oscilloscope horizontal setting to 0.1 Vs/Division.

NOTE

The A and B CURSOR CONTROL KNOBS are digital pulse stream generators. The pulses generated depend on the speed at which the knob is rotated. Verification of performance consists of observing the presence of a TTL pulse stream on each of the output pins.

10. Refer to FO-13, sheet 1 of 6. Connect oscilloscope probe to output pins J26E-3 and J26E-4 in turn. Turn the A CURSOR knob and observe a pulse stream as shown.



- If pulses appear as shown and front panel controls still do not function properly, replace 1A2A5 SIO CCA (para 2-65).

- If pulses do not appear and front panel controls still do not function properly, replace 1A2A1 (para 2-76).

11. Refer to FO-13, sheet 1 of 6. Connect oscilloscope probe to output pins J26E-1 and J26E-2 in turn. Turn the B CURSOR knob and observe a pulse stream as shown.

- If pulses appear as shown and front panel controls still do not function properly, replace 1A2A5 SIO CCA (para 2-65).
- If pulses do not appear and front panel controls still do not function properly, replace 1A2A1 (para 2-76).

2-31. 1A2A1 FRONT PANEL CCA SERIAL SIGNALS TEST - Continued.

12. Remove power and disconnect test equipment.

13. On TS-4320:

- Reinstall top cover (para 2-63).

2-32. 1A2A9 CRT DRIVER CCA TEST.

DESCRIPTION

This test is used to check the Horizontal and Vertical drive signal supplied to the CRT.

WARNING

Lethal, charged-CRT voltages may be present on the CRT Anode for some time after power is removed.

1. On TS-4320:

- Set POWER to OFF.
- Remove top cover (para 2-63).

2. Refer to FO-11. Connect the oscilloscope probe ground to pin 10 of J101. (This is the same as pin 10 of connector J35 on 1A2A11 Backplane CCA.)

3. Set the oscilloscope controls as follows:

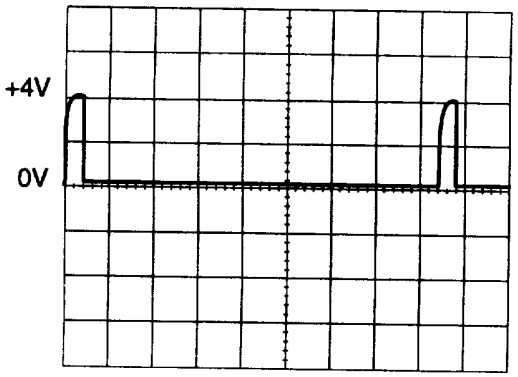
HORIZONTAL	VERTICAL	COUPLING	MODE	SLOPE	SOURCE
2 ms/Div	2 V/Div	DC	Normal	Positive	Ch 1

4. Set POWER to ON.

5. Observe VERTICAL SYNC signal by connecting the oscilloscope probe to pin 9 of J101.

- The pulses should have a period of 16.7 ms, as shown in the 2 ms/Div VERTICAL SYNC graph.

6. Set the oscilloscope horizontal controls to 0.5 ms/Div.



2 ms/Div
VERTICAL SYNC

2-32. 1A2A9 CRT DRIVER CCA TEST - Continued.

7. Observe VERTICAL SYNC signal.

   • The Display should appear as shown in the 0.2 ms/Div VERTICAL SYNC graph.

8. Set the oscilloscope horizontal controls to 10 µs/Div.

9. Connect the oscilloscope probe to pin 6 of J101 and observe HORIZONTAL SYNC signal.

   * The pulses should have a period of 65 µs, as shown in the 10 is/Div HORIZONTAL SYNC graph.

10. Set the oscilloscope horizontal controls to 2 µs/Div.

11. Observe HORIZONTAL SYNC signal.

   * The display should appear as shown in the 2 µs/Div HORIZONTAL SYNC graph.

12. Connect the oscilloscope probe to W103 and observe VIDEO signal at 1V/Div vertical.

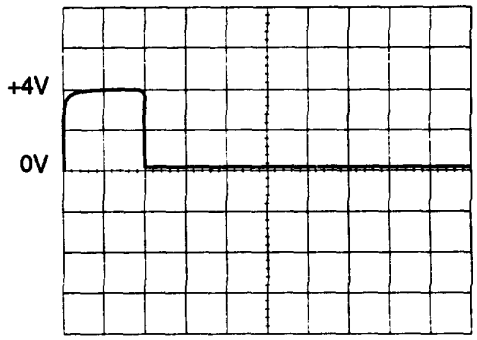
   * The display should appear as shown in the VIDEO graph.

13. Remove power and disconnect test equipment.

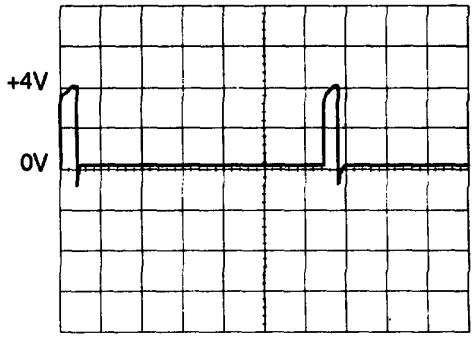
14. On TS-4320:

   •· Reconnect Cable Assembly.

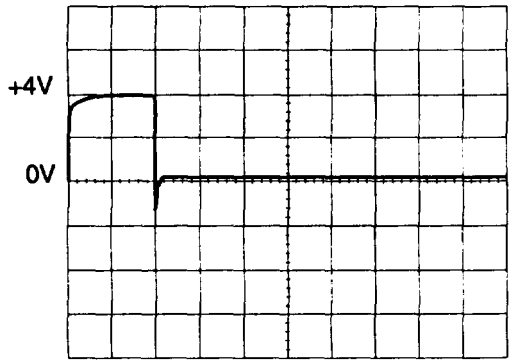
   •· Reinstall top cover (para 2-63).



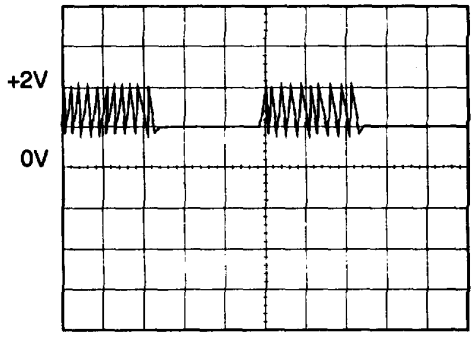
0.2 ms/Div
VERTICAL SYNC



10 µs/Div
HORIZONTAL SYNC



2 µs/Div
HORIZONTAL SYNC



2 µs/Div and 1V/Div
VIDEO

2-33. 1A2A7 COLOR GRAPHIC ADAPTER CCA VIDEO SIGNAL TEST.

DESCRIPTION

This test checks the Color Graphic Adapter CCA Video Signals at the Video Multiplexer on the 1A2A11 Backplane Assembly CCA.

WARNING

Lethal, charged-CRT voltages may be present on the CRT Anode for some time after power is removed.

1. On TS-4320:

   * Set POWER to OFF.
   *· Remove top cover (para 2-63).

2. Refer to FO-13, sheet 1 of 6. Connect the oscilloscope probe ground to 1CU2, pin 8 on the Backplane Assembly.

3. Set the Oscilloscope controls as follows:

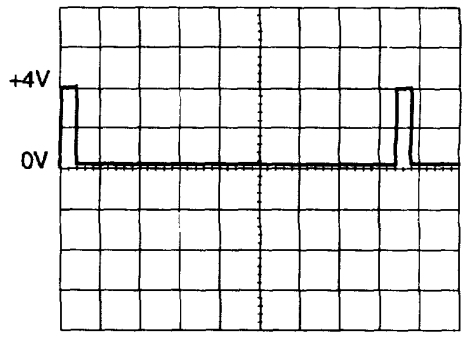
HORIZONTAL	VERTICAL	COUPLING	MODE	SLOPE	SOURCE
2 ms/Div	2 V/Div	DC	Normal	Positive	Ch 1

4. Set POWER to ON.

5. Connect the oscilloscope probe to ICU2, pin 14 and observe the VERTICAL SYNC signal. The display should appear as shown.

   • If the display is not as shown, replace 1A2A11 CCA (para 2-80).

6. Set the oscilloscope horizontal controls to 10 µs/Div.



2 ms/Div
VERTICAL SYNC

2-33. 1A2A7 COLOR GRAPHIC ADAPTER CCA VIDEO SIGNAL TEST--Continued.

7. Connect the oscilloscope probe to ICU2, pin 11 and observe the HORIZONTAL SYNC signal.

The display should appear as shown.

- If the display is not as shown, replace 1A2A11 CCA (para 2-80).

8. Connect the oscilloscope probe to ICU1, pin 1 and observe the RED VIDEO signal. The display will be a TTL pulse train in bursts of 23 25 µs each as shown.

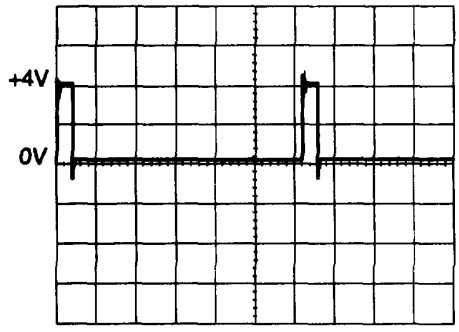
- If the display is not as shown, replace 1A2A11 CCA (para 2-80).

9. Connect the oscilloscope probe to ICU1, pin 3 and observe the GREEN VIDEO signal. The display will be a TTL pulse train in bursts of 23 25 µs each as shown.

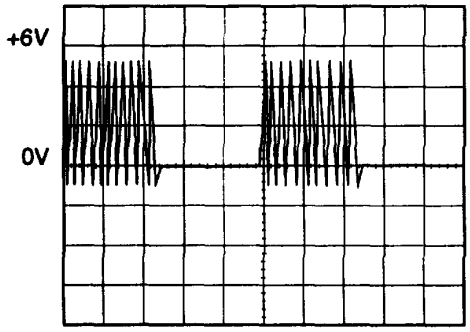
- If the display is not as shown, replace 1A2A11 CCA (para 2-80).

10. Connect the oscilloscope probe to ICU1, pin 5 and observe the BLUE VIDEO signal. The display will be a TTL pulse train in bursts of 23 25 µs each as shown.

- If the display is not as shown, replace 1A2A11 CCA (para 2-80).



10 µs/Div
HORIZONTAL SYNC



10 µs/Div
VIDEO SIGNALS

11. Set the oscilloscope Mode to AUTO and connect the probe to ICU1, pin 9.

12. Observe the INTENS VIDEO signal to be a TTL LOW level.

- If the display is not as described, replace 1A2A11 CCA (para 2-80).

13. On TS-4320:

- Set POWER to OFF.
- Disconnect test equipment.
- Reinstall top cover.

2-34. 1A2A7 COLOR GRAPHICS ADAPTER CCA DRIVER TEST.

DESCRIPTION

This test checks the HORIZONTAL, VERTICAL, and VIDEO drive signals generated by the 1A2A7 Color Graphics Adapter CCA.

WARNING I

Lethal, charged-CRT voltages may be present on the CRT Anode for some time after power is removed.

1. On TS-4320:

   * Set POWER to OFF.
   * Remove top cover (para 2-63).

2. Refer to FO-9. Perform Continuity Check on cable 1A2W3.

   * If any reading is greater than one ohm, replace 1A2W3.

3. Refer to FO-13, sheet 1 of 6. Connect the oscilloscope probe ground to ICU2, pin 8 on the 1A2A11 CCA.

4. Set the oscilloscope controls as follows:

HORIZONTAL	VERTICAL	COUPLING	MODE	SLOPE	SOURCE
2 ms/Div	2 V/Div	DC	Normal	Positive	Ch 1

5. Set POWER to ON.

6. Observe the VIDEO RELAY PICK signal by connecting the scope probe on ICU2, pin 4. The signal should be a steady voltage level of 0 (-0 +<.8V).

   * If this level is correct go to step 8.

7. Connect the oscilloscope probe to ICU2, pin 1 and observe the PICSEL signal. The signal should be a steady voltage level of 0 (-0 +<.8V).

   * If this level is correct, replace 1A2A11 CCA (para 2-80).

8. Refer to FO-9. Connect the oscilloscope probe ground to ICU3, pin 10 on the 1A2A7 CCA.

2-34. 1A2A7 COLOR GRAPHIC ADAPTER CCA DRIVER TEST--Continued.

9. Connect the oscilloscope probe to the lower node of R6 of 1A2A7 CCA and observe the VERTICAL SYNC signal.

   * If the display appears as shown in the 2 ms/Div VERTICAL SYNC graph, go to step 13.

10. Set the oscilloscope horizontal controls to 0.1 ms/Div.

11. Observe the VERTICAL SYNC signal.

   • If the display appears as shown in the 0.1 ms/Div VERTICAL SYNC graph, go to step 13.

12. Disconnect Cable Assembly 1A2W3 from Backplane Assembly connector J34 and repeat step 11.

   •· If the display is still wrong, replace 1A2A7 CCA (para 2-69).

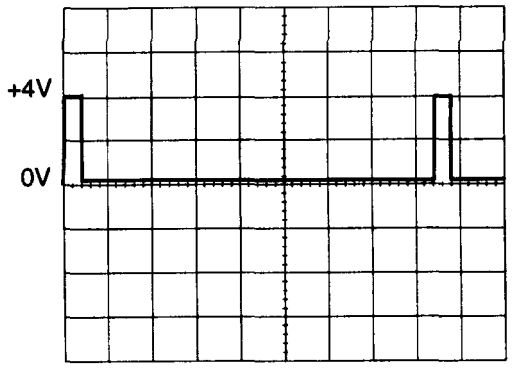
   • If the display is correct, replace 1A2A11 CCA (para 2-80).

13. Set the oscilloscope horizontal controls to 10 µs/Div.

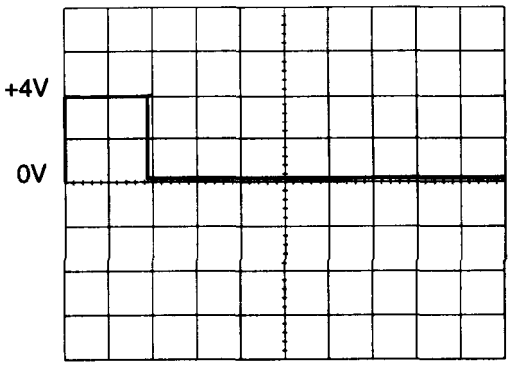
14. Connect the oscilloscope probe to R5 (lower) on the 1A2A7 CCA and observe the HORIZONTAL SYNC signal.

   • If the display appears as shown in the 10 µs/Div HORIZONTAL SYNC graph, go to step 18.

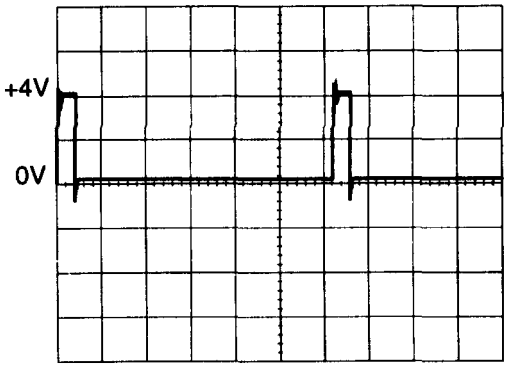
15. Set the oscilloscope horizontal controls to 2 µs/Div.



2 ms/Div
VERTICAL SYNC



0.1 ms/Div
VERTICAL SYNC



10 µs/Div
HORIZONTAL SYNC

2-34. 1A2A7 COLOR GRAPHIC ADAPTER CCA DRIVER TEST - Continued.

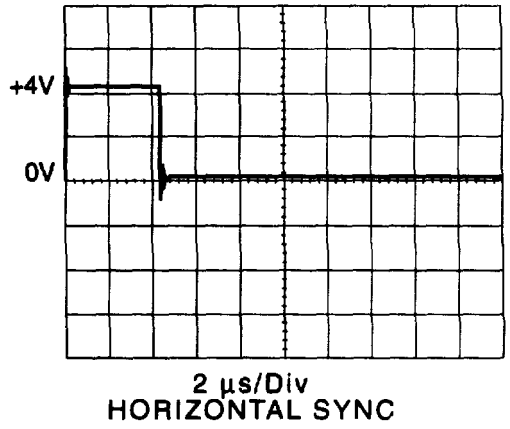
16. Observe the HORIZONTAL SYNC signal.

    • If the display appears as shown in the 2 µs/Div HORIZONTAL SYNC graph, go to step 18.

17. Disconnect Cable Assembly 1A2W3 from the Backplane Assembly connector J34 and repeat step 16.

    • If display is still wrong, replace 1A2A7 CCA (para 2-69).

    • If display is correct, replace 1A2A11 CCA (para 2-80).



18. Set the oscilloscope horizontal controls to 10 µs/Div.

19. Connect the oscilloscope probe to R9 (lower) of 1A2A7 CCA and observe RED VIDEO.

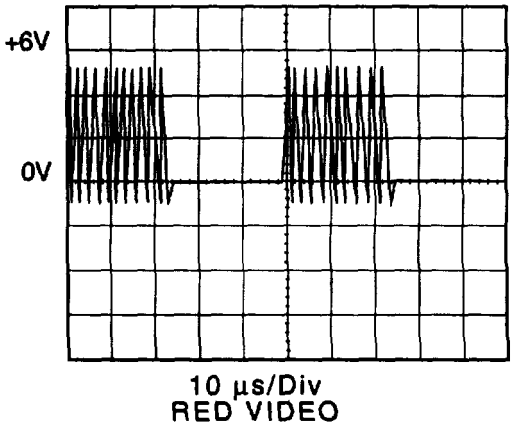
    • If a TTL pulse train in bursts of 23 25 Is each as shown is displayed, go to step 21.

    • If the display is not as shown, continue.

20. Refer to FO-13, sheet 1 of 6. Disconnect the 1A2W3 Cable Assembly from Backplane Assembly connector J34 and repeat stepl9.

    • If display is still wrong, replace 1A2A7 CCA (para 2-69).

    • If display is correct, replace 1A2A11 CCA (para 2-80).



21. Connect the oscilloscope probe to R8 (lower) of 1A2A7 CCA and observe GREEN VIDEO.

    • If a TTL pulse train in bursts of 23 25 Is each as shown is displayed, go to step 23.

    • If the display is not as shown, continue.

22. Disconnect the 1A2W3 Cable Assembly from the Backplane Assembly connector J34 and repeat step 21.

    • If the display is still wrong, replace 1A2A7 CCA (para 2-69).

    • If the display is correct, replace 1A2A11 CCA (para 2-80).

23. Refer to FO-9. Connect the oscilloscope probe to R7 on the side toward U7 and observe BLUE VIDEO.

    • If a TTL pulse train in bursts of 23 25 µs each as shown is displayed, go to step 25.

    • If the display is not as shown, continue.

2-34. 1A2A7 COLOR GRAPHIC ADAPTER CCA DRIVER TEST - Continued.

24. Disconnect 1A2W3 Cable Assembly from Backplane Assembly connector J34 and repeat step 23.

    • If the display is still wrong, replace 1A2A7 CCA (para 2-69).

    • If display is correct, replace 1A2A11 CCA (para 2-80).

25. Connect the oscilloscope probe to Resistor R10 on the side toward U7 and observe INTENS VIDEO.

26. If the display is not a TTL LOW level, disconnect 1A2W3 Cable Assembly from 1A2A11 Backplane Assembly connector J34 and repeat step 21.

    •· If the display is still wrong, replace 1A2A7 CCA (para 2-69).

    •· If display is correct, replace 1A2A11 CCA (para 2-80).

27. On TS-4320:

    • Set POWER to OFF.

    • Disconnect test equipment.

    • Reinstall top cover (para 2-63).

2-35. 1A2A2 BIT MAPPED GRAPHICS ADAPTER CCA DRIVER TEST.

DESCRIPTION

This test checks the Horizontal, Vertical, and Video drive signals generated by the 1A2A2 Bit Mapped Graphics Adapter CCA.

1. On TS-4320:

    •· Set POWER to OFF.
    •· Remove top cover (para 2-63).

2. Refer to FO-13, sheet 1 of 6. Remove 1A2A2 CCA (para 2-66).

3. Install Extender Card (tool 17, Appendix B, TM 11-6625-3271-12) in connector J21AB.

4. Install Extender Card (tool 16, Appendix B, TM 11-6625-3271-12) in connector J19GH.

5. Install 1A2A2 CCA into Extender Cards.

2-35. 1A2A2 BIT MAPPED GRAPHICS ADAPTER CCA DRIVER TEST--Continued.

6. Connect the oscilloscope probe ground to 1A2A11 ICU3, pin 8.

7. Set the oscilloscope controls as follows:

HORIZONTAL	VERTICAL	COUPLING	MODE	SLOPE	SOURCE
2 ms/Div	2 V/Div	DC	Normal	Positive	Ch 1

8. Set POWER to ON.

NOTE

Because the 1A2W7 Cable Assembly has been disconnected, an erroneous System Battery Status: LOW error will be displayed, without lighting the INTERN BATT LOW light.

9. Connect the oscilloscope probe to 1A2A11 ICU2, pin 4 and observe the VIDEO RELAY PICK signal.

   * If the signal is a steady voltage level of +5.00V (-1.00 +0.25V), go to step 12.

10. Set the oscilloscope Mode to AUTO and connect the probe to 1A2A11 ICU2, pin 1.

11. Observe the PICSEL signal.

    - If the signal is a steady voltage level of +5.00V (-1.00 +0.25V), replace 1A2A11 CCA (para 2-80).

12. Connect the oscilloscope probe to 1A2A11 ICU2, pin 13 and observe the VERTICAL SYNC signal.

    - If the display appears as shown in the 2 ms/Div graph, go to step 16.

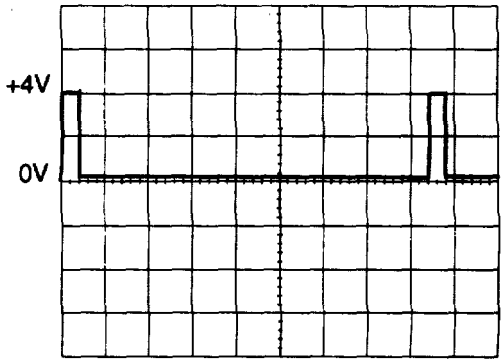
13. Set the oscilloscope horizontal controls to 0.1 ms/Div and observe the VERTICAL SYNC signal.

    - If the display appears as shown in the 0.1 ms/Div graph, go to step 16.

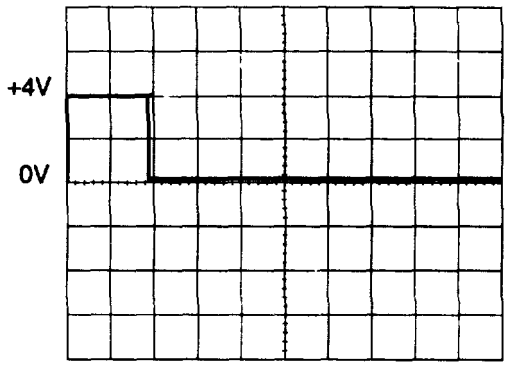
14. Refer to FO-4. Connect the oscilloscope probe ground to 1A2A2 IC53, pin 7.

15. Connect the oscilloscope probe to 1A2A2 R60 (left) and observe the VERTICAL SYNC signal.

    - If the display does not appear as shown in the 0.1 ms/Div graph, replace 1A2A2 CCA (para 2-66).



2 ms/Div
VERTICAL SYNC



0.1 ms/Div
VERTICAL SYNC

2-35 1A2A2 BIT MAPPED GRAPHICS ADAPTER CCA DRIVER TEST -Continued.

16. Set the oscilloscope horizontal controls to 10 µs/Div.

17. Refer to FO-13, sheet 1 of 6. Connect oscilloscope probe to 1A2A11 ICU2, pin 10 and observe the HORIZONTAL SYNC signal.

    • If the display appears as shown in the 10 µs/Div graph, go to step 20.

18. Set the oscilloscope horizontal controls to 2 µs/Div and observe the HORIZONTAL SYNC signal.

    • If the display appears as shown in the 2 µs/Div graph, go to step 20.

19. Refer to FO-4. Connect the oscilloscope probe to 1A2A2 R63 (left) and observe the HORIZONTAL SYNC signal.

    • If display still does not appear as shown in the 2 µs/Div graph, replace 1A2A2 CCA (para 2-66).

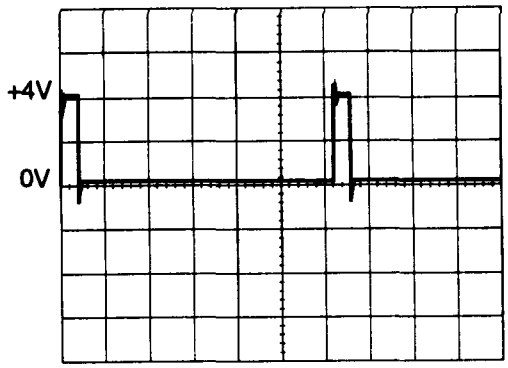
20. Set POWER to OFF.

21. Set the oscilloscope horizontal controls to 10 µs/Div.

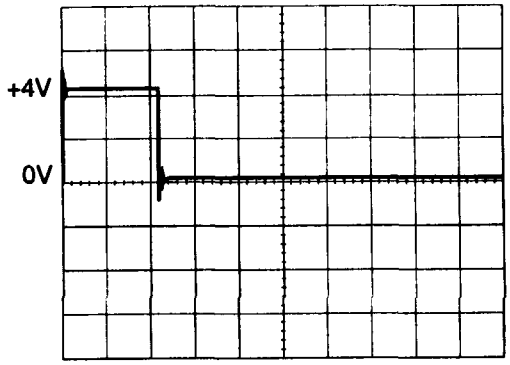
22. Refer to FO-13, sheet 1 of 6. Connect oscilloscope probe to 1A2A11 ICU3, pin 3.

23. Set POWER to ON and observe that the RED VIDEO pulse stream signal appears as shown.

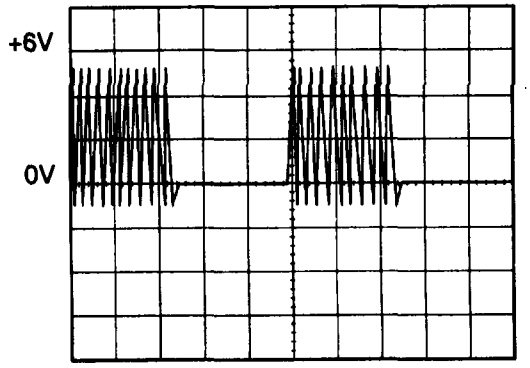
    • If the display is as shown, go to step 29.



10 µs/Div
HORIZONTAL SYNC



2 µs/Div
HORIZONTAL SYNC



10 µs/Div
RED VIDEO

2-35. 1A2A2 BIT MAPPED GRAPHICS ADAPTER DRIVER CCA TEST-Continued.

24. Set the oscilloscope vertical controls to 1 V/Div.

25. Refer to FO-4. Connect the oscilloscope ground probe to ICU53, pin 7 of 1A2A2 CCA.

26. Connect the oscilloscope probe to TEST PAD J7 (either pad) of 1A2A2 CCA.

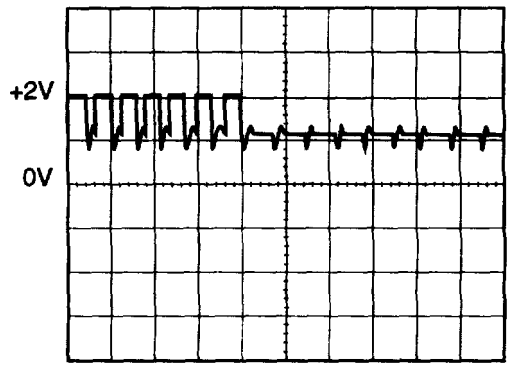
27. Press any front panel key to display the OTDR screen.

28. Observe VIDEO SIGNAL on oscilloscope.

    * If display is not as shown, replace 1A2A2 CCA (para 2-66).

29. On TS-4320:

    * Set POWER to OFF.
    * Disconnect test equipment.
    * Reinstall top cover (para 2-63).



2-36. VIDEO SELECT ENABLE TEST

DESCRIPTION

This test checks the integrity of the circuit from the 1A2A5 Special Input/Output CCA connector to the video select multiplexer on the Backplane Assembly.

WARNING I

Lethal, charged-CRT voltages may be present on the CRT Anode for some time after power is removed.

1. On TS-4320:

   - Set POWER to OFF.
   - Remove top cover (para 2-63).
   - Remove 1A2A5 CCA (para 2-65).

2. Refer to FO-13, sheet 1 of 6. Using the multimeter, place the "+" lead on pin 1 of ICU2 and the "-" lead on pin 15 of connector J26E on the 1A2A11 CCA.

   - The meter reading should be less than 2 ohms.

2-36. VIDEO SELECT ENABLE TEST - Continued.

3. On TS-4320:

   •· Remove power and disconnect test equipment.
   •· Reinstall 1A2A5 CCA.
   •· Reinstall top cover.

2-37. 1A2A6 GENERAL INPUT/OUTPUT CCA TO 1A2A11 CCA TEST.

DESCRIPTION

This test checks the integrity of the General Purpose Interface Bus circuits from the 1A2A6 General Input/Output CCA connector to the 1A2A11 Rear Panel Assembly connector.

1. On TS-4320:

   •· Set POWER to OFF.
   •· Remove top cover (para 2-63).
   •· Remove 1A2A2, 1A2A4 (para 2-66), and 1A2A6 (para 2-65) CCAs.

2. Refer to FO-2. Remove cables between 1A2A10 CCA and J17 and J18 of 1A2A11 CCA.

3. Refer to FO-12 and FO-13, sheet 1 of 6. Use multimeter to measure resistances between J17 and J30.

   • If any measurement is not less than 2 ohms, replace 1A2A11 CCA (para 2-80).

4. Refer to FO-12. Check fuses F5 and F12 on 1A2A10 CCA.

   • Replace fuse(s), if blown.

5. Remove power and disconnect test equipment.

6. On TS-4320:

   •· Reconnect ribbon cables.

   •· Reinstall 1A2A2, 1A2A4, and 1A2A6 CCAs.

   •· Reinstall top cover (para 2-63).

2-38. 1A2A5 SPECIAL INPUT/OUTPUT CCA MODULE INTERFACE TEST.

DESCRIPTION

This test checks the Special Input/output 1A2A5 CCA Module Interface.

1. On TS-4320:
   - •· Set POWER to OFF.
   - •· Remove top cover (para 2-63).
   - •· Remove 1A2A5 CCA (para 2-65).
   - • Refer to FO-13, sheet 1 of 6. Install Extender cards (tool 17, Appendix B, TM 11-6625-3271-12) in connectors J28AB and J26EF.
   - •· Install Extender card (tool 16, Appendix B, TM 11-6625-3271-12) in connector J27CD.
   - •· Install 1A2A5 CCA into Extender Cards.
   - •· Install keyboard.
2. Refer to FO-2. Install Module Simulator (tool 20, Appendix B, TM 11-6625-3271-12) CCA onto Module Connector JM1.
   - • Set the Module ID Select switch for positions 1 thru 8 to OPEN.
3. Set the oscilloscope controls as follows:

HORIZONTAL	VERTICAL	COUPLING	MODE	SLOPE	SOURCE
0.2 ms/Div	1 V/Div	DC	Normal	Positive	Ch 1

4. Insert the ROM Card Diagnostic CCA (tool 23, Appendix B, TM 11-6625-3271-12) into the ROM/RAMCARD drive.
5. Set POWER to ON.
6. Observe that the "READY/IN USE" light on the ROM/RAMCARD drive front panel is illuminated GREEN and that the other two lights are OFF.
7. Observe the following:
   - •· The Power-On Self Test runs.
   - •· The CECOM OTDR TEST FUNCTIONS PACKAGE menu is displayed.
8. On the Keyboard type 5.
   - • The SIO Board Test will load and run.
9. Type 'N' (No) for Memory Test.
10. Step through the test sequences until the CONFIGURATION REGISTER test is active.

2-38. 1A2A5 SPECIAL INPUT/OUTPUT CCA MODULE INTERFACE TEST - Continued.

11. Refer to FO-7. Connect the oscilloscope probe ground to ICU30, pin 10 on 1A2A5 CCA.

12. Connect the oscilloscope probe to ICU30, pin 12. The display should be as shown.

13. Connect the oscilloscope probe to ICU30, pins 13 through 19 in sequence. The display will be a square wave as shown with each successive pin doubling in frequency (ie. 512 µs, 256 µs, 128 µs, 64 µs etc.).

    - If any of the signals are not as shown, go to Step 28.

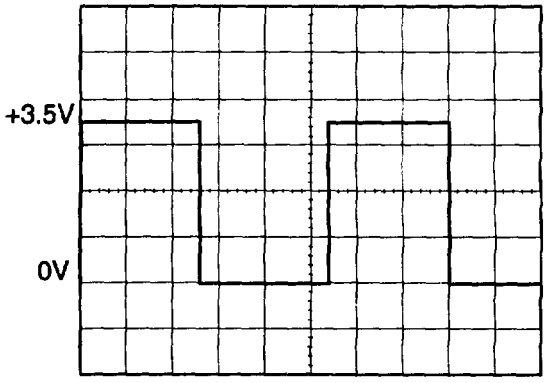
14. Connect the oscilloscope probe ground to TP1 on the Module Simulator.

15. Connect the oscilloscope probe to TP8. The display should be as shown.

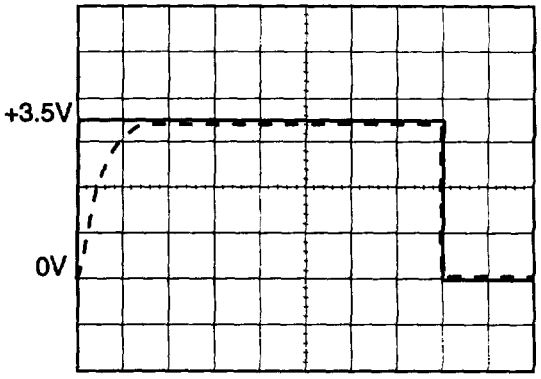
    Note: Test Point may appear rounded on leading edge.

16. Connect the oscilloscope probe to TP9 and then to TP10. Observe a display as shown.

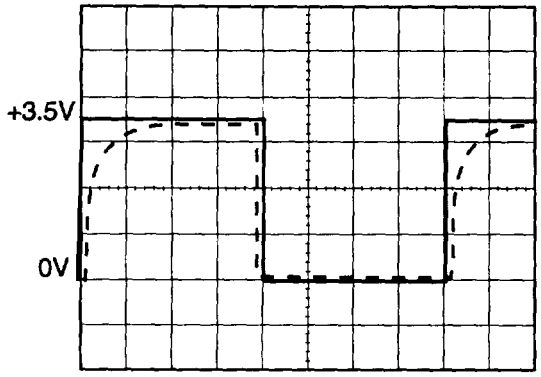
    If all signals are correct, go to step 20.



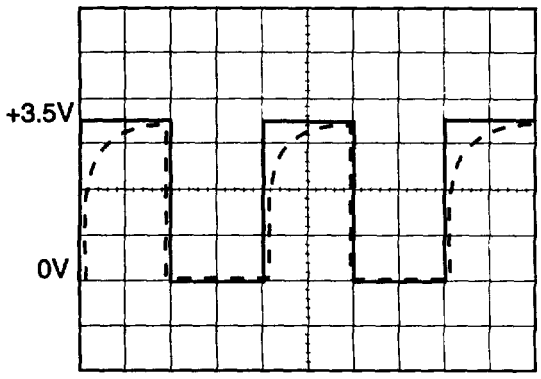
2 µs/Div
ICU30, PIN 12



2 µs/Div
TP8 and ICU30, PIN 17



2 µs/Div
TP9 and ICU30, PIN 18



2 µs/Div
TP10 and ICU30, PIN 19

2-38. 1A2A5 SPECIAL INPUT/OUTPUT CCA MODULE INTERFACE TEST --Continued.

17. Remove the Diagnostic ROMCARD CCA and set POWER to OFF.

18. Remove test equipment.

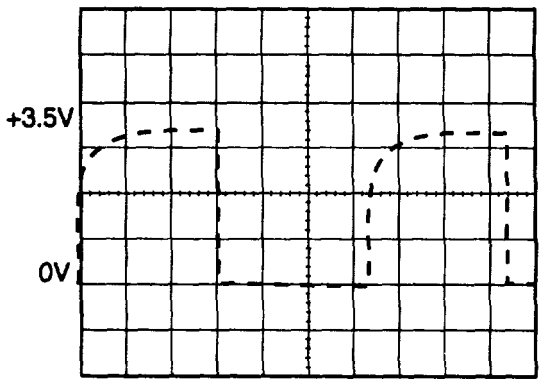
19. Perform 1A2W4 Cable Test (para 2-44).

    * If cable passes test, replace 1A2A11 CCA (para 2-80).

20. Set the Module ID Select switch (DP1) to positions 1, 2, 5, 6, 7, and 8 to OPEN; 3 and 4 to CLOSED.

21. Connect the oscilloscope probe ground to ICU33, pin 10 on the 1A2A5 CCA.

22. Connect the oscilloscope probe to ICU33, pin 4. Observe a 32 µs square wave, as shown above.



5 µs/Div
ICU33, PINS 2, 3, and 4

    * If any of the signals do not look like the display, perform 1A2W4 Cable Test (para 2-44) and then 1A2A11 CCA Test (para 2-48).

23. Set the Module ID Select switch (DP1) positions 1, 3, 5, 6, 7, and 8 to OPEN; 2 and 4 to CLOSED.

24. Connect the oscilloscope probe to 1A2A5 CCA, ICU33, pin 3. Observe a 32 us square wave, as shown above.

    • If any of the signals do not look like the display, perform 1A2W4 Cable Test (para 2-44).

25. Set the Module ID Select switch (DP1) positions 2, 3, 5, 6, 7, and 8 to OPEN; 1 and 4 to CLOSED.

26. Connect the oscilloscope probe to 1A2A5 CCA, ICU33, pin 2. Observe a 32 µs square wave as shown above.

    •· If any of the signals do not look like the display, perform 1A2W4 Cable Test (para 2-44).

    •· Replace 1A2A11 Backplane CCA (para 2-80).

27. On TS-4320:

    • Remove the Diagnostic ROMCARD CCA.

    • Set POWER to OFF.

    • Disconnect test equipment.

    • Reinstall top cover (para 2-63).

2-38. 1A2A5 SPECIAL INPUT/OUTPUT CCA MODULE INTERFACE TEST - Continued.

28. On TS-4320: •· Set POWER to OFF.

    •· Remove 1A2A5 CCA from Extender Cards.

    •· Refer to FO-13, sheet 1 of 6. Remove the Extender Card from connector J27CD.

    •· Install 1A2A5 CCA into Extender Cards in J28AB and J26EF.

    •· Set POWER to ON.

29. Observe that the "READY/IN USE" light on the ROM/RAMCARD drive front panel is illuminated GREEN and that the other two lights are OFF.

30. Observe the following:

    •· The Power-On Self Test runs.

    •· The CECOM OTDR TEST FUNCTIONS menu is displayed.

31. On the Keyboard type 5.

32. Type 'N' for NO.

    • The SIO Board Test will load and run.

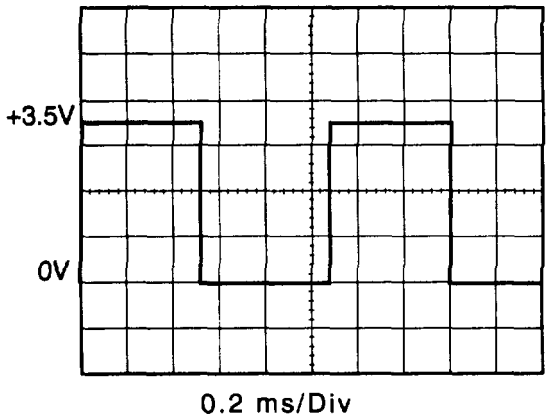
33. Step through the test sequences until the CONFIGURATION REGISTER test is active.

34. Refer to FO-7. Connect the oscilloscope probe ground to ICU30, pin 10 on 1A2A5 CCA.

35. Connect the oscilloscope probe to ICU30, pin 12. The display should be as shown.

36. Connect the oscilloscope probe to ICU30, pins 13 through 19 in sequence. The display will be a square wave as shown with each successive pin doubling in frequency (ie. 512 µs, 256 µs, 128 µs, 64 µs, etc.).

    • If the displays are still not correct, replace 1A2A5 CCA (para 2-65).



37. On TS-4320:

    •· Remove the Diagnostic ROMCARD CCA.

    •· Set POWER to OFF.

    •· Disconnect test equipment.

    •· Reinstall top cover (para 2-63).

2-39. 1A2A4 DATA ACQUISITION SYSTEM CCA OSCILLATOR TEST.

DESCRIPTION

This test checks the frequency of the clock oscillator on the 1A2A4 CCA by measuring the frequency of a TTL compatible signal using a frequency counter.

1. On TS-4320: •· Set to POWER to OFF.

   •· Remove top cover (para 2-63).

2. Refer to FO-2. Connect the probe ground of the Frequency Counter (tool 6, Appendix B, TM 11-6625-3271-12) to the ground strap on the TS-4320 chassis.

3. Set POWER to ON.

4. Refer to FO-6. On the solder side of 1A2A4 CCA, measure the frequency at ICU71, pin 9.

   • Frequency shall be 24.9975 MHz to 25.0025 MHz. If incorrect, replace 1A2A4 CCA (para 2-66).

5. On TS-4320.

   • Set POWER to OFF.

   • Disconnect test equipment.

   • Reinstall top cover (para 2-63).

2-40. 1A2A4 DATA ACQUISITION SYSTEM CCA TEST.

DESCRIPTION

This test checks the functionality of the 1A2A4 CCA including DAS memory. An A/D Simulator is used to simulate data collection.

1. On TS-4320:
   - Set POWER to OFF.
   - Connect keyboard.
   - Remove top cover (para 2-63).
   - Remove 1A2A8 CCA (para 2-64).
2. Refer to FO-6. Set SW2 on the A/D Data Simulator (tool 22, Appendix B, TM 11-6625-3271-12) to "COUNT" position.
3. Install the A/D Data Simulator into 1A2A8 CCA location.
4. Insert the ROM Card Diagnostic CCA (tool 23, Appendix B, TM 11-6625-3271-12) into the ROM/RAMCARD Drive.
5. Set POWER to ON.
6. Observe that the "READY/IN USE" light on the ROM/RAMCARD Drive front panel is illuminated GREEN and that the other two lights are OFF.
7. Observe the following: • The Power-On Self Test runs.
   - The CECOM OTDR DIAGNOSTIC TEST FUNCTIONS PACKAGE is displayed.
8. On the KEYBOARD type 3 to run the DAS Memory Test.
   - If a failure is reported, replace 1A2A4 CCA (para 2-66).
9. Remove the Diagnostic ROMCARD from the ROM/RAMCARD Drive. Store it in a protective envelope.
10. On TS-4320: • Set POWER to OFF.
    - Disconnect test equipment.
    - Reinstall top cover (para 2-63).

2-41. 1A2A4 DATA ACQUISITION SYSTEM CCA MODULE INTERFACE TEST.

DESCRIPTION

This test checks the functionality of 1A2A4 CCA Module Interface.

1. On TS-4320:
   - Set POWER to OFF.
   - Connect keyboard.
   - Remove top cover (para 2-63).
2. Refer to FO-2. Remove 1A2W7 Cable Assembly by disconnecting it from 1A2A13 CCA and 1A2A12 CCA.
3. Remove 1A2A4 CCA (para 2-66).
4. Refer to FO-13, sheet 1 of 6. Install Extender Card (tool 17, Appendix B, TM 11-6625-3271-12) in connector J7AB.
5. Install Extender Card (tool 16, Appendix B, TM 11-6625-3271-12) in connector J4GH.
6. Install 1A2A4 CCA into Extender Cards.
7. Connect the Disk Drive Unit (tool 18, Appendix B, TM 11-6625-3271-12) to the Rear Panel Connector "EXT. DISK".
8. Insert Diagnostic Disk (tool 19, Appendix B, TM 11-6625-3271-12) into the Disk Drive Unit.
9. Set POWER to ON.
10. Observe the following:
    - The Power-On Self Test will run.
    - The CECOM OTDR TEST FUNCTIONS are displayed.
11. On the KEYBOARD type 2.
    - The DAS Timing Tests will load and run.
    - Answer Y to the question:
      Is this a TS-4320 board? (y/n)-
12. Refer to FO-6. Connect the oscilloscope Probe Ground to ICU76, pin 7.

2-41. 1A2A4 DATA ACQUISITION SYSTEM CCA MODULE INTERFACE TEST - Continued.

13. Follow directions that appear on the screen and set the oscilloscope accordingly to run the following tests: • Data Collect Timing Test.

    • Laser Fire Timing Test.

    • Interlace Timing Test.

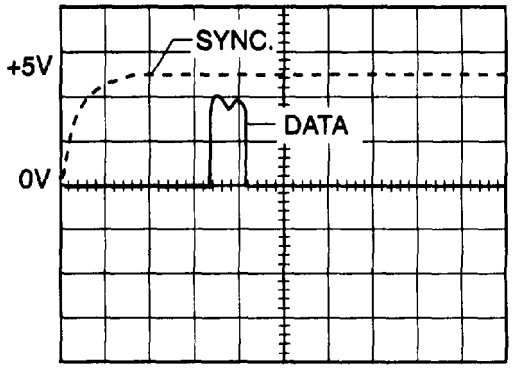
14. Observe that the traces appear as shown.

    • If DASTEST2 indicates a failure, replace 1A2A4 CCA (para 2-66).

15. While the Interlace Timing Test is still running, use oscilloscope Probe 2 and look at R28 (lower) lead. The display should be the inverse of that seen on ICU75, pin 5.

    • If this display is wrong continue.

    • If this display is correct, go to step 23.



100 ns/Div
Interlace Timing Test on R28

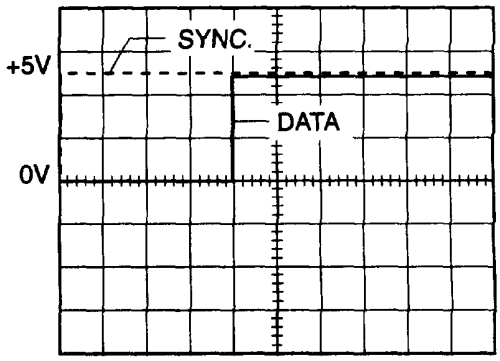
16. Set POWER to OFF.

17. Remove the 1A2A4 CCA from Extender Cards.

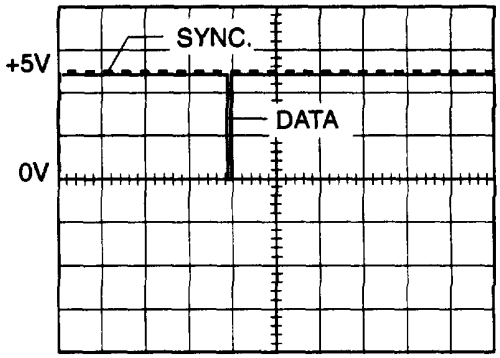
18. Remove Extender Card from J4GH.

19. Install 1A2A4 CCA into Extender Card.

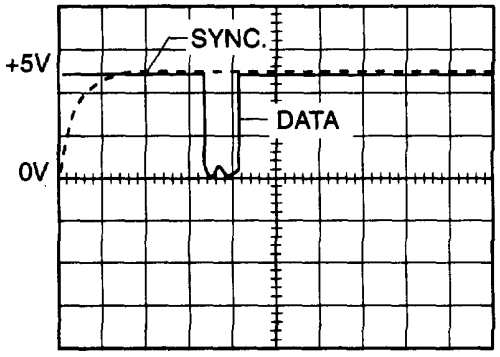
20. Repeat Steps 8 through 14.



5 µs/Div
Data Collect Timing Test



5 µs/Div
Laser Fire Timing Test



100 ns/Div
Interlace Timing Test

- If the displays are good, record the results and return to the malfunction step in table 2-1 that requested this test.

2-41. 1A2A4 DATA ACQUISITION SYSTEM CCA MODULE INTERFACE TEST-- Continued.

21. If the displays are still bad, replace 1A2A4 CCA (para 2-66).

22. Remove the Diagnostic Disk from the Disk Drive.

23. On TS-4320:

    - Set POWER to OFF.
    - Remove the 1A2A4 CCA from Extender Card.
    - Remove test equipment.
    - Reinstall 1A2W7 cable and 1A2A4 CCA.
    - Reinstall top cover (para 2-63).

2-42. ANALOG INTERFACE MODULE TEST.

DESCRIPTION

This test checks the Analog Interface Module of the mainframe.

1. On TS-4320:

    - Set POWER to OFF.
    - Remove the top cover (para 2-63).

2. Refer to FO-2. Install Module Simulator CCA (tool 20, Appendix B, TM 11-6625-3271-12) onto Connector JM1.

3. Set the Module ID Select switch positions 1, 2, 4, 5, 7, and 8 to OPEN; 3 and 6 to CLOSED. This will cause the Module Simulator CCA to be identified as a TD-260C Module.

4. Set the oscilloscope controls as follows:

HORIZONTAL	VERTICAL	COUPLING	MODE	SLOPE	SOURCE
0.1 ms/Div	2 V/Div	DC	Normal	Positive	Ch 1

5. Set POWER to ON.

6. After program loading, press the PULSE WIDTH key until the "LONG" light is ON.

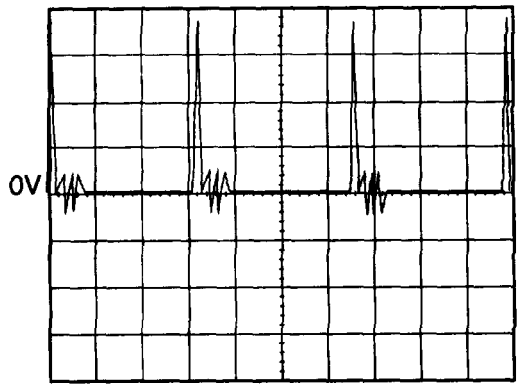
7. Set the fiber length/resolution to 8km/0.5m and press the HOR CONT to view the full eight kilometers.

8. Press the REAL TIME key.

2-42. ANALOG INTERFACE MODULE TEST - Continued.

9. Observe the LASER SYNC pulse by connecting oscilloscope Probe 1 to TP5 and Probe 1 Ground to TP1 of Module Simulator CCA.

   • If no LASER SYNC pulse, replace 1A2A4 Data Acquisition System CCA (para 2-66).

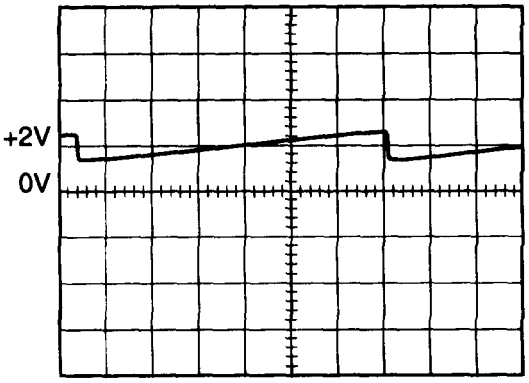


0.1 ms/Div
TP5 LASER SYNC

10. Set oscilloscope horizontal control to 50 µs/Div.

11. Refer to FO-10. Connect oscilloscope Probe 2 to TP2 center post of the Analog/Digital Converter 1A2A8 CCA and oscilloscope Ground lead to TP2 case. (Suggest making connections on solder side of CCA.)

    • If display is as shown, replace 1A2A8 CCA (para 2-64).



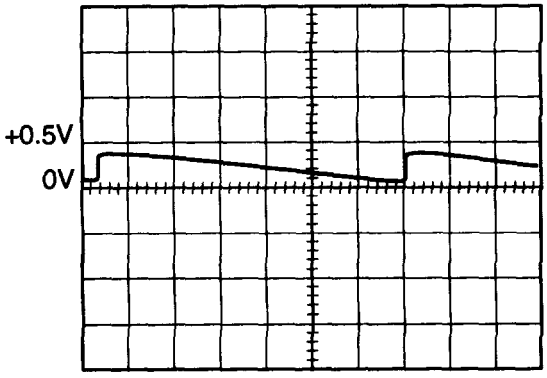
50 µs/Div
TP2 of 1A2A8 CCA

12. Set the oscilloscope vertical control for Channel #2 to 0.5V/Div.

13. Connect oscilloscope Probe 2 to J1 Header, center pin on solder side of 1A2A8 CCA and Probe Ground lead to TP2 case.

14. If "LASER ON" is not ON, depress REAL TIME key.

    • If display is as shown, replace 1A2A8 CCA (para 2-64).



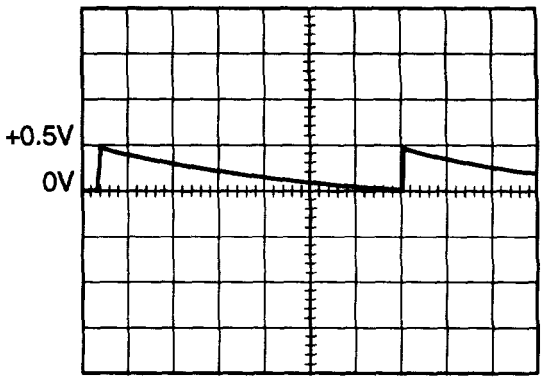
50 µs/Div
J1 of 1A2A8 CCA

2-42. ANALOG INTERFACE MODULE TEST - Continued.

15. Connect oscilloscope Probe 1 to TP6 and Probe Ground lead to TP1 of Module Simulator CCA.

16. If "LASER ON" is not ON, depress REAL TIME key.

    • If the display is as shown, the Coax Cable in Assembly 1A2W4 (Optical Module Interface) is defective. Replace 1A2W4.



50 µs/Div
TP6 of MODULE SIMULATOR

17. If "LASER ON" is displayed, press the N/LASER OFF key.

18. Press the REAL TIME key. The trace display should appear as shown in REAL TIME Display which represents a typical good display.

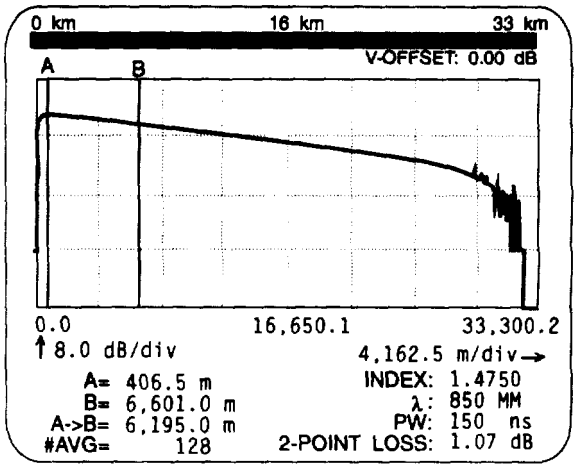
    • If the display is correct, Analog Interface Module is functional. Refer to the Symptom Index if original malfunction has not been corrected.

19. On TS-4320:

    • Set POWER to OFF.

    • Remove test equipment.

    • Reinstall top cover (para 2-63).



REAL TIME Display

2-43. 1A2A4 DAS CCA TO 1A2A8 A/D CONVERTER CCA INTERCONNECT TEST.

DESCRIPTION

This test checks the integrity of the circuits on the Backplane Assembly 1A2A11 CCA which interconnect the 1A2A4 DAS CCA and the 1A2A8 A/D Converter CCA.

1. On TS-4320:

    • Set POWER to OFF.

    • Remove top cover (para 2-63).

2. Refer to FO-2. Remove 1A2W7 Cable Assembly

2-43. 1A2A4 DAS CCA TO 1A2A8A/D CONVERTER CCA INTERCONNECT TEST - Continued.

3. Remove 1A2A2, 1A2A4 CCA's (para 2-66), and 1A2A8 CCA (para 2-64).

4. Refer to FO-13, sheet 1 of 6. Using the multimeter, measure the one-to-one resistances between J1A-5 through J1A-18 and J4H-5 through J4H-18 of the 1A2A11 Backplane Assembly CCA. The resistances should all be less than 1 ohm.

   • If any measurements are incorrect, replace 1A2A11 CCA (para 2-80).

5. On TS-4320:

   •· Remove test equipment.

   •· Reinstall 1A2A2, 1A2A4, and 1A2A8 CCA's.

   •· Reinstall 1A2W7 Cable Assembly.

   •· Reinstall top cover (para 2-63).

2-44. 1A2W4 CABLE ASSEMBLY TEST.

DESCRIPTION

This test checks the integrity of the digital portion of Cable Assembly 1A2W4.

1. On TS-4320:

   •· Set POWER to OFF.

   •· Remove top cover (para 2-63).

2. Refer to FO-2. Remove the 1A2W7 Cable Assembly .

3. Remove 1A2A2 and 1A2A4 CCA's (para 2-66); 1A2A5 and 1A2A6 CCA's (para 2-65); 1A2A3 CCA (para 2-67), 1A2A12 CCA (para 2-68), and 1A2A13 CCA (para 2-74) from the 1A2A11.

4. Disconnect 1A2W4 from J13 on the Backplane Assembly.

5. Refer to FO-2. Using the multimeter, measure the resistances between P13 and JM1.

   • If any measurement is greater than 1 ohm, replace cable 1A2W4.

6. On TS-4320:

   •· Reinstall 1A2W4

   •· Reinstall 1A2A2, 1A2A3, 1A2A4, 1A2A5, 1A2A6, 1A2A12, and 1A2A13 CCAs.

   •· Reinstall 1A2W7 Cable Assembly.

   •· Reinstall top cover (para 2-63).

2-45. 1A2A3 PROCESSOR CCA BEEPER DRIVER AND BEEPER TEST.

DESCRIPTION

This test checks the system speaker drive from the 1A2A3 Processor CCA and the speaker.

1. On TS-4320:

   •· Set POWER to OFF.

   •· Remove top cover without disconnecting battery lead (para 2-63).

2. Set oscilloscope controls as follows:.

HORIZONTAL	VERTICAL	COUPLING	MODE	SLOPE	SOURCE
2 ms/Div	2 V/Div	DC	Auto	Negative	Ch 1

3. Refer to FO-14. Connect oscilloscope probe ground to ICU5, pin 7 on 1A2A13 CCA.

4. Refer to FO-5. Connect oscilloscope probe 1 to pin 1 of JP3/P3 connector on the 1A2A3 Processor CCA.

   • If the signal does not display as a constant DC level of +4.75 to +5.25 volts, replace 1A2A3 Processor CCA (para 2-67).

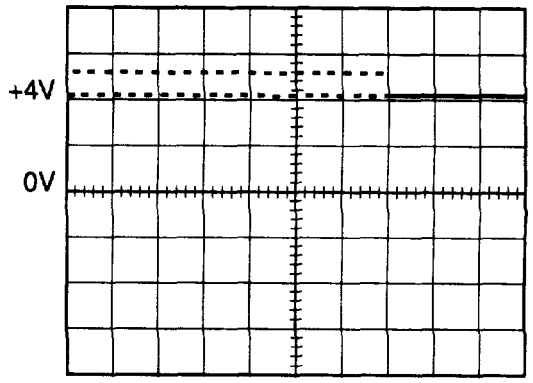
5. Connect oscilloscope probe 1 to pin 4 of JP3/P3 connector.

6. Press and release the "HOR CONT" key on the front panel eleven times.

   • If the BEEPER DRIVE + signal does not then briefly appear as shown each time the key is pressed, replace 1A2A3 CCA (para 2-67).

7. Refer to FO-13, sheet 1 of 6. Connect oscilloscope probe 1 to pin 1 of J9/P9 connector.

   • If the signal does not display as a constant DC level of +4.75 to +5.25 volts, replace 1A2W6 cable assembly.



2 ms/Div
BEEPER DRIVE +

8. Connect oscilloscope probe 1 to pin 4 of J9/P9 connector.

9. Press and release the "HOR CONT" key on the front panel.

   •· If the BEEPER DRIVE + signal does not briefly appear as shown each time the key is pressed, replace 1A2W6 cable assembly.

   •· Replace 1A2A11 Backplane CCA (para 2-80).

2-45. 1A2A3 PROCESSOR CCA BEEPER DRIVER AND BEEPER TEST - Continued.

10. On TS-4320:

    •· Set POWER to OFF.

    •· Remove test equipment.

    •· Reinstall top cover (para 2-63).

2-46. KEYBOARD ENTRY DATA LINE TEST.

DESCRIPTION

This test checks the Keyboard Data Entry signals at the 1A2A3 Processor CCA, and the cable and backplane continuity.

1. On TS-4320:

    • Set POWER to OFF.

    • Connect Keyboard.

    • Remove top cover without disconnecting the Battery Lead (para 2-63).

2. Refer to FO-14. Connect oscilloscope probe ground to pin 7 of ICU5 on 1A2A13 CCA.

3. Set POWER to ON.

4. Set oscilloscope controls as follows:

HORIZONTAL	VERTICAL	COUPLING	MODE	SLOPE	SOURCE
100 µs/Div	2 V/Div	DC	Auto	Negative	Ch 1

5. Refer to FO-5. Connect oscilloscope probe to pin 5 of JP1 on 1A2A3 CCA and observe a constant DC level of +4.75 to +5.25 volts on the display.

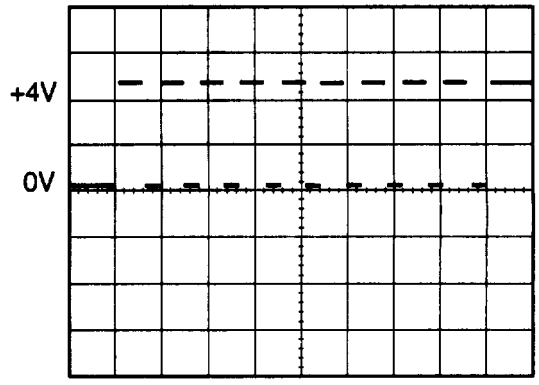
    • If the voltage is incorrect, replace 1A2A3 Processor CCA (para 2-67).

6. Connect oscilloscope probe to pin 2 of JP1 on 1A2A3 CCA and verify a constant DC level of -0.90 to +0.10 volts on the display.

    • If the voltage is incorrect, replace 1A2A3 Processor CCA (para 2-67).

7. Connect oscilloscope probe to pin 5 of JP1 connector on 1A2A3 CCA. Observe Keyboard Clock by repeatedly pressing and releasing the ESC key on the keyboard.

    • If display is not as shown, replace keyboard.



100 µs/Div
KEYBOARD CLOCK

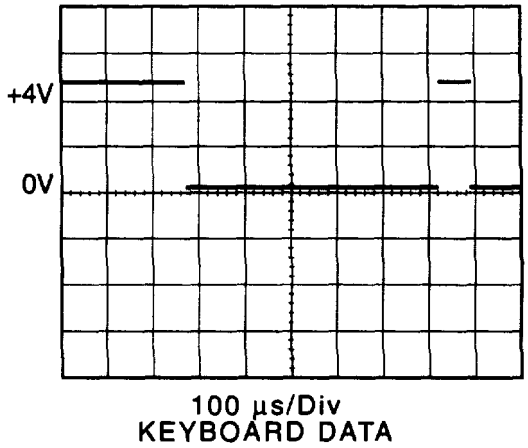
2-46. KEYBOARD ENTRY DATA LINE TEST - Continued.

8. Change oscilloscope Slope to Positive.

9. Connect oscilloscope probe to pin 4 of JP1 connector on 1A2A3 CCA. Observe Keyboard Data by repeatedly pressing and releasing the ESC key on the keyboard.

   • If display is not as shown, replace keyboard.

   •· If the signals are correct, perform steps 10-12.



10. On TS-4320:

   • Set POWER to OFF.

   • Disconnect test equipment.

   • Remove 1A2A3 CCA (para 2-67).

   • Remove 1A2W2.

   • Disconnect Keyboard Cable from the TS-4320 Backpanel.

11. Refer to FO-13, sheet 1 of 6. Using multimeter, measure the resistances between J14 and J12 of the Backplane Assembly.

+ METER LEAD	- METER LEAD	READING
J14-1	J12-1	< 1 Ω
J14-2	J12-3	< 1 Ω
J14-4	J12-7	< 1 Ω
J14-5	J12-9	< 1 Ω

   • If any measurement is incorrect, replace 1A2A11 CCA (para 2-80).

12. Using multimeter measure the resistances between P12 and JP1 of cable assembly 1 A2W2.

+ METER LEAD	- METER LEAD	READING
P12-1	JP1-1	< 1 Ω
P12-3	JP1-2	< 1 Ω
P12-7	JP1-4	< 1 Ω
P12-9	JP1-5	< 1 Ω

   • If any measurement is incorrect, replace 1A2W2 cable assembly.

   • If all measurements above are correct, replace 1A2A3 processor (para 2-67).

13. On TS-4320:

   • Set POWER to OFF, if required.

   • Remove test equipment.

   • Reinstall 1A2A3 CCA and 1A2W2 Cable Assembly.

   • Reinstall top cover (para 2-63).

2-47. GPIB CIRCUIT AT 1A2A10 REAR PANEL ASSEMBLY TEST.

DESCRIPTION

This test checks the integrity of the General Purpose Interface Bus Circuits on the 1A2A10 Rear Panel Assembly.

1. On TS-4320:

•· Set POWER to OFF.

•· Remove top cover (para 2-63).

•· Remove the 1A2A2 and 1A2A4 CCAs (para 2-66).

2. Refer to FO-13, sheet 1 of 6. Disconnect the Rear Panel Assembly ribbon cables from 1A2A11.

3. Refer to FO-12. Using the multimeter, measure resistances between P17 and J6 of the Rear Panel Assembly 1A2A10.

- If any measurement is greater than 1 Q, replace 1A2A10 CCA (para 2-75).

4. On TS-4320:

- Disconnect test equipment.

•· Reconnect the cable Assemblies.

•· Reinstall 1A2A2, and 1A2A4 CCAs.

•· Reinstall top cover (para 2-63).

2-48. 1A2A11 BACKPLANE CCA ASSEMBLY SERIAL I/O TEST.

DESCRIPTION

This test checks the integrity of the serial interface circuits on the 1A2A11 Backplane Assembly.

1. On TS-4320:

•· Set POWER to OFF.

•· Remove top cover (para 2-63).

•· Remove the 1A2A5 and 1A2A6 CCAs (para 2-65).

•· Remove the 1A2A2 and 1A2A4 CCAs (para 2-66).

2. Refer to FO-2. Disconnect the 1A2A10 ribbon cables from J17 and 18 on 1A2A11 CCA.

2-48. 1A2A11 BACKPLANE CCA ASSEMBLY SERIAL I/O TEST - Continued.

3. Using the multimeter, measure resistances between J17 and J18, and J30 and J31 as defined below.

+METER LEAD	-METER LEAD
J17-20	J30E-26
J17-22	J30E-28
J17-24	J30E-31
J18-23	J30F-31
J18-12	J31B-31
J18-26	J30F-29
J18-25	J30F-27
J17-26	J30F-28
J18-24	J30E-30

   - If any measurement is not less than 1Q, replace 1A2A11 CCA (para 2-80).

4. On TS-4320:

   - Disconnect test equipment.
   - Reconnect the cable assemblies.
   - Reinstall 1A2A2 and 1A2A4 (para 2-66)
   - Reinstall 1A2A5 and 1A2A6 CCAs (para 2-65).
   - Reinstall top cover (para 2-63).

2-49. GPIB INTERFACE TEST.

DESCRIPTION

This test checks the interface between the 1A2A6 GIO CCA and the GPIB (J6) connector on the 1A2A10 Rear Panel Assembly.

1. On TS-4320:

   - Connect keyboard.
   - Insert the ROM Card Diagnostic CCA (tool 23, Appendix B, TM 11-6625-3271-12) into the ROM/RAMCARD drive.
   - Set POWER to ON.
   - Observe that all the LED indicators on the front panel light momentarily.

2. When the CECOM OTDR TEST FUNCTIONS PACKAGE screen is displayed, type 4 on the keyboard to select the GIO Board Test.

3. When the test loads, the GIO BOARD TEST MENU is displayed.

2-49. GPIB INTERFACE TEST - Continued

4. Type D on the keyboard to select the GPIB INTERFACE TEST.

   • If the test fails, replace the 1A2A6 GIO CCA (para 2-65).

5. On TS-4320:

   •· Remove the ROM Card Diagnostic CCA from the ROM/RAMCARD Drive.

   •· Set POWER to OFF.

   •· Disconnect keyboard.

2-50. RS-232 INTERFACE TEST.

DESCRIPTION

This test checks the interface between the 1A2A6 GIO CCA and the RS-232 (J3) connector on the 1A2A10 Rear Panel Assembly.

---

1. On TS-4320:

   • Connect keyboard.

   • Refer to FO-12. Install Electrical Connector Assembly (tool 21, Appendix B, TM 11-6625-3271-12) on the 1A2A10 Rear Panel Assembly Connector J3.

   • Insert the ROM Card Diagnostic CCA (tool 23, Appendix B, TM 11-6625-3271-12) into the ROM/RAMCARD drive.

   • Turn the Power switch ON.

   • Observe that all the LED indicators on the front panel light momentarily.

2. When the CECOM OTDR TEST FUNCTIONS PACKAGE screen is displayed, type 4 on the keyboard to select the GIO Board Test.

3. When the test loads, the GIO BOARD TEST MENU is displayed.

4. Type A on the keyboard to select the SERIAL PORT TEST.

NOTE

The test is run at several baud rates.

   • If the test fails, note results and return to the malfunction step in table 2-1 that requested this test.

5. On TS-4320:

   •· Remove the ROM Card Diagnostic CCA from the ROM/RAMCARD Drive.

   •· Remove POWER and disconnect test equipment.

   •· Disconnect keyboard.

2-51. 1A2A5 SPECIAL INPUT/OUTPUT CCA TEST.

DESCRIPTION

This test checks the 1A2A5 Special Input/Output CCA and the 1A2A1 Front Panel Assembly.

1. On TS-4320:
   - Connect keyboard.
   - Insert the ROM Card Diagnostic CCA (tool 23, Appendix B, TM 11-6625-3271-12) into the ROM/RAMCARD drive.
   - Set POWER to ON.
   - Observe that all the LED indicators on the front panel light momentarily.
2. When the CECOM OTDR TEST FUNCTIONS PACKAGE screen is displayed, type 5 on the keyboard to select the SIO Board Test.
3. When the test loads, Running TESTSIO.EXE... is displayed.
4. Type Y on the keyboard to run the memory test.
5. Type N when prompted to Verify Data Retention.

NOTE

Approximately 50 seconds is required to run the test. Then a memory pattern test will run.

   - If the test fails, replace the 1A2A5 SIO CCA (para 2-65).
6. Run 3 minute data retention test per instructions on the screen.
   - If the test fails, replace the 1A2A5 SIO CCA (para 2-65).
7. Type 'N' for NO additional testing.
8. On TS-4320:
   - Remove .the ROM Card Diagnostic CCA from the ROM/RAMCARD Drive.
   - Remove power and disconnect test equipment.
   - Disconnect keyboard.

2-52. 1A2W5 POWER SWITCH TEST.

DESCRIPTION

This test checks the electrical continuity of the Power Switch when closed.

1. On TS-4320:
   - Set POWER to OFF.
   - Remove AC POWER cable.
   - Remove top cover (para 2-63).
2. Refer to FO-2. Disconnect the in-line connector P1 of the Power Supply from the Power Switch connector J1.
3. Set the POWER to ON.
4. Using the multimeter, measure resistances at J1 as shown below.

+ METER LEAD	- METER LEAD	RESISTANCE
J1-1	J1-5	1 Ω
J1-2	J1-6	1 Ω
J1-2	J1-1	∞

   - If any measurements are not correct, replace 1A2W5.
5. On TS-4320:
   - Remove power and disconnect test equipment.
   - Reconnect P1 to J1.
   - Reinstall top cover (para 2-63).
   - Reconnect AC POWER cable.

2-53. BRIGHTNESS CONTROL TEST.

DESCRIPTION

This test checks the functionality of the brightness control pot.

1. On TS-4320:
   - Set POWER to OFF.
   - Remove top cover (para 2-63).
2. Refer to FO-13, sheet 1 of 6. Disconnect connector P36 from J36.
3. Set Brightness Control knob fully CCW.
4. Using the multimeter, measure resistances shown below.

KNOB POSITION	+ METER LEAD	- METER LEAD	READING
CCW	P36-1	P36-3	80 KΩ- 120 KΩ
CCW	P36-1	P36-4	80 KΩ - 120 KΩ
CW	P36-1	P36-3	< 5 Ω
CCW	P36-3	P36-4	< 5 Ω
mid-range	P36-1	P36-3	40 KΩ - 60 KΩ
mid-range	P36-3	P36-4	40 KΩ - 60 KΩ

   - Replace Brightness Control Pot if any of the above fail.
5. On TS-4320:
   - Disconnect test equipment.
   - Reconnect P36 to J36.
   - Reinstall top cover (para 2-63).

2-54. 1A2A9 CRT DRIVER CCA 12 VOLT DC TEST.

DESCRIPTION

This test checks the +12 volts on 1A2A9 CRT Driver CCA.

WARNING

Hazardous voltages are present when covers are removed. Where maintenance can be performed without having power applied, power should be removed.

1. On TS-4320:
   - Set POWER to OFF.
   - Remove top cover (para 2-63).
   - Set POWER to ON.
2. Refer to FO-2. Connect ground lead of multimeter to wire ground strap.
3. Refer to FO-11. Using multimeter, verify the voltage at W101 on 1A2A9 CCA is +11.4 to +12.6 VDC.
   - If voltage is correct, replace 1A2A9 (para 2-72).
4. Set Power to OFF.
5. Refer to FO-2 and FO-13, sheet 1 of 6. Disconnect the short cable between J35 on the 1A2A11 Backplane CCA and J101 on the 1A2A9 Driver CCA.
6. Check the one-to-one continuity of the cable removed in step 5.
   - If resistance of any wire is greater than 0.5 ohms, replace faulty wire.
   - If resistance of all wires is less than 0.5 ohms, replace 1A2A11 CCA (para 2-80)
7. On TS-4320:
   - Remove power and disconnect test equipment.
   - Reinstall top cover (para 2-63).

2-55. INVERTER STATIC POWER TEST.

PROCEDURE

This test is used to check the functionality of the DC/AC Inverter.

NOTE

12 VDC source required with minimum 12 amps for 12 VDC check.

1. On Inverter:
   - Set POWER to OFF.
   - Connect input power cable to DC connector.
   - Connect input power cable to DC source.
   - Set DC Source to +12 VDC.
   - Set POWER to ON.
2. Refer to FO-15. Use a multimeter to check for an AC output of 103 to 127 VAC from the inverter.
   - If incorrect, go to Step 9.
3. Connect TS-4320 AC power cable to the unused output connector of the inverter.
4. On TS-4320: • Set POWER to ON.
5. The multimeter should still indicate an AC output of 103 to 127 VAC from the inverter.
   - If incorrect, replace inverter.
6. Observe inverter power lamp is ON.
   - If not ON, go to Step 13.
7. On inverter: •· Set POWER to OFF.
   •· Repeat Steps 1-6 above using 24 and 28 VDC settings.
8. Observe inverter lamp goes OFF and multimeter indicates 0 VAC.
   •· If the indications are correct, inverter is functional.
   •· If the indications are incorrect, continue.

2-55. INVERTER STATIC POWER TEST - Continued.

9. On Inverter:

   •· Set POWER to OFF.

   •· Disconnect DC input power cable.

   •· Remove top cover (para 2-82).

10. Refer to FO-15. Use a multimeter to check the resistance of the power switch.

   • If resistance is not greater than 15 Kilo-ohms, replace power switch.

11. Set POWER switch to ON.

12. Use a multimeter to check the resistance of the power switch.

   • If the switch resistance is not less than 2 ohms, replace power switch.

   • If correct, go to step 13.

13. On Inverter:

   • Connect input power cable to DC connector.

   • Connect input power cable to DC source.

WARNING

Hazardous voltages are present when covers are removed. Where maintenance can be performed without having power applied, power should be removed.

   • Set POWER to ON.

14. Refer to FO-15. Place multimeter leads as shown to measure lamp voltage.

   •· If voltage is +1.6 to +2.4 VDC, replace lamp.

   •· If voltage is incorrect, replace Inverter.

15. Remove power and disconnect test equipment.

16. On Inverter

   • Disconnect DC power cable from source and inverter.

   • Reinstall top cover (para 2-63).

Section IV. MAINTENANCE PROCEDURES

2-56. PERFORMANCE TEST.

DESCRIPTION

This procedure covers the parameters listed below.

- DISTANCE ACCURACY.
- DYNAMIC RANGE (TRANSMITTER).
- DYNAMIC RANGE (RECEIVER).
- SPATIAL RESOLTUION.
- ATTENUATION DEAD ZONE.

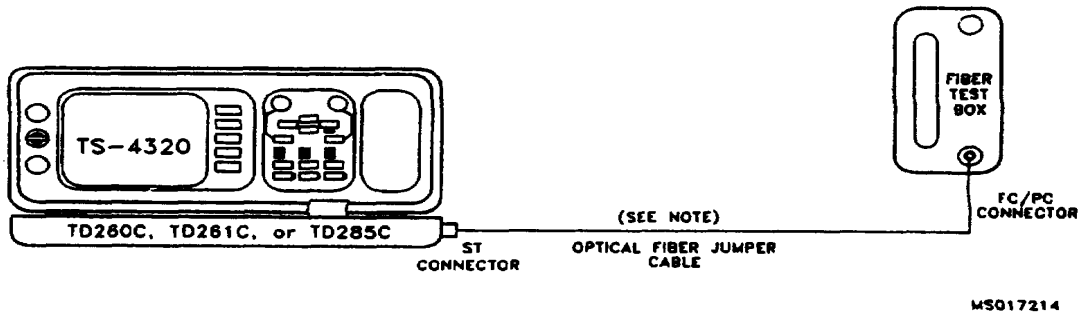
NOTE

* The following test procedures are performed utilizing the Fiber Optic Universal Calibration Set (FOCUS). Use of Optical Test Fiber is explained in appendix C.
* Performance test procedure steps should be done in the order given.
* When testing a TD-285C, perform each test at the 1310nm wavelength first and then repeat at 1550nm.
* Allow a 15-minute warmup period to allow TS-4320 to stabilize. Then cycle the POWER OFF and ON once before performing the first test.
* Before connecting a test giver, always clean the test fiber end with a Kimwipe (Appendix B, Item 14) and isopropyl alcohol (Appendix B, Item 1). Dry with Canned Air (Appendix B, Item 13).
* It may be necessary to expand the display horizontally and/or vertically to obtain certain designated settings in these tests.
* If a failure occurs, refer to Symptoms Index, Section III.

DISTANCE ACCURACY.

- **Insertion Delay Characterization**

1. Connect equipment as shown.



2-56. PERFORMANCE TEST-Continued

NOTE

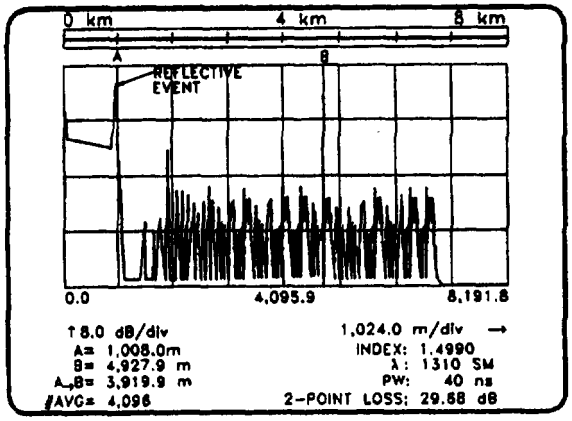
Use 2.0 +0.1m 9/125 micron jumper fiber cable for the TD-260C, TD0261C and TD-285C optical modules. This cable is supplied with FOCUS.

2. On the TS-4320, set the following:

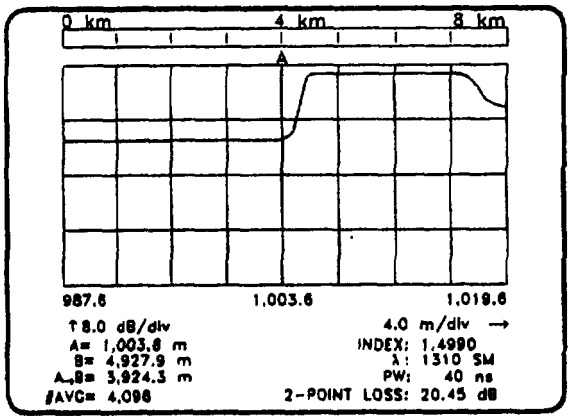
   - Highest Resolution.
   - Shortest Range.
   - "MEDIUM" PULSEWIDTH.
   - "INDEX" = 1.4990
   - DISPLAY FROM "ORIGIN"

3. On the TS-4320:

   - Press FAST SCAN.
   - Wait for acquisition to be complete.
   - Place cursor "A" at the leading edge of the reflective event of the fiber as shown. (approx 1000 meters)
   - Press DISPLAY FROM to select "A."
   - Press HOR EXP until 4.0m/div is displayed.
   - Carefully adjust cursor "A" to the beginning of the leading edge of the reflective event as shown.
   - Record the "A = " distance in meters.



INITIAL CURSOR PLACEMENT

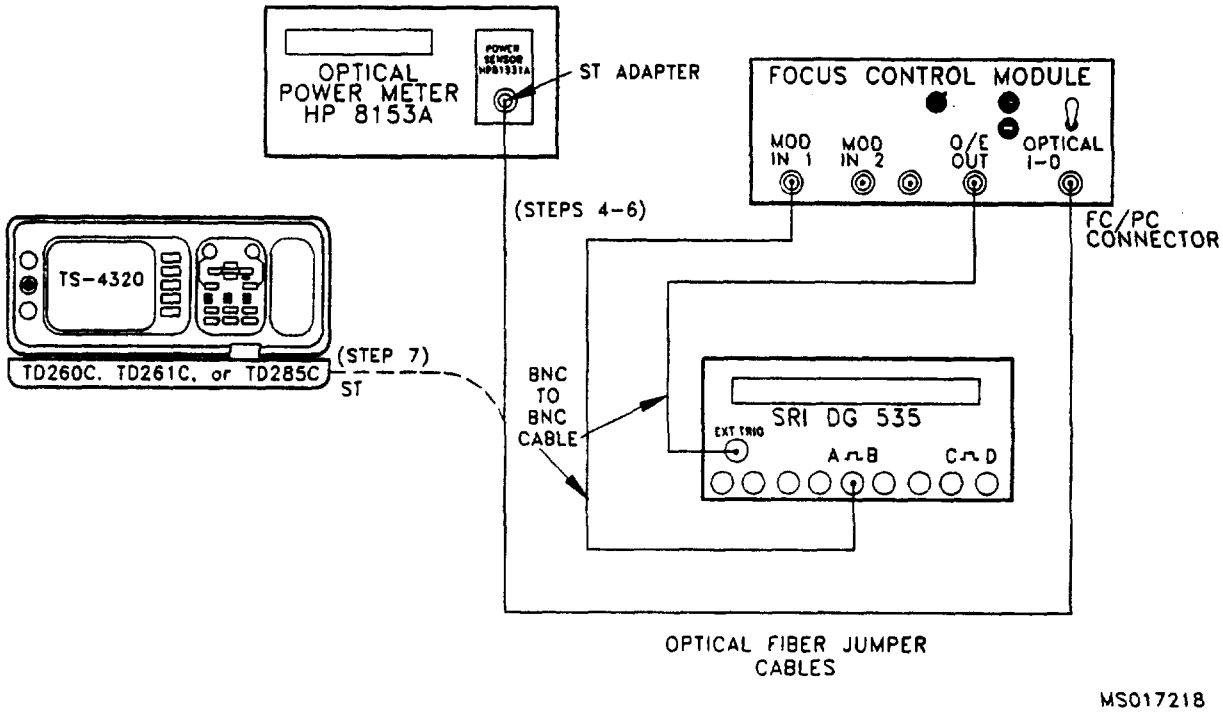


ADJUSTED CURSOR PLACEMENT

MS017215

2-56. PERFORMANCE TEST-Continued

4. Disconnect jumper fiber from Fiber Test Box and reconnect equipment as shown.



NOTE

- Use SWCM for Optical Module TD-260C and LWCM for Optical Modules TD-261C and TD-285C.
- Use 2.0 ± 0.1m 9,125 micron jumper fiber cable for optical modules TD-260C, TD261C and TD-285C.
- Use 1.0 ± 0.1m BNC to BNC cables. All of these cables are included with the FOCUS set.

5. On the Optical Power Meter, set to measure optical power at nominal wavelength from the FOCUS control module.
6. On the FOCUS control module:
   - Set LD BIAS CURRENT switch to LD PULSED.
   - Set SWITCHED ATTEN switch to OUT.
   - Using the Optical Power Meter as a monitor, adjust VAR ATTN 1 for maximum output optical power and minimum attenuation. (For TD-285C,1310nm, adjust optical power to -43dBm; for TD-285C,:1550nm, adjust optical power to -38dBm.)
7. Disconnect fiber jumper from the optical power meter and reconnect to the optical input connector of the optical module under test on the TS-4320.

2-56. PERFORMANCE TEST-Continued

8. On the Digital Delay Generator (DDG), DG 535:

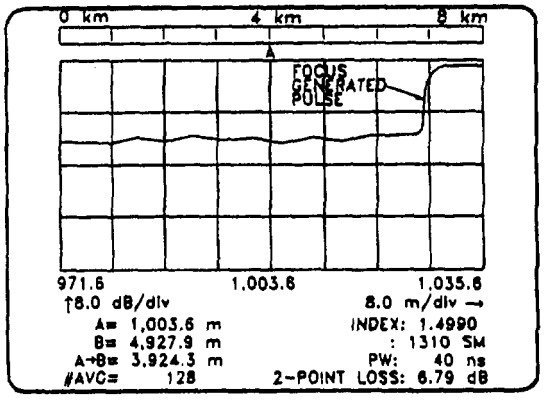
- Set TRIG to EXT, threshold = + 0.50V, slope (+;- = +, Trigger Term = 50 ohm.
- Set OUTPUT to "AB", AB & -AB Loads = 50 ohm, AB: "VAR", AB: Amplitude = + 2.00V, AB: offset = 1.6V.
- Set "A" delay to "A = T + 10.000000 microseconds."
- Set "B" delay to "B = A + 10.000000 microseconds."

9. On the TS-4320:

- Press REAL TIME.
- Press HOR CONT as required to display FOCUS generated pulse.

NOTE

Do not change "A" cursor position using "A" cursor adjustment knob so as not to lose reference position. If "A" cursor is moved during this procedure, it must be readjusted to the recorded "A=" distance (step 3).



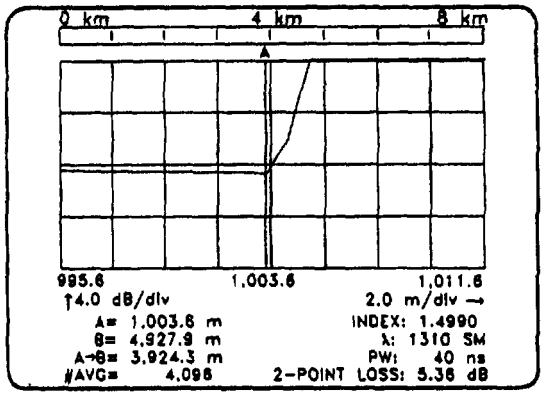
FOCUS GENERATED PULSE

10. On DG 535:

Decrease "A" delay in 100 nanosecond increments until FOCUS generated pulse leading edge is almost to the "A" cursor.

11. On TS-4320:

- Press HOR EXP and VERT EXP as required to obtain best FOCUS generated pulse placement to the "A" cursor.
- FOCUS generated pulse should still be at "A" cursor ± 0.2m. If not, decrease or increase "A" delay until ± 0.2m tolerance is obtained after FAST SCAN.



INSERTION DELAY CHARACTERIZATION
PULSE PLACEMENT
MS017219

12. On the DG 535:

* Record "A = T +" in nanoseconds (µs).

- Recorded figure will be referred to in calculations as "Equivalent Delay."

13. Compute the following calculations:

TID t 2 (TOF FIBERBOX + TOF JUMPER FIBER) Equivalent Delay

2-56. PERFORMANCE TEST--Continued

NOTE

- TID is the FOCUS Insertion Delay in nanoseconds (ns).
- TOF FIBERBOX is the Time of Flight in ns of the Fiber Test Box from the Fiber Test Box Calibration Report.
- TOF JUMPER FIBER is the Time of Flight in ns of the interconnecting jumper fiber. It is equal to 10 ns for a 2.0m jumper.
- Equivalent Delay is the recorded delay in ns from step 12.

- **Distance Accuracy Test**

1. On the OG 535:

Using the chart below, set the DDG to the FIRST specified time delay setting.

2. On the TS-4320:

Using the chart below, set to the FIRST specified length/resolution setting.

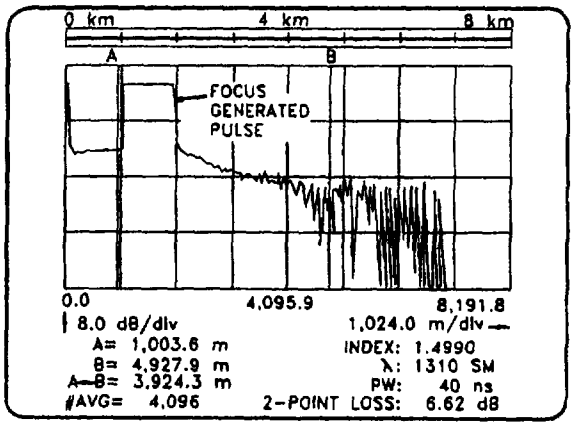
	DDG Time Delay Setting	TS-4320 Length (km/m)
1st	A = T + 10.000 µs	8,0.5
2nd	A = T + 100.000 µs	16/1.0
3rd	A = T + 300.000 µs	32i2.0

- Press DISPLAY FROM to select ORIGIN.
- Press PULSE WIDTH to select SHORT.
- Press HOR CONT as required until 1,024.0 m/div is displayed.
- Press VERT EXP until 8.0 dB/div is displayed.
- Set INDEX as required to 1.4990.

2-56. PERFORMANCE TEST-Continued

3. On TS-4320:

- Press FAST SCAN and allow acquisition to complete.
- FOCUS generated pulse leading edge should appear at approximately 10000 meters from origin as shown in diagram.
- Adjust "A" cursor knob until "A" cursor is at the leading edge of the FOCUS generated pulse.
- Press DISPLAY FROM to SELECT A.
- Press HOR EXP as required until 2.0 m/div is displayed.
- Using "A" cursor knob, adjust the "A" cursor so that it is at the exact beginning of the FOCUS generated pulse as shown in diagram.
- Record the "A = " value from the display as the Measured Distance (Dmeas).

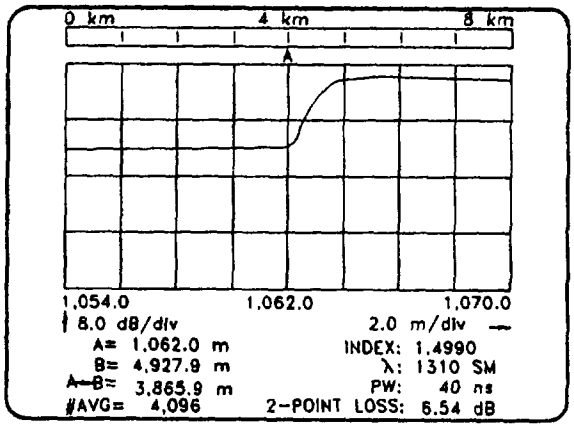


FOCUS GENERATED PULSE

NOTE

Accurate cursor positioning to the exact beginning of the FOCUS pulse leading edge is required to obtain best results.

4. Copy the chart below for use in calculating Reference



"A" CURSOR POSITIONING

MS017222

Distance (D_{REF}) in meters using formula;

D_{REF} = 9.9997500 X 107 (TDG + TID):

TDG	+	TID	X	9.9997500	=	Dmeas
	+		X	9.9997500	=	
	+		X	9.9997500	=	
	+		X	9.9997500	=	

2-56. PERFORMANCE TEST-Continued

NOTE

- TDG is the "A" delay setting on the DG 535 from the chart in step 2.
- TID is the Insertion Delay as measured for given interconnecting cable lengths and the specific FOCUS unit.
- The TID applies for BNC to BNC cables that are 1.0 ± 0.1m long and the optical jumper cable that is 1.0 ± 0.1m long (the nominal FOCUS optical fiber jumper cable length). If longer or shorter cables must be used, add or subtract respectively 1 nanosecond to or from TID per 0.1m difference in total length.

5. Copy the chart below for use in calculating Measured Error (Emeas) in meters using formula; Emeas - Dmeas - D_{REF}:

Dmeas	-	D_{REF}	=	Emeas (note)

NOTE

If Emeas is negative, change to positive number.

6. Copy the chart below for use in calculating the maximum error allowable (Emax) in meters using formula; Emax = $2.5 \pm 3 \times 10^{-5} \times D_{REF}$:

D_{REF}	X	0.00003	+	2.5	=	Emax
	X	0.00003	+	2.5	=	
	X	0.00003	+	2.5	=	
	X	0.00003	+	2.5	=	

7. If Emeas exceeds Emax for any D_{REF}:
- Power down and power up the TS-4320.
- Repeat steps 1 through 6 above.

8. If Emeas still exceeds Emax for any D_{REF}:
- Power down TS-4320 and replace optical module with a similar module unit.
- Power up the TS-4320 and repeat steps 1 through 6 above.

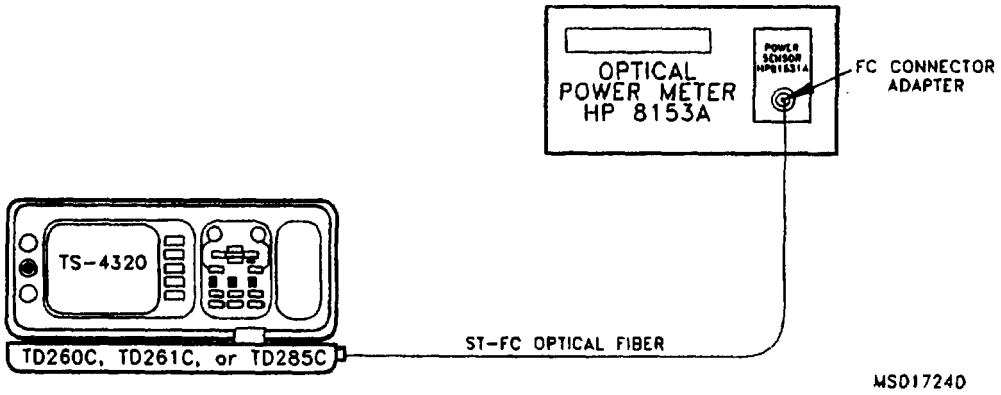
9. If Emeas persists in exceeding Emax after performing all possibilities above, notify the next higher level of maintenance.

10. Power down and disconnect equipment.

2-56. PERFORMANCE TEST-Continued

DYNAMIC RANGE (TRANSMITTER)

1. Connect equipment as shown.



NOTE

Use fiber jumper cables for each module under test as indicated in the chart below.

Optical Module	Fiber Jumper Cable	Cable Kit Location
TD-260C	50/125 Micron	TS-4320
TD-261C	50/125 Micron	TS-4320
TD-285C	9/125 Micron	FOCUS & TS-4320

2. On the TS-4320:
- Press REAL TIME and SHORT pulse width buttons.
- Optimize fiber connector and fiber jumper connection for maximum optical output using the optical power meter as a monitor to obtain the best connection.
- Set for minimum fiber length.
- Set for maximum resolution (lowest number attainable).

3. On the Optical Power Meter:
- Set to read optical power in dBm at nominal wavelength for the specific TS-4320 optical module under test.
- Record optical power displayed on the optical power meter for "SHORT," "MEDIUM," and "LONG," pulsewidths.
- Repeat the process for each optical module.
- Compare recorded readings with the tolerances below.

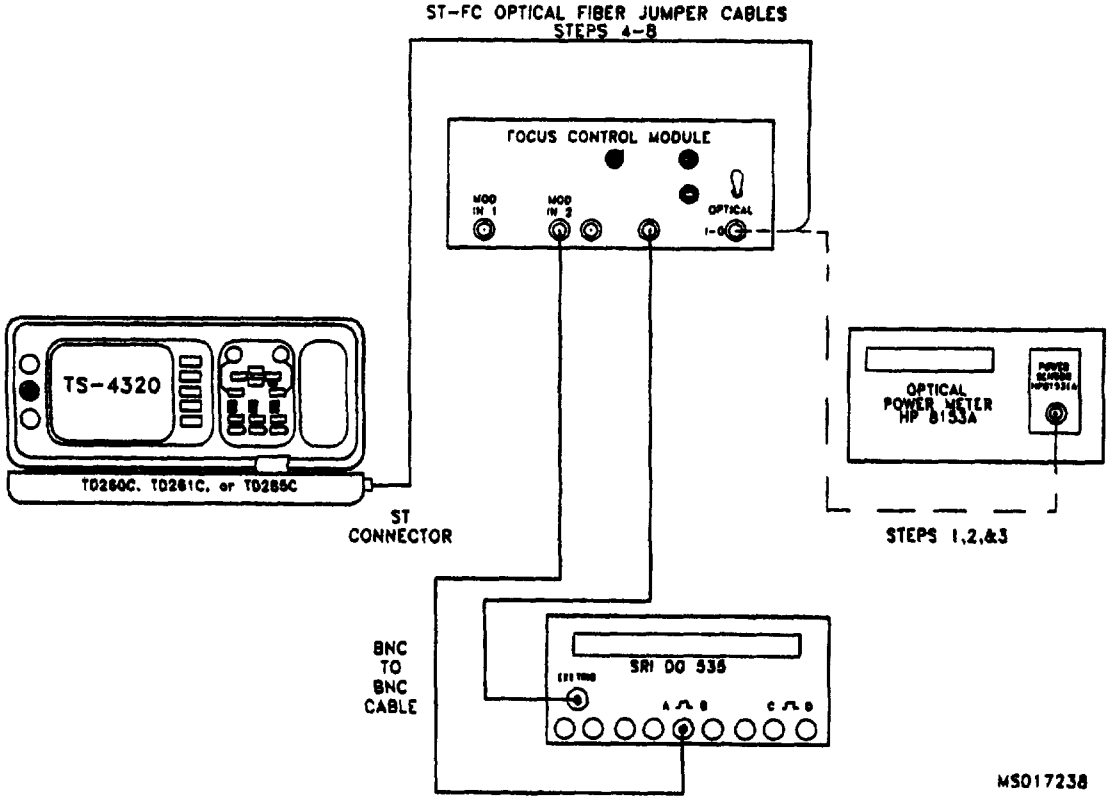
2-56. PERFORMANCE TEST-Continued

TS-4320 OPTICAL MODULE	OPTICAL POWER (dBm, minimum)/PULSEWIDTH		
	"SHORT"	"MEDIUM"	"LONG"
TD-260C	-26.5	-21.5	-19.6
TD-261C	-40.6	-39.0	-36.2
TD-285/1310nm	-41.0	-39.0	-19.2
TD-285/1550nm	-41.0	-39.2	-19.5

- If any optical power level is not within minimum tolerance, notify the next higher level of maintenance.
- Power down and disconnect equipment.

DYNAMIC RANGE (RECEIVER)

1. Connect equipment as shown.



2-58. PERFORMANCE TEST-Continued

NOTE

Use FOCUS CONTROL MODULES and fiber jumper cables for each TS-4320 Optical Module under test as indicated in the chart below.

OPTICAL MODULE	FOCUS CM	FIBER CABLE	KIT LOCATION
TD-260C	SWCM	5i125 MICRON	TS-4320
TD-261C	LWCM	51125 MICRON	TS-4320
TD-285C	LWCM	9/125 MICRON	FOCUS/TS-4320

2. On the Optical Power Meter, set to measure optical power at nominal wavelength from the FOCUS control module.

3. On the FOCUS Control Module:

- Set LD BIAS CURRENT switch to LD PULSED.
- Set SWITCHED ATTN switch to OUT.
- Set WAVELENGTH to the wavelength of the TS-4320 Optical Module under test.
- Using the Optical Power Meter as a monitor, adjust VAR ATTN 1 for the maximum output optical power and minimum attenuation.

NOTE

For the TD-285C optical modules under test, optical power will be adjusted as indicated below.

OPTICAL MODULE:	ADJUST OPTICAL POWER TO:
TD-285C/1310 nm	-43 dBm ± 0.1 dBm
TD-285C/1550 nm	-38 dBm ± 0.1 dBm

4. Disconnect fiber jumper cable from the optical power meter and reconnect to the optical input connector of the optical module under test on the TS-4320.

5. On the Digital Delay Generator (DDG) DG 535:

- Set "A" delay to A = T + 100.000000 microseconds.
- Set "B" delay to B = A + 10.000000 microseconds.
- Set TRIGGER to EXT, THRESHOLD = + 0.50V, SLOPE (+/+, TRIGGER TERM = 50 ohms.
- Set OUTPUT to "AB," AB&AB LOADS= 50 ohms, AB: "VAR," AB: AMPLITUDE =+2.00V, AB: OFFSET = -1.60V.

2-56. PERFORMANCE TEST-Continued

6. On the TS-4320, set as follows:

- Pulse width: "LONG"
- Fiber Length: 16 km
- Resolution: 1.0 m
- Display From: Origin
- Index: 1.4990
- Vert Cont/Exp: 8.0 dB/Div
- HOR Cont/Exp: 2,048.0 m/Div
- Averaging: Real Time
- Loss Mode: 2-Point

7. Conduct test using the steps as follows:

Step 1. Press REAL TIME on the TS-4320 and set the "A" cursor to the TS-4320 DEAD ZONE PEAK; set the "B" cursor to the center of the FOCUS generated pulse as shown.

Step 2. Adjust FOCUS VAR ATTN 1 until the TS-4320 "2 POINT LOSS" reading is 0.02 dB ± 0.01 dB.

Step 3. Adjust VAR ATTN 1 on FOCUS and monitor the TS-4320 until FOCUS generated upulse is attenuated down near the point of disappearing in the noise floor of the trace as shown.

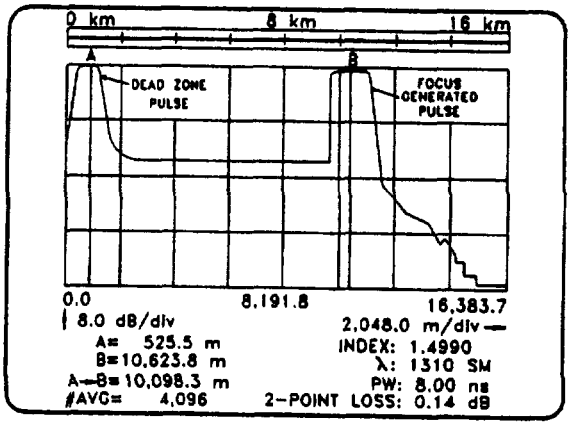
Step 4. Press FAST SCAN on the TS-4320 and wait for acquisition to complete.

Step 5. Record the "2 POINT LOSS" from the display of the TS-4320.

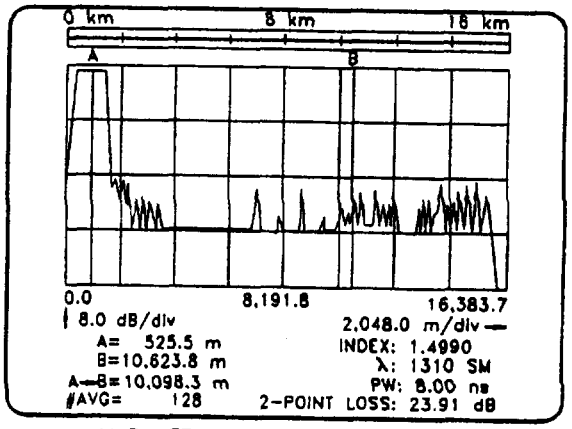
NOTE

After the FAST SCAN acquisition is complete, the FOCUS generated pulse must be discernible above the noise floor. See diagram for typical display for optical modules.

Step 6. Compare the recorded reading with the minimum range tolerance in the chart below.

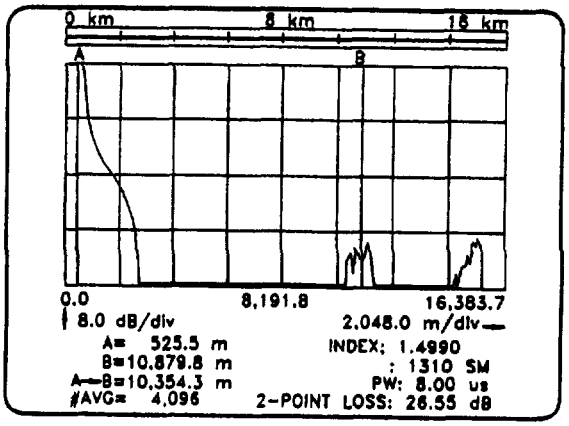


A&B CURSOR POSITIONS



VAR ATTN1 ADJUSTMENT DURING REAL TIME

MS017226



FOCUS GENERATED PULSE ABOVE NOISE FLOOR AFTER FAST SCAN

MS017229

2-56. PERFORMANCE TEST-Continued

OPTICAL MODULE:	DYNAMIC RANGE dB MINIMUM
TD-260C	22
TD-261C	22
TD-285C/1310 nm	26
TD-285C/1550 nm	23

Step 7. If minimum range is not met, repeat steps 3 through 6 above. Each time adjust VAR ATTN 1 for more attenuation.

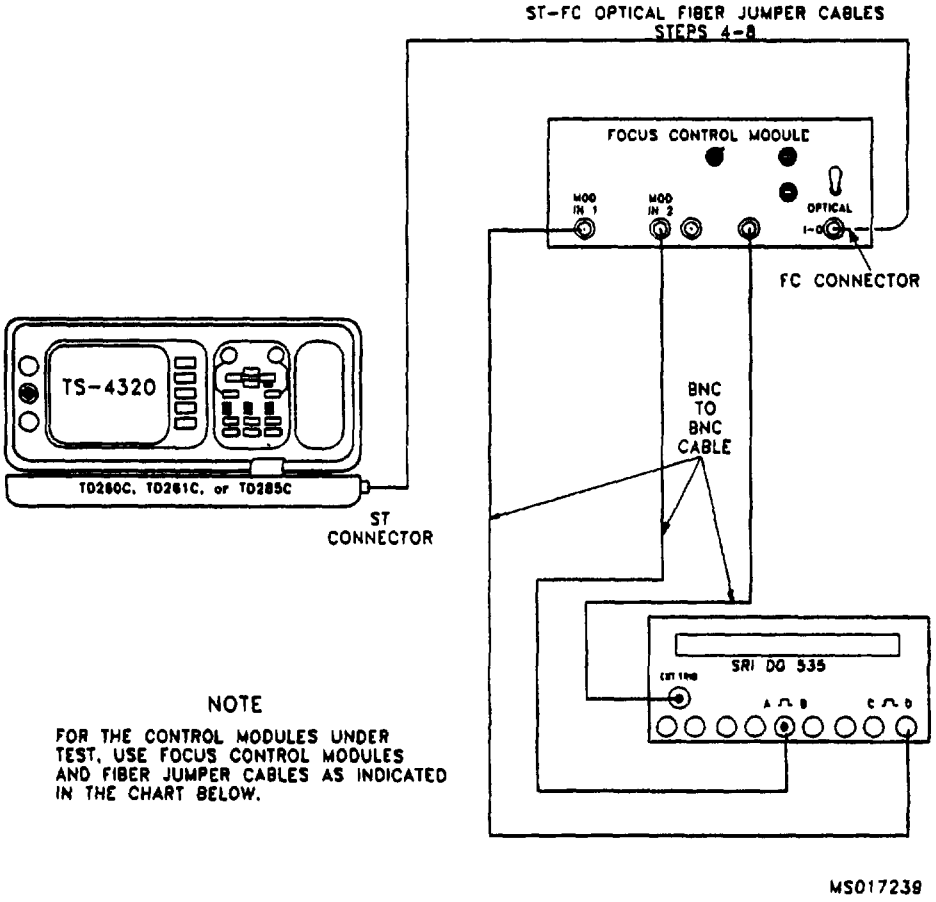
NOTE

If the Optical Module is marginal or only slightly out of tolerance, repeat steps 4 through 7 in the SLOW SCAN mode as required. This procedure may result in additional receiver dynamic range. Tolerance met in SLOW SCAN is acceptable.

8. If tolerance still cannot be met after repeated attempts, notify the next higher level of maintenance.

SPATIAL RESOLUTION

1. Connect equipment as shown.



2-56. PERFORMANCE TEST-Continued

NOTE

For the control modules under test, use FOCUS CONTROL MODULES and fiber jumper cables as indicated in the chart below.

OPTICAL MODULE	FOCUS CM	FIBER CABLE	KIT LOCATION
TD-260C	SWCM	5/125 MICRON	TS-4320
TD-261C	LWCM	5/125 MICRON	TS-4320
TD-285C	LWCM	9/125 MICRON	FOCUS/TS-4320

2. On the DG-535 DDG, set the following settings applicable to all optical modules.

- Set "A Delay" to 20.000000 microseconds.
- Link "B Delay" to "A Delay" ("B +A+").
- Set "B Delay" to 500.0 nanoseconds (ns).
- Link "C Delay" to "B Delay" ("C = B +").
- Set "C Delay to 100 ns.
- Set "D Delay" to "C Delay ("D=C+").
- Set "D Delay" to 500.0 ns.
- Set TRIGGER to EXT, THRESHOLD = +0.50V, SLOPE = (+/-) = "+." TRIGGER TERM = 50 ohms.
- Set OUTPUT to "AB," AB&-AB LOADS = 50 ohms, AB: "VAR," AB: AMPLITUDE = +2.0V, AB: OFFSET = -1.60V.

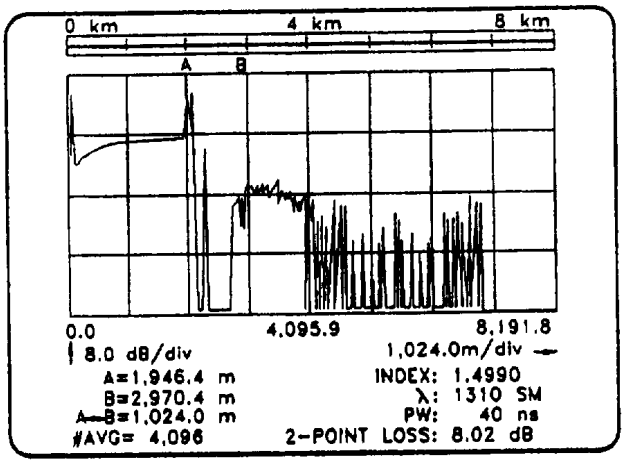
3. On the TS-4320, set the following:
- Highest Resolution.
- Shortest Range.
- "SHORT" pulsewidth.
- "INDEX" = 1.4990.
- "2-POINT LOSS"
- Display from "Origin"

4. On the FOCUS CM, set the following:
- LD BIAS CURRENT "LD PULSED"
- SWITCHED ATTN to "OT"
- VAR ATTN 1 to full ccw for minimum attenuation.

2-56. PERFORMANCE TEST-Continued

5. On the TS-4320:

- Press FAST SCAN.
- Locate FG pulses on displayed trace at approximately 2 km as shown.
- Place Cursor "A" at the leading edge of the left hand pulse and cursor "B" at the leading edge of the right hand pulse.
- Press DISPLAY FROM to select "A."
- Press HOR EXP until "8.0 m/div" is selected.



LOCATION OF FG PULSES (SPATIAL RESOLUTION)

MS017232

6. On the DG-535:

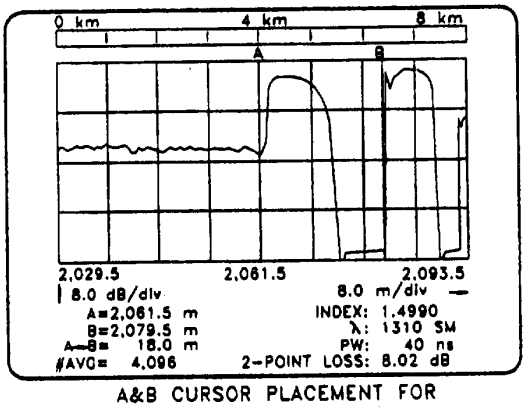
- Set "B Delay" to the nominal pulsewidth displayed on the TS-4320 optical module: "PW."
- Set "D Delay" to this same value.
- Set "C Delay" for the appropriate optical module as specified in the chart below.

RA-4320 OPTICAL MODULE:	DG-535 "C Delay"
TD-260C	30.000 ns
TD-261 C	30.000 ns
TD-285C, 1310	130.000 ns
TD-285C/1550	110.000 ns

7. On the TS-4320:

- Press FAST SCAN.
- Complete trace acquisition.
- Observe display. Two distinct pulse peaks should be discernible as separate pulses on the displayed trace as shown.

8. If spatial resolution is not obtained, notify the next higher level of maintenance.

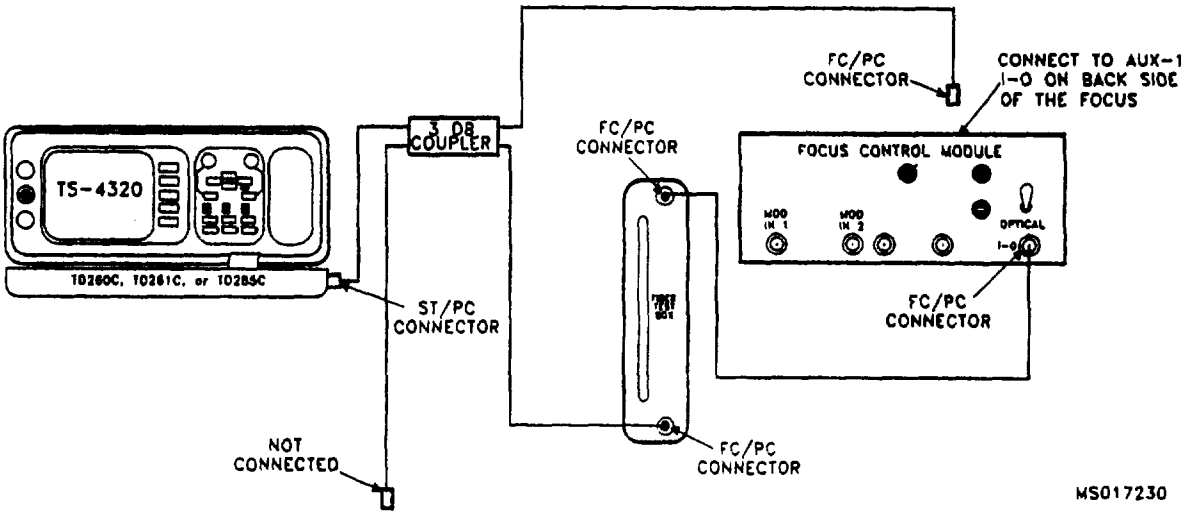


A&B CURSOR PLACEMENT FOR SPATIAL RESOLUTION MS017234

2-56. PERFORMANCE TEST-Continued

ATTENUATION DEAD ZONE

9. Connect equipment as shown.



NOTE

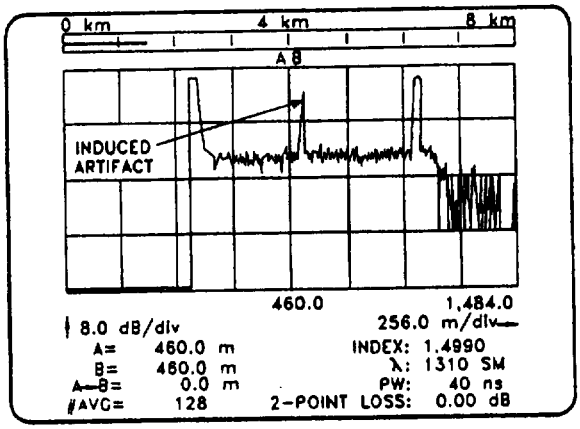
The FOCUS CM must be configured as Stand-Alone Optical Attenuator. Configuration must be performed in accordance with appendix II, part 1.0 of the FOCUS manual prior to conducting the Attenuation Dead Zone test.

10. On the TS-4320:

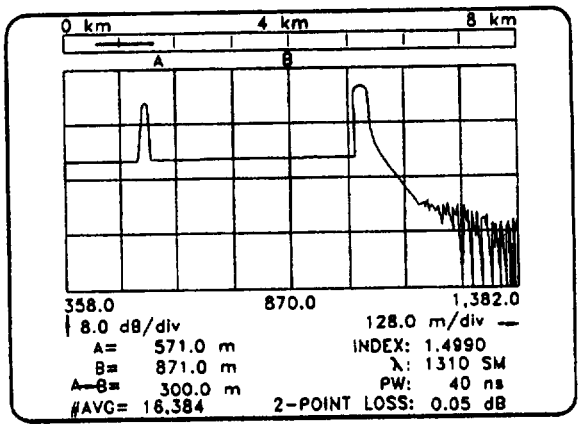
- Set Range/Resolution to 8km,0.5m. (TM 11-6625-3271-12, para. 2-27.)
- Set the Index of Refraction to the index of the test fiber.
- Press the LOSS MODE key to select 2 POINT.
- Press the DISPLAY FROM key to select ORIGIN.
- Press the PULSE WIDTH key to select SHORT.
- Press the REAL TIME key and optimize the fiber connection for maximum backscatter signal.
- Place the A and B cursors at approximately the midpoint of the fiber trace.
- Press DISPLAY FROM to select A.
- Expand horizontally to display the artifact that is induced by FOCUS as shown.
- Place the A cursor at the beginning of the artifact and the B cursor at the highest point.

2-56. PERFORMANCE TEST-Continued

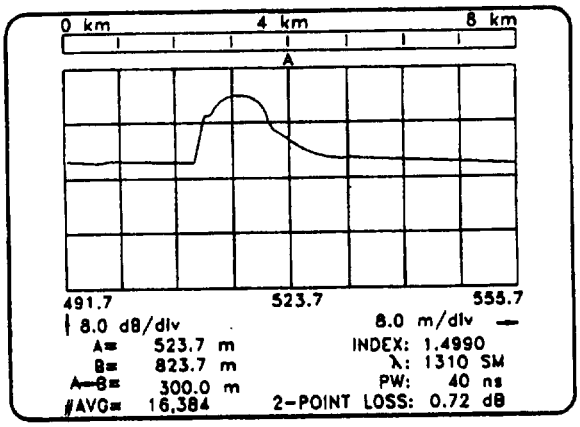
- Using the VAR ATTN 2 knob on the FOCUS CM, adjust the attenuation to set the 2-POINT LOSS between -10.00 to -6.00 dB.
- Press SLOW SCAN key.
- Observe #AVG = and press the N-LASER OFF key when the number of averages exceeds 16,000.
- Place the A and B cursors 300m apart and press LOCK key.
- Use the B cursor control to move the cursors into the backscatter beyond the induced artifact as shown.
- Press the LSA key (second from top) and record the LSA/2PT LOSS. Multiply the LSA/2PT LOSS by 3.3 to obtain 3.3 (LSA/2PT LOSS).
- Add 0.5 dB to the 3.3 (LSA/2PT LOSS) in the previous step to obtain the Dead Zone Deviation.
- Press the LSA key to select 2-POINT LOSS.
- Observe 2-POINT LOSS while using the B cursor knob to move the A cursor toward the induced artifact reflection. Stop moving the cursors when 2-POINT LOSS equals the Dead Zone Deviation ± 0.01 dB as shown.
- Press the LOCK key to unlock the cursors and move the B cursor to meet the A cursor.
- Expand the display as needed and move the A cursor to the beginning of the rising edge of the induced artifact.
- Record the Attenuation Dead Zone from the A-B distance. The value should be less than the maximum values shown in the table below.



FOCUS INDUCED ARTIFACT



A&B CURSORS POSITIONED IN BACKSCATTER



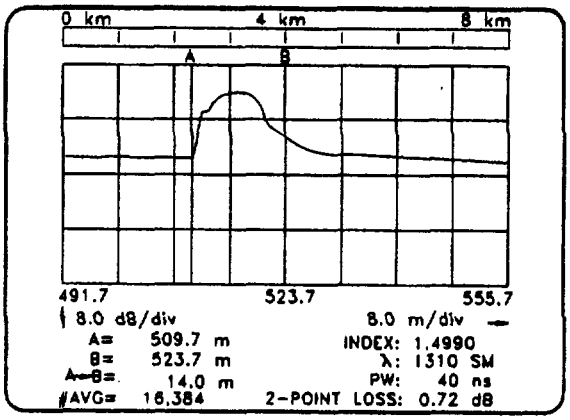
A CURSOR POSITION

MS017237

2-56. PERFORMANCE TEST-Continued

Pulse Width	TD-260C	TD-261C	TD-285C	
			1310nm	1550nm
LONG	290m	290m		
MEDIUM	20m	30m	120m	130m
SHORT	4m	30m	18m	18m

- Repeat this test using MEDIUM and LONG pulsewidths. If Attenuation Dead Zone ex- ceeds specified length, nofity the next higher level of maintenance.
- Power off on FOCUS CM and disconnect equipment.



FINAL A&B CURSOR POSITION

MS017231

2-57. ADJUSTMENTS.

DESCRIPTION
This procedure is used to adjust the TS-4320(P)/G after an assembly is replaced. These adjustment procedures cover:

- 1A2A8 A/D CCA Chip Rail Voltages (para 2-59).
- 1A2A8 A/D CCA Center Voltage (para 2-60).
- 1A2A8 A/D CCA Offset Voltage (para 2-61).

1A2A9 CRT Driver CCA Preliminary Video (para 2-62).

NOTES

- Specific adjustments may be necessary after repair/replacement of specific assemblies in the TS-4320 or failure of a performance test. Adjustment is not required if malfunction has been cleared after repair.
- The adjustment needed after repair/replacement of specific CCAs are as shown in table 2-2.

After adjustment procedure is completed, remove power and install Equipment Top Cover (para 2-63).

WARNING

Hazardous voltages are present with the cover removed. Where maintenance can be performed without power applied, the power should be removed.

CAUTION

Use ESD precautionary procedures when touching, removing or installing CCAs.

2-57. ADJUSTMENTS - Continued.

Table 2-2. Post Repair/Replace Adjustments.

REPAIRED/REPLACED ASSEMBLY	ADJUSTMENT
1A2A8 A/D CCA	1A2A8 Chip Rail Voltages (para 2-59) 1A2A8 Center Voltage (para 2-60) 1A2A8 Offset Voltage (para 2-61)
1A2A9 CRT Subassembly & CCA	1A2A9 CRT Driver Preliminary Video (para 2-62)

2-58. INITIAL SETUP.

1. On TS-4320:

- Set POWER to OFF.
- Remove AC Power Cord.
- Remove the Equipment Top Cover (para 2-63).

WARNING

Hazardous voltages are present with the cover removed. Where maintenance can be performed without power applied, the power should be removed.

CAUTION

Use ESD precautionary procedures when touching, removing or installing CCAs.

VOLTAGE CHECKS.

1. Remove 1A2A8 CCA (para 2-64).
2. Refer to FO-10. Install Electrical Connector Assembly (tool 15, Appendix B, TM 11-6625-3271-12) in connector J1 of 1A2A8 CCA.
3. Refer to FO-13, sheet 1 of 6. Install Extender Card (tool 16, Appendix B, TM 11-6625-3271-12) in connector J1AB. Install 1A2A8 into Extender Card.
4. On TS-4320:
Connect power cord.
Set POWER to ON.

2-58. INITIAL SETUP - Continued.

5. Refer to FO-10. Using the multimeter, measure the voltages shown below:

METER LEAD	- METER LEAD	VOLTAGE
ICU9, Pin 16	ICU9, Pin 8	+4.75 to +5.25
ICU15, Pin 1	ICU15, Pin 2	+11.40 to +12.60

6. Refer to FO-10. Using the multimeter, measure the voltages shown below:

+ METER LEAD	- METER LEAD	VOLTAGE
ICU16, Pin 3	TP2 GROUND	+4.75 to +5.25
ICU15, Pin 3	TP2 GROUND	+14.25 to +15.75
ICU15, Pin 5	TP2 GROUND	-14.25 to -15.75
ICU10, Pin 2	TP2 GROUND	+4.75 to +5.25
ICU11, Pin 2	TP2 GROUND	-4.75 to -5.25

7. If any of the voltages are incorrect, replace 1A2A8 (para 2-64).

2-59. ADJUST 1A2A8 A/D CCA CHIP RAIL VOLTAGE.

1. Perform the Initial Setup procedure (para 2-58).
2. On TS-4320:
- Connect power cord.
- Set POWER to ON.
3. Refer to FO-10. Connect the digital multimeter negative lead to ICU6, pin 12 and positive lead to ICU6, pin 23. Note the voltage, which shall be negative.
4. Connect digital multimeter positive lead to ICU5, pin 24. Note voltage, which shall be positive.
5. Adjust Pot R6 so that the magnitude of the reading in step 3 is as close to 2.00 VDC as possible.
6. Adjust Pot R6 until the positive (ICU5, pin 24) and negative (ICU6, pin 23) voltages are equal in magnitude, ± .05 VDC.
7. Set POWER to OFF.
8. Remove the 1A2A8 CCA from the Extender Card and remove the Extender Card from the TS-4320.
9. Remove the Electrical Connector Assembly from connector J1.
10. Reinstall the 1A2A8 CCA (para 2-64).

2-60. ADJUST 1A2A8 A/D CCA CENTER VOLTAGE.

1. Perform the Initial Setup procedure (para 2-58).
2. On TS-4320:
- Connect power cord.
- Set POWER to ON.
3. Refer to FO-10. Connect the digital multimeter negative lead to ICU6, pin 12 and the positive lead to ICU5, pin 23.
4. Adjust Pot R1 for a reading of +9 mv to +11 mv.
5. Set POWER to OFF.
6. Remove the 1A2A8 CCA from the Extender Card and remove the Extender Card fro m the TS-4320.
7. Remove the Electrical Connector Assembly from connector J1.
8. Reinstall the 1A2A8 CCA (para 2-64).

2-61. ADJUST 1A2A8 A/D CCA OFFSET VOLTAGE.

1. Perform the Initial Setup procedure (para 2-58).
2. Set POWER to OFF.
3. Remove 1A2A8 CCA from the Extender Card and remove the Extender Card.
4. Refer to FO-10. Install the Electrical Shunt on JP2. (The shunt is currently on one of the two pins of JP2.) Remove the shunt and rotate it to connect both pins of JP2 on 1A2A8 CCA.
5. Remove the Electrical Connector Assembly from connector J1 ON 1A2A8 CCA that was Installed in Initial Setup (para 2-58).
6. Reinstall 1A2A8 CCA (para 2-64).
7. Refer to FO-2. Install the Module Simulator CCA (tool 20, Appendix B, TM 11-6625-3271-12) into connector JM1.
8. On TS-4320:
- Connect power cord.
- Set POWER to ON.

2-61. ADJUST 1A2A8 A/D CCA OFFSET VOLTAGE - Continued.

NOTE

Allow 15 minutes for warm-up before making voltage adjustments.

9. Refer to FO-2. Connect the digital multimeter negative lead to TP1 and positive lead to TP7 of the Module Simulator CCA
10. Adjust pot R9 for a reading of +150 to +170mv.
11. Refer to FO-10. Connect the digital multimeter negative lead to ICU6, pin 12, and positive lead to TP2 center post. (Suggest making connection on solder side of CCA at TP2.)
12. Adjust pot R21 for a reading of +1.70 to +1.65 VDC.
13. Set POWER to OFF.
14. Remove test equipment.
15. Remove the Electrical Shunt from connector JP2. Reinstall the shunt to a single pin of JP2.
16. Refer to FO-2. Remove the Module Sumulator CCA from connector JM1.

2-62. ADJUST 1A2A9 CRT DRIVER PRELIMINARY VIDEO.

1. On TS-4320:
- Set POWER to OFF.
- Remove AC Power Cord.
- Remove the Equipment Top Cover (para 2-63).

WARNING

Hazardous voltages are present with the cover removed. Where maintenance can be performed without power applied, the power should be removed.

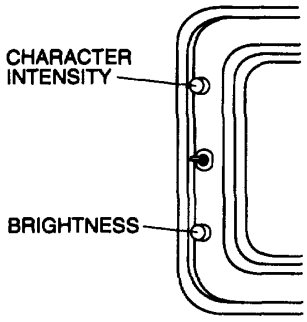
CAUTION

Use ESD precautionary procedures when touching, removing or installing CCAs.

2. Connect power cord, and set TS-4320 POWER to ON.

2-62. ADJUST 1A2A9 CRT DRIVER PRELIMINARY VIDEO--Continued.

3. If no raster or image on the CRT, rotate BRIGHTNESS control fully clockwise.



4. If still no raster or image, refer to FO-11 and adjust the Master Brightness trim pot R165 clockwise until a raster or image is seen on the CRT screen.

5. Adjust the Horizontal Hold R145 and Vertical Hold R106 trim pots as needed to stabilize the image.

6. Set the front panel CHARACTER INTENSITY and BRIGHTNESS controls to center position.

7. Adjust the Master Brightness trim pot R165, so the raster is just visible in a well lit room.

8. Rotate the Horizontal Hold trim pot R145 in both directions to locate the range of adjustment where the image is horizontally synchronized. Set the trim pot to the center of its synchronized range.

9. Rotate the Vertical Hold trim pot R106 fully counter-clockwise. Then slowly rotate the Vertical Hold trim pot clockwise until the picture just starts to roll. Back off 1/8 of a turn in the counter-clockwise direction.

10.Adjust the Horizontal Centering trim pot R138 to center the grid on the raster.

11.Press the "HELP" key. Adjust the Vertical Linearity trim pot R110 for equal character height on the top and bottom rows.

12. Press the "Return to OTDR mode" key. Adjust the Height trim pot R108 so there is 1/8 inch between the grid and the bezel.

13.Adjust the Horizontal Linearity Coil L103 for the best overall linearity.

14.Adjust Width Coil L104 for 1/8 inch clearance between the grid and the CRT bezel.

15.Repeat steps 9, 12, and 13 until optimum results are obtained.

16.Adjust Focus trim pot R157 for best overall balance between center, sides and corners.

17. Inspect the grid for squareness. Check to see that the corners are not pulled or pushed out of square.

- If the corners are out of square, replace 1A2A9 assembly.

2-63. REPLACE EQUIPMENT TOP COVER.

DESCRIPTION
This procedure covers: Remove. Install.

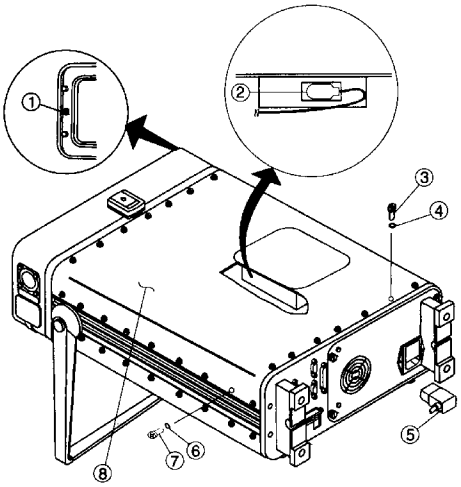
INITIAL SETUP

WARNING
Hazardous voltages are present when covers are removed. Where maintenance can be performed without having power applied, disconnect power cord from AC source.

REMOVE
1. Set power switch (1) to OFF.
2. Disconnect power cable (5).
3. Remove 14 screws (3), 14 washers (4), 18 screws (7), and 18 washers (6).

NOTE
Do not disconnect battery cable (2) if removing cover to perform internal tests.

4. Lift the top cover (8) off and set aside, being careful not to stretch battery cable (2).



INSTALL
1. Connect battery cable (2), if previously disconnected.
2. Install top cover (8).
3. Install 18 screws (7), 18 washers (6), 14 screws (3) and 14 washers (4).
4. Connect power cable (5). END OF TASK

2-64. REPLACE 1A2A8 ANALOG/DIGITAL CONVERTER CCA.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES:

- Remove Equipment Top Cover (para 2-63).

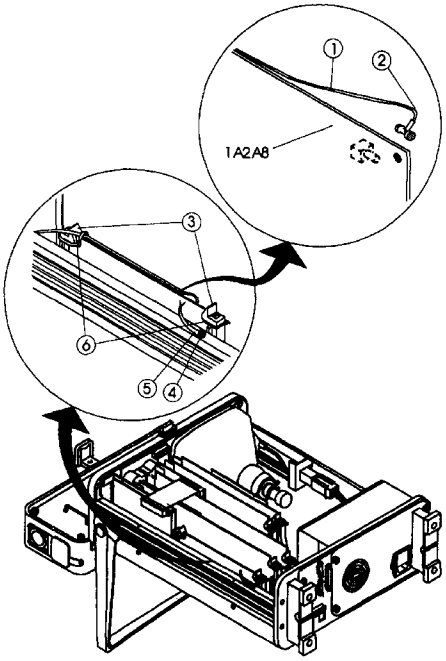
REMOVE

1. Cut three electrical tiedown straps (6).

CAUTION

Twisting connector (2) or stretching may damage coax cable (1).

2. Disconnect coax cable connector (2) from 1A2A8 CCA by pulling straight off.
3. Remove screw (4) securing ground braid (5) to chassis.
4. Release electrical card holders (3), and remove CCA by lifting out with a slight rocking motion.



2-106

2-64. REPLACE 1A2A8 ANALOG/DIGITAL CONVERTER CCA - Continued.

INSTALL

1. Holding electrical card holders (3) in the released position, insert 1A2A8 CCA.
2. Press on 1A2A8 CCA top edge to seat bottom edge-connector.
3. Replace ground braid (5) and screw (4).

CAUTION

Twisting connector (2) or stretching may damage coax cable (1).

4. Connect coax connector (2) to 1A2A8 CCA.
5. Install electrical tiedown straps (6) (Appendix B, Item 6) through holes in each end of 1A2A8 CCA and around electrical card holders (3).
6. Install electrical tiedown strap (6) (Appendix B, Item 6) through hole in 1A2A8 CCA and around coax cable (1).

NOTE

FOLLOW-ON MAINTENANCE:

- Install Equipment Top Cover (para 2-63).
- Perform Post Repair/Replace Adjustments (table 2-2).
- Set POWER to ON and leave on for 48 hours.
- Perform Post Repair/Replace Adjustments (table 2-2).

END OF TASK

2-65. REPLACE 1A2A5 OR 1A2A6 CCA.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

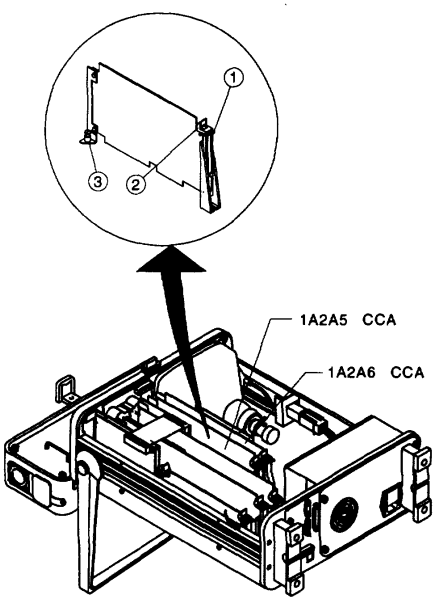
NOTE

PRELIMINARY PROCEDURES:

- Remove Equipment Top Cover (para 2-63).

REMOVE

1. Cut electrical tiedown strap (1) on electrical card holder.
2. Remove captive mounting screw (3) on front lower edge of CCA.
3. Release electrical card holder (2), and remove CCA by lifting out with a slight rocking motion.



INSTALL

1. Hold electrical card holder (2) in the release position and insert CCA.
2. Press on CCA top edge to seat bottom edge-connector.
3. Install captive mounting screw (3).
4. Install electrical tiedown strap (1) (Appendix B, Item 6) on CCA.

NOTE

FOLLOW-ON MAINTENANCE:

- Install Equipment Top Cover (para 2-63).
- Perform Initial Loading of Operating Software, TM 11-6625-3271-12 (para 3-5c).

END OF TASK

2-66. REPLACE 1A2A2 OR 1A2A4 CCA.

DESCRIPTION
This procedure covers: Remove. Install.

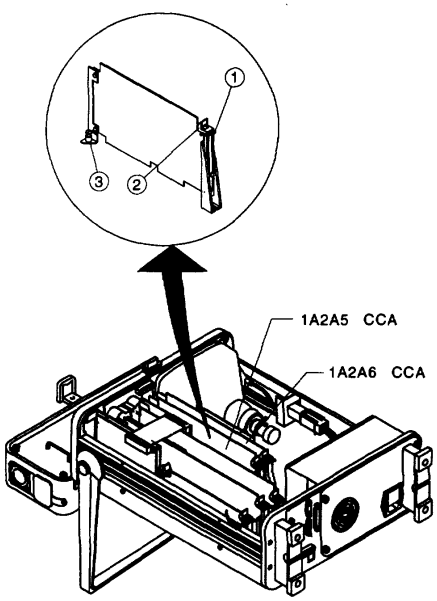
INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES:
- Remove Equipment Top Cover (para 2-63).

REMOVE

1. Remove 1A2W7 Cable Assembly (1) and retaining clips.
2. Cut electrical tiedown strap (3) on electrical card holder.
3. Remove captive mounting screw (2) on front lower edge of CCA.
4. Release electrical card holder (4), and lift CCA out with a slight rocking motion.



INSTALL

1. Hold electrical card holder (4) in the release position, insert CCA, and press top edge to seat bottom edge-connector.
2. Install captive mounting screw (2).
3. Install electrical tiedown strap (3) (Appendix B, Item 6) on CCA.
4. Install 1A2W7 Cable Assembly (1).

NOTE
FOLLOW-ON MAINTENANCE:
- Install Equipment Top Cover (para 2-63).

END OF TASK

2-67. REPLACE 1A2A3 PROCESSOR CCA.

DESCRIPTION

This procedure covers: Remove. Install.

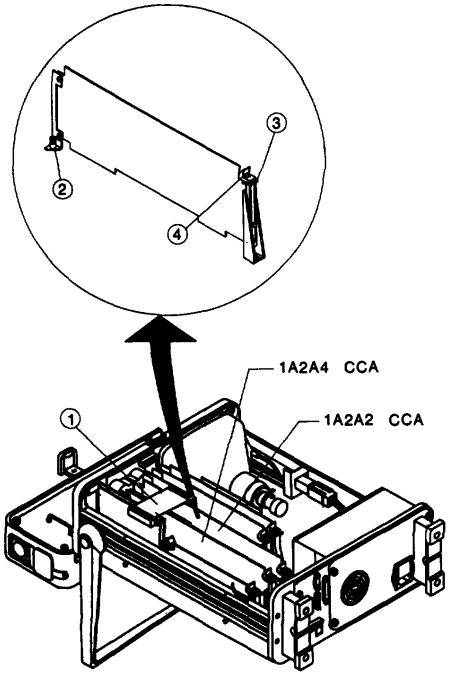
INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES:
- Remove Equipment Top Cover (para 2-63).

REMOVE

1. Remove 1A2W7 cable assembly (1) and retaining clips.
2. Remove 1A2A2 CCA (para 2-66).
3. Refer to FO-2. Disconnect cable 1A2W6 from connector J9 on 1A2A11 CCA.
4. Remove retaining clip and disconnect cable 1A2W2 from connector J12 on 1A2A11 CCA.
5. Remove captive screw (7).
6. Remove screw (5) and lock washer (6).
7. Remove 1A2A3 CCA by lifting out with a slight rocking motion.
8. Release the electrical tiedown strap (4) from the 1A2A3 CCA. Note position of strap.
9. Cut RTV sealant securing P1 (2) to JP1 and P3 (3) to JP3.
10. Disconnect P1 from JP1 and P3 from JP3.



INSTALL

1. Install electrical tiedown strap on 1A2A3 CCA (4).

2-67. REPLACE A2A3 PROCESSOR CCA - Continued.

2. Connect P1 (2) of 1A2W6 to JP1 on 1A2A3 CCA and secure with RTV sealant (Appendix B, Item 7)..
3. Connect P3 (3) of 1A2W2 to JP3 on 1A2A3 CCA and secure with RTV sealant.
4. Insert 1A2A3 CCA in unit; do not seat.
5. Refer to FO-2. Connect 1A2W6 cable connector to J9 on 1A2A11 CCA.
6. Connect 1A2W2 cable connector to J12 on 1A2A11 CCA and attach retaining clip.
7. Press on top edge of 1A2A3 CCA to seat bottom edge connector.
8. Install screw (5) and washer (6).
9. Install captive screw (7).
10. Install 1A2A2 CCA (para 2-66).
11. Install 1A2W7 cable assembly (1) and secure with retaining clips .

NOTE

FOLLOW-ON MAINTENANCE:

- Install Equipment Top Cover (para 2-63).

END OF TASK

2-68. REPLACE 1A2A12 RAMCARD INTERFACE CCA.

DESCRIPTION

This procedure covers: Remove. Install.

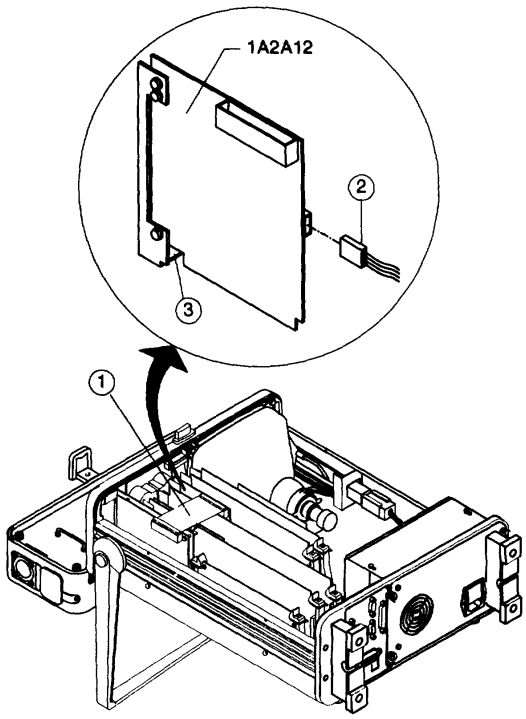
INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES:

- Remove Equipment Top Cover (para 2-63).

REMOVE



1. Remove 1A2W7 cable assembly (1) and retaining clips .
2. Remove captive screw (3).
3. Remove 1A2A12 CCA by lifting out with a slight rocking motion.
4. Remove cable connector P1 (2).

INSTALL

1. Install P1 (2).
2. Install 1A2A12 CCA. Press on top edge to seat bottom edge-connector.
3. Install captive screw (3).
4. Install 1A2W7 cable assembly (1) and secure with retaining clips .

NOTE

FOLLOW-ON MAINTENANCE:

- Install Equipment Top Cover (para 2-63).

END OF TASK

2-69. REPLACE 1A2A7 COLOR GRAPHICS ADAPTER CCA.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

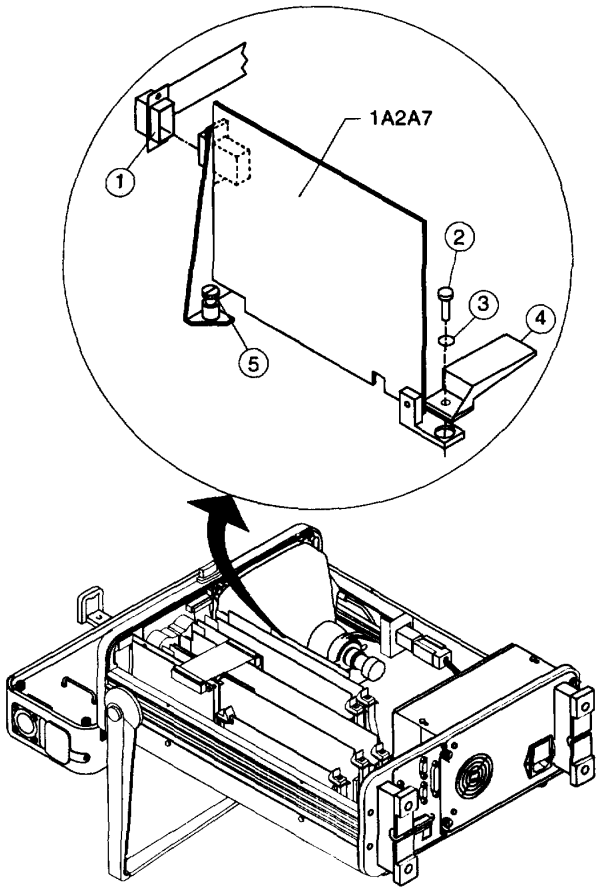
NOTE

PRELIMINARY PROCEDURES:

- Remove Equipment Top Cover (para 2-63).
-

REMOVE

1. Cut the RTV sealant on P2 (1).
2. Remove P2 (1).
3. Remove captive screw (5).
4. Remove screw (2) and washer (3).
5. Move bracket (4) aside.
6. Remove 1A2A7 CCA by lifting out with a slight rocking motion.



INSTALL

1. Install 1A2A7 CCA. Press on top edge to seat bottom edge-connector.
2. Install captive screw (5).
3. Install screw (2) and washer (3), securing bracket (4) in place.
4. Install P2 (1) and secure with RTV sealant (Appendix B, Item 7).

NOTE

FOLLOW-ON MAINTENANCE:

- Install Equipment Top Cover (para 2-63).

END OF TASK

2 70. REPLACE 1A2W8 DISPLAY BRIGHTNESS CONTROL OR CHARACTER INTENSITY CONTROL.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES:

- Remove Equipment Top Cover (para 2-63).

REMOVE

1. Open Optical Module.
2. Pry cap (1) from knob base (3).
3. Hold knob base (3) firmly and loosen screw (2) counterclockwise. Do not remove screw from knob base.
4. Remove knob base (3) straight out.
5. Remove nut (4) and washer (5).
6. Slide character intensity control (6) out.

NOTE

Follow the same procedure for 1A2W8 (7).

7. Disconnect P36 (8) on 1A2W8 (7) only.

NOTE

Character Intensity Control is part of 1A2A9.

1. Connect P36 (8) on 1A2W8 (7) only.
2. Slide control (6) into position.
3. Install washer (5) and nut (4).
4. Install knob base (3) straight on.

2-70. REPLACE 1A2W8 DISPLAY BRIGHTNESS CONTROL OR CHARACTER INTENSITY CONTROL - Continued.

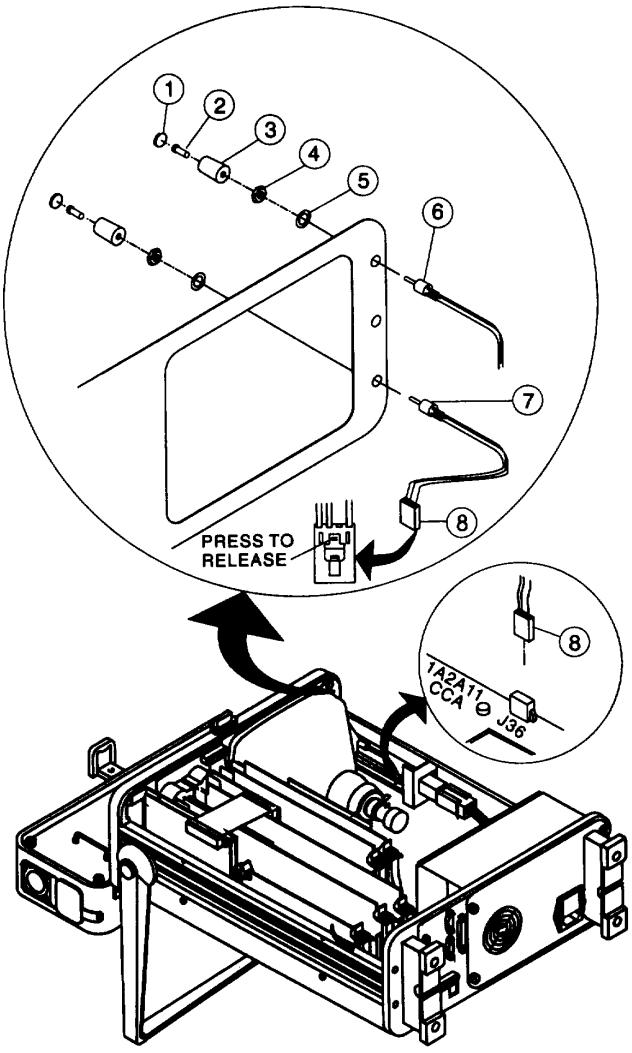
5. Hold knob base (3) firmly and tighten screw (2) clockwise.

6. Install cap (1).

NOTE

FOLLOW-ON MAINTENANCE:

- Install Equipment Top Cover (para 2-63).



END OF TASK

2-71. REPLACE 1A2PS1 POWER SUPPLY ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES:

- Remove Equipment Top Cover (para 2-63).

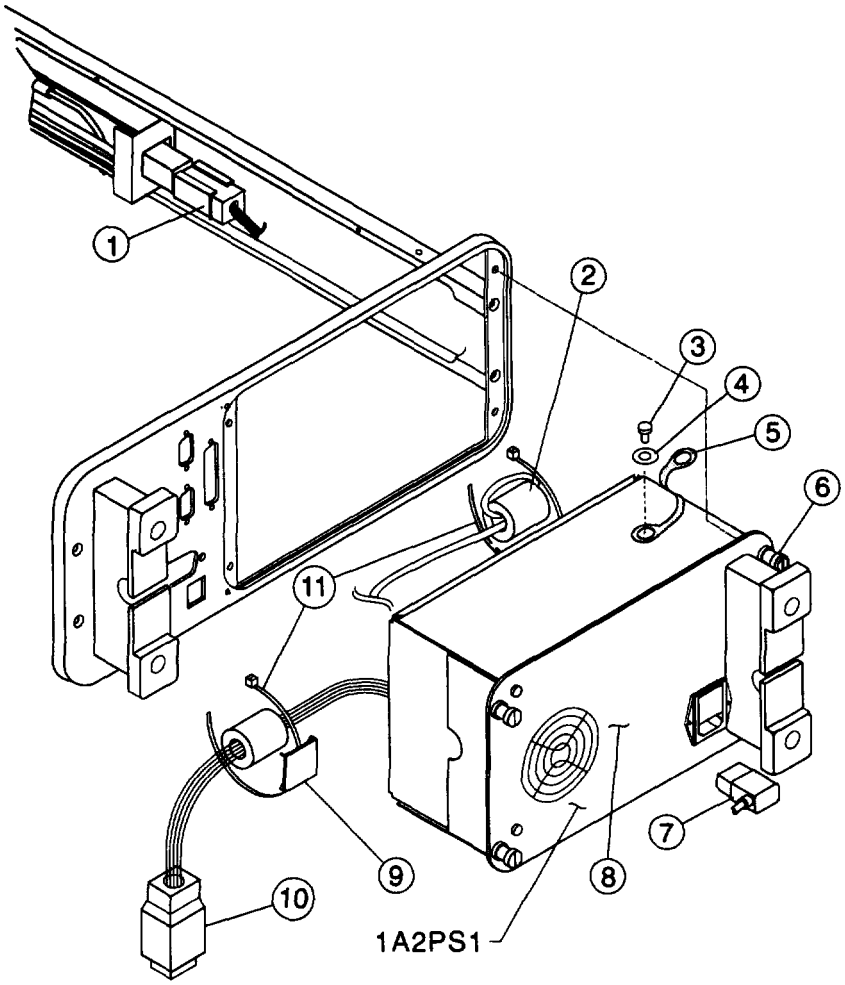
REMOVE

1. Disconnect Power Cable (7).
2. Remove screws (3) and star washers (4) that secure ground strap (5) to power supply (8).
3. Disconnect inline connector (1).
4. Cut electrical tiedown strap (11) that ties the ferrite bead (2) on the (red) anode lead to the 1A2PS1 (8).
5. Loosen four captive screws (6) that secure 1A2PS1 (8).
6. Slide 1A2PS1 (8) out about two inches and disconnect P25 (10) from 1A2A11 CCA.
7. Remove 1A2PS1 (8) from unit.

INSTALL

1. Attach two tiedown strap holders (9) (Appendix B, Item 8) to the power supply assembly. Place them in the same position as those on the 1A2PS1 removed above.
2. Verify voltage and fuses (TM 11-6625-3271-12, para 3-5).
3. Slide 1A2PS1 (8) two inches into unit and connect P25 (10) to 1A2A11 CCA.
4. Slide 1A2PS1 (7) into installed position and tighten four captive screws (6).
5. Tie the ferrite beads on the P25 (10) wires and the (red) anode lead to the tiedown strap holders installed in step 1, using two electrical tiedown straps (11) (Appendix B, Item 9).
6. Install inline connector (1).
7. Install ground strap (5), using screws (3) and star washers (4).
8. Install power cable (7).

2-71. REPLACE 1A2PS1 POWER SUPPLY ASSEMBLY -Continued.



NOTE

FOLLOW-ON MAINTENANCE:

- Install Equipment Top Cover (para 2-63).

END OF TASK

2-72. REPLACE 1A2A9 ELECTRON TUBE ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES:

- Remove Equipment Top Cover (para 2-63).
- Remove 1A2A7 CCA (para 2-69).
- Remove 1A2A6 CCA (para 2-65).
- Remove 1A2PS1 (para 2-71).
- Remove Character Intensity Control (para 2-70).

REMOVE

WARNING

Discharging of the CRT Anode in the following step exposes lethal, charged-CRT voltage.

1. Discharge CRT Anode (1) to the ground strap (5), using a high voltage probe.
2. Cut electrical tiedown straps (2).
3. Unscrew to disconnect CRT anode cable connector (3).
4. Refer to FO-2. Observe the location of the three ferrite beads used on 1A2A9 Assembly. Cut the electrical tiedown strap that secures each ferrite bead.
5. Remove cable connector from CRT neck (4).
6. Remove cable connector from J102 (6).
7. Disconnect cable connector from J101 (7).
8. Remove four CCA mounting screws (9) and lockwashers (8).

2-72. REPLACE 1A2A9 ELECTRON TUBE ASSEMBLY - Continued.

9. Remove 1A2A9 Driver CCA from unit.

10. With Optical Module closed and latched, and handle rotated in upper forward position, set unit on Optical Module end.

11. Remove four screws (10) and star washers (11) that secure CRT.

12. Remove CRT by lifting it up about a half inch and out of unit.

INSTALL

1. Carefully set CRT in place on the light filter (12) in the unit.

2. Install four screws (10) and star washers (11).

NOTE

Use care not to move CRT Light Filter.

3. Position unit on its feet.

4. Install 1A2A9 Driver CCA and secure with four screws (9) and washers (10).

5. Connect cable to J101 (7).

6. Connect cable to J102 (6).

7. Refer to FO-2. Secure the three ferrite beads with electrical tiedown straps (Appendix B, Item 9).

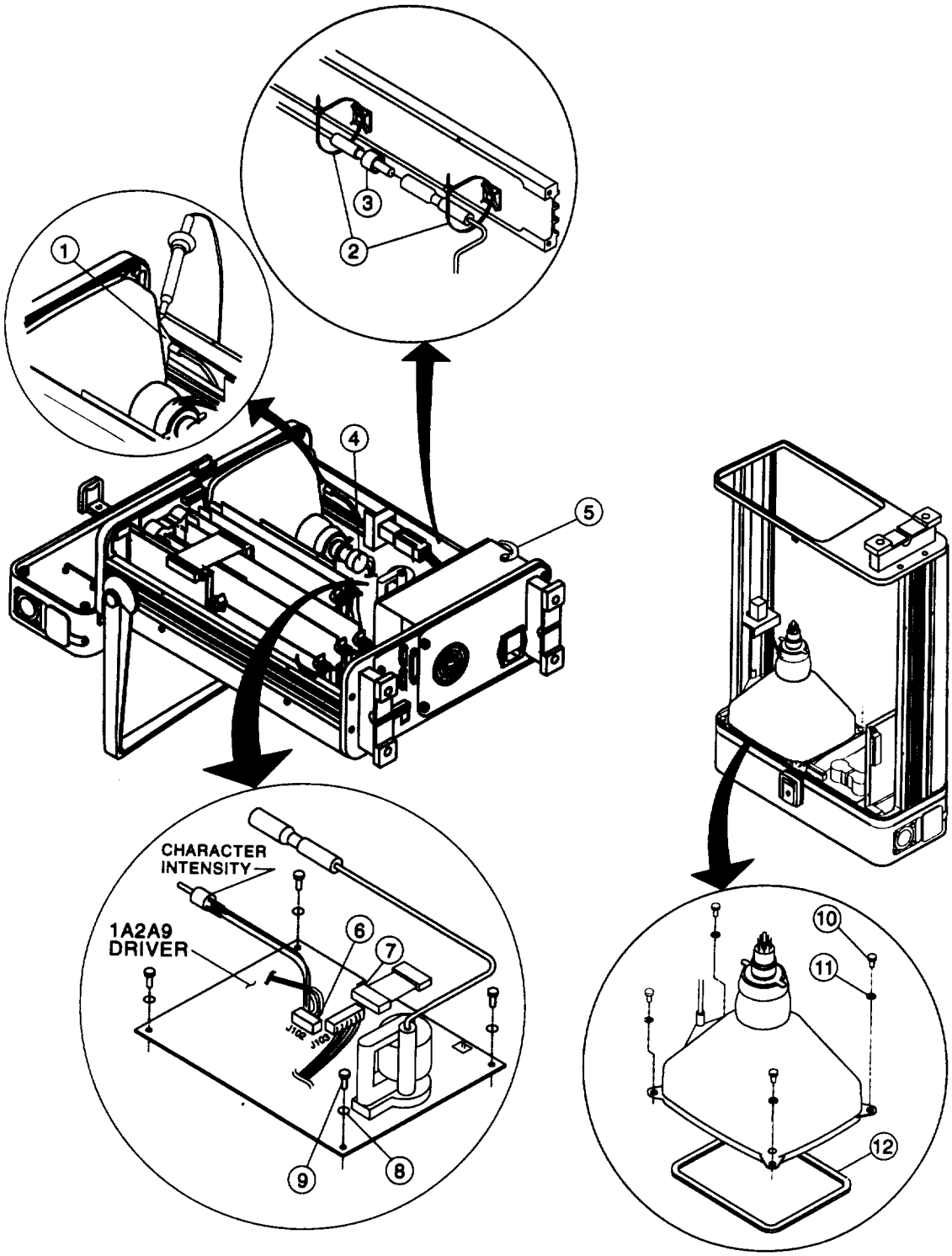
8. Connect CRT anode inline cable connector (3) and secure with electrical tiedown straps (2) (Appendix B, Item 6).

9. Connect cable connector to CRT neck (4).

NOTE
FOLLOW-ON MAINTENANCE:

- Install Character Intensity Control (para 2-70).
- Install 1A2PS1 (para 2-71).
- Install 1A2A6 CCA (para 2-65).
- Install 1A2A7 CCA (para 2-69).
- Reinstall top cover (para 2-63).

2-72. REPLACE 1A2A9 ELECTRON TUBE ASSEMBLY - Continued.



END OF TASK

2-73. REPLACE CRT LIGHT FILTER.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE
PRELIMINARY PROCEDURES:

- Remove Equipment Top Cover (para 2-63).
- Remove 1A2A7 CCA (para 2-69).
- Remove 1A2PS1 (para 2-71).
- Remove 1A2A9 Assembly (para 2-72).

REMOVE

1. Remove CRT Light Filter (1).

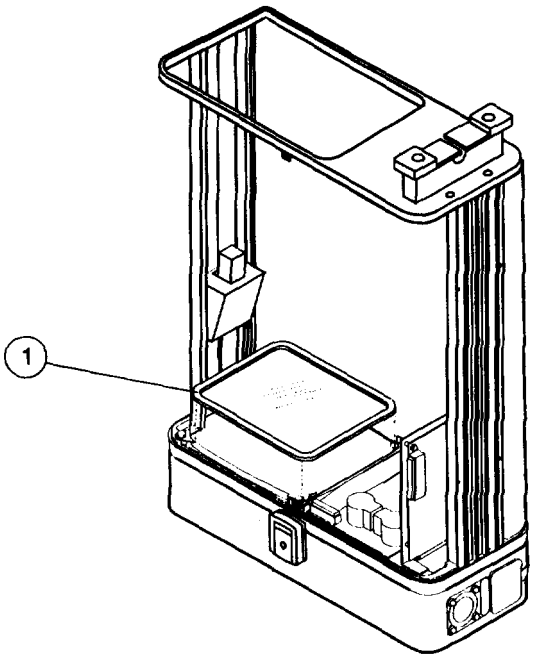
INSTALL

1. Install CRT Light Filter (1).

NOTE

FOLLOW-ON MAINTENANCE:

- Install 1A2A9 Assembly (para 2-72).
- Install 1A2PS1 (para 2-71).
- Install 1A2A7 CCA (para 2-69).
- Install Equipment Top Cover (para 2-63).



END OF TASK

2-74. REPLACE 1A2A13 RAMCARD DRIVER CCA.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE
PRELIMINARY PROCEDURES:

- Remove Equipment Top Cover (para 2-63).
- Remove 1A2A8 CCA (para 2-64).
- Remove 1A2A4 CCA (para 2-66).
- Remove 1A2A3 CCA (para 2-67).
- Remove 1A2A2 CCA. (para 2-66).

REMOVE

1. Remove 1A2W7 Cable Assembly and retaining clips (1).
2. Cut electrical tiedown straps (2).

CAUTION
Do not put undue strain on coax cable.

3. Remove two nuts (4) and star washers (5).
4. Remove 1A2A13 CCA. Note routing of coax cable.

INSTALL

1. Install new tiedown strap holder (3) (Appendix B, item 8). Position strap holder in same relative position as on 1A2A13 CCA removed.
2. Form indicator lamp leads in the same manner as the indicators on the CCA that was removed.
3. Install 1A2A13 CCA, routing coax cable as originally installed. Secure with nuts (4) and star washers (5).
4. Install electrical tiedown strap (2) (Appendix B, Item 6).

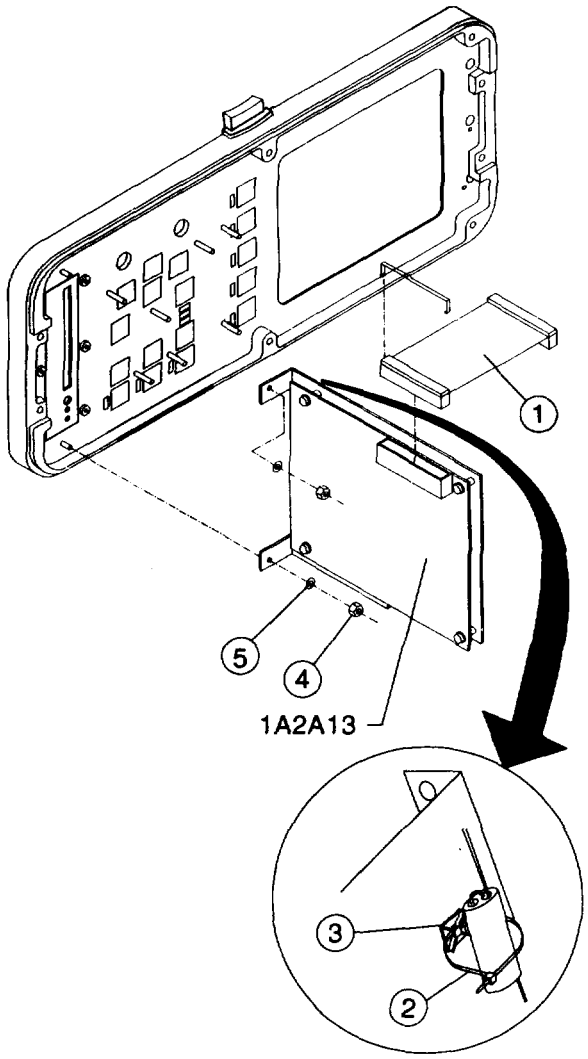
2-74. REPLACE 1A2A13 RAMCARD DRIVER CCA -- Continued.

5. Install 1A2W7 Cable Assembly and retaining clips (1).

NOTE

FOLLOW-ON MAINTENANCE: ·

- Install 1A2A2 CCA (para 2-66).
- Install 1A2A3 CCA (para 2-67).
- Install 1A2A4 CCA (para 2-66).
- Install 1A2A8 CCA (para 2-64).
- Install Equipment Top Cover (para 2-63).



END OF TASK

2-75. REPLACE 1A2A10 REAR PANEL ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

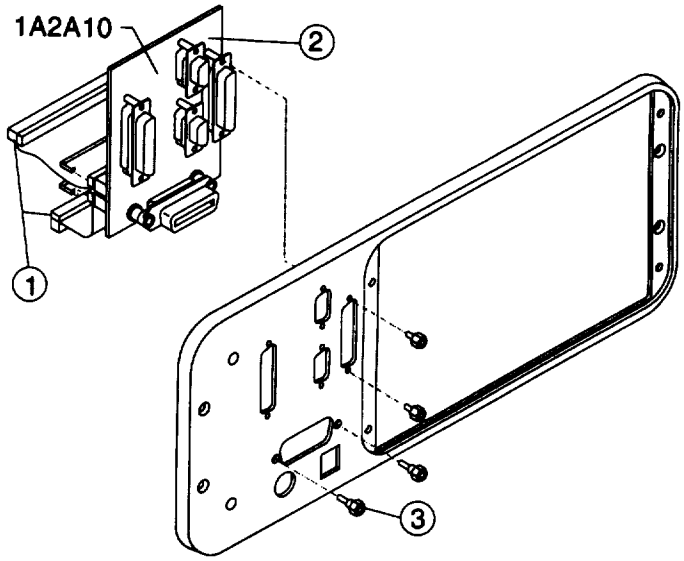
INITIAL SETUP

NOTE
PRELIMINARY PROCEDURES:

- Remove Equipment Top Cover (para 2-63).

REMOVE

1. Remove two interface cables and retaining clips (1).
2. Remove ten jackscrews (3).
3. Remove IA2A10 CCA (2).



INSTALL

1. Install 1A2A10 CCA (2).
2. Install ten jackscrews (3).
3. Install two Interface cables and retaining clips (1).

NOTE
FOLLOW-ON MAINTENANCE:

- Install Equipment Top Cover (para 2-63).

END OF TASK

2-76. REPLACE 1A2A1 FRONT PANEL CCA.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE
PRELIMINARY PROCEDURES:

- Remove Equipment Top Cover (para 2-63).
- Remove 1A2A4 CCA (para 2-66).
- Remove 1A2A3 CCA (para 2-67).
- Remove 1A2A2 CCA (para 2-66).
- Remove 1A2A12 CCA (para 2-68).
- Remove 1A2A5 CCA (para 2-65).
- Remove 1A2A6 CCA (para 2-65).
- Remove 1A2A7 CCA (para 2-69).

REMOVE

WARNING I

Discharging of the CRT Anode in the following step exposes lethal, charged-CRT voltage.

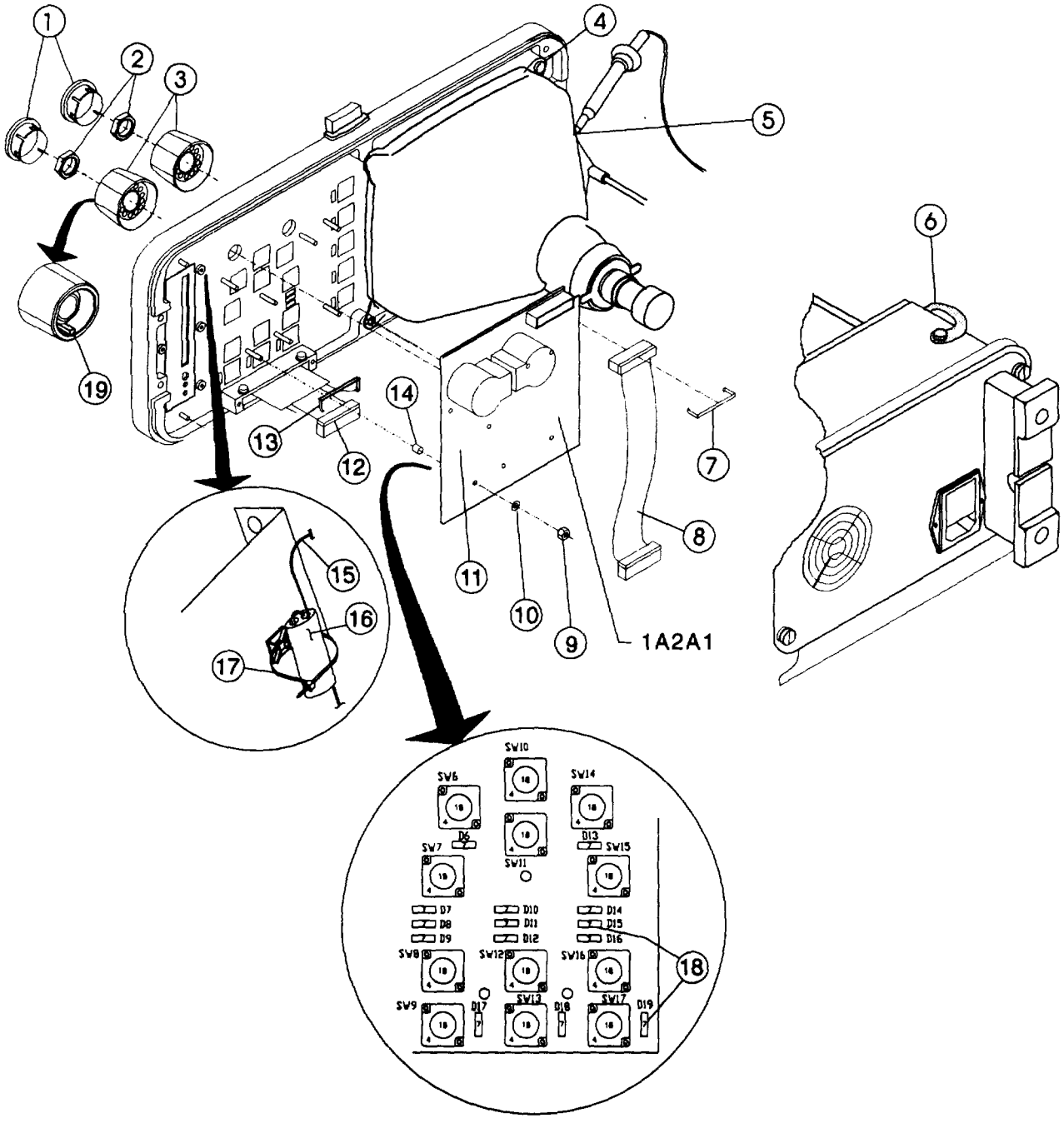
1. Discharge CRT Anode (5) to the ground strap (6), using a high voltage probe.
2. Using a knife edge, carefully pry off two dial control knob caps (1).

NOTE:
If a knob key (19) is present inside knob (3), it must be removed before a socket can be placed on the nut (2).

3. Remove key if present.
4. Loosen two nuts (2) and remove two knobs (3). Use 10mm socket.

2-76. REPLACE 1A2A1 FRONT PANEL CCA - Continued.

5. Remove clip (7) and cable assembly (8).
6. Remove clip (13), disconnect J13 (12), and move cable away from 1A2A1 CCA.
7. Cut tiedown strap (17) on ferrite bead (16) and move coax cable (15) aside.
8. Close and latch front cover and position unit on optical module end.



2-76. REPLACE 1A2A1 FRONT PANEL CCA - Continued.

9 Loosen four mounting screws (4) that secure CRT, so tube can be moved toward side of unit.

10. Remove seven nuts (9) and star washers (10) that secure 1A2A1 CCA (11).

11. Remove 1A2A1 CCA (11). Leave stand-offs (14) in place.

INSTALL

1. Verify that there is a key top on each of the 17 key switches on the 1A2A1 CCA (11).

2. Verify that each of the 14 LEDs (D7 through D19) are in upright position (18).

3. Install IA2A1 CCA (11) with the keys and LEDs in the appropriate cutouts.

4. Install seven nuts (9) and star washers (10) that secure 1A2A1 CCA (11).

5. Reposition CRT and tighten four mounting screws (4).

6. Install cable tiedown strap (17) (Appendix B, Item 6) on ferrite bead (16).

7. Connect J13 (12) and replace retaining clip (13).

8. Install cable assembly (8) and retaining clips (7).

9. Install two dial control knobs (3) and tighten nuts (2).

10. Install dial control knob caps (1).

NOTE
FOLLOW-ON MAINTENANCE:

- Install 1A2A7 CCA (para 2-69).
- Install 1A2A6 CCA (para 2-65).
- Install 1A2A5 CCA (para 2-65).
- Install 1A2A12 CCA (para 2-68).
- Install 1A2A2 CCA (para 2-66).
- Install 1A2A3 CCA (para 2-67).
- Install 1A2A4 CCA (para 2-66).
- Install Equipment Top Cover (para 2-63).

END OF TASK

2-77. REPLACE 1A2W1 CABLE ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE
PRELIMINARY PROCEDURES:

- Remove Equipment Top Cover (para 2-63).
- Remove 1A2A12 CCA (para 2-68).
- Remove 1A2A5 CCA (para 2-65).
- Remove 1A2A6 CCA (para 2-65).

REMOVE

1. Remove clips (1), disconnect both ends of 1A2W1 cable assembly (2), and remove cable.

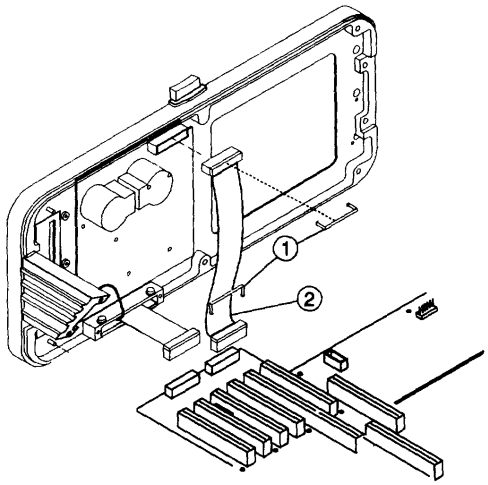
INSTALL

1. Install 1A2W1 cable assembly (2) and clips (1).

NOTE
FOLLOW-ON MAINTENANCE:

- Install 1A2A6 CCA (para 2-65).
- Install 1A2A5 CCA (para 2-65).
- Install 1A2A12 CCA (para 2-68).
- Install Equipment Top Cover (para 2-63)

.



END OF TASK

2-78. REPLACE 1A2W4 CABLE ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE
PRELIMINARY PROCEDURES:

- Remove Equipment Top Cover (para 2-63).
- Remove 1A2A8 CCA (para 2-64).
- Remove 1A2A4 CCA (para 2-66).
- Remove 1A2A3 CCA (para 2-67).
- Remove 1A2A2 CCA (para 2-66).
- Remove 1A2A12 CCA (para 2-68).
- Remove 1A2A5 CCA (para 2-65).
- Remove 1A2A6 CCA (para 2-65).
- Remove 1A2A7 CCA (para 2-69).
- Remove 1A2A13 CCA (para 2-74).
- Remove Light Signal Receiver-Transmitter Subassembly TM 11-6625-3271-12 (para 2-6).

REMOVE

1. Carefully cut adhesive (5) that secures coax cable (6) to cover.
2 Remove retainer strap (3) by removing two screws (2) accessible from outside of access cover.
3. Remove two mounting screws (1).
4. Cut and remove black heat shrink tubing (8) nearest the power supply from red and black fan wires (7) and unsolder both wires at connection points.
5. Cut electrical tiedown strap (9).

2-78. REPLACE 1A2W4 CABLE ASSEMBLY - Continued.

6. Remove 1A2W1 cable assembly (para 2-77).

7. Remove retaining clip and disconnect P13 (11).

8. Remove two screws (13) to release retainer strap (12).

9. Remove 1A2W4 cable. (Pull out through the front panel.) INSTALL 1. Insert P13 and coax connector of 1A2W4 cable in front panel.

2. Install retainer strap (12) with two screws (13). Do not overtighten.

3. Connect P13 (11) and replace retaining clip.

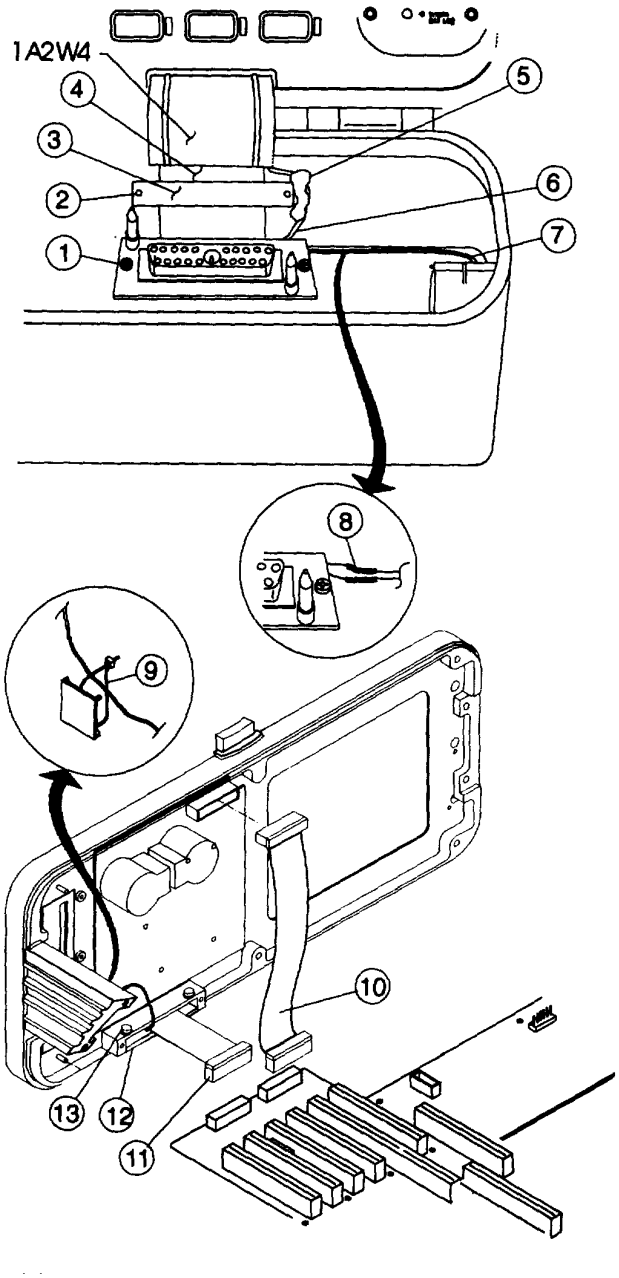
4. Install 1A2W1 cable assembly (10) (para 2-77).

CAUTION
Use care to avoid damaging coax cable.

5. Install electrical tiedown strap (9) (Appendix B, Item 6) to secure coax cable.

NOTE
There must be sufficient slack in cable to route cable up and over 1A2A13 CCA.

6. Solder red and black fan wires (7) at connection point. Cover soldered connections with heat shrink tubing (8) (Appendix B, Item 11)



7. Form coax cable (6) to prevent damage to cable and install mounting screws (1).Connector should be able to float.

8. Install retainer strap (3) with two screws (2) inserted from outside of access cover. Leave a 0.5 inch gap (3) between retainer strap and insulation.

9. Secure coax cable (6) with adhesive (Appendix B, Item 7)

2-78. REPLACE 1A2W4 CABLE ASSEMBLY - Continued.

NOTE
FOLLOW-ON MAINTENANCE:

- Install 1A2A13 CCA (para 2-74).
- Install 1A2A7 CCA (para 2-69).
- Install 1A2A6 CCA (para 2-65).
- Install 1A2A5 CCA (para 2-65).
- Install 1A2A12 CCA (para 2-68).
- Install 1A2A2 CCA (para 2-66).
- Install 1A2A3 CCA (para 2-67).
- Install 1A23A4 CCA (para 2-66).
- Install 1A2A8 CCA (para 2-64).
- Install Equipment Top Cover (para 2-63).
- Install Light Signal Receiver-Transmitter Subassembly TM 11-6625-3271-12 (para 2-6).

END OF TASK

2-79. REPLACE 1A2W5 POWER ON/OFF SWITCH.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE
PRELIMINARY PROCEDURES:

- Remove Equipment Top Cover (para 2-63).

REMOVE

1. Open Optical Module.

2-79. REPLACE 1A2W5 POWER ON/OFF SWITCH - Continued.

2. Remove nut (1) from switch base (2).
3. Disconnect P1 (6) from J1 (5).
4. Remove two mounting screws (4) that secure mounting bracket (3).
5. Slide power ON/OFF switch (2) out.

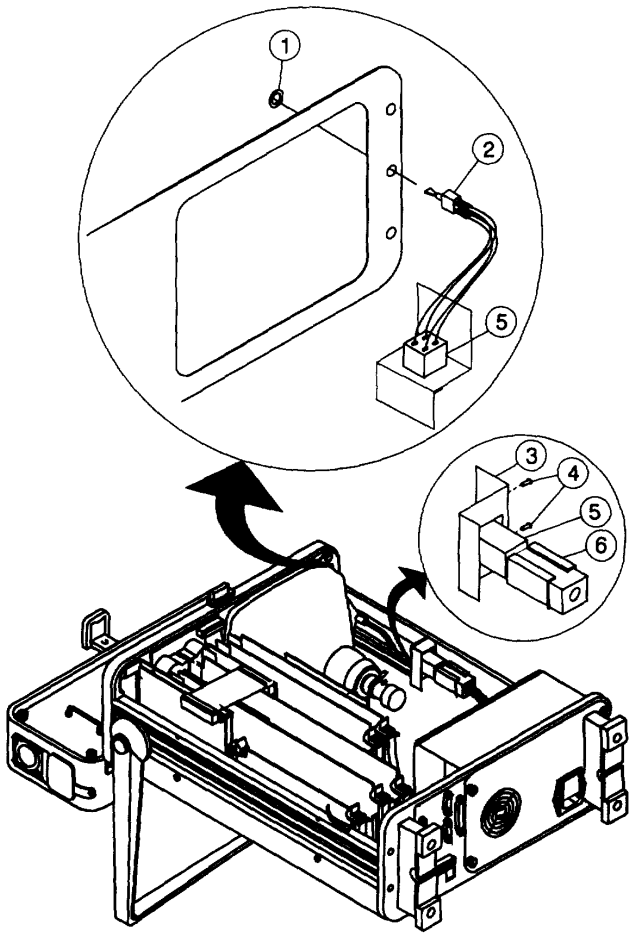
INSTALL

1. Slide power ON/OFF switch (2) into position.
2. Install two mounting screws (4) that secure mounting bracket (3).
3. Connect P1 (6) to J1 (5).
4. Install nut (1) to switch base (2).

NOTE

FOLLOW-ON MAINTENANCE:

- Install Equipment Top Cover (para 2-63).



END OF TASK

2-80. REPLACE 1A2A11 BACKPLANE CCA ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES:

- Remove Equipment Top Cover (para 2-63).
- Remove 1A2A8 CCA (para 2-64).
- Remove 1A2A4 CCA (para 2-66).
- Remove 1A2A3 CCA (para 2-67).
- Remove 1A2A2 CCA (para 2-66).
- Remove 1A2A12 CCA (para 2-68).
- Remove 1A2A5 CCA (para 2-65).
- Remove 1A2A6 CCA (para 2-65).
- Remove 1A2A7 CCA (para 2-69).
- Remove 1A2PS1 (para 2-71).

REMOVE

1. Remove only Driver CCA of 1A2A9 Electronic Tube Assembly (para 2-72).
2. Remove P36 (2).
3. Remove Plug BT1 (1).
4. Remove P18 (6) and P17 (7) with their retaining clips.
5. Remove seven recessed screws (8) in bottom back edge.
6. Remove four side rail screws (9).
7. Remove Instrument Mounting Bezel (10).

2-80. REPLACE 1A2A11 BACKPLANE CCA ASSEMBLY - Continued.

8. Remove the 15 screws (3), 14 star washers (4), and one nylon washer (5) that secure 1A2A11.
9. Slide 1A2A11 out the back of unit.

INSTALL

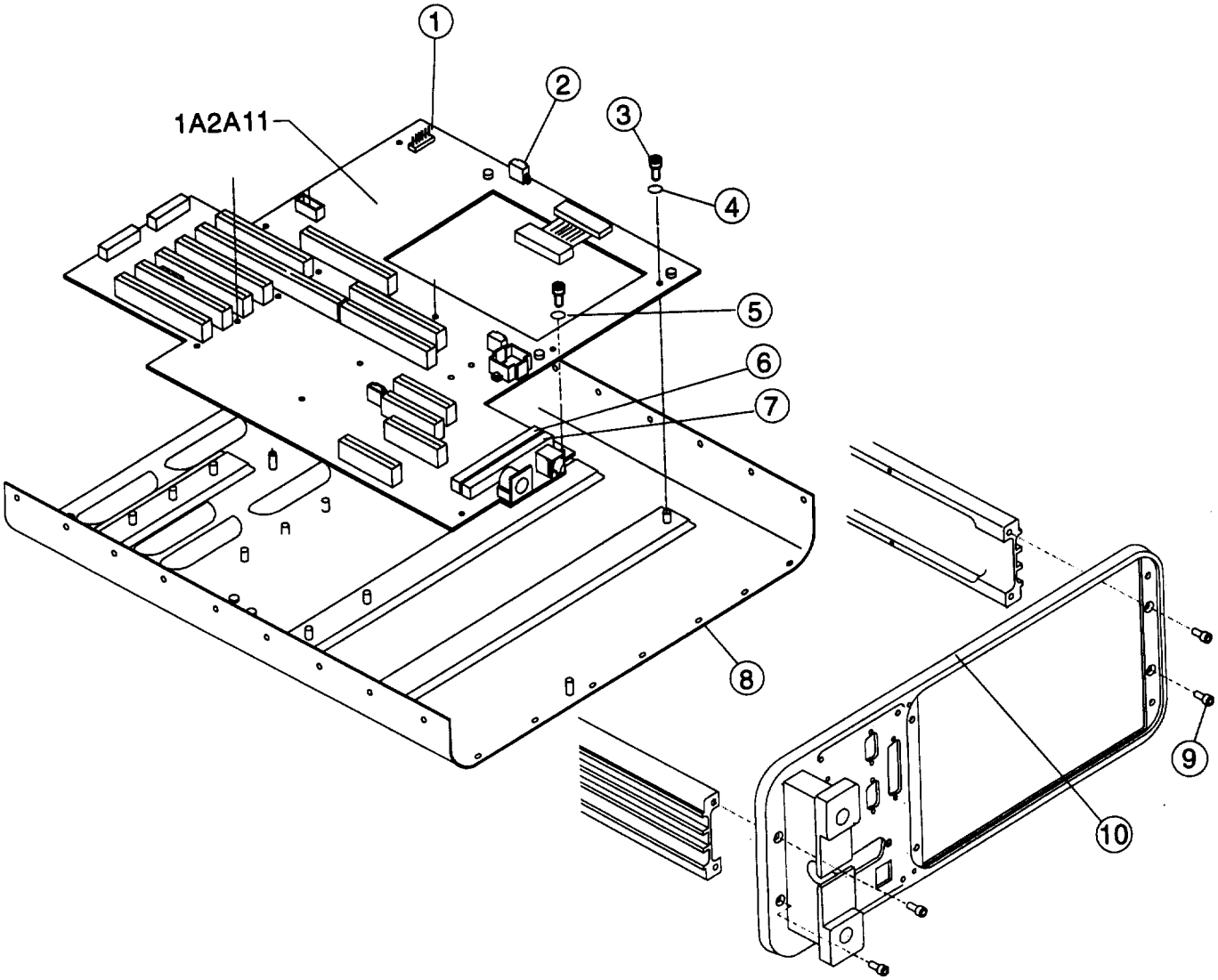
1. Slide 1A2A11 into unit.
2. Install the 15 screws (3), 14 star washers (4), and one nylon washer (5) that secure 1A2A11.
3. Install Instrument Mounting Bezel (10).
4. Install four side rail screws (9).
5. Install seven recessed screws (8) in bottom back edge.
6. Install P17 (7) and P18 (6) and replace retaining clips.
7. Install Plug BT1 (1).
8. Install P36 (2).
9. Install only Driver CCA of 1A2A9 Electronic Tube Assembly (para 2-72).

NOTE

FOLLOW-ON MAINTENANCE:

- Install 1A2PS1 (para 2-71).
- Install 1A2A7 CCA (para 2-69).
- Install 1A2A6 CCA (para 2-65).
- Install 1A2A5 CCA (para 2-65).
- Install 1A2A12 CCA (para 2-68).
- Install 1A2A2 CCA (para 2-66).
- Install 1A2A3 CCA (para 2-67).
- Install 1A2A4 CCA (para 2-66).
- Install 1A2A8 CCA (para 2-64).
- Install Equipment Top Cover (para 2-63).

2-80. REPLACE 1A2A11 BACKPLANE CCA ASSEMBLY - Continued.



END OF TASK

2-81. REPLACE BOTTOM COVER

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES:

- Remove Equipment Top Cover (para 2-63).
- Remove 1A2A8 CCA (para 2-64).
- Remove 1A2A4 CCA (para 2-66).
- Remove 1A2A3 CCA (para 2-67).
- Remove 1A2A2 CCA (para 2-66).
- Remove 1A2A12 CCA (para 2-68).
- Remove 1A2A5 CCA (para 2-65).
- Remove 1A2A7 CCA (para 2-69).
- Remove 1A2PS1 (para 2-71).
- Remove 1A2A11 CCA (para 2-80).

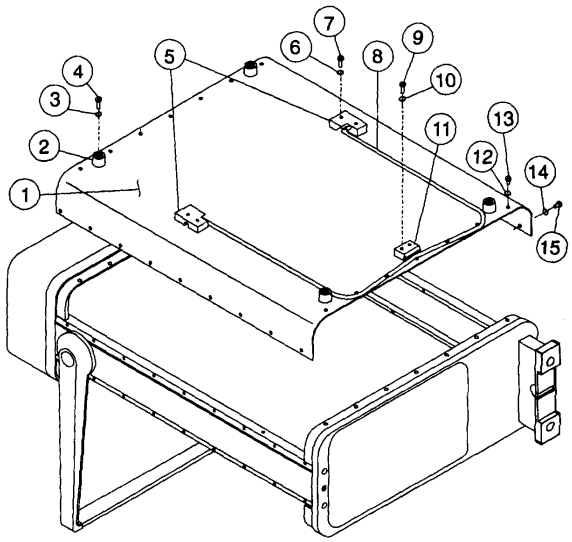
REMOVE

1. Position TS-4320 upside down as shown.
2. Remove 4 screws (4), 4 washers (3), and 4 feet (2).
3. Remove 4 screws (7), 4 washers (6), and 2 block clamps (5). Make a note of the position of the clamps.
4. Remove retaining bail (8).
5. Remove 2 screws (9), 2 washers (10), and the rim clinching clamp (11).
6. Remove 14 screws (13), 14 washers (12), 18 screws (15), and 18 washers (14).
7. Remove bottom cover (1).

2-81. REPLACE BOTTOM COVER --Continued

INSTALL

1. Install bottom cover (1).
2. Install 14 screws (13), 14 washers (12), 18 screws (15), and 18 washers (14).
3. Install rim clinching clamp (11) and secure with 2 screws (9), and 2 washers (10).
4. Install retaining bail (8).
5. Install 2 block clamps (5), secure with 4 screws (7), and 4 washers (6).
6. Install 4 feet (2) and secure with 4 screws (4), and 4 washers (3).
7. Position TS-4320 right side up.



NOTE

FOLLOW-ON MAINTENANCE:

- Install 1A2A11 CCA (para 2-80).
- Install 1A2PS1 (para 2-71).
- Install 1A2A7 CCA (para 2-69).
- Install 1A2A5 CCA (para 2-65).
- Install 1A2A12 CCA (para 2-68).
- Install 1A2A2 CCA (para 2-66).
- Install 1A2A3 CCA (para 2-67).
- Install 1A2A4 CCA (para 2-66).
- Install 1A2A8 CCA (para 2-64).
- Install Equipment Top Cover (para 2-63).

END OF TASK

2-82. REPLACE DC/AC INVERTER TOP COVER.

DESCRIPTION

This procedure covers: Remove. Install.

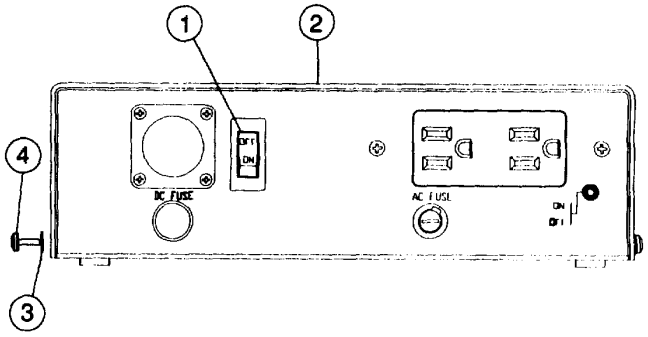
INITIAL SETUP

WARNING

Hazardous voltages are present when covers are removed. Where maintenance can be performed without having power applied, disconnect power cord from DC source.

REMOVE

1. Set POWER switch (1) to OFF.
2. Disconnect from input power source.
3. Remove screws (4) and washer (3).
4. Lift the upper cover (2) away from the inverter.



INSTALL

1. Install upper cover (2) onto inverter.
2. Install screws (3) and washer (4).

END OF TASK

Section V. PREPARATION FOR STORAGE OR SHIPMENT

2-83. PACKAGING.

Package TS-4320(P)/G in original shipping container. When using packing materials other than the original, use following guidelines:

- Wrap TS-4320(P)/G in plastic packing material.
- Use double-wall cardboard shipping container.
- Protect all sides with shock-absorbing material to prevent TS-4320(P)/G
- movement within container.
- Seal the shipping container with approved sealing tape.
- Mark "FRAGILE" on all sides, top, and bottom of shipping container.

2-84. TYPES OF STORAGE.

- Short-Term (administrative) = 1 to 45 days.
- Intermediate = 46 to 180 days.
- Long term = over 180 days. After long term storage, perform procedures given in TM-11-6625-3271-12 and then Performance Test (para 2-56). If this test fails,
  refer to the Troubleshooting Symptom Index.

2-85. ENVIRONMENT.

TS-4320(P)/G should be stored in a clean, dry environment. In high humidity environments, protect TS-4320(P)/G from temperature variations that could cause internal condensation. The following environmental conditions apply to both shipping and storage:

Temperature ..... -14°F to +131°F (-10°C to +55°C).
Relative Humidity..... less than 95%, non-condensing.
Altitude ..... less than 15,000 feet (4,570 meters).
Vibration .....less than 3 g.
Shock.....less than 40 g.

APPENDIX A

REFERENCES

A-1. SCOPE.

This appendix lists all forms, field manuals, technical manuals, and miscellaneous publications referenced in this manual.

A-2. FORMS.

Equipment Inspection and Maintenance Worksheet .....DA Form 2404

Product Quality Deficiency Report ..... Form SF 368

Recommended Changes to Publications and Blank Forms .....DA Form 2028

Report of Discrepancy (ROD) ..... Form SF 364

Transportation Discrepancy Report (TDR) ..... Form SF 361

A-3. TECHNICAL MANUALS.

Operator's and Unit Maintenance Manual, for Optical Fiber Test Set TS-4320(P)/G ..... TM 11-6625-3271-12

Procedures for Destruction of Electronics Materiel to Prevent Enemy Use (Electronics Command) ..... TM 750-244-2

Unit and Intermediate Direct Support and General Support Repair Parts and Special Tools List, for Optical Fiber Test Set TS-4320(P)/G.....TM 11-6625-3271-24P

A-4. MISCELLANEOUS.

Abbreviations for Use on Drawings, Specifications, Standards and in Technical Documents MIL-STD-12

Interactive Electronic Technical Manual for Calibration and Requirements for the Maintenance or Army Materiel..... TB 43-180

Common Table of Allowances .....CTA 50-970

Consolidated Index of Army Publications and Blank Forms ..... DA Pam 25-30

First Aid.....FM 4-25.11

Safety Precautions for Maintenance of Electrical/Electronic Equipment ..... TB 385-4

The Army Maintenance Management System (TAMMS) ..... DA Pam 750-8

APPENDIX B
EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST

Section I. INTRODUCTION

B-1. SCOPE.

This appendix lists expendable supplies needed for maintenance on TS-4320(P)/G. These items are authorized by CTA 50-970, Expendable Items (Except Medical, Class V, Repair Parts, and Heraldic Items).

B-2. EXPLANATION OF COLUMNS.

a. **Column 1. Item Number**. This number is assigned to the entry in the listing and is referenced in the narrative instructions to identify the item (e.g. "Use cleaning compound, item 3, Appendix B").

b. Column 2. Level. This column identifies the lowest level of maintenance that requires the item.

C - Operator/Crew.

O - Unit Maintenance.

H - General Support Maintenance

c. Column 3. National Stock Number. This column indicates the national stock number assigned to the item and will be used for requisitioning purposes.

d. Column 4. Description. This column indicates the federal item name and if required a minimum description to identify the item. The last line for each item indicates the CAGE (in parenthesis) followed by the part number.

e. Column 5. Unit of Measure (U/M). This column indicates the measure used in performing the actual maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e.g. EA, IN, PR). If the unit of measure differs from the unit of issue, requisition the lowest unit of issue that will satisfy your requirements.

Section II. EXPENDABLE SUPPLIES AND MATERIALS LIST

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION	(5) UN
1	C	6810-00-753-4993	Alcohol, Isopropyl, 8OZ. Can, TT-I-735, Grade A (81349)	CN
2	C	8305-00-267-3015	Cloth, Cheesecloth, Cotton, Lintless, CCC-C-440, Type II, Class 2 (81349)	YD
3	C	7930-00-068-1669	Detergent, Mild, Liquid	OZ
4	C		Circuit Card Assembly, RAMCARD, 128K x 8 SRAM, Fujitsu (61271) MB98A9070-25	EA
5	C		Swabs, Foam, Lintless (OHZ49) 4105	DOZ
6	H	5975-01-087-2879	Strap, Tiedown Electrical (OK1B5)	EA
7	H	8040-00-117-8510	Sealastic, Adhesive RTV (71984) 3145	OZ
8	H	5975-01-107-8200	Strap, Tiedown Holder (OK B5)	EA
9	H	667-00-727-5153	Strap, Tiedown Electrical (53421) T181	EA
10	H		Disk, Flexible, 3.5 in. Diskette, 3M (OBNA8) 12042	EA
11	H	4720-00-868-4521	Tubing, Shrinkable Polyolefin, Black, 4’ (92194) FIT-221-1/16	EA
12	H		Loctite Thermal Conductive Adhesive (05972) 17098	OZ
13	H		Canned Air, Falcon Safety Products (02670) DPNR	CN
14	H		Kim Wipes, Kimberly Clark 34155	BOX

APPENDIX C

OPTICAL TEST FIBER

C-1. SCOPE.

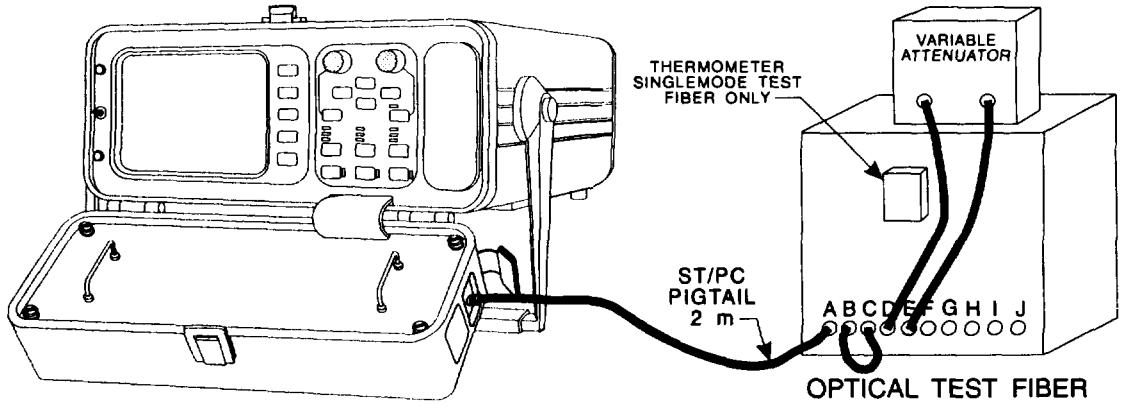
This Appendix describes the Optical Test Fiber to be used when making the Performance Test on the TS-4320(P)/G.

C-2. GENERAL.

The TS-4320(P)/G operates in Singlemode, using the TD-285C Optical Module, and Multimode using the TD-260C Optical Module or TD261C Optical Module. When executing the Performance Test with the TD-285C Optical Module installed in the TS-4320(P)/G, the Singlemode Optical Test Fiber must be used. When executing the Performance Test with the TD-260C or TD-261C Optical Modules installed in the TS-4320(P)/G, the Multimode Optical Test Fiber must be used. Further, there are three configurations of the Optical Test Fiber: Spatial Resolution/Attenuation Dead Zone, Distance Accuracy, and Dynamic Range.

C-3. OPERATING PROCEDURE.

Connect the TS-4320(P)/G as shown below using the configuration shown in para C-4 and C-5.



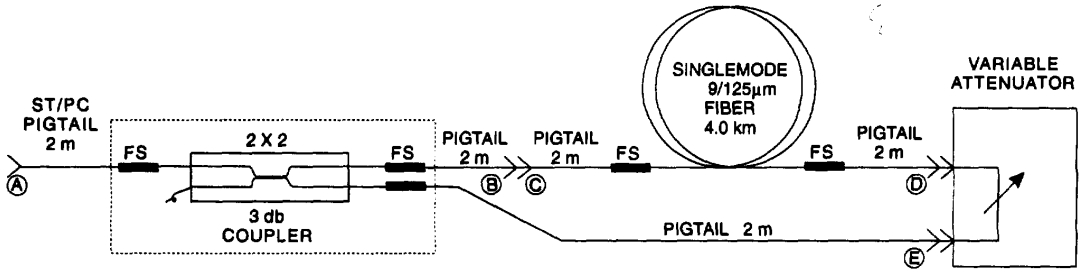
TEST	CONFIGURATION SINGLEMODE	CONFIGURATION MULTIMODE
Spatial Resolution/ Attenuated Dead Zone	A to TS-4320 B to C D to Variable Attenuator IN E to Variable Attenuator OUT	A to TS-4320 B to C D to Variable Attenuator IN E to Variable Attenuator OUT
Distance Accuracy	F to TS-4320 C to G D to H	F to TS-4320
Dynamic Range	I to TS-4320	C to TS-4320

C-4. SINGLEMODE OPTICAL TEST FIBER.

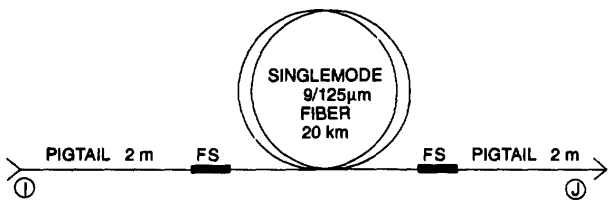
The following schematics represent the configurations required for the Performance Test on the TS-4320(P)/G with a TD-285C installed. Also included is the list of items required to assemble the configurations. With reference to the schematics and items, follow the Fabrication Instructions in para C-7.

After assembling the Singlemode Optical Test Fiber, a Fiber Length Deviation as a Function of Temperature Chart must be created. Follow the procedure in para C-6.

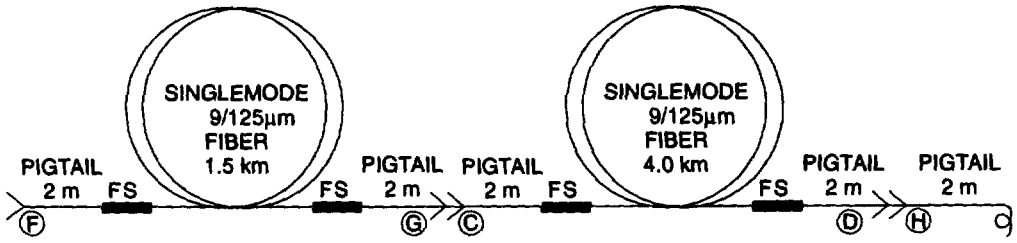
Fusion Splice (FS)	Fiber Optic Splice Conductor (OC5R7) FP-3M	9 EA
Coupler (2x2)	Fiber Optic Coupler (02660) 945-999-1177	1 EA
Pigtail	Singlemode 9/125, Fiber Optic Pigtail ST/PC Connector, 2 meters	10 EA
Fiber	Singlemode 9/125, Fiber optic Cable (Lengths as defined.)	
Variable Attenuator	Singlemode Variable Attenuator	1 EA
Digital Thermometer	MICRONTA Min-Max Digital Thermometer	1 EA
Splice Block	Splice Block (51275) 20230	1 EA



SPATIAL RESOLUTION
AND
ATTENUATION DEAD ZONE



DYNAMIC RANGE

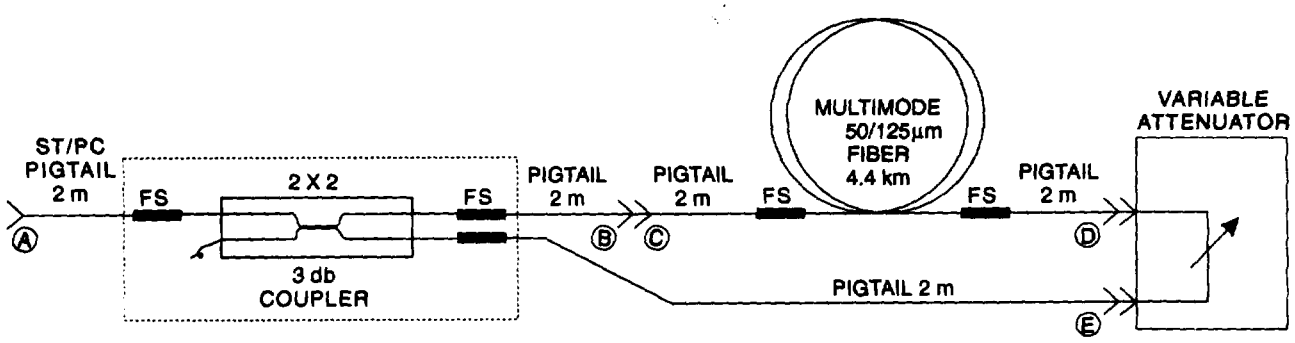


DISTANCE ACCURACY

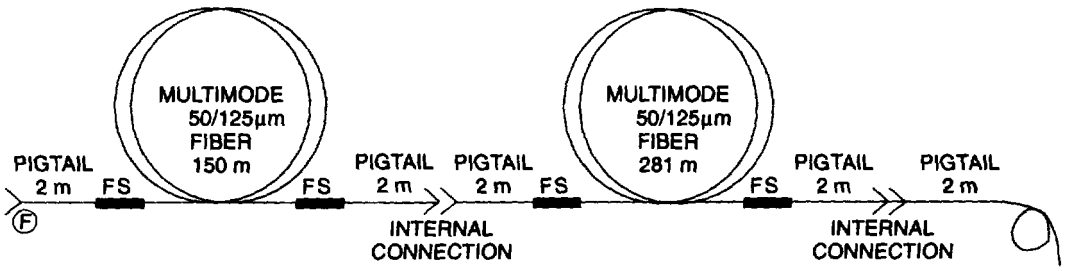
C-5. MULTIMODE OPTICAL TEST FIBER.

The following schematics represent the configurations required for the Performance Test on the TS-4320(P)/G with a TD-260C or TD-261C installed. Also included is the list of items required to assemble the configurations. With reference to the schematics and items, follow the Fabrication Instructions in para C-7.

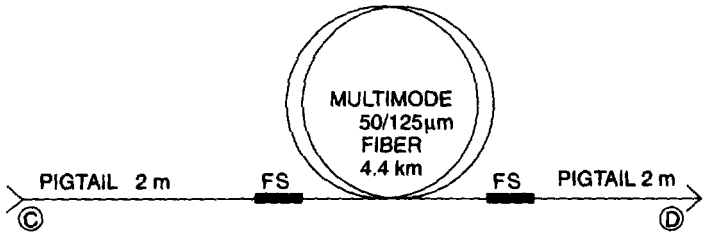
Fusion Splice (FS)	Fiber Optic Splice Conductor (OC5R7) FP-3M	9 EA
Coupler (2x2)	Fiber Optic Coupler (02660) 945-999-1097	1 EA
Pigtail	Multimode 50/125, Fiber Optic Pigtail ST/PC Connector, 2 meters	10 EA
Fiber	Multimode 50/125, Fiber optic Cable (Lengths as defined.)	
Variable Attenuator	Multimode Variable Attenuator	1 EA
Splice Block	Splice Block (51275) 20230	1 EA



SPATIAL RESOLUTION
AND
ATTENUATION DEAD ZONE



DISTANCE ACCURACY



DYNAMIC RANGE

C-6. FIBER LENGTH DEVIATION AS A FUNCTION OF TEMPERATURE.

In a test/calibration environment where the precise length of the fiber is important, consideration must be given to the temperature of the fiber. The longer the test fiber, the more critical the length deviation becomes.

The length of the fiber in the Multimode Configurations does not dictate the use of a thermometer. However, Singlemode Configurations do require the use of a thermometer to monitor the fiber temperature.

After fabricating the Test Fiber, as described in para C-7, follow the procedure below to create a Fiber Length Deviation as a Function of Temperature Chart.

1. Remove the top from the test fiber enclosure and then place the test fiber enclosure in the environmental chamber and set the chamber temperature to 70 degrees F. Allow the fiber to stabilize for a period of 1.5 hours. The temperature as indicated on the test fiber thermometer should be the same as the chamber temperature.

2. Install the TD-285C Optical Module in the Optical Test Set TS-4320(P)/G (tool 24, Appendix B, TM 11-6625-3271-12). Turn the TS-4320 ON and allow a 30 minute warm up.

3. On the TS-4320:

   - Set the INDEX to the same value as the INDEX of the Test Fiber.
   - Set the Wavelength to 1310nm.

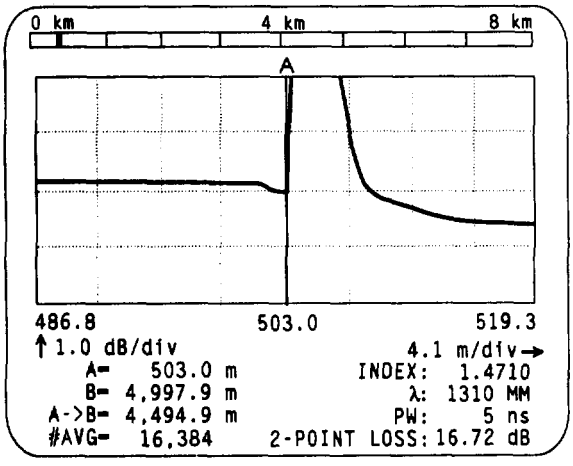
- Set Range to 8 km and Resolution to 0.5 m.
- Set the Pulse Width to SHORT.

4. Configure the Test Fiber for a Distance Accuracy measurement.
5. Connect the Test Fiber to the TS-4320, press the REAL TIME KEY, and optimize the fiber connection.
6. Press the SLOW SCAN key and then press the Laser OFF key when the TS-4320 has completed 16,000+ averages.
7. Position the A cursor near the artifact on the test fiber.
8. Press DISPLAY FROM to select A.
9. Expand as necessary and position the A cursor at the beginning of the artifact.
10. Press DISPLAY FROM to select B.
11. Expand the screen to ldB/DIV vertically and approximately 4m/DIV Horizontally.

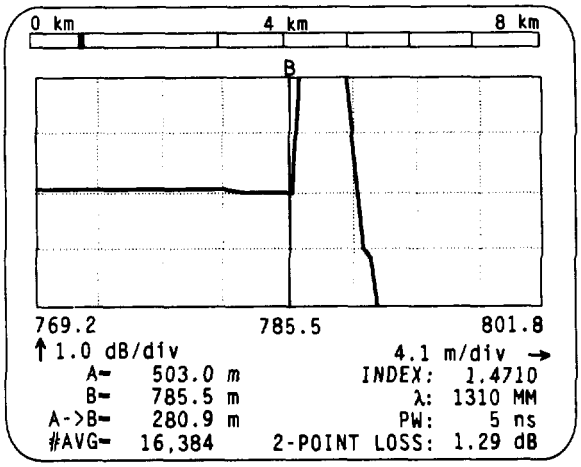
Note

The Index of Refraction may not allow exactly 4m/Div horizontally.

12. Position the B cursor on the first major data point of the fiber termination reflection.
13. Record the measurement Distance between the A and B cursors (A-B) in the Fiber Length Deviation as a Function of Temperature Chart.
14. Repeat the above sequence for Medium and Long pulses at 1310nm, then repeat the sequence for all three pulse widths at 1550nm.
15. After completing the sequence at 70 deg F, change the temperature of the chamber to 75 deg F, allow the temperature to stabilize and repeat the sequence. Upon completing follow the same procedure for 80 deg F.



Cursor A at Artifact



Cursor B at Termination Reflection

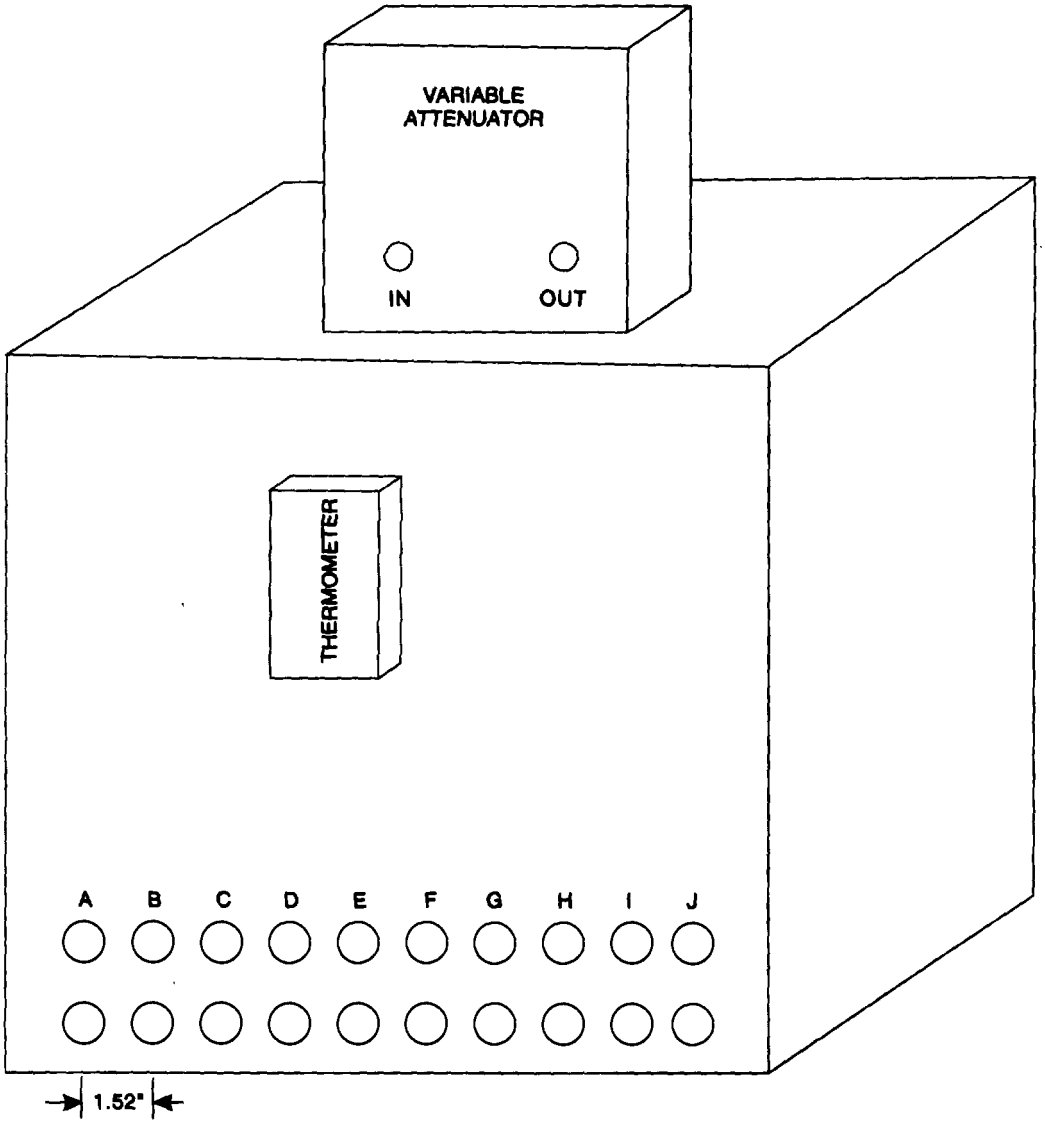
FIBER LENGTH DEVIATION AS A FUNCTION OF TEMPERATURE CHART

SINGLEMODE TEST FIBER---------- INDEX OF REFRACTION----------				
DISTANCE ACCURACY Grid set at .5dB/DIV vertical and 4.lm/DIV horizontal for all readings.				
Wavelength	Pulse Width	Range/Reso	DISTANCE	TEMPERATURE
1310	Short	8km, 0.5m	----------	65 deg F
1310	Short	8km, 0.5m	----------	70 deg F
1310	Short	8km, 0.5m	----------	75 deg F
1310	Short	8km, 0.5m	----------	80 deg F
1310	Medium	8km, 0.5m	----------	65 deg F
1310	Medium	8km, 0.5m	----------	70 deg F
1310	Medium	8km, 0.5m	----------	75 deg F
1310	Medium	8km, 0.5m	----------	80 deg F
1310	Long	16km, 1.0m	----------	65 deg F
1310	Long	16km, 1.0m	----------	70 deg F
1310	Long	16km, 1.0m	----------	75 deg F
1310	Long	16km, 1.0m	----------	80 deg F
1550	Short	8km, 0.5m	----------	65 deg F
1550	Short	8km, 0.5m	----------	70 deg F
1550	Short	8km, 0.5m	----------	75 deg F
1550	Short	8km, 0.5m	----------	80 deg F
1550	Medium	8km, 0.5m	----------	65 deg F
1550	Medium	8km, 0.5m	----------	70 deg F
1550	Medium	8km, 0.5m	----------	75 deg F
1550	Medium	8km, 0.5m	----------	80 deg F
1550	Long	16km, 1.0m	----------	65 deg F
1550	Long	16km, 1.0m	----------	70 deg F
1550	Long	16km, 1.0m	----------	75 deg F
1550	Long	16km, 1.0m	----------	80 deg F

C-7. FABRICATING THE TEST FIBER.

The following illustrations depicts a method to fabricate the Test Fiber. Dimensions of the enclosure are given as inside dimensions (ID), since the thickness of the building material may vary. Other approaches may be taken, however, there are some precautions that must be adhered to.

1. Optical Test Fiber.



OPTICAL TEST FIBER

- The lower set of holes (A - J, for Singlemode and A - F, for Multimode) is where the pigtails exit the enclosure. These holes should be 0.5" ID and spaced 1.52" on center for singlemode and 2.39" on center for multimode.

- The upper set of holes are for the Bulkhead connectors, there diameter is determined by the type of Bulkhead connector used.

- The Thermometer is only required for Singlemode and may be positioned such that the probe can be installed at the top of the 4.0 km spool as shown in the side view.

- The Variable Attenuator is called out as a free standing unit and may be placed where appropriate for convenient operation.

- The length of the Pigtails are as shown below:

PIGTAIL	A	B	C	D	E	F	G	H	I	J
LENGTH	2m	2m	2m	2m	2m	2m	2m	2m	2m	2m

- The top and bottom of the enclosure must be removable to provide access to the pigtails when they must be replaced.

2. Side View.

- The foam that supports the spools should be 1" thick, 2 pound Polyester or denser.

- If the Test Fiber is to be subjected to excess vibration resulting from frequent transporting, then, a piece of cardboard should be installed on top of the foam that is the load bearing surface for the spools. In this case the inside dimension must be adjusted.

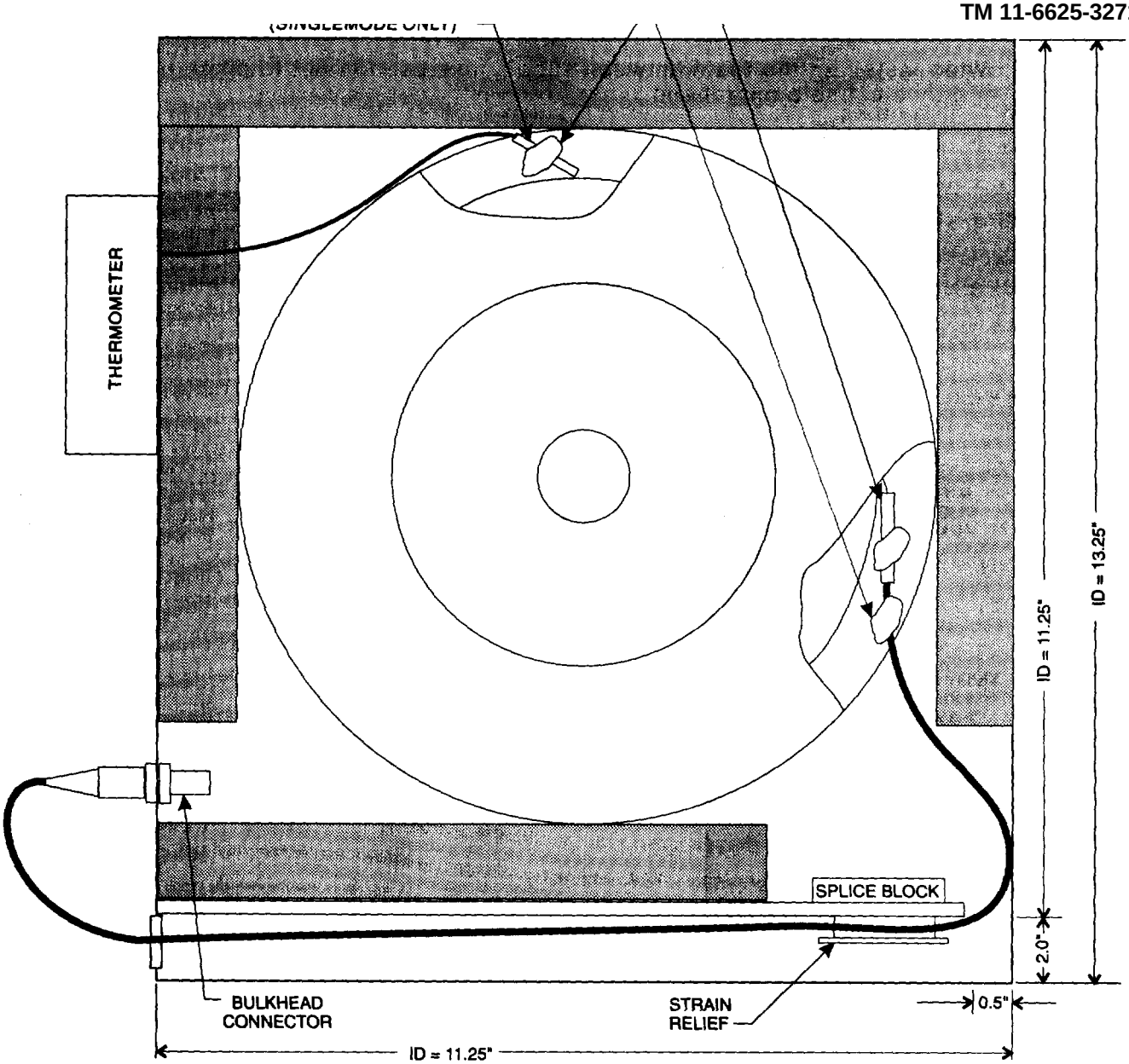
- The foam that separates the spools should be 1" thick, but may be less than 2 pound Polyester.

- The Strain Relief is made up of 2 pieces of 0.5" thick by 2.0" wide by 14.0" long, 2 pound Polyester foam, supported by 0.25" x 2.0" x 15.0" plyboard. The fiber should be sandwiched between the foam strips.

- Use RTV to fasten the pigtail and splice conductor to the side of the spool. Use caution not to allow the RTV to contact the fiber. The ST/PC connector end of the pigtail will become damaged as a result of continued use and the pigtail will have to be replaced, therefore, don't use an excess amount of RTV as it will have to be removed when the pigtail is replaced.

- The Temperature Probe is only used in the Singlemode Test Fiber and is installed on the 4.0 km spool. When installing the probe, position the tip inside the spool close to the fiber, tip should not contact the fiber. Use RTV to fasten the probe to the side of the spool. Use caution not to allow the RTV to contact the fiber.

- Spools used in this configuration are 9.25" in diameter and 4.25" wide.

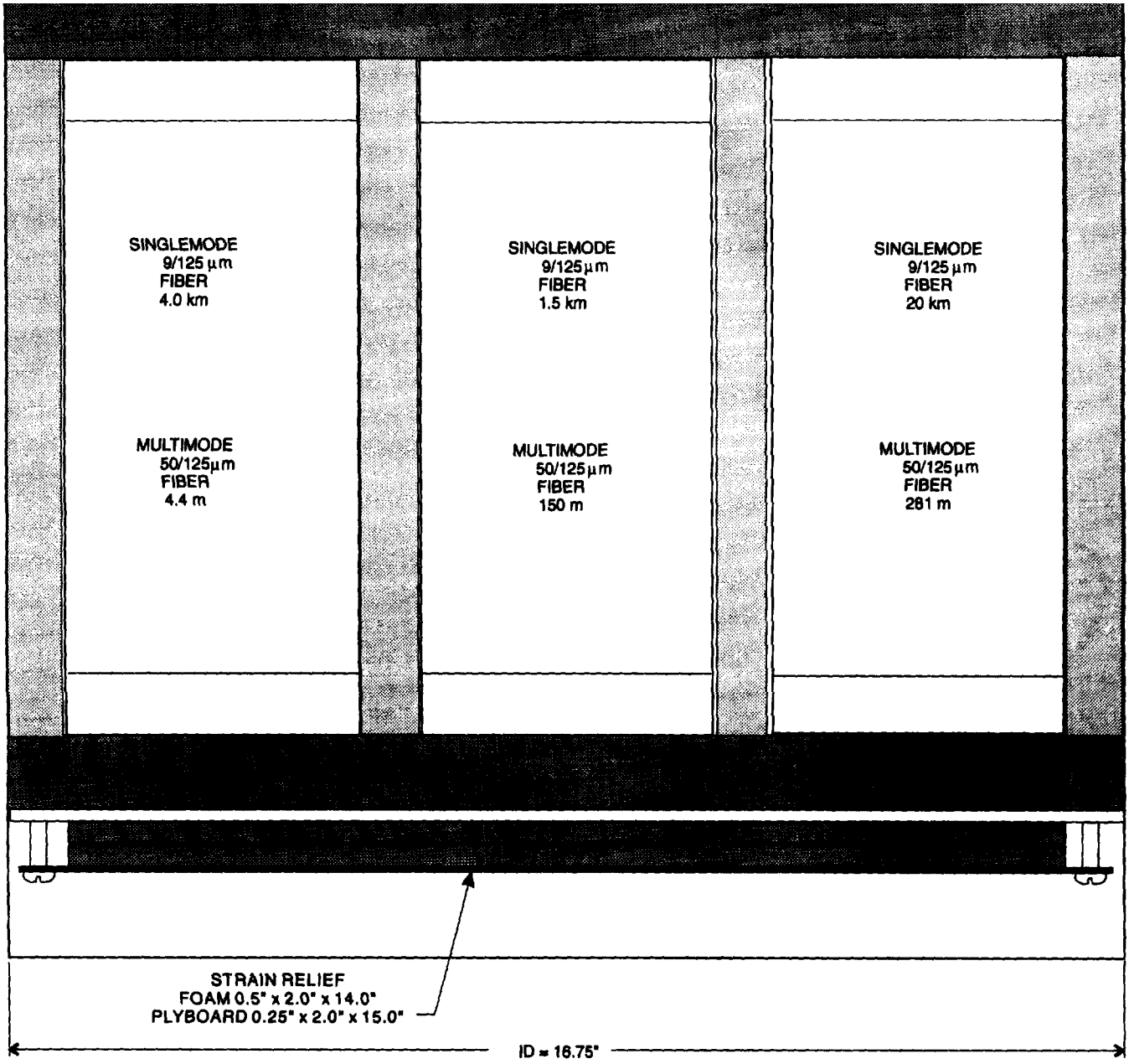


SIDE VIEW

SIDE VIEW

3. Spool Location.

   - Position the spools as shown to accomodate installation of the pigtails.
   - When installing the foam between spools take caution not to pinch the fiber and thus cause a microbend.



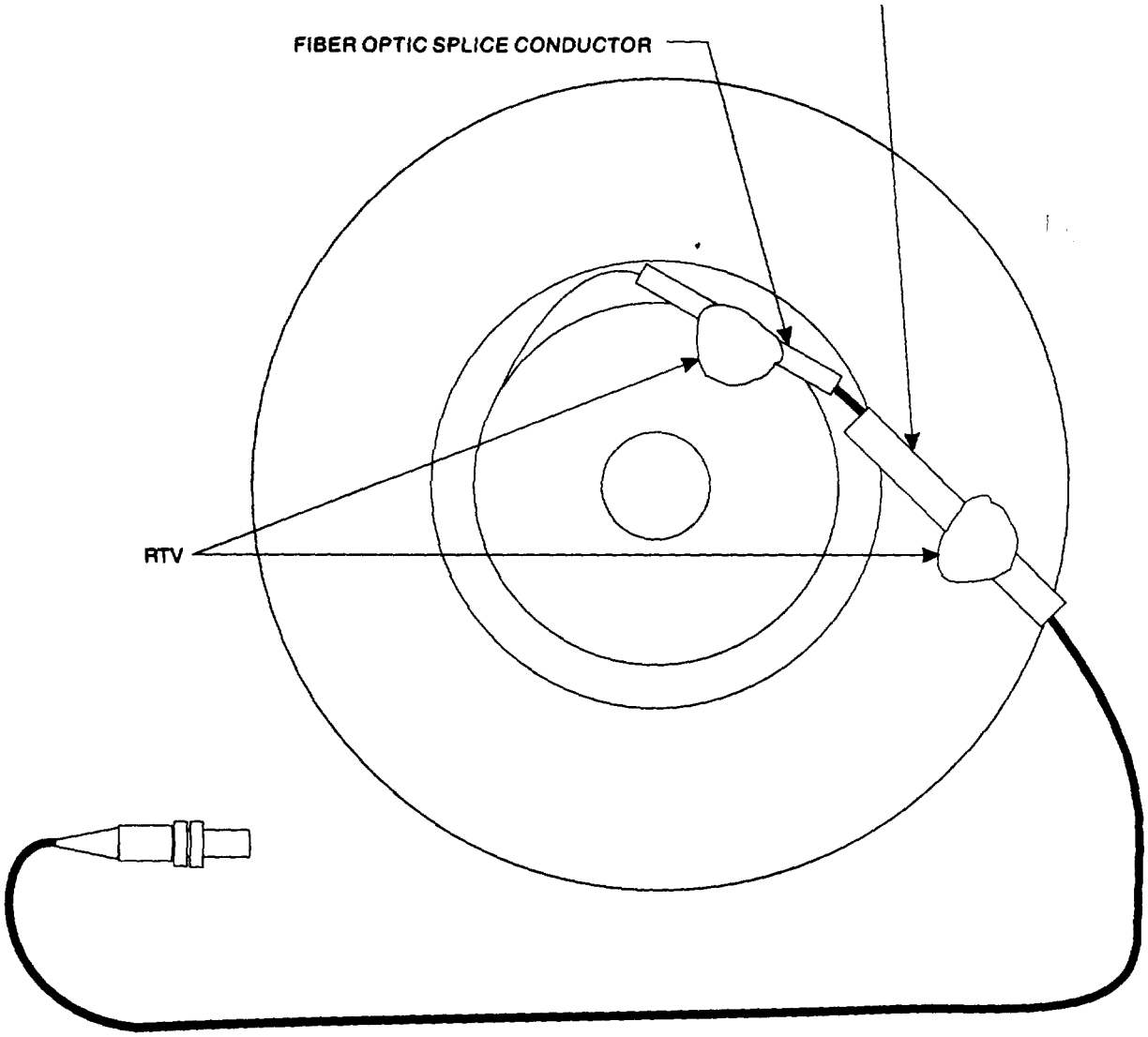
SPOOL LOCATION FRONT VIEW

SPOOL LOCATION FRONT VIEW

4. Fusion Splice To Inside Lead.

   - Use RTV to fasten Acrylic Tubing, 0.125" ID, to the outside edqe of the spool. Position tubing as shown. This tubing protects the pigtail from microbends caused by the foam placed between the spools.

   - Use RTV to fasten splice conductor to the outside edge of the spool. Use caution not to form a microbend as the fiber exits the splice conductor.

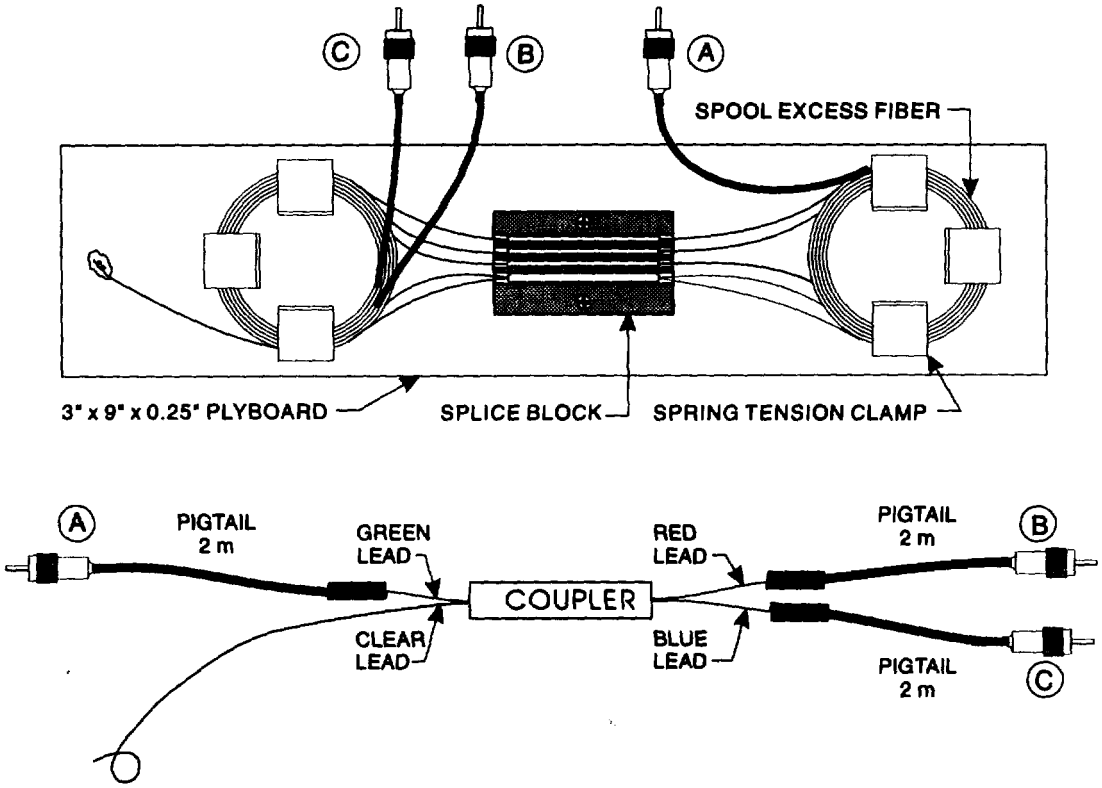


FUSION SPLICE TO INSIDE LEAD

FUSION SPLICE TO INSIDE LEAD

5. Coupler Assembly.

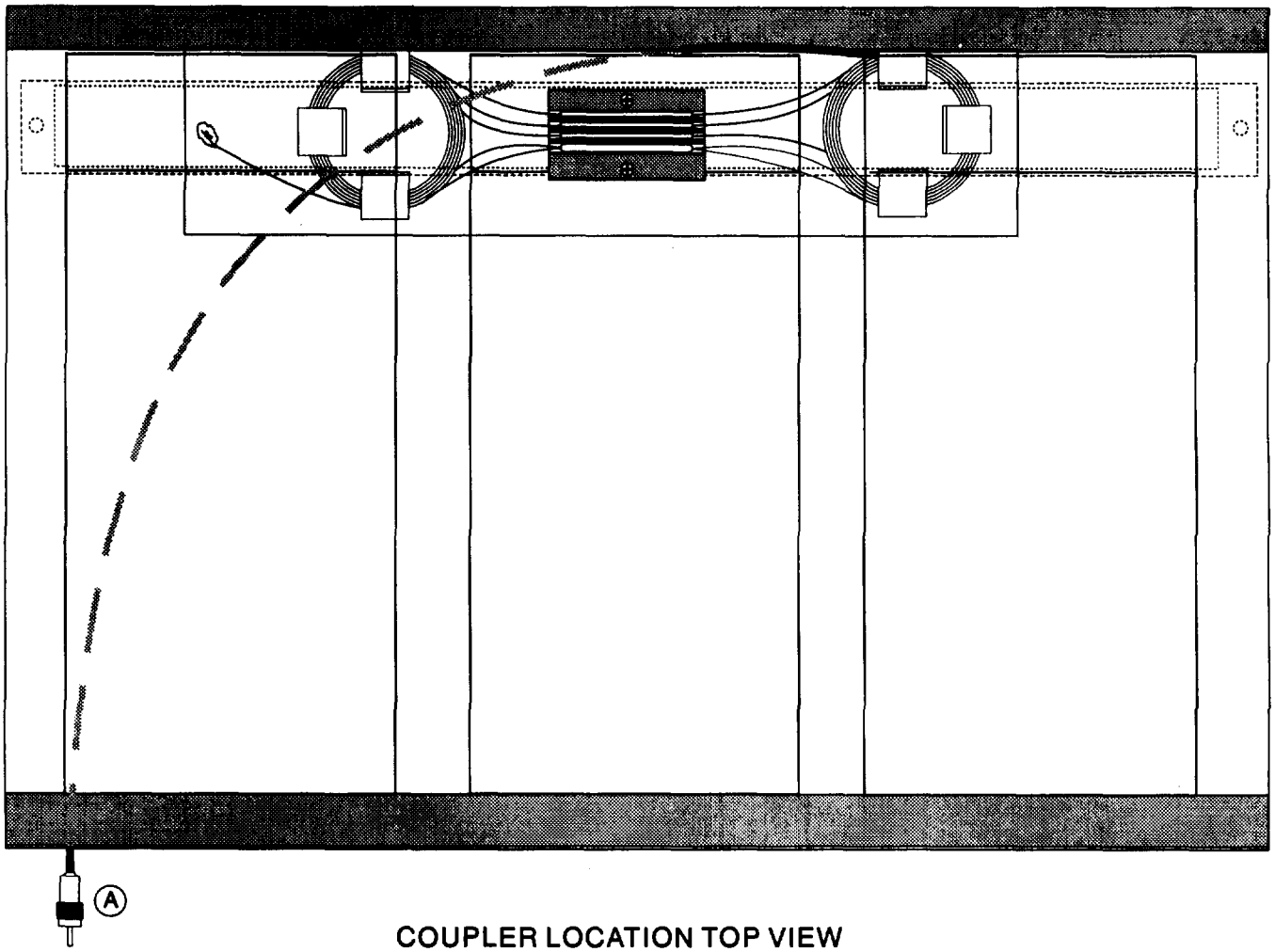
   - Assemble the Coupler Assembly outside the enclosure to make the assembly process easier. Suggest assembling to a 3" x 9" x 0.25" plyboard and then installing final assembly in the enclosure.
   - The unused lead of the coupler must be formed into a knot and secured with RTV.



COUPLER ASSEMBLY

6. Coupler Location Top View.

   - Install coupler assembly into enclosure as shown.
   - When routing pigtails use caution not to form microbends. The radius of bend should be greater than 2".



COUPLER LOCATION TOP VIEW

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Paragraph
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W

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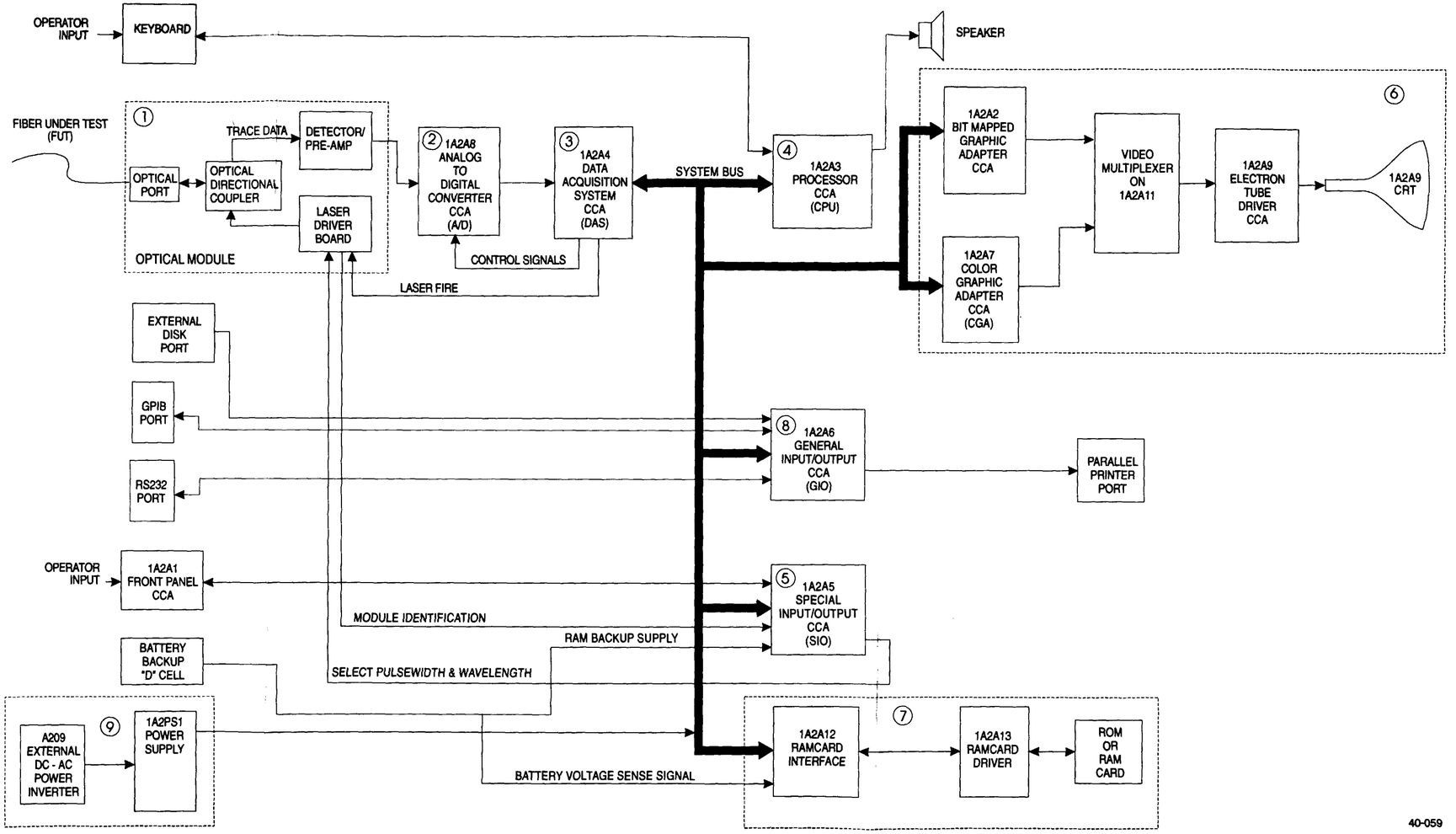
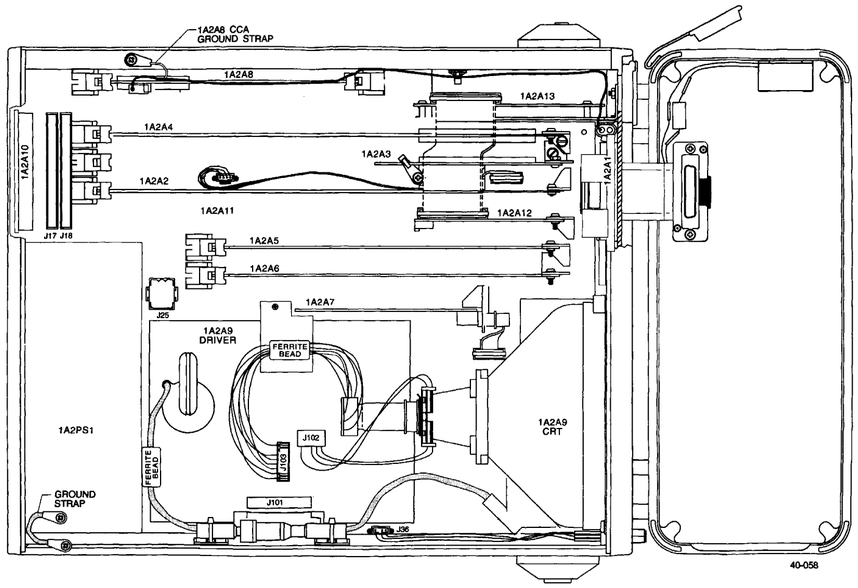
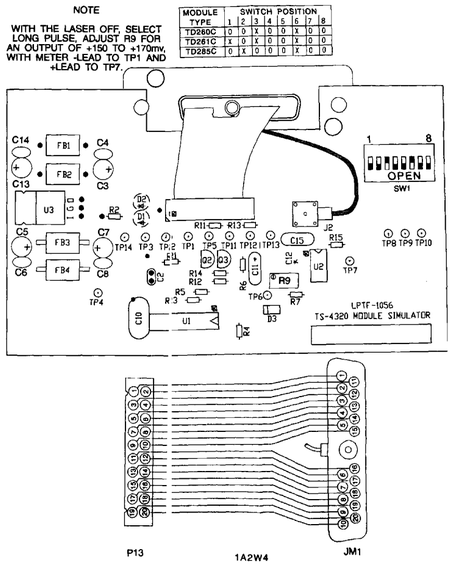


Figure FO-1. TS-4320 Functional Diagram.





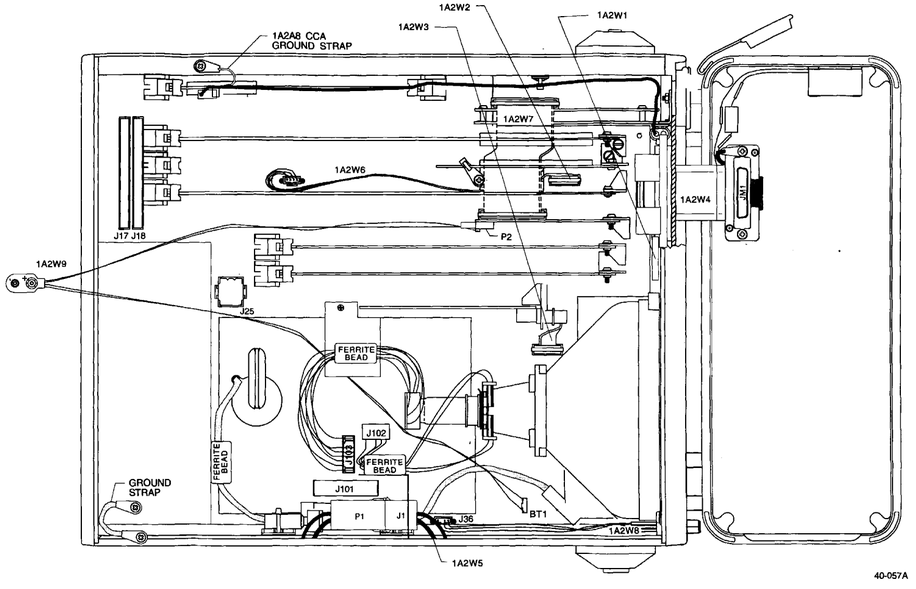


Figure FO-2. Assembly & Cable Locator Diagram.

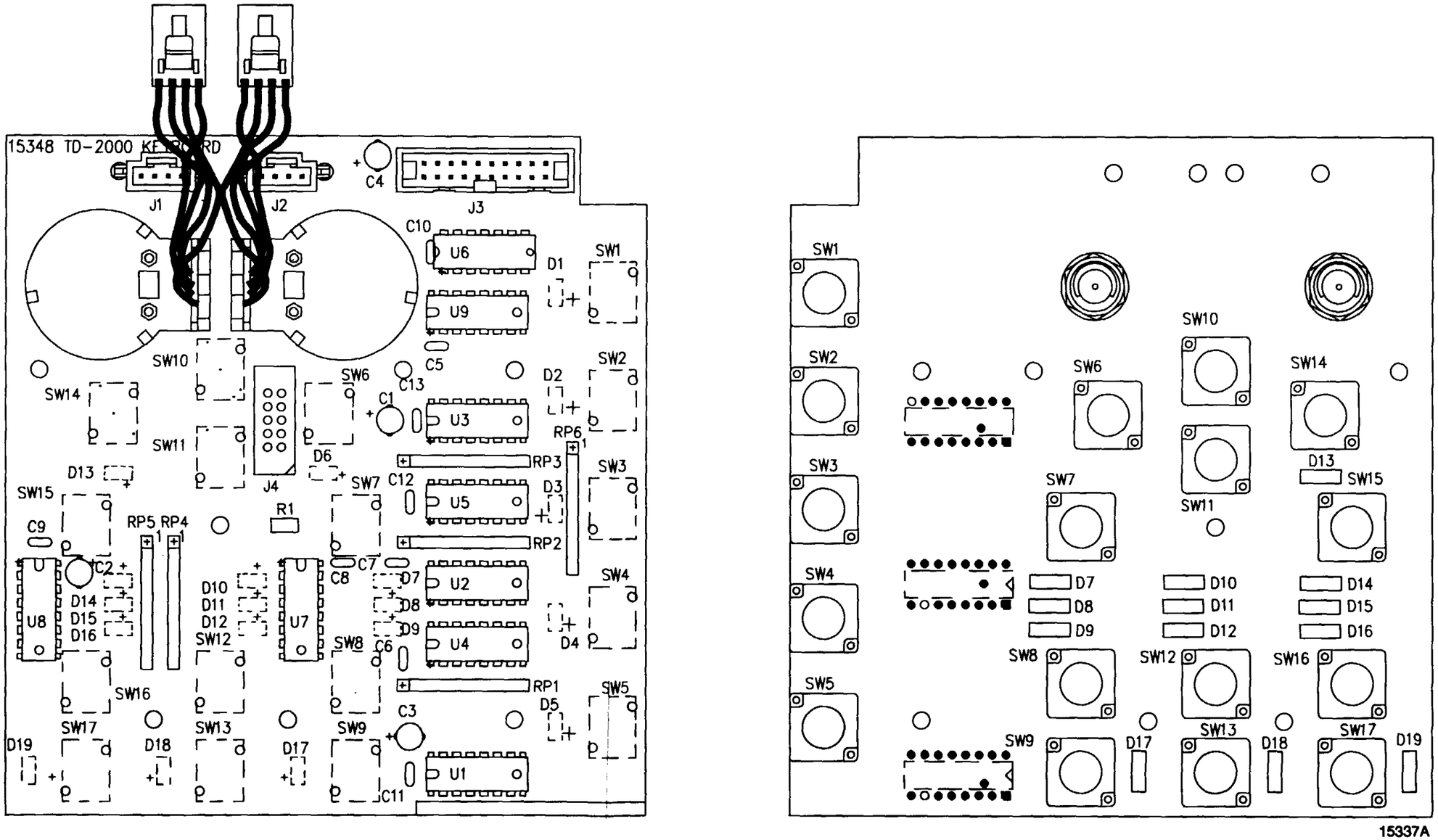


Figure FO-3. 1A2A1 Front Panel Interface CCA Component Locator Diagram.

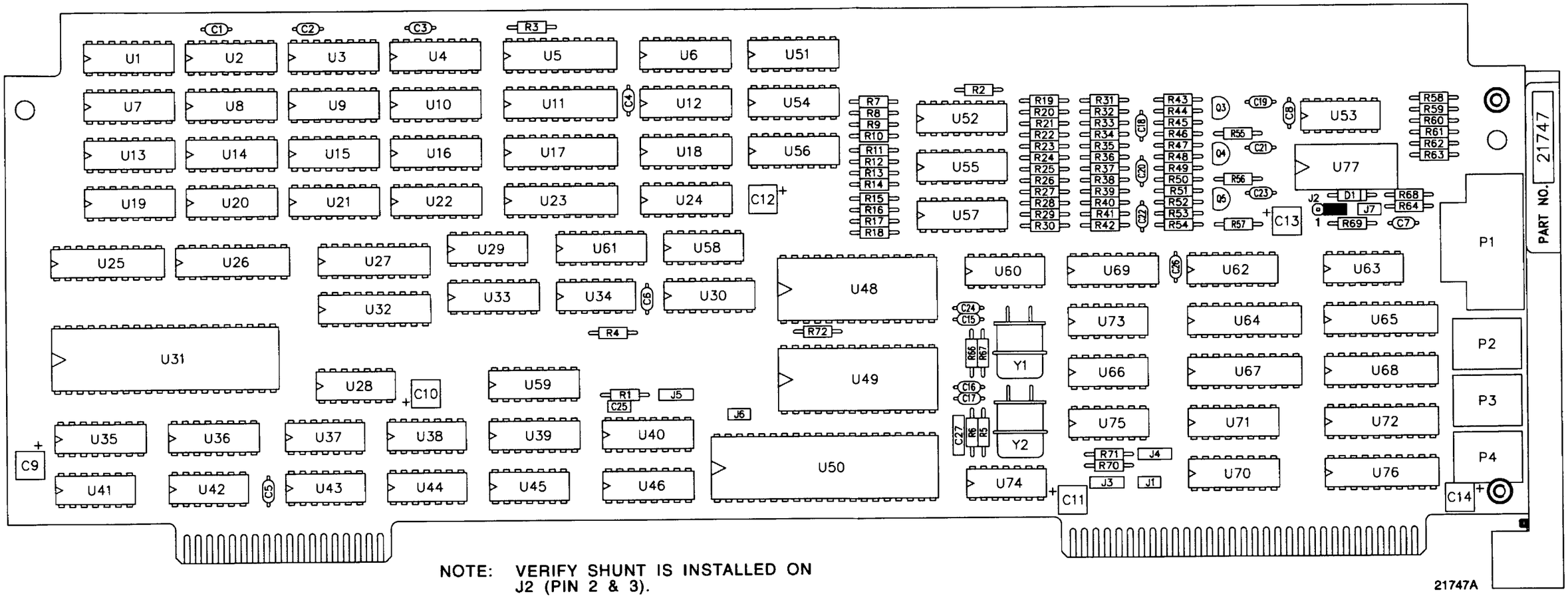


Figure FO-4. 1A2A2 Bitmapped Graphic Adapter CCA Component Locator Diagram.

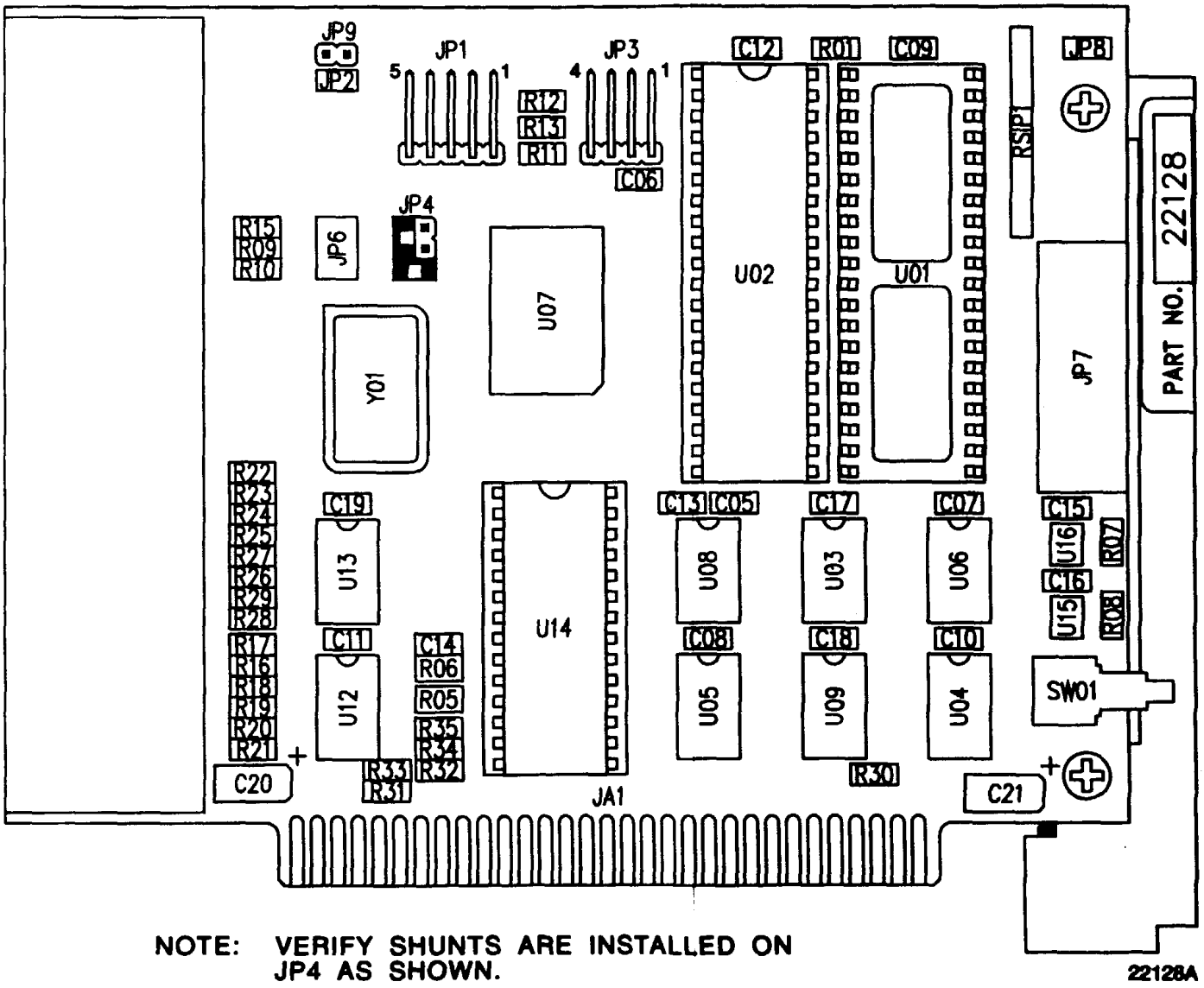
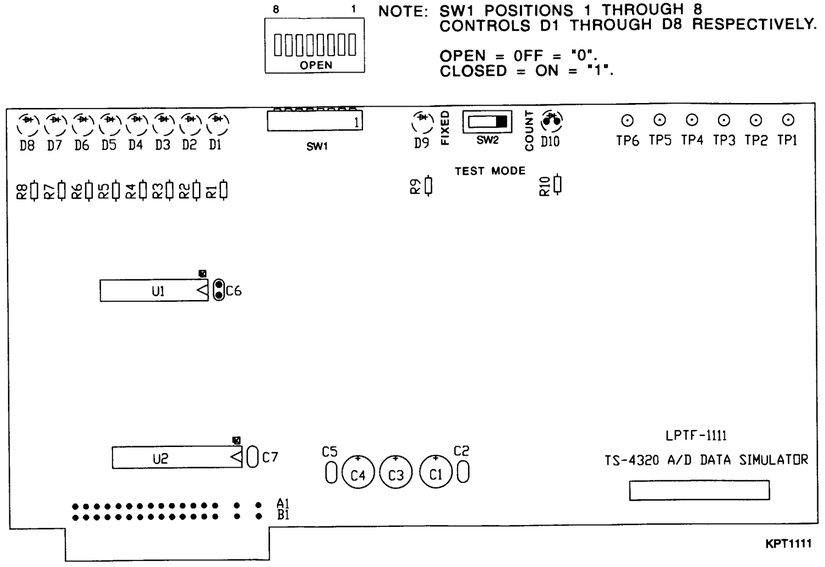


Figure FO-5. 1A2A3 Processor CCA Component Locator Diagram



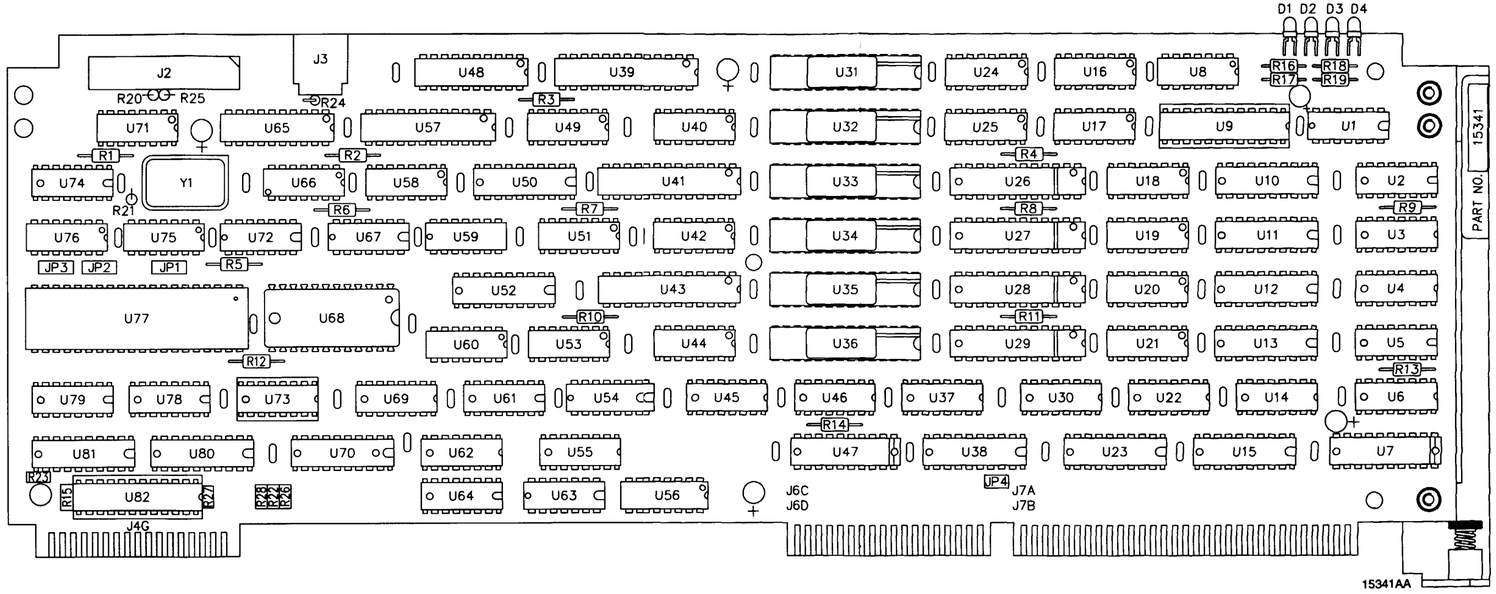
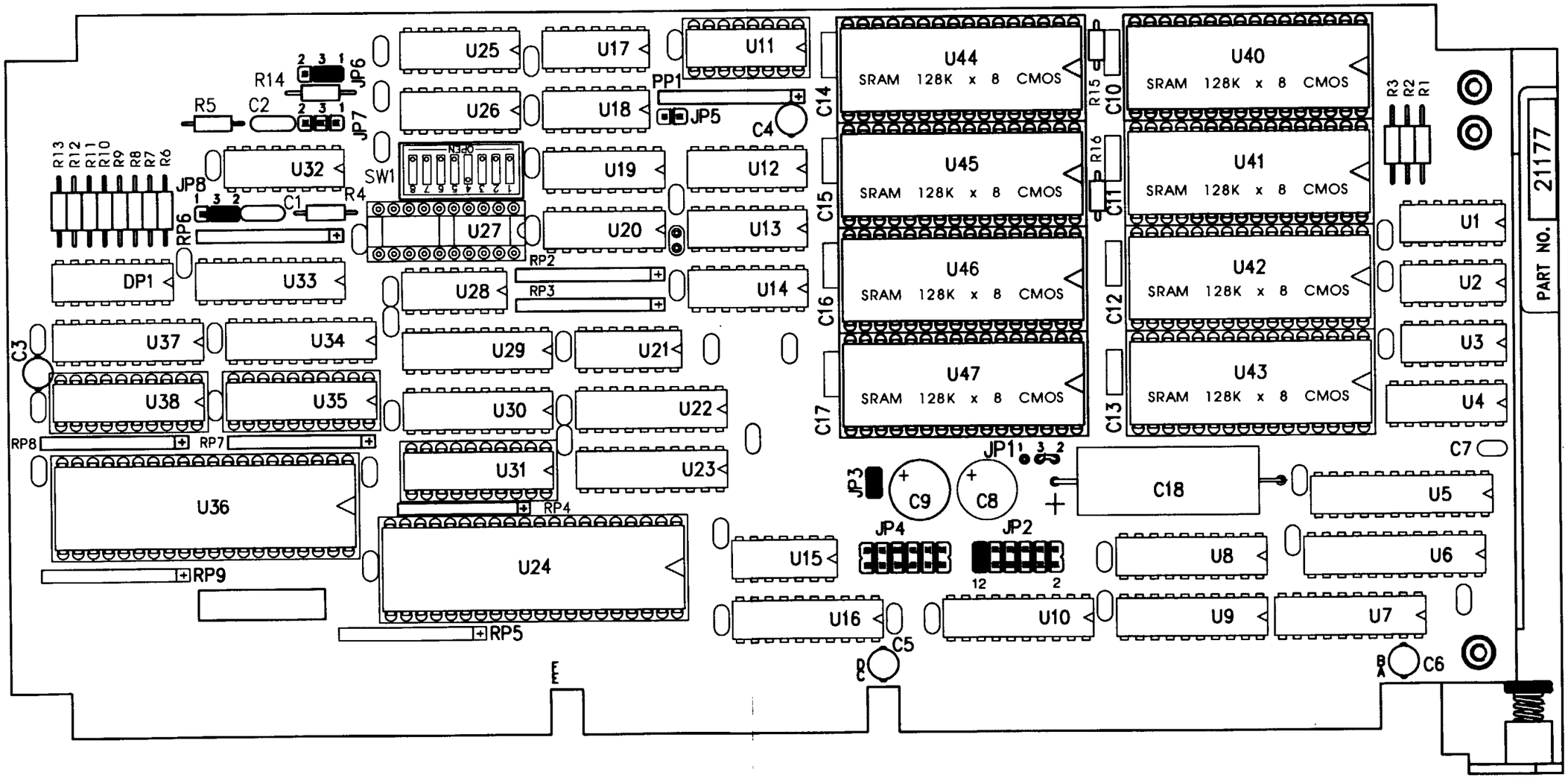


Figure FO-6. 1A2A4 DAS CCA Component Locator Diagram.

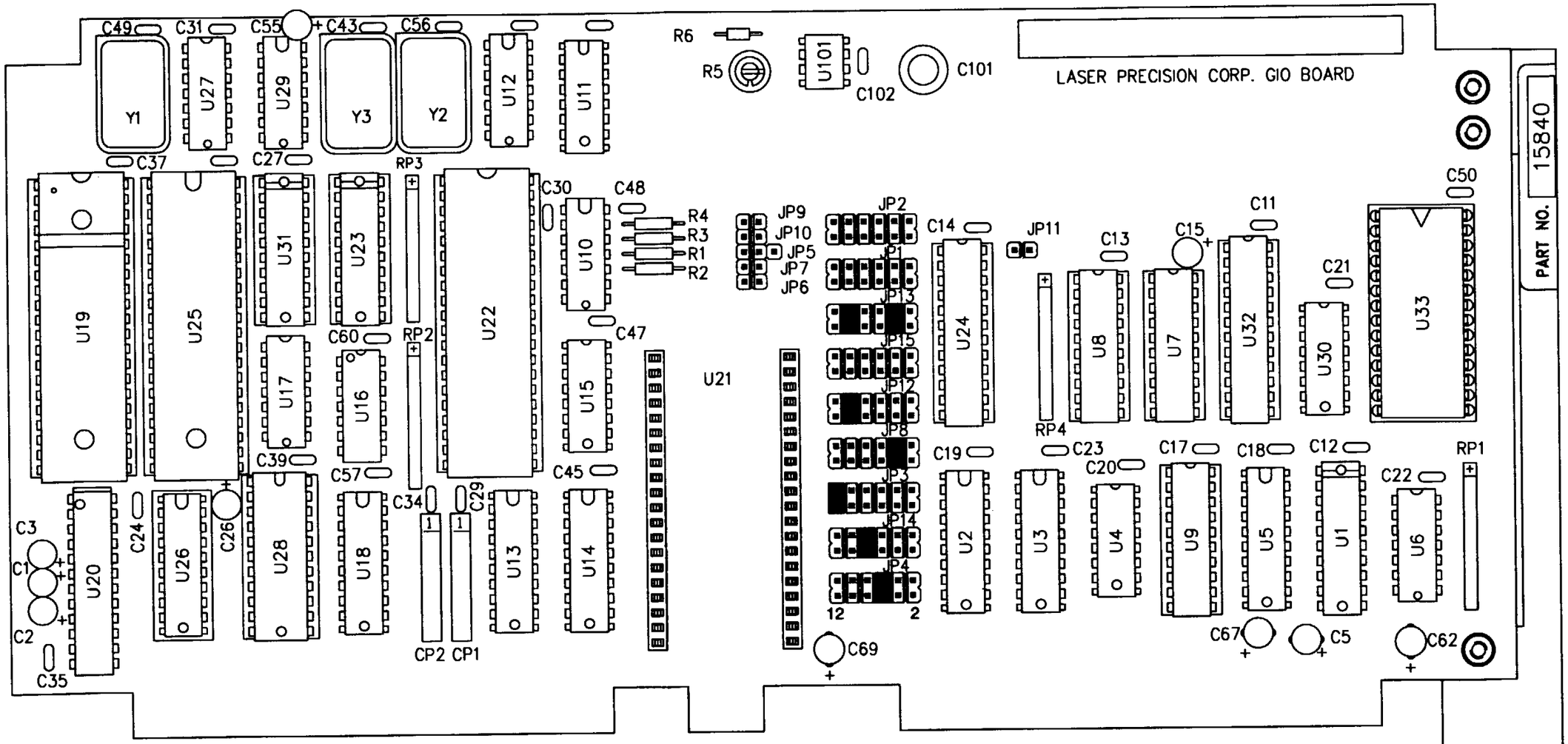


NOTE: 1. FOR NORMAL OPERATION, ON DIP SWITCH SW1
SET SW #4 CLOSED
ALL OTHER SW'S OPEN.

2. VERIFY SHUNTS ARE INSTALLED ON
JP2 (PINS 11 & 12), JP3, JP6 (PINS 1 & 3), AND JP8 (PINS 2 & 3).

21177A4

Figure FO-7. 1A2A5 SIO CCA Component Locator Diagram



NOTE: VERIFY SHUNTS ARE INSTALLED ON JP3 (PINS 11& 12), JP4 (PINS 5 & 6), JP8 (PINS 3 & 4), JP12 (PINS 9 & 10), JP13 (PINS 3 & 4, AND PINS 9 & 10), AND JP14 (PINS 7 & 8).

Figure FO-8. 1A2A6 GIO CCA Component Locator Diagram.

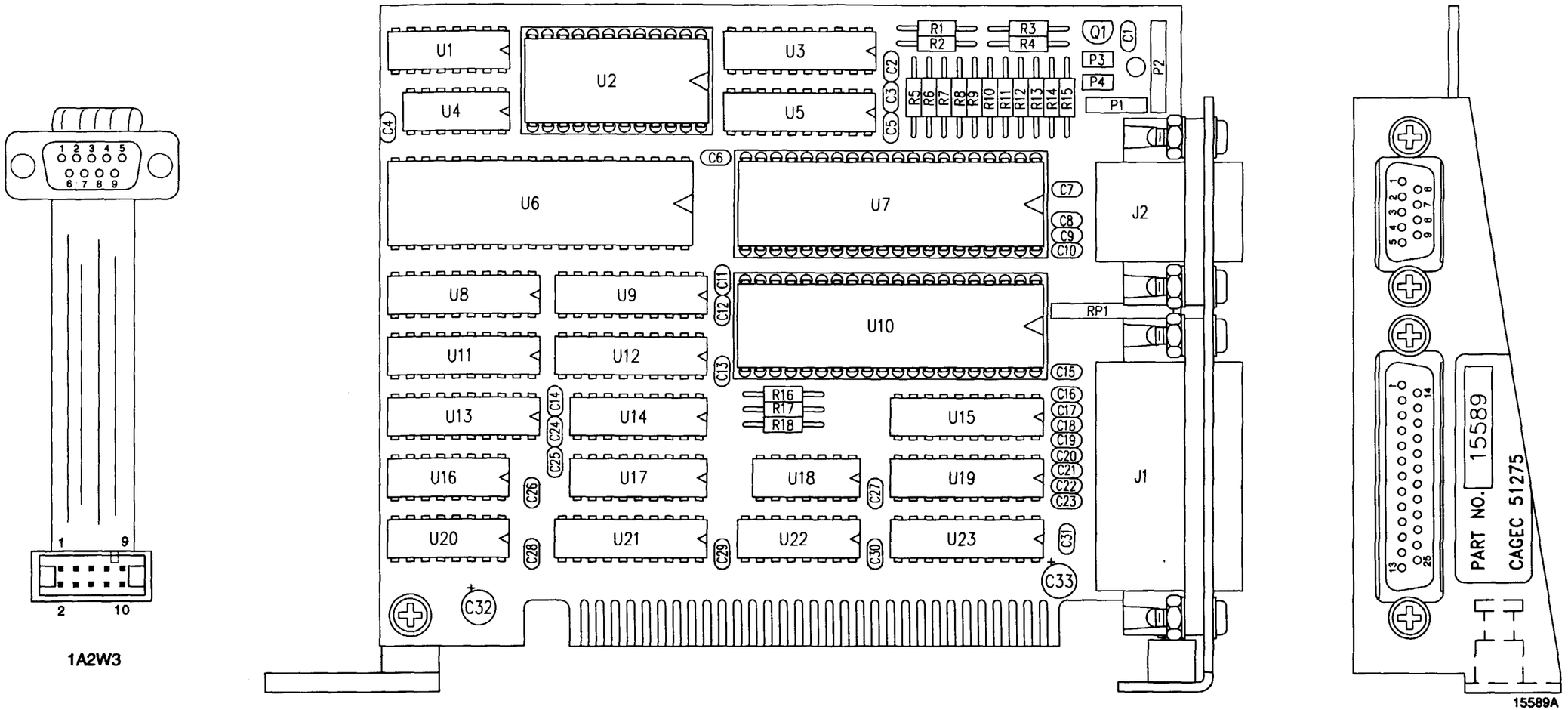


Figure FO-9. 1A2A7 Color Graphic Adapter CCA Component Locator Diagram.

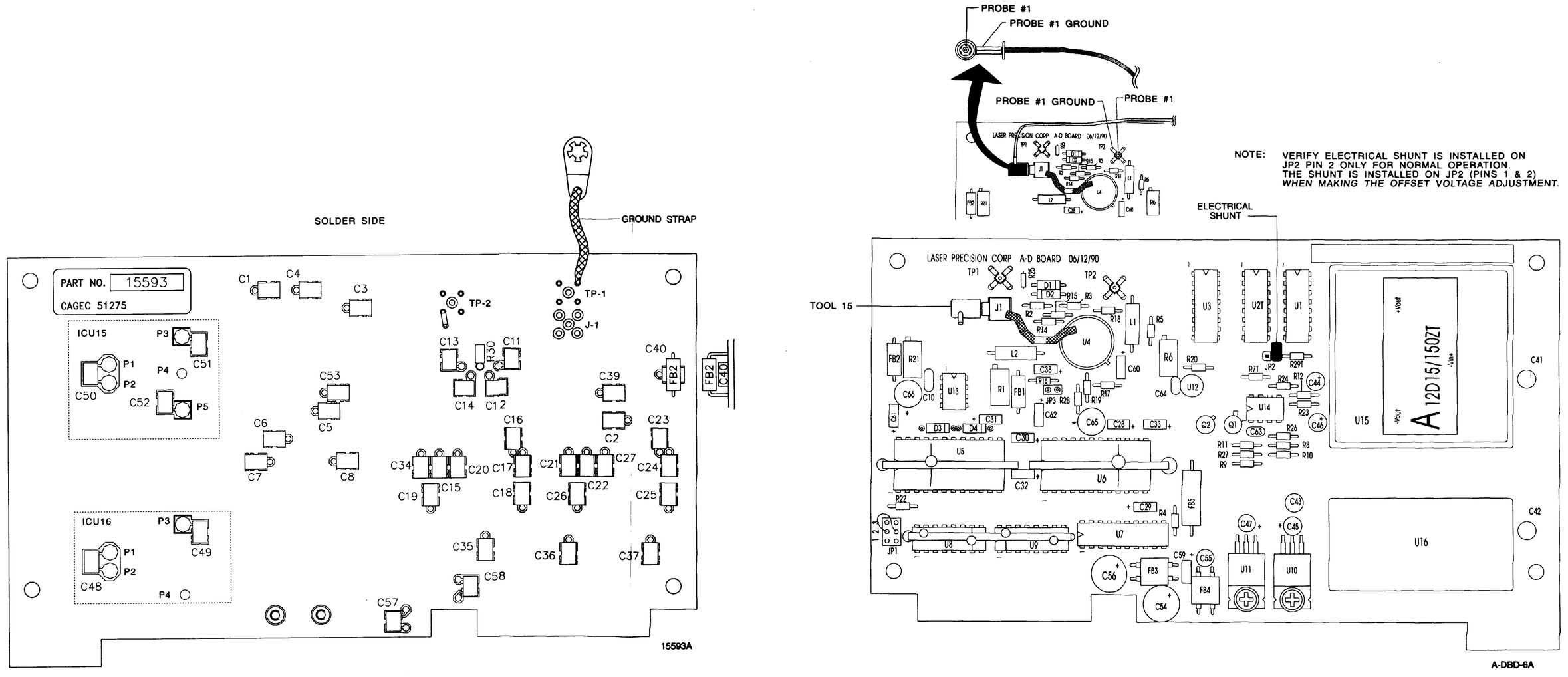
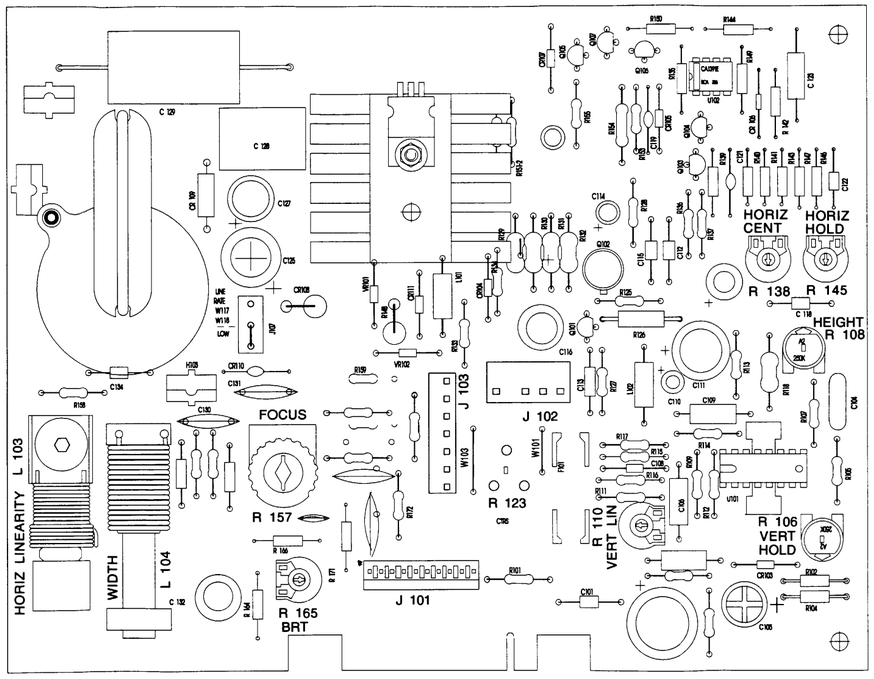


Figure FO-10. 1A2A8 A to D Converter CCA Component Locator Diagram.



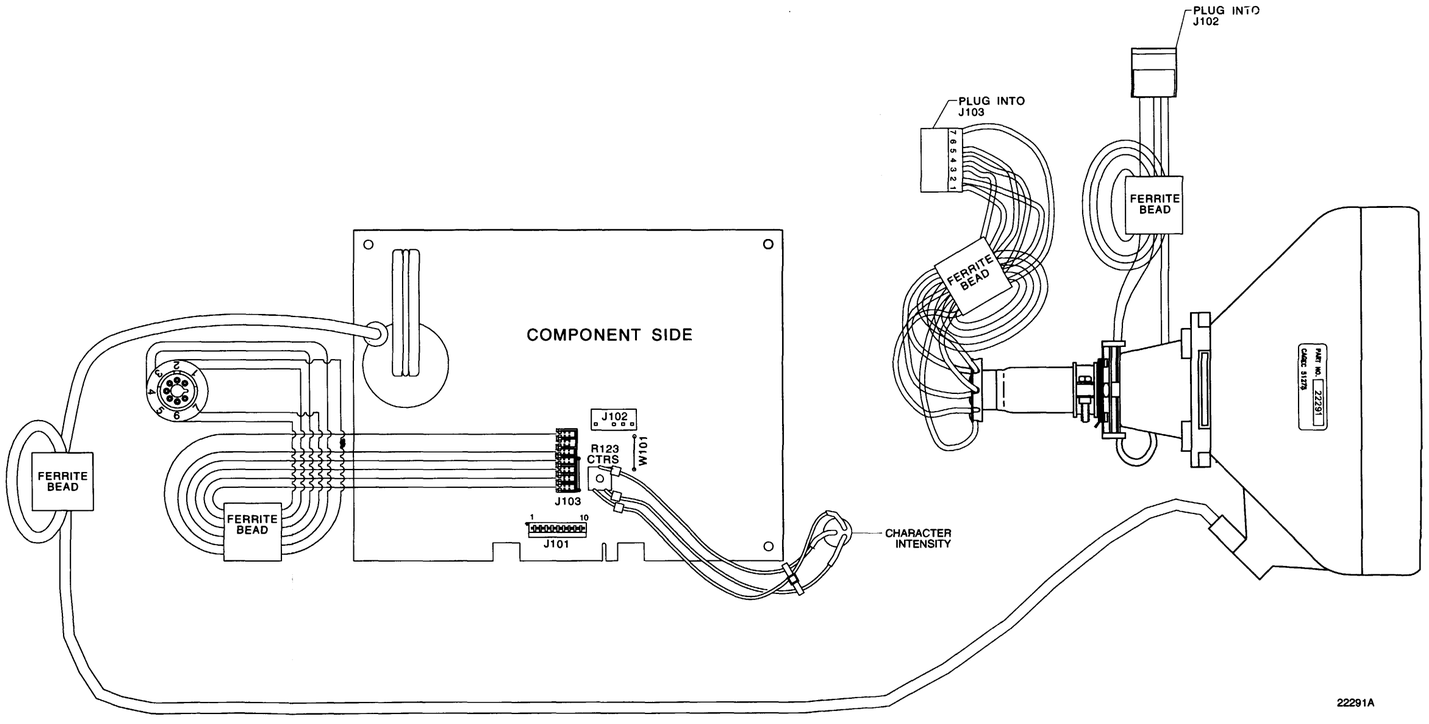
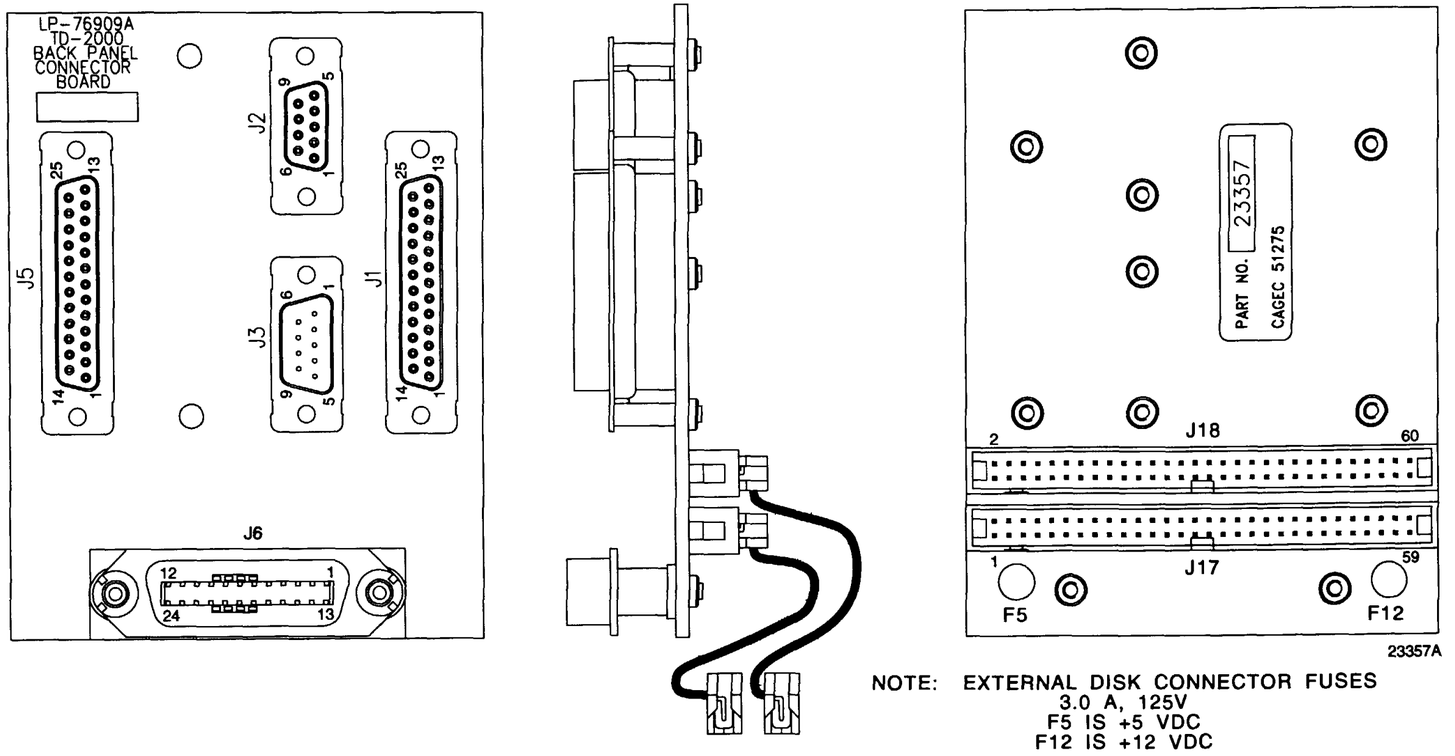


Figure FO-11. 1A2A9 Electron Tube Assembly Component Locator Diagram.

+ METER LEAD	-METER LEAD
P17-15	J30E-21
P17-17	J30E-23
P17-19	J30E-25
P17-21	J30E-27
P17-23	J30E-29
P17-25	J30F-30
P17-27	J30F-26
P17-29	J30F-25
P17-31	J30F-24
P17-33	J30F-23
P17-35	J30F-22
P17-37	J30F-21
P17-39	J30F-20
P17-14	J30E-20
P17-16	J30E-22
P17-18	J30E-24

+ METER LEAD	-METER LEAD
J17-19	J6-1
J17-21	J6-2
J17-23	J6-3
J17-25	J6-4
J17-27	J6-5
J17-29	J6-6
J17-31	J6-7
J17-33	J6-8
J17-35	J6-9
J17-37	J6-10
J17-39	J6-11
J17-53	J6-12
J17-17	J6-13
J17-18	J6-14
J17-16	J6-15
J17-15	J6-16
J17-14	J6-17



NOTE: EXTERNAL DISK CONNECTOR FUSES
3.0 A, 125V
F5 IS +5 VDC
F12 IS +12 VDC

Figure FO-12. 1A2A10 Rear Panel Assembly Component Locator Diagram.

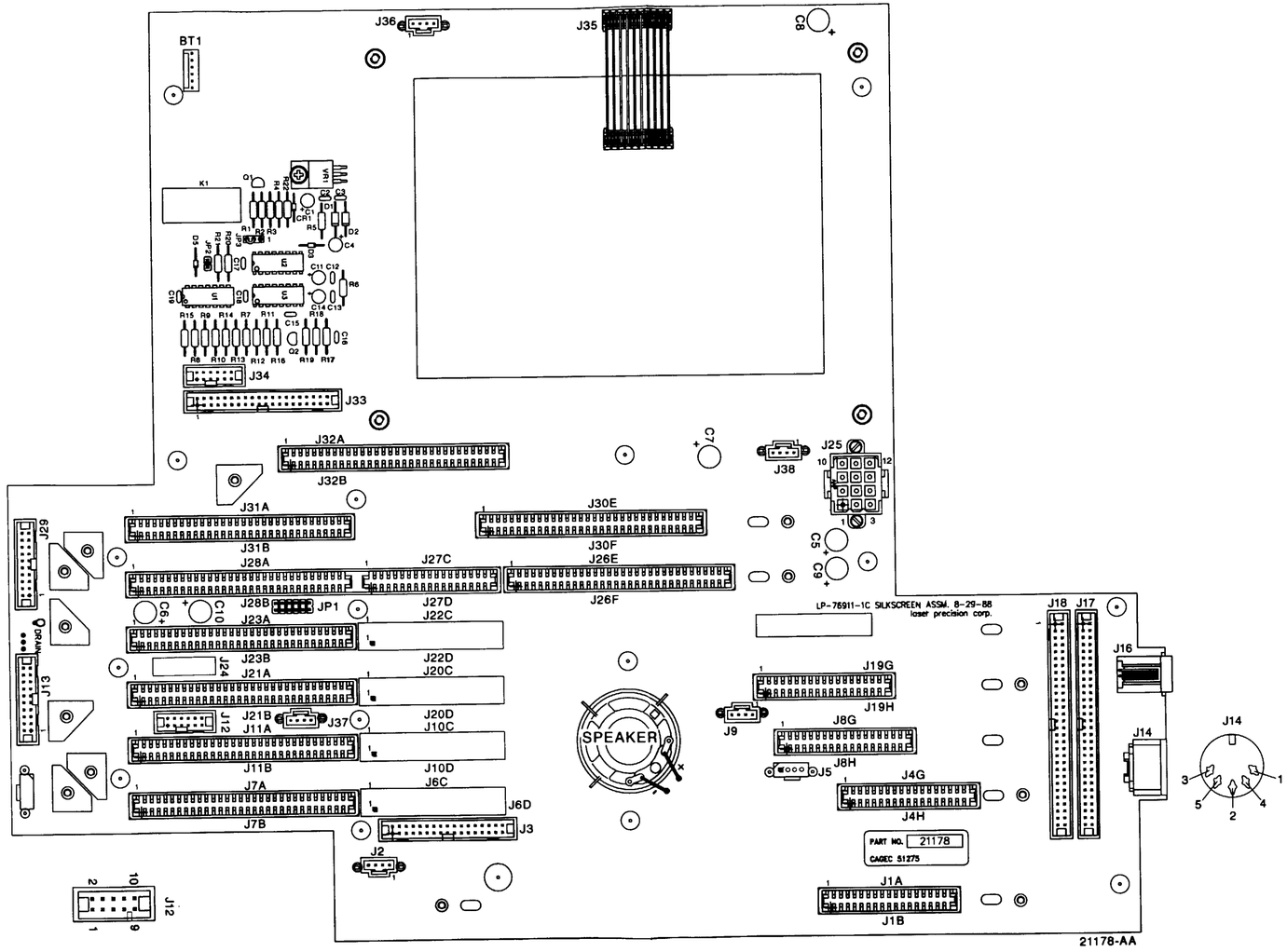


Figure FO-13. 1A2A11 CCA Backplane Component Locator & Schematic Diagram (Sheet 1 of 6).

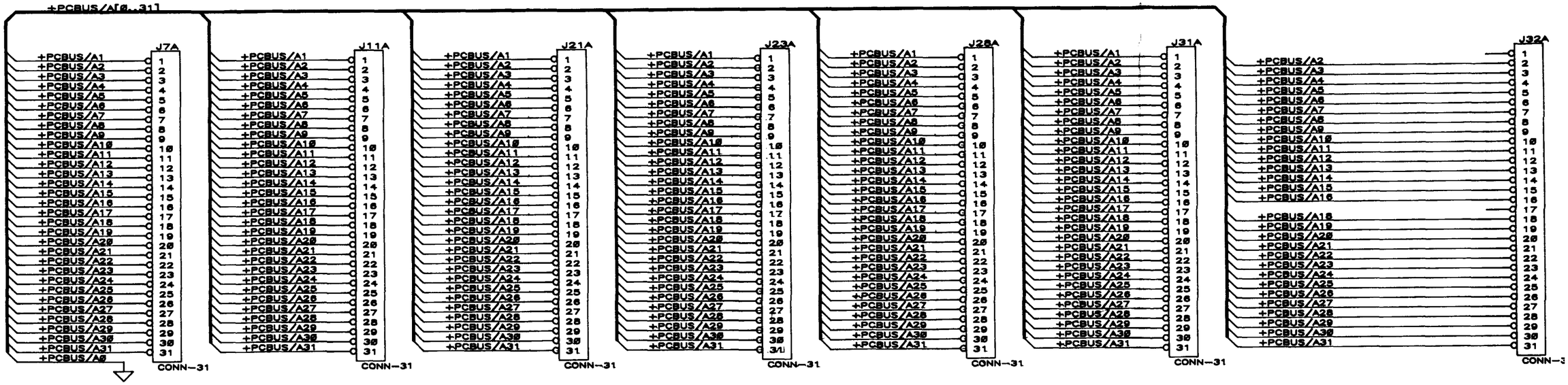


Figure FO-13. 1A2A11 CCA Backplane Component Locator & Schematic Diagram (Sheet 2 of 6).

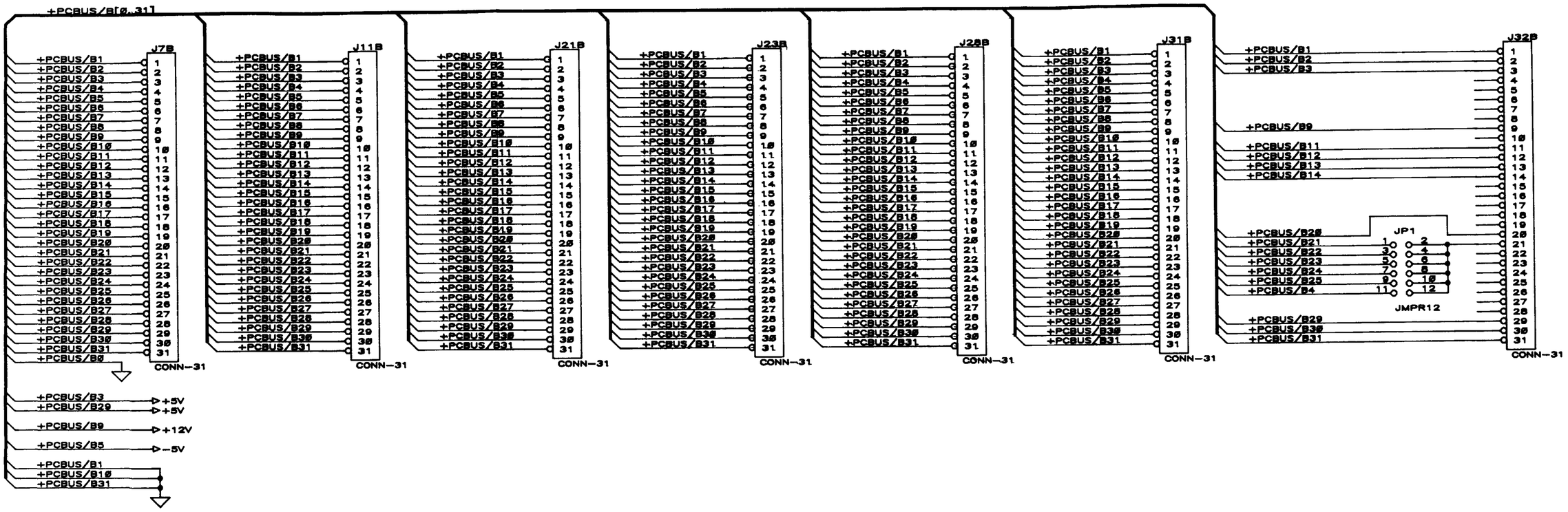


Figure FO-13. 1A2A11 CCA Backplane Component Locator & Schematic Diagram (Sheet 3 of 6).

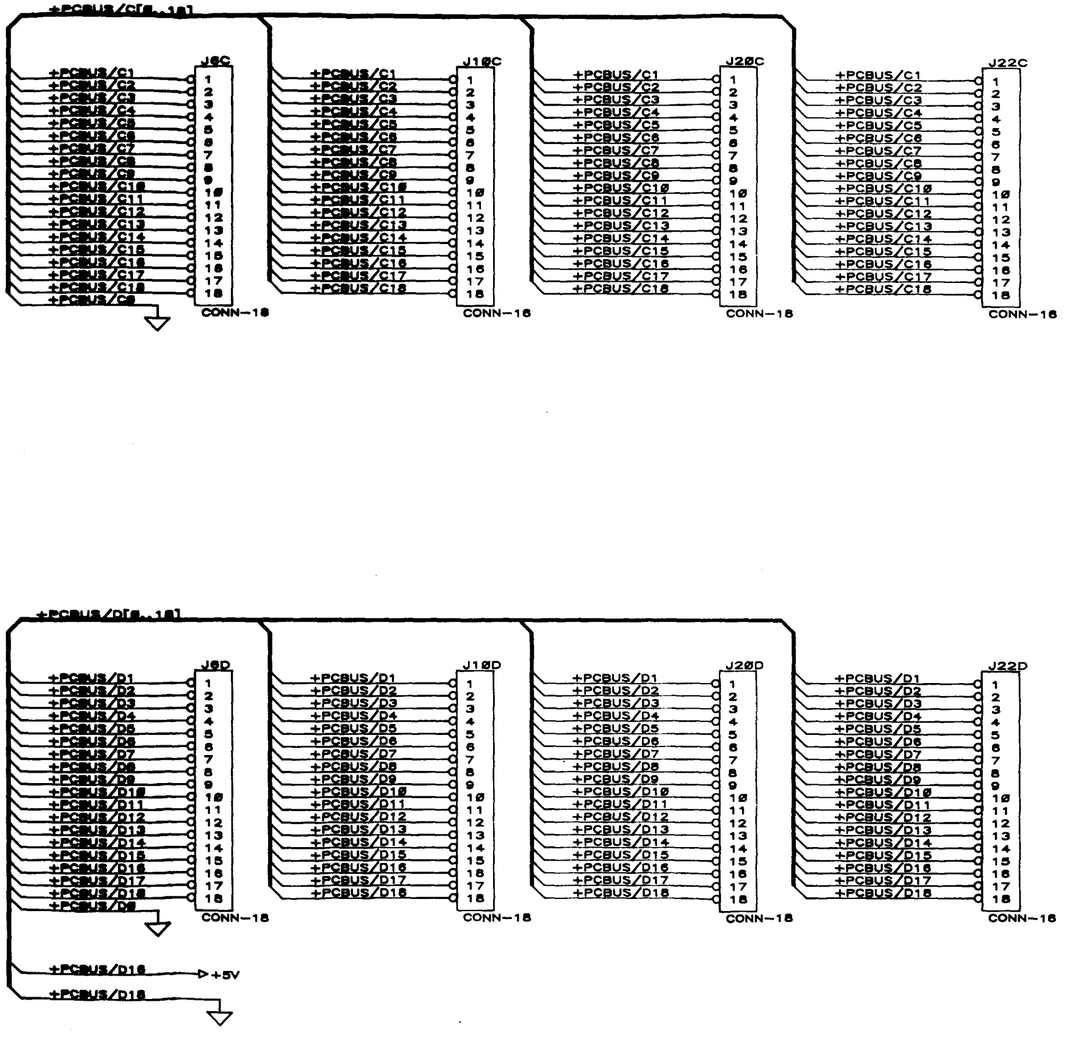


Figure FO-13. 1A2A11 CCA Backplane Component Locator & Schematic Diagram (Sheet 4 of 6).

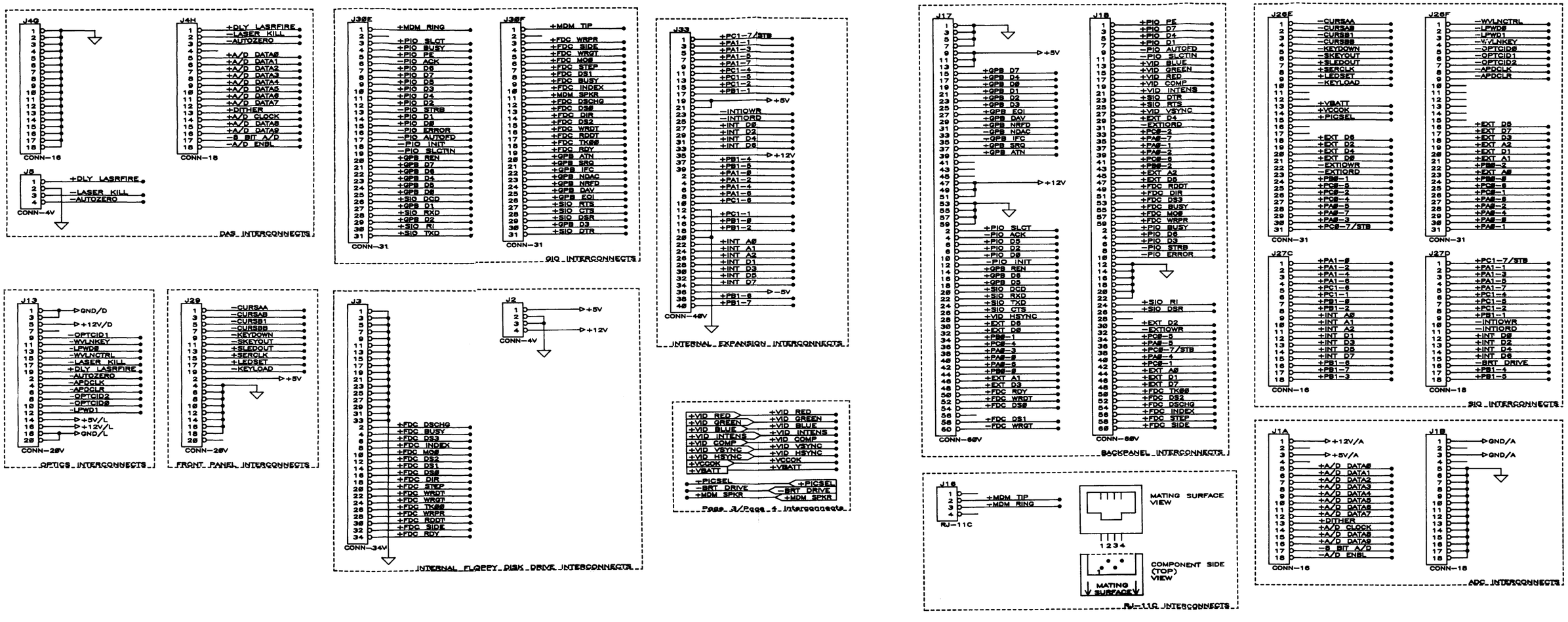


Figure FO-13. 1A2A11 CCA Backplane Component Locator & Schematic Diagram (Sheet 5 of 6).

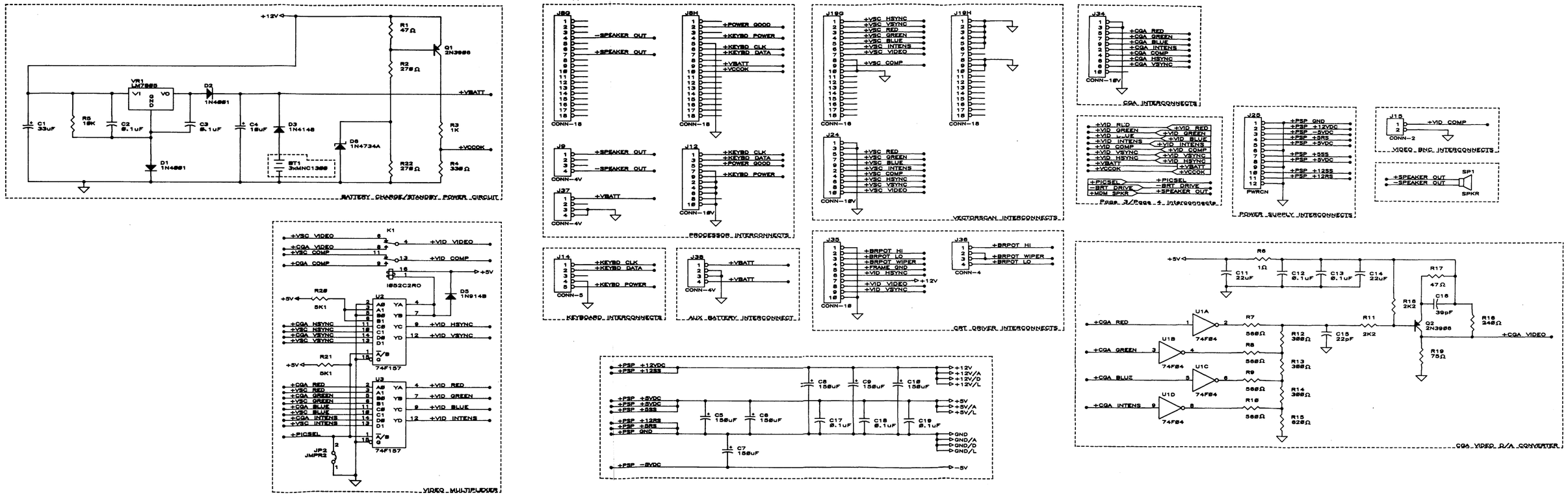
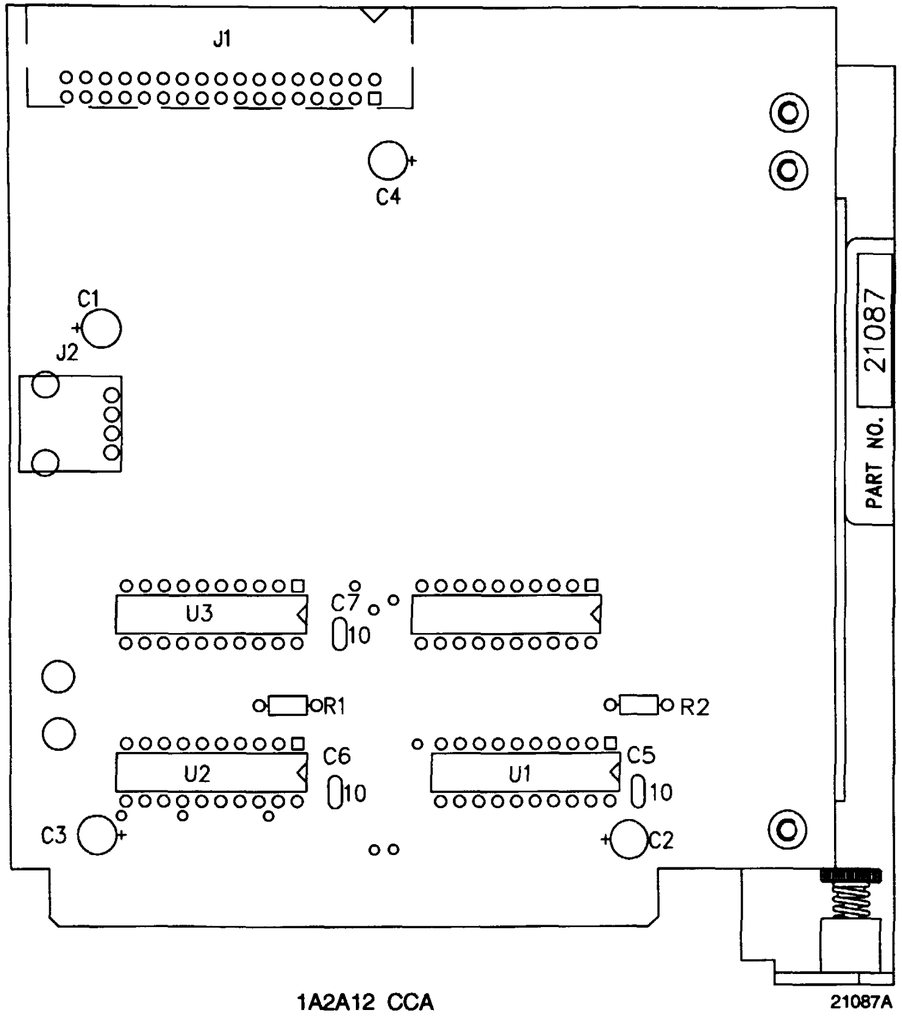


Figure FO-13. 1A2A11 CCA Backplane Component Locator & Schematic Diagram (Sheet 6 of 6).

FP-35/(FP-36 blank)



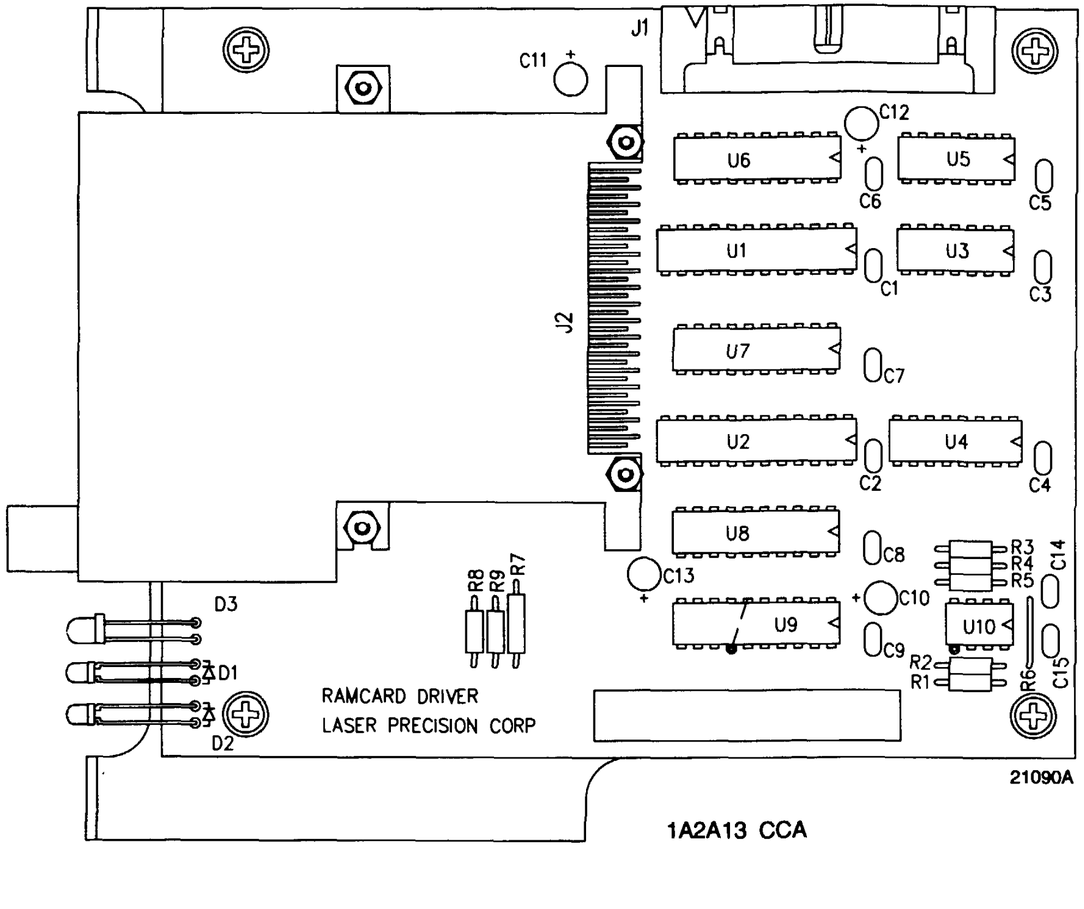
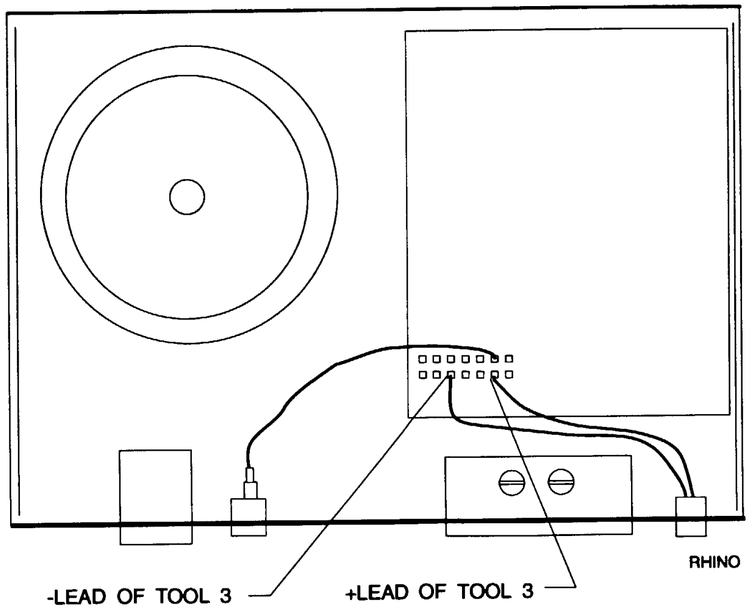
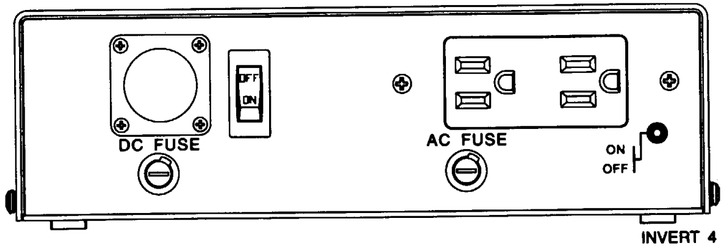


Figure FO-14. 1A2A12 RAMCARD INTERFACE and 1A2A13 RAMCARD DRIVER CCA's Component Locator Diagrams.



EARLY MODEL TEST POINTS



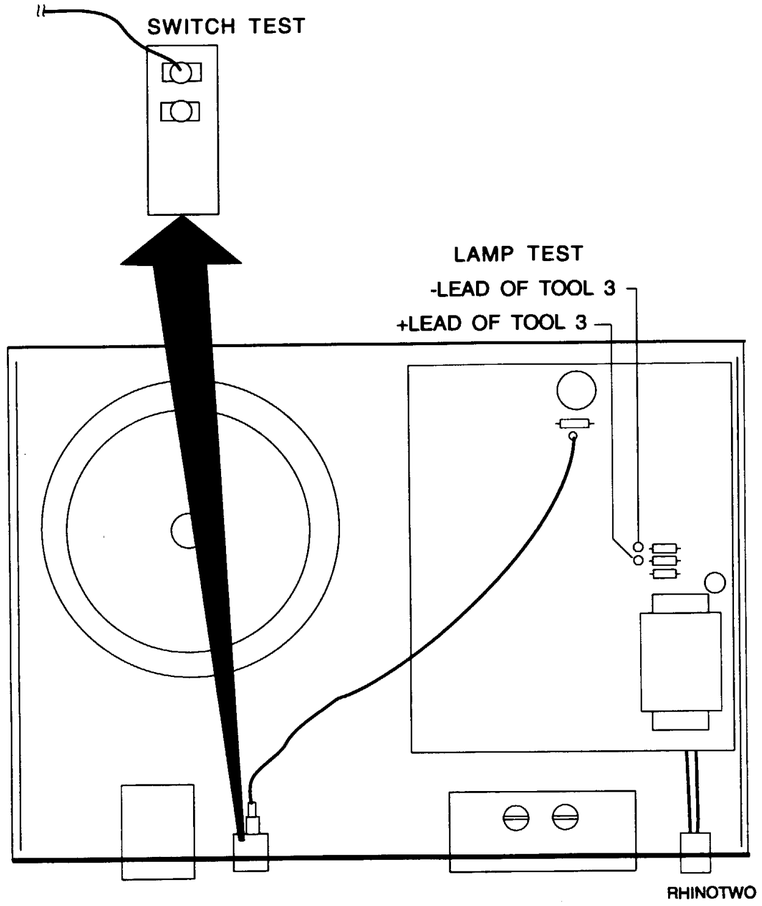


Figure FO-15. Static Power Inverter

These are the instructions for sending an electronic 2028

The following format must be used if submitting an electronic 2028. The subject line must be exactly the same and all fields must be included; however only the following fields are mandatory: 1, 3, 4, 5, 6, 7, 8, 9, 10, 13, 15, 16, 17, and 27.

From: "Whomever" <whomever@wherever.army.mil>
To: 2028@redstone.army.mil

Subject: DA Form 2028

1. ***From:*** Joe Smith
2. *Unit:* home
3. ***Address:*** 4300 Park
4. ***City:*** Hometown
5. ***St:*** MO
6. ***Zip:*** 77777
7. ***Date Sent:*** 19−OCT−93
8. ***Pub no:*** 55−2840−229−23
9. ***Pub Title:*** TM
10. ***Publication Date:*** 04−JUL−85
11. *Change Number:* 7
12. *Submitter Rank:* MSG
13. ***Submitter FName:*** Joe
14. *Submitter MName:* T
15. ***Submitter LName:*** Smith
16. ***Submitter Phone:*** 123−123−1234
17. ***Problem:*** **1**
18. *Page:* 2
19. *Paragraph:* 3
20. *Line:* 4
21. *NSN:* 5
22. *Reference:* 6
23. *Figure:* 7
24. *Table:* 8
25. *Item:* 9
26. *Total:* 123
27. ***Text:***

This is the text for the problem below line 27.

RECOMMENDED CHANGES TO PUBLICATIONS AND BLANK FORMS For use of this form, see AR 25–30; the proponent agency is ODISC4.	Use Part II (*reverse)* for Repair Parts and Special Tool Lists (RPSTL) and Supply Catalogs/ Supply Manuals (SC/SM)	DATE 8/30/02
TO: (*Forward to proponent of publication or form)(Include ZIP Code)* Commander, U.S. Army Aviation and Missile Command ATTN: AMSAM–MMC–MA–NP Redstone Arsenal, 35898	FROM: (*Activity and location)(Include ZIP Code)* MSG, Jane Q. Doe 1234 Any Street Nowhere Town, AL 34565	

PART 1 – ALL PUBLICATIONS (EXCEPT RPSTL AND SC/SM) AND BLANK FORMS

PUBLICATION/FORM NUMBER	DATE	TITLE
TM 9–1005–433–24	16 Sep 2002	Organizational, Direct Support, And General Support Maintenance Manual for Machine Gun, .50 Caliber M3P and M3P Machine Gun Electrical Test Set Used On Avenger Air Defense Weapon System

ITEM NO.	PAGE NO.	PARA–GRAPH	LINE NO. *	FIGURE NO.	TABLE NO.	RECOMMENDED CHANGES AND REASON
1	WP0005 PG 3		2			Test or Corrective Action column should identify a different WP number.

** Reference to line numbers within the paragraph or subparagraph.*

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/ AUTOVON, PLUS EXTENSION	SIGNATURE
MSG, Jane Q. Doe, SFC	788–1234	

TO: (*Forward direct to addressee listed in publication)*	**FROM:** (*Activity and location) (Include ZIP Code)*	**DATE**
Commander, U.S. Army Aviation and Missile Command ATTN: AMSAM–MMC–MA–NP Redstone Arsenal, 35898	MSG, Jane Q. Doe 1234 Any Street Nowhere Town, AL 34565	8/30/02

PART II – REPAIR PARTS AND SPECIAL TOOL LISTS AND SUPPLY CATALOGS/SUPPLY MANUALS

PUBLICATION NUMBER	DATE	TITLE

PAGE NO.	COLM NO.	LINE NO.	NATIONAL STOCK NUMBER	REFERENCE NO.	FIGURE NO.	ITEM NO.	TOTAL NO. OF MAJOR ITEMS SUPPORTED	RECOMMENDED ACTION

PART III – REMARKS (*Any general remarks or recommendations, or suggestions for improvement of publications and blank forms. Additional blank sheets may be used if more space is needed.)*

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	SIGNATURE
MSG, Jane Q. Doe, SFC	788–1234	

RECOMMENDED CHANGES TO PUBLICATIONS AND BLANK FORMS For use of this form, see AR 25–30; the proponent agency is ODISC4.	Use Part II (*reverse)* for Repair Parts and Special Tool Lists (RPSTL) and Supply Catalogs/ Supply Manuals (SC/SM)	DATE
TO: (*Forward to proponent of publication or form)(Include ZIP Code)*	FROM: (*Activity and location)(Include ZIP Code)*	

PART 1 – ALL PUBLICATIONS (EXCEPT RPSTL AND SC/SM) AND BLANK FORMS

PUBLICATION/FORM NUMBER	DATE	TITLE

ITEM NO.	PAGE NO.	PARA–GRAPH	LINE NO. *	FIGURE NO.	TABLE NO.	RECOMMENDED CHANGES AND REASON

** Reference to line numbers within the paragraph or subparagraph.*

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/ AUTOVON, PLUS EXTENSION	SIGNATURE

TO: (*Forward direct to addressee listed in publication)*	**FROM:** (*Activity and location) (Include ZIP Code)*	**DATE**

PART II – REPAIR PARTS AND SPECIAL TOOL LISTS AND SUPPLY CATALOGS/SUPPLY MANUALS

PUBLICATION NUMBER	DATE	TITLE

PAGE NO.	COLM NO.	LINE NO.	NATIONAL STOCK NUMBER	REFERENCE NO.	FIGURE NO.	ITEM NO.	TOTAL NO. OF MAJOR ITEMS SUPPORTED	RECOMMENDED ACTION

PART III – REMARKS (*Any general remarks or recommendations, or suggestions for improvement of publications and blank forms. Additional blank sheets may be used if more space is needed.)*

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	SIGNATURE

The Metric System and Equivalents

Linear Measure

1 centimeter = 10 millimeters = .39 inch
1 decimeter = 10 centimeters = 3.94 inches
1 meter = 10 decimeters = 39.37 inches
1 dekameter = 10 meters = 32.8 feet
1 hectometer = 10 dekameters = 328.08 feet
1 kilometer = 10 hectometers = 3,280.8 feet

Weights

1 centigram = 10 milligrams = .15 grain
1 decigram = 10 centigrams = 1.54 grains
1 gram = 10 decigram = .035 ounce
1 decagram = 10 grams = .35 ounce
1 hectogram = 10 decagrams = 3.52 ounces
1 kilogram = 10 hectograms = 2.2 pounds
1 quintal = 100 kilograms = 220.46 pounds
1 metric ton = 10 quintals = 1.1 short tons

Liquid Measure

1 centiliter = 10 milliters = .34 fl. ounce
1 deciliter = 10 centiliters = 3.38 fl. ounces
1 liter = 10 deciliters = 33.81 fl. ounces
1 dekaliter = 10 liters = 2.64 gallons
1 hectoliter = 10 dekaliters = 26.42 gallons
1 kiloliter = 10 hectoliters = 264.18 gallons

Square Measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch
1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches
1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet
1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet
1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches
1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

Approximate Conversion Factors

To change	*To*	*Multiply by*	*To change*	*To*	*Multiply by*
inches	centimeters	2.540	ounce-inches	Newton-meters	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29,573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound-feet	Newton-meters	1.356	metric tons	short tons	1.102
pound-inches	Newton-meters	.11296			

Temperature (Exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C