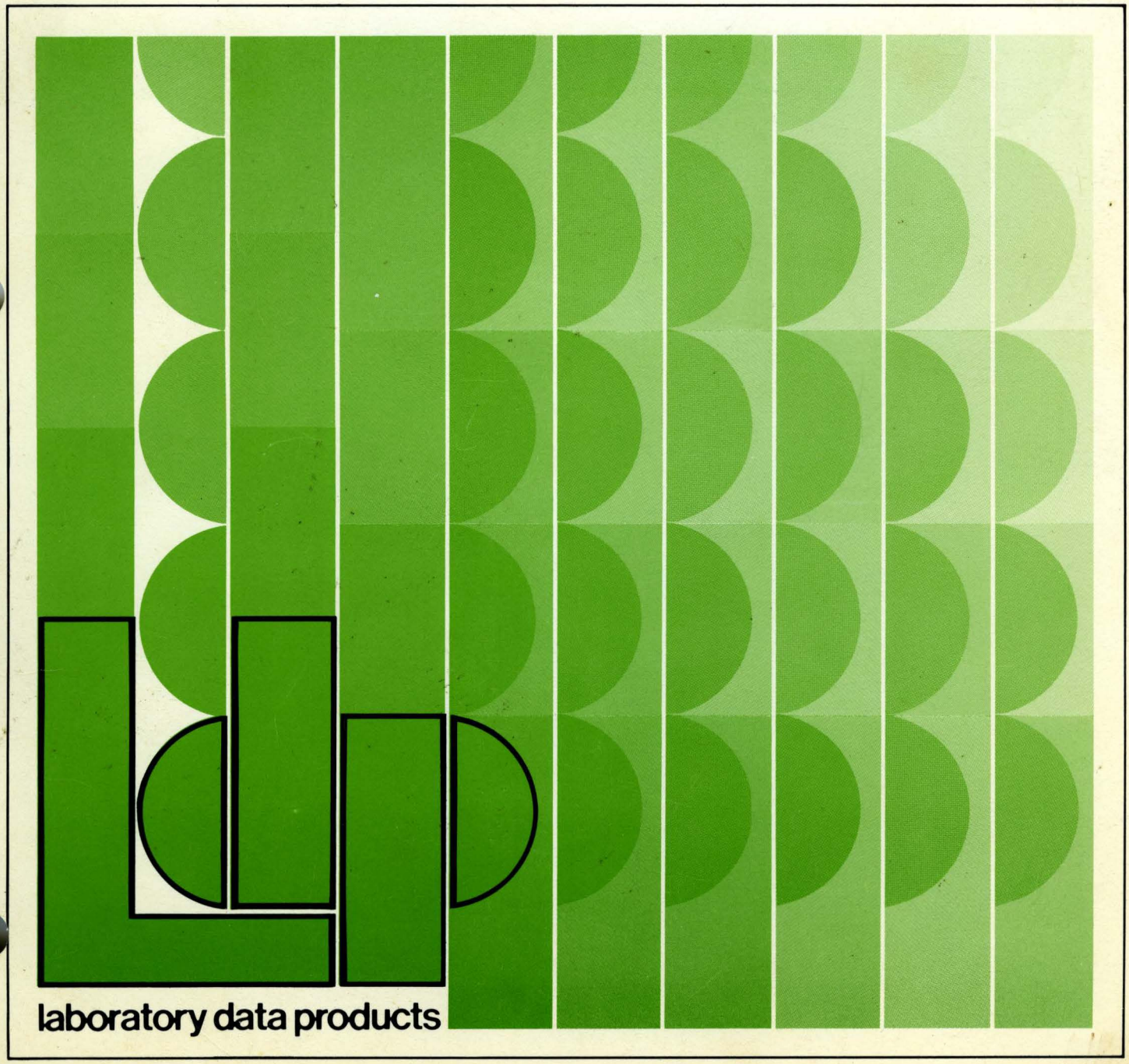
MASTER

Digital Equipment Corporation
Maynard, Massachusetts

digital

PDP-12
PM procedures



DEC-12-HPMPA-A-D

PDP-12
PM procedures

digital equipment corporation · maynard, massachusetts

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The material in this manual is for informational purposes and is subject to change without notice.

These procedures are intended for use by Digital Equipment Corporation Field Service personnel. DEC cannot assume responsibility for errors or omissions when this manual is used as a guideline by other than authorized service representatives.

Corrections, additions, and comments should be directed to PDP-12 Support, Digital Field Service, Maynard.

CONTENTS

INTRODUCTION

These PM procedures are intended as a guide for field service and other personnel who might become involved in the care and maintenance of PDP-12 computer systems. They augment, rather than replace, the *PDP-12 Maintenance Manual* and other related literature.

A PDP-12 PM Procedure Checklist (form no. DEC-12-(551) 1142-N173) should be used to check off the PM steps as they are performed. Appendix B provides a copy of this checklist.

Careful attention to standardized PM procedures should lead to increased MTBF and decreased MTTR; hence, more efficient PDP-12 performance and a higher degree of customer satisfaction with the equipment. These factors, in turn, should result in more profitable operation on the part of both the customer and Digital Equipment Corporation.

Each major subsystem of the PDP-12 is covered in a separate section of the following PM procedures. All of the sections follow the same format:

A. Equipment Required
B. Material Required
C. Inspection
D. Voltage Checks
E. Adjustments and Maintenance
F. Diagnostic Testing
G. Cleaning and Touchup

For further information concerning these adjustments and for items not covered, consult the *PDP-12 Maintenance Manual, Volume II.*

EQUIPMENT AND MATERIAL

The following list details the types and amounts of equipment and material required for these procedures. Each section also contains a subset of these lists, configured to the requirements of the individual procedure covered in that section.

A. Equipment Required

1. Oscilloscope, Tektronix 453/454/454A or equivalent, with two 10:1 probes
2. Multimeter, Triplett Model 630-NA or Simpson Model 260 or equivalent, with standard test leads
3. P6001 oscilloscope current probe
4. Precision voltage source, Electronic Development Corporation (EDC) or equivalent
5. Light bulb removal tool
6. Vacuum cleaner
7. DEC Skew Checker with G500 module and instructions
8. Reel Hub Alignment Gauge, Model 74-08010
9. DEC W982 FLIP CHIP Module Extender
10. Standard hand tools

B. Material Required

1. Cable, shielded, six-foot twisted pair
2. Capacitor, 1000 pF
3. Phone plug
4. Wire (22 gauge)
5. Spray cleaner
6. Contact cleaner (DEC 29-15200)
7. Paint, DEC light grey (DEC 29-15203)
8. Paint, DEC black (DEC 29-15201)
9. Paint brush, small, thin
10. Potter Head Cleaning Kit (DEC 29-10906) or Miller Stephenson M200 Head Cleaner (DEC 29-15199)
11. Cotton swabs

12. Cleaning cloth, soft, lint-free

13. Kimwipes

14. Lubricant spray, with thin plastic nozzle tube

15. ECO stickers (DEC 29-19197)

16. PDP-12 PM Procedures and Checklist (DEC-12-(551) 1142-N173)

17. *PDP-12 Maintenance Manual,* Volumes I through IV

18. PDP-12 LAP-6 DIAL Basic Diagnostics Tape, MAINDEC-12-D7AH-UO, and Optional Diagnostics Tape, MAINDEC-12-D8GF-UO

19. *VR12 Maintenance Manual,* DEC-CR-H6AA-D, or *VR14 Maintenance Manual,* DEC-12-HRZA-D

20. PDP-12 System Exerciser, MAINDEC-12-D7CD-PB, and Family-of-8 System Exerciser, MAINDEC-X8-DDQAA-B-UO

21. KF12B Automatic Priority Interrupt, MAINDEC-12-D0SA-PB

22. Field Service Report Form

23. Chain Monitor Diagnostic System (CMDS) Basic Battery LINC tape MAINDEC-12-D7DA-UO, consisting of the following programs:

    CBH
    MAINDEC-8-D1L2 MOD 12-1-71

    ADRSH1
    MAINDEC-8-D1B2 MOD 12-1-71

    ADRSL0
    MAINDEC-8-D1B1 MOD 12-1-71

    INST2B
    MAINDEC-8-D02B MOD 12-1-71

    CPTST1
    MAINDEC-12-D0BA MOD 12-1-71

    CPTST3
    MAINDEC-12-D0CA MOD 12-1-71

    RELAY
    MAINDEC-12-D8AB MOD 12-1-71

    BMC12
    MAINDEC-12-D1FA MOD 7-1-72

EXMC12
MAINDEC-12-D1AC MOD 12-1-71

KW12A
MAINDEC-12-D8CD MOD 7-1-72

KW12B-C
MAINDEC-12-D8EB MOD 7-1-72

EAE3A
MAINDEC-8I-D0AA MOD 12-1-71

EAE3B
MAINDEC-8I-D0BA MOD 12-1-71

TAPE DA
MAINDEC-12-D3FA MOD 12-1-71

RK8
MAINDEC-8-D5HA MOD 12-1-71

RF08
MAINDEC-8-D5FA MOD 12-1-71

DF32
MAINDEC-8-D5CE MOD 12-1-71

I. 724 POWER SUPPLY PM PROCEDURE

A. Equipment Required

1. Oscilloscope, Tektronix 453 or 454A or equivalent, with a set of two 10:1 probes
2. Screwdriver, medium-size Phillips head
3. Screwdriver, medium-size flat-blade
4. Pliers, needlenose
5. Vacuum cleaner

B. Material Required

1. None

WARNING

High voltages are present within the PDP-12 cabinet! Disconnect the equipment at the power source before performing the inspection!

C. Inspection

1. Ensure that all applicable Field Change Orders (FCOs) have been installed in the 724 Power Supply.
2. Remove the power supply cover and visually inspect the transformer, rectifiers, and all other components for burn marks, chafed or frayed wires, and other signs of deterioration. Repair or replace components as necessary.
3. Check for and tighten any loose screws on the ac output terminals, rectifier mountings, and capacitor terminals.
4. Pull on all wires that are connected with Faston connectors to ensure that they are properly crimped and that the connectors fit tightly on the spade lugs.
5. Trip the circuit breakers manually, and feel for binding or roughness of operation. Replace any defective breakers.

D. Voltage Checks

1. Reconnect the equipment at the power source. Turn on the computer.
2. Make the following voltage measurements with the oscilloscope. (These measurements are preliminary, and will be further checked in the Basic PDP-12 System Procedure.)

Nominal Voltage	Test Point	Tolerance
+5V	PS Connector P6, Pin 5	+4.75V to +5.25V (with less than 20 mV of noise)
-15V	PS Connector P6, Pin 10	-14.25V to -15.75V
-30V	PS Connector P9, Pin 7	-27.0V to -33.0V
+10V	PS Connector P9, Pin 4	+8V to +12V

E. Adjustments and Maintenance

1. None

F. Diagnostic Testing

1. None

G. Cleaning and Touchup

1. Disconnect the equipment at the power source.
2. Using a soft-mouthed brush, vacuum the interior of the power supply and its fan.
3. Replace the power supply cover.

II. CONSOLE PM PROCEDURE

A. Equipment Required

1. Multimeter
2. Screwdriver, Phillips head, No. 2
3. Screwdriver, six-inch flat-blade
4. Pliers, needlenose
5. Light bulb removal tool

B. Material Required

1. Spray cleaner
2. Contact cleaner
3. Soft cloth or Kimwipes
4. Paint, DEC light grey
5. Paint, DEC black

C. Inspection

1. Turn off the computer.
2. Check that the console is securely fastened to the processor cabinet.
3. Ensure that all switches operate smoothly, without binding on the switch bezel.
4. Check the power lugs on the rear of the light panel and on the bottom of the switch panel for good electrical connections. Replace damaged lugs as required.
5. Check the Mylar cable on the rear of the light panel for cracks, pinching, or chafing. Replace any damaged cables.
6. Check the Lexan panel for warping. Replace if necessary.
7. Turn on the computer.
8. Check all indicator lights on the console. Replace any defective lights.
9. Perform all switch functions, and ensure that they are executed properly.

D. Voltage Checks

1. None

E. Adjustments and Maintenance

1. Adjust switch mounting rack for smooth mechanical operation of all switches.

F. Diagnostic Testing

1. None

G. Cleaning and Touchup

1. Remove front glass and switch bezel, and spray switch contacts with contact cleaner.
2. With spray cleaner and either soft cloth or Kimwipes, clean exterior surfaces and switch caps.
3. Repaint any scratches or chips with the appropriate color of DEC paint.

III. MODULE AND CABLING PM PROCEDURE

A. Equipment Required

1. Oscilloscope, Tektronix 453 or 454A or equivalent
2. Vacuum cleaner
3. Screwdriver, Phillips head, No. 2
4. Pliers, needlenose
5. Multimeter

B. Material Required

1. None

C. Inspection

1. With power off, ensure that the logic blocks are attached securely to the door frame.
2. Ensure that all modules and connectors make good electrical connections in their respective sockets.
3. Check all cables and connectors for damage to conductors or insulation, and for broken or poorly connected ground leads.
4. Ensure that the rear door closes without pinching or pulling cables.

D. Voltage Checks and Adjustments

1. None

E. Adjustments and Maintenance

1. None

F. Diagnostic Testing

1. None

G. Cleaning and Touchup

1. Remove any dust accumulation from module surfaces.
2. Inspect pin side of the logic assembly for bent pins and foreign particles.

IV. TU56 TAPE DRIVE PM PROCEDURE

NOTE

This procedure should be performed at least monthly on each tape deck that operates on a standard eight-hour shift. If the tape deck is operated for more than one shift, this procedure should be performed correspondingly more often. Monthly checkouts for individual tape decks should be staggered throughout the month.

A. Equipment Required

1. Oscilloscope, Tektronix 453 or 454 or equivalent, with standard probes
2. Multimeter, Triplett Model 630-NA or Simpson Model 260, with standard test leads
3. DEC Skew Checker with G500 module and instructions
4. Reel Hub Alignment Gauge
5. DEC W982 FLIP CHIP Module Extender
6. Vacuum cleaner, small
7. Allen wrench set
8. Screwdriver, small-blade

B. Material Required

1. Potter Head Cleaning Kit or Miller Stephenson M200 Head Cleaner (see CAUTION, Paragraph G7)
2. Kimwipes
3. Cotton swabs
4. Cleaning cloth, soft, lint-free

C. Inspection

1. Inspect the overall condition of the transport.
2. Inspect the cable and logic modules to ensure that the modules are securely seated in the logic mounting block.
3. Ensure that the connections between the transport and the power supply are tight.
4. Ensure that the reel motor cable connectors are tight.
5. Check for proper operation of the reel motors and electronic brakes by momentarily pushing the Forward (→) and Reverse (←) tape motion switches, and observing that the tape moves in the corresponding direction. If the tape does not stop smoothly, adjust the electronic brake in the manner described in Section E of this procedure.

D. Voltage Checks

1. Measure the ac line voltage input to the 725 dc Reel Motor Power Supply at the convenience outlet at the back of the power supply. The line voltage should be within the following limits:

Nominal	Maximum	Minimum
115 Vac	126.5V	103.5V
230 Vac	253.0V	207.0V

2. Measure all the dc voltages at TB1 on the rear of the H725 Power Supply. Ensure that either +10 Vdc or +5 Vdc, but not both, is connected to the correct TB1 terminal. Voltages should be within the following limits:

Nominal	Maximum	Minimum
-15 Vdc	-16.5 Vdc	-13.5 Vdc
+5 Vdc	+5.5 Vdc	+4.5 Vdc
+10 Vdc	+11.0 Vdc	+9.0 Vdc

3. Set the WRITE ENABLE/WRITE LOCK switch to WRITE ENABLE and ensure that the WRITE indicator lights.

4. Check for a ground signal at A06 pin S1 (left transport) or A07 pin S1 (right transport) when the transport is selected.

5. Set the WRITE ENABLE/WRITE LOCK switch to WRITE LOCK and ensure that the WRITE indicator goes off.

6. Check for a -3V signal at A06 pin S1 or A07 pin S1.

7. To check the head output, use the G500 module and follow the instructions that come with it.

8. If the read head performance is not satisfactory, shim or replace the head.

NOTE

Transports with misaligned heads must be realigned by a qualified DEC field service engineer.

E. Adjustment and Maintenance

1. With the hub gauge, check for 0.017-in. clearance between the tape reel hub and the flange on the mounting panel.

2. If the clearance is incorrect, loosen the Allen screws on the hub and make the necessary adjustment.

3. Retighten the Allen screws.

NOTE

Do not repeatedly loosen or tighten the hub Allen screws. These screws are serrated cup type and may become damaged with excessive use.

4. Load a tape on the transport to be tested.

5. Set the REMOTE/OFF/LOCAL switch to LOCAL.

6. Press and hold the Forward (→) tape motion switch. When the tape is up to speed, release the switch and observe that the tape braking action is smooth without overshoot. If tape motion stops, then reverses slightly when the switch is released, the braking time is too long. If the tape coasts, the braking time is too short.

7. If necessary, adjust the top R2 (left transport) or bottom R13 (right transport) potentiometer on the M302 module to obtain the correct brake indications.

F. Diagnostic Testing

1. Diagnostics applicable to the TU56 Tape Drive are covered in the procedures for the PDP-12 Basic System and the TC12 LINC Tape Controller.

G. Cleaning and Touchup

1. Clean the exterior and interior of the cabinet with a vacuum cleaner and clean cloths, moistened, if necessary, with a nonflammable solvent. **Do not use solvents that will remove paint!**

2. Clean the air filters at the top or bottom of the equipment rack as described in the preventive maintenance section of the appropriate controller maintenance manual.

3. Clean the most frequently used tapes by placing a clean, dry, lint-free cloth over the read/write head, loading the tape on the transport, and manually running the tapes over the cloth.

4. Clean the take-up reels, if heavy use has caused oxide buildup around the hub.

NOTE

Special emphasis should be placed on the cleanliness of tape-handling surfaces, because dust and oxide particles contribute to read errors.

5. Unload all tapes from the transport.

6. Using a dry, lint-free cloth, remove all lint, dust, and loose oxide from the front mounting panel. **Do not use head cleaning solvent on any painted surfaces!**

7. Moisten one of the cotton swabs with head cleaning solvent and clean the oxide from the edges of the tape guides and the abutting surfaces. Once a swab has been in contact with a dirty surface, do not remoisten that swab in such a way as to contaminate the cleaning solvent that remains in the container.

CAUTION

Do not allow solvent to come into contact with tape! Ensure that all cleaned surfaces are completely dry before replacing tape! The solvent supplied with the DEC Head Cleaning Kit (Potter) is recommended. The M200 Head Cleaner does not damage paints, but does dissolve tape.

8. If necessary, use a pointed wooden dowel that has been soaked in cleaning solvent to remove very old and/or very hard oxide deposits from the edges of the tape guides.

9. Clean the tape guide path and the top of the read/write head with a clean, lint-free cloth moistened with head cleaning solvent.

10. Using a dry, lint-free cloth, wipe the excess cleaning solvent from the read/write head and the tape guides.

11. Allow at least five minutes for the remaining solvent to evaporate, then reload the tapes.

V. BASIC PDP-12 SYSTEM PM PROCEDURE

A. Equipment Required

1. Oscilloscope, Tektronix 453/454/454A or equivalent
2. Multimeter
3. Screwdriver, Phillips head
4. Screwdriver, small flat-blade
5. Vacuum cleaner

B. Material Required

1. MAINDEC-12-D7DA-D and MAINDEC-12-D7DA-UO, CMDS Basic Battery LINC Tape

C. Inspection

1. Inspect the fans for proper operation in the following locations:
    a. PDP-12
        (1) Top of cabinet – Two large fans
        (2) Back door – Six small fans on the side
        (3) H724 Power Supply – One small fan in the top of the power supply frame
    b. VR12
        (1) One small fan on the bottom of the frame, under the deflection amplifiers
    c. VR14 or VR20
        (1) Two small fans on the bottom of the frame, one under the power supply and one under the deflection amplifiers
    d. TU56
        (1) One small fan at the top of the frame above the motors
    e. LA30
        (1) Two small fans in the rear of the electronics package

2. Check all of the above fans for the following:

   a. Noise

   b. Vibration

   c. Failure to run up to speed

   d. Binding of the rotor

   e. Looseness of mounting bolts

   f. Electrical arcing or sparking

   g. Loose, frayed, or broken electrical connections and wires

3. Repair or replace as needed to correct any of the above problem conditions

D. Voltage Checks

1. Check the 115 Vac or 230 Vac primary power as follows:

   NOTE
   115 Vac indicates a peak-to-peak reading on the oscilloscope of 320 Vac to 330 Vac.

   a. Check for spikes or dropouts of 15V or greater. Such spikes can pass through the power supply to the load and cause damage to modules or components. They can also be induced into the A/D section, where they could cause errors in the voltages being sampled.

   b. Check for spikes on the neutral line. This causes the same problems as spikes on the hot line.

   c. Check that the ground line is properly grounded and not connected to the neutral line.

   d. Notify the customer of any level or spike problems and the difficulties that these can cause if they are not corrected. Also, record the problem in the log book and notify the Field Service Branch Manager.

2. Check the +5V logic power for spikes, level, and ripple as follows:

   NOTE
   Spikes should not be present in the +5V power. Spikes that go up to +8V are at the breakdown rating of ICs and may cause module failure.

   a. Check the +5V power at each of the pin numbers below with the oscilloscope. Ripple must not exceed ±250 mV. The combination of spikes, level error, and ripple must not exceed ±250 mV from the nominal level of +5V.

+5V Pin	Ground Pin
A01A2	A01C2
B01A2	B01C2
C01A2	C01C2
D01A2	D01C2
E01A2	E01C2
F03A2	F03C2
F20A2	F20C2
H40A2	H40C2
J40A2	J40C2
K40A2	J40C2
L40A2	L40C2
M40A2	M40A2
N40A2	N40C2
P40A2	P40C2
R40A2	R40C2

b. If spikes are detected, check for the following possible problem areas:

(1) Loose connections

(2) Defective power supply components

(3) Loose or missing grounds

(4) Primary power spikes

3. Check the -15V logic power for spikes, level, and ripple as follows:

a. Using the oscilloscope, check the -15V power at each of the pins listed below. Ripple must not exceed ±750 mV. The combination of spikes, level error, and ripple must not exceed ±750 mV from the nominal level of -15.00V.

-15V Pin	Ground Pin
A01B2	A01C2
B01B2	B01C2
D33B2	D22C2
E37B2	E37C2
N02B2	N02C2
N03B2	N03C2
N33B2	N33C2

4. Check the ±15V precision power supply output for spikes, level, or ripple as follows:

a. Ripple must not exceed ±1 mV. No spikes can be tolerated. Level limits are as follows:

Maximum	Nominal	Minimum
+15.015 -15.015	+15.00 -15.00	+14.985 -14.985

b. Check the ±15V power at each of the pins listed below, using the oscilloscope:

+15V Pin	-15V Pin	High Quality Gnd
D35U2 D34D2 E34D2 F34L2	C35V2 D34E2 E34E2 F34M2	D35N2 D34F2 E34F2 F34K2

5. Check the +10V power for spikes, level, and ripple in the following manner:

   a. Ripple must not exceed ±0.3V. The combination of spikes, level error, and ripple must not exceed ±2V from the nominal value of +10V.

   b. Check the +10V power at each of the pins listed below, using the oscilloscope:

+10V Pin	Ground Pin
F11A2 N26A2	F11C2, F11T1 N26C2, N26T1

6. Check the -30V power for spikes, level, and ripple as follows:

   a. Ripple must not exceed ±3V. The combination of spikes, level error, and ripple must not exceed ±3V from the nominal value of -30V.

   b. Check the -30V power at each of the pins listed below, using the oscilloscope:

-30V Pin	Ground Pin
E01E2 E01F2 E01H2	E01C2 E01C2 E01C2

E. Adjustments and Maintenance

1. If precision (analog) voltages are not within specified limits, adjust the associated potentiometer located in the upper part of the analog power supply. Depending on the way in which the analog power supply is turned in the mounting bracket, adjustment can be made either by putting a small, flat-blade screwdriver straight into the potentiometer from the side of the power supply or by pushing down gently on the edge of the potentiometer from the top of the power supply, thus causing the potentiometer to rotate.

F. Diagnostic Testing

1. Load and start the processor/memory CMDS Basic Battery LINC Tape and as many of the optional system equipment programs as are applicable to the option equipment for this system.

2. While the battery of programs is running, perform part G of this procedure.

G. Cleaning and Touchup

1. Clean the spongy-type filters in the cabinet tops as follows:

   a. Remove the filter

   b. Brush off or vacuum

   c. Wash in clean water

   d. Squeeze and shake dry

   e. When dry, reinstall

   f. Replace filter if it is torn or deteriorated

2. Vacuum or brush the guard screens for the small fans in the following locations:

   a. Back door (may have filters also)

   b. H724 power supply – top

   c. VR12 – Bottom of frame

   d. VR14 – Bottom of frame

   e. VR20 – Bottom of frame

   f. TU55 – Top of frame, above motor

   g. TU56 – Top of frame, above motor

VI. TC12 PM PROCEDURES

NOTE

Prior to performing preventive maintenance on the TC12 LINC Tape Controller, ensure that all outstanding module and logic Field Change Orders (FCOs) have been installed, and that all MAINDEC change orders have been implemented. Also, ensure that the basic system diagnostics have been run successfully, and that the Basic PDP-12 PM Procedures (Section V) and TU56 Tape Drive PM Procedures (Section IV) have been performed.

A. Equipment Required

1. Oscilloscope, Tektronix 453 or 454 or equivalent, with a set of two 10:1 probes
2. Screwdriver, small, flat-blade

B. Material Required

1. DEC-12-D7AH-UO, Basic Diagnostics Tape, including:
   a. MAINDEC-12-D3AE, Tape Control Test, Part 1 (TC12I)
   b. MAINDEC-12-D3GA, Tape Control Test, Part 2 (TC12II)
   c. MAINDEC-12-D3DB, Tape Data Exerciser

C. Inspection

1. None

D. Voltage Checks

1. None

E. Adjustment and Maintenance

1. Initial setup
   a. Remove any tapes currently mounted on the transports.
   b. Set the MODE switch to LINC; press I/O PRESET.
   c. Set 0516 in the LEFT SWITCHES.
   d. Set 0200 in the RIGHT SWITCHES.
   e. Press DO.

f. Set 0001 in the LEFT SWITCHES.

g. Press the MARK switch, and hold.

h. Press DO.

i. The MK indicator is on and the Mark Clock should now be running.

2. Connect Channel 1 of the oscilloscope to E21 D2.

3. Adjust the oscilloscope for a 1 μs/cm sweep.

4. Adjust the Mark Clock potentiometer (M401 module in location E21) for a clock period of 7.5 μs ±0.3 μs

5. Tape Timing

   a. Toggle the following program into core:

4020	0700	/READ A BLOCK
4021	1270	/BLK 270 INTO QUAD. 1
4022	6020	/JUMP.–2

   b. Mount a formatted LINC tape on Unit 0.

   c. Set the MODE switch to LINC and press I/O PRESET, then START 20.

6. LTD TTOK Delay Adjustment

   a. Connect Channel 1 of the oscilloscope to C28 E2.

   b. Adjust the oscilloscope for a 5 μs/cm sweep.

   c. Adjust the TTOK Delay potentiometer (M307 module in location C28, left potentiometer) for a delay of 48 μs ±4 μs.

7. LTD XTLK Delay Adjustment

   a. Connect Channel 1 of the oscilloscope to C28 F2.

   b. Adjust the oscilloscope for a 1 μs/cm sweep.

   c. Adjust the XTLK Delay potentiometer (M307 module in location C28, right potentiometer) for a delay of 7 μs ±1 μs.

8. LTD ACIP Delay Adjustment

   a. Connect Channel 1 of the oscilloscope to C30 E2.

   b. Adjust the oscilloscope for a 20 μs/cm sweep.

   c. Adjust the ACIP Delay potentiometer (M307 module in location C30, left potentiometer) for a delay of 180 μs ±20 μs.

F. Diagnostic Testing

1. Load and start TC12I. Allow the diagnostic to complete five passes successfully.

2. Load and start TC12II. Allow the diagnostic to complete five passes successfully.

3. Load and start Tape Data Exerciser. This diagnostic must run a minimum of 15 minutes on each transport.

G. Cleaning and Touchup

1. None

VII. VC12 PM PROCEDURE

A. Equipment Required

1. Oscilloscope, Tektronix 453, 454A or equivalent

2. Screwdriver, small, flat-bladed

B. Material Required

1. None

C. Inspection

1. Ensure that the M711 control switches are in the proper position:

Display Type	Cable Length	Pol	Width	PRR
VR12/VR14	≤25 ft	–	Min	Fast
VR12/VR14	>25 ft	–	Max	Slow
VR20	≤25 ft	–	Max	Slow

D. Voltage Checks

1. Load, start, and freeze Display Test M12-D6BA (DISPTST) in the "X" pattern.

2. Measure the A615 output at E36J2 and E37J2. The negative-going sawtooth should vary from 0 to -6 Vdc without oscillation or overexcursion. Replace the A615 or precision power supply, if necessary, to obtain this value.

E. Adjustments and Maintenance

1. Verify that the "X" pattern is reproduced smoothly, without noticeable breaks or jumps. Adjust the A615 D/A ladder, if necessary.

F. Diagnostic Testing

1. None

G. Cleaning and Touchup

1. None

VIII. VR12 PM PROCEDURE

A. Equipment Required

1. Multimeter
2. Screwdriver, Phillips head, No. 2
3. Screwdriver, six-inch, flat-blade with insulated shaft
4. Pliers, needlenose

B. Material Required

1. Spray cleaner
2. Paint, DEC light grey
3. Paint, DEC black
4. *VR12 Maintenance Manual,* DEC-CR-H6AA-D
5. DEC-12-D7AH-UO, Basic Diagnostic Tape, including Display Test M12-D6BA (DISPTST)

C. Inspection

1. With power off, thoroughly clean the module heat sinks. Ensure that the flow of air will not be blocked by dust or foreign objects.
2. Check that all cables, Mate-N-Lok pins, and Faston connectors are tight.
3. With power on, ensure that the fan is delivering the proper airflow.

D. Voltage Checks

1. Load, start, and freeze DISPTST in the crosshatch box pattern.
2. Measure the following deflection supply voltages:

Pin	Nominal	
A1E	+8V ±1V	Incremental yoke supply
A4E	+8V ±1V	Incremental yoke supply
B1N	+35V ±4V	Switched yoke supply
B4N	+35V ±4V	Switched yoke supply

E. Adjustments and Maintenance

1. Check that the picture is squared and centered on the CRT. Rotate the yoke assembly, if necessary, to ensure that the yoke is pushed completely forward on the tube neck.

2. Freeze DISPTST in the "X" pattern; check for crossover distortion ("lumps" in the X pattern near the center of the display). If crossover distortion is detected, perform quiescent current adjustment, below.

3. Quiescent current adjustment:

   a. Starting from the fully counterclockwise position and using a screwdriver with an insulated shaft, adjust the potentiometer on each deflection amplifier module to provide straight lines at the crossover points with the least possible amount of noise. Overadjustment of the quiescent current adjustment will result in pattern shifting, indicating that the OFF side of the amplifier is always turned on. This can cause overheating.

   b. Check the current adjustment by switching to the CHAN 1/CHAN 2 pattern. Oscillation within a character matrix (smearing or sparkle) may be corrected by a **slight** readjustment of the quiescent bias.

4. Adjust the X and Y position potentiometers to position the left and lower edges of the crosshatch 1/4 in. from the respective edges of the CRT mask. Remove the glare shield, if necessary, to make this adjustment.

5. Adjust the X and Y gain potentiometers to position the right and upper edges 1/4 in. from the respective edges of the CRT mask.

6. Check that intensity can be varied from full cut-off to a bright display without blooming. Adjust intensity limit potentiometer, if necessary.

7. Check that focus is sharp and even across the entire face of the CRT. Adjust the focus potentiometer, if necessary.

8. Allow DISPTST to cycle through to the CHAN 1/CHAN 2 display. Check that the channel selection switch operates correctly.

F. Diagnostic Testing

1. None

G. Cleaning and Touchup

1. Repaint any scratches or chips with the appropriate color DEC paint.

2. Wash the face of the CRT and the flare shield free of dust, smudges, etc.

3. Oil the chassis track slides lightly; wipe off any excess oil.

IX. VR14 PM PROCEDURE

A. Equipment Required

1. Multimeter
2. Screwdriver, Phillips head No. 2
3. Screwdriver, small flat-blade
4. Pliers, needlenose

B. Material Required

1. Spray cleaner
2. Paint, DEC light grey
3. Paint, DEC black
4. *VR14 Maintenance Manual,* DEC-12-HRZA-D
5. DEC-12-D7AH-UO, Basic Diagnostic Tape, including Display Test M12-D6BA (DISPTST)

C. Inspection

1. With power off, clean the heat sink assemblies and modules thoroughly. Ensure that the flow of air will not be impeded by dust or foreign objects.
2. Check that all cables, Mate-N-Lok pins, and Faston connectors are tight.
3. With power on, ensure that fans are delivering proper airflow.

D. Voltage Checks

1. Load, start, and freeze DISPTST in the crosshatch box pattern.
2. Measure the regulated deflection supply voltages:

Pin	Nominal	Limits
A01U	+21.5 Vdc	+20.5 to +23.5
B01U	+21.5 Vdc	+20.5 to +23.5
A01K	-21.5 Vdc	-20.5 to -23.5
B01R	-21.5 Vdc	-20.5 to -23.5

NOTE

If ±21.5 Vdc supply is reading ±23V or greater, ECO G836-00005 has probably not been installed. Check that R2 and R17 are 1.78K, and not 1.62K. This ECO lowered the B+ by 1.5 Vdc.

E. Adjustments and Maintenance

1. Check that the picture is squared and centered on the CRT. Rotate the yoke assembly to adjust, if necessary.

2. Adjust the X and Y position potentiometers to position the left and lower edges of the picture 1/4 in. from the respective edges of the CRT mask.

3. Adjust the X and Y gain potentiometers to position the right and upper edges of the picture 1/4 in. from the respective edges of the CRT mask.

NOTE

If the X and Y gain adjustment is coarse and jumpy, ECO A225-00006 has probably not been installed. Check that R1 and R2 are 10K.

4. Check that intensity can be varied smoothly from full cut-off to a bright display without evidence of blooming. Adjust intensity limit potentiometer, if necessary.

5. Check that focus is sharp and even across the entire face of the CRT. Adjust the focus potentiometer, if necessary.

6. Allow DISPTST to cycle through to the CHAN 1/CHAN 2 display. Check that the channel selection switch operates properly.

F. Diagnostic Testing

1. None

G. Cleaning and Touchup

1. Repaint any scratches or chips with the appropriate color DEC paint.

2. Wash the CRT face free of dust, smudges, etc.

3. Oil the chassis track slides lightly; wipe off any excess oil.

X. AD12 PM PROCEDURE

A. Equipment Required

1. Oscilloscope, Tektronix Model 453 or 454A or equivalent

2. Precision voltage source, Electronic Development Corporation (EDC) or equivalent

B. Material Required

1. Cable, shielded, six-foot twisted pair

2. Capacitor, 1000 pF

3. Phone plug

4. Wire (22 gauge)

5. DEC-12-D7AH-UO, Basic Diagnostic Tape, including A/D Test Diagnostic

C. Inspection

1. None

D. Voltage Checks

1. None

NOTE

The AD12 is a bipolar (−5V to 0 to +5V) analog-to-digital converter comprising two modules: the converter module (A811) and the sample-and-hold module (A404). The A811 is a unipolar (0 to 10V) converter. The bipolar effect of the AD12 results from the action of the A404, which samples the input, shifts the level of the input, and holds the shifted level value for the A/D conversion. In order to check out the operation of the AD12 completely, the following tests should be performed.

E. Adjustments and Maintenance

Knob Tests

1. Sample a channel.

2. Turn the front panel potentiometer for the selected channel slowly 10 turns over the full range. Ensure that each digit may be selected (0-7, 10-70, 100-700).

3. Repeat this test on each of the remaining potentiometers. The last 30 to 90 degrees at each end of the potentiometer should not affect the end value (±777).

A/D Converter Module (A811) Check Procedure

1. Load A/D test.

2. Ensure proper operation of A/D test. Press STOP. Shut down computer.

3. Remove A404 sample-and-hold module from slots E and F 34.

4. Connect one end of the twisted-pair shielded cable to the output terminals of the precision voltage source (EDC).

5. Connect the other end of the cable to the following points:

EDC Connection	Backplane Pin	Point Name
Output	D35V2	A/D input
Common	D35N2	Analog ground
Shield	A C2	Logic ground

6. Set the EDC polarity switch to "0".

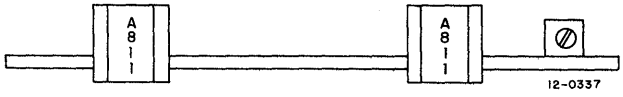
7. Turn on the EDC, and allow a 5-minute warmup.

8. Turn on the computer. Press I/O PRESET and START 20. All channels will display the same values (+777±2 LSB).

CAUTION
Because the A/D converter module is unipolar, do not set the EDC output switch to "–".

9. Set the EDC to +5.000V.

10. The reading on the display should be switching between ±000. If this is not the case, adjust the potentiometer on the A811 until the switching point is located.



11. Check the linearity of the A/D by the following table:

EDC Setting	Display Reading
+10.000V	-777±2 LSB
+ 8.750V	-577
+ 7.500	-377
+6.250	-177
+5.000	±000
+3.750	+177
+2.500	+377
+1.250	+577
0.000	+777

12. If the A/D converter module does not meet the above checks, replace it with another.

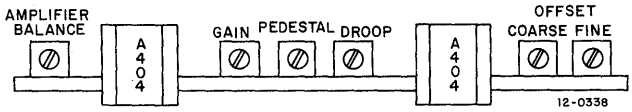
13. Shut down power.

14. Remove the cable connections called for in Step 5.

15. Replace the A404 sample-and-hold module in slots E and F 34.

Sample-and-Hold Module (A404) Check Procedure

(This procedure assumes that the A811 is linear and in conformance with specification tolerances.)



1. Load A/D test.

2. After establishing that the A/D test is running properly, halt the computer and turn off the power.

3. Remove module A214 (analog preamplifier) at location E33.

4. Install a jumper from D32R2 (the output of op amp Channel 17) to D32F2 (high quality ground).

5. Turn on the computer and press I/O PRESET.

6. Press START 20. (This should restart the A/D test.)

7. Monitor Channel 17. Display should be switching between ±000. If adjustment is required, turn Coarse Offset potentiometer on the A404 until Channel 17 displays 000. Then turn Fine Offset until the sign of Channel 17 oscillates between + and -. This oscillation indicates proper adjustment.

8. Stop the computer and turn off the power.

9. Remove the jumper installed in Step 4.

10. Replace the A214 module removed in Step 3.

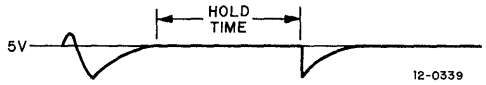
NOTE

Only the offset potentiometer should be adjusted in the normal setup procedure of the PDP-12 A/D converter. If any other potentiometer should be inadvertently adjusted, the following information may prove helpful.

Pedestal

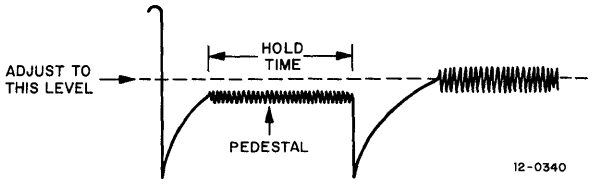
1. Set the EDC to "0".

2. Run the A/D test, checking pin E34V2 (output of sample-and-hold). Because a level shift is performed, pin E34V2 should be 5V.



3. Set the scope ground on centerline; switch to AC 5 μs/division; 10 MV/division.

   A waveform like the one below should be seen on the oscilloscope. The pedestal shown below is maladjusted.



Amplifier Balance and Gain

This adjustment compensates for the differences in positive and negative level outputs with respect to positive and negative level inputs.)

1. Shut down the computer.

2. Remove the A215 analog buffer from slot D34.

3. Connect the output terminal of the EDC to pin E34S2 (sample-and-hold input) and connect the common side of the EDC to pin E34F2 (HQ ground).

4. Set the output polarity switch on the EDC to "0".

5. Turn on the computer and the EDC and allow a 5-minute warmup period.

6. Start the A/D test; all of the channels should have the same reading (±000).

7. Ensure switching between + and −0.

8. Set the EDC to +4.990. The reading should be +776±2LSB. Set the EDC to -4.990. The reading should be -776±2LSB. Both values should be equal, except for the sign. If they are not, adjust the amplifier balance until they agree. Then set the EDC to "0", and adjust the gain potentiometer until switching between + and -000 is noted.

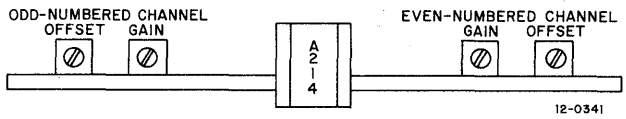
NOTE

Amplifier gain and amplifier balance are somewhat dependent upon one another; therefore, it is necessary to zero in on each until correct values are obtained. The gain potentiometer has the least effect.

9. Set the EDC to -5.000. The reading should be -777+2LSB. Set the EDC to +5.000. The reading should be +777-2LSB.

Preamplifier Check (A214)

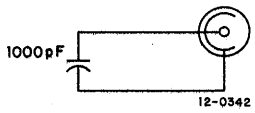
1. Connect one end of the twisted-pair shielded cable to the output terminals of the EDC.
2. Connect the other end of the cable to the input (+,-,shield) of the channel selected, or of Channel 10 initially.
3. Set the output polarity switch of the EDC to "0".
4. Turn on the EDC and allow a 5-minute warmup period.
5. Load the A/D test.
6. Monitor the channel selected in Step 2 for display reading that switches between ±000. If the reading is not ±000, adjust A214 offset potentiometer on the selected channel. If still unable to adjust for ±000, refer to the Biasing Procedure, below.
7. Set the EDC for 0.9850V.



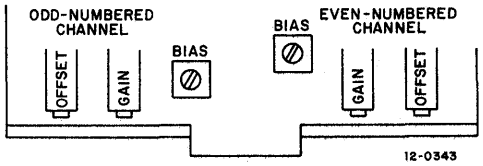
8. Set the EDC output selected to "+".
9. Ensure that the channel selected has a reading of +776. If it does not, adjust the A214 gain potentiometer.
10. Set the EDC output selected to "-".
11. Ensure that the channel selected has a reading of -776. If it does not, adjust the A214 offset potentiometer until the + and - values are equal.
12. Set the EDC for 0.9950V.
13. Ensure that the channel selected has a reading of +777 or -777, depending on the EDC output selector.
14. Repeat the above procedure for the remaining channels.

Biasing Procedure

1. If a ±000 cannot be displayed during the preamplifier check procedure, place the A214 on module extender and insert a phone plug with the following circuit in place of the EDC plug.



2. Adjust the bias potentiometer on that channel to ensure ±0V display.



3. Replace EDC and ensure ±0V.

4. Readjust offset, if necessary.

F. Diagnostic Testing

1. No further testing required.

G. Cleaning and Touchup

1. None

XI. KW12 PM PROCEDURE

A. Equipment Required

1. Oscilloscope, Tektronix 453 or 454A or equivalent, with two 10:1 probes
2. Allen wrenches, small

B. Material Required

1. Contact cleaner and lubricant spray, with a thin plastic nozzle tube
2. Paint, DEC black
3. Paint, DEC light grey
4. Chain Monitor Diagnostic System, Basic Battery LINC Tape (MAINDEC-12-D7DA-D and MAINDEC-12-D7DA-UO), including:
   a. MAINDEC-12-D8CD-D, KW12A Clock Test
   b. MAINDEC-12-D8EB-D, KW12B-C Clock Test

C. Inspection

1. Check all wiring for bare spots, breaks, etc.
2. Ensure that all connections are tight and free of electrical shorts.
3. Ensure that all knobs, switches, telephone jacks, and the front panels are tightly mounted.

D. Voltage Checks

1. Using the oscilloscope, check the following pins:

	Input	Output
Channel 1	F23H1	F23P2
Channel 2	F23K1	F23R2
Channel 3	F24H1	F24P2

2. Set source knobs to LINE.
3. Input pins should show a 60 Hz sine wave of 17V to 20V from peak to peak on the oscilloscope.
4. Output pins should show a 60 Hz, 3V square wave, indicating that the Schmitt triggers are operating.
5. Set source knobs to EXTernal − or +.
6. Output pins should show a 0V to 3V level change if the Threshold knobs are turned when the source knob is in either EXTernal + or −.

7. Check pin F23J2 by oscilloscope; a dc level should be observed.

8. Turn the Threshold knob on the front panel for Channel 1. The dc level should vary from -7V to +7V when the source knob is in both external input + and external input -.

9. When the source knob is in the line position, the Threshold control has no effect, and the level at pin F23J2 should remain at ground.

10. Same as for Channel 1, except that pin numbers should be as follows:

    a. Channel 2 pin – F23L2

    b. Channel 3 pin – F24J2

11. Using the oscilloscope, check the following pins:

	Pulse Amp Output Pin
Channel 1	F23T2
Channel 2	F23V2
Channel 3	F24T2

12. Set source knob to LINE.

13. Set the oscilloscope to the following settings:

    a. Sync Negative

    b. Internal Trigger

    c. Time/DIV = 0.1 μs/cm

14. Output pins should show a negative (+3V to 0V) pulse of 80 to 100 ns.

NOTES

1. EM12 ECOs through EM12-00034 and ECO EM12-00055 are to be installed. To confirm ECO EM12-00055, check for an M216 module, which should be present in slot A10.

Not Installed

2 These ECOs correct such KW12 problems as:

a. Reversal of + and - external sync inputs for all channels from front panel markings.
b. Errors created by the overflow flip-flop in Mode 3.
c. Erratic overflow pulses from the counter with a constant preset number in the counter.

3. Installation of ECO EM12-00055 will cause old KW12 diagnostics to fail! Use new diagnostics KW12A MAINDEC-12-D8CD or KW12B-C MAINDEC-12-D8EB.

4. **The new diagnostics will fail if ECO EM12-00055 is not installed, or if it is installed incorrectly.**

5. **Some customer programs may not work after ECO EM12-00055 is installed if the customer has operated in previously undefined areas; e.g., using Mode 3 → 0 to generate an overflow pulse.**

E. Adjustments and Maintenance

1. None

F. Diagnostic Testing

1. Load and run KW12A Clock Test.

2. Load and run KW12B and KW12C Clock Tests.

G. Cleaning and Touchup

1. Spray small amount of contact cleaner into the openings of the potentiometers located in back of the front panel. Rotate the potentiometers a few times.

2. Spray the switch contacts with contact cleaner and move the switches back and forth a few times.

3. Wash front panel free of dirt, smudges, and fingerprints.

4. Touch up any scratches on paint.

XII. EM12 PM PROCEDURE

A. Equipment Required

1. Oscilloscope, Tektronix 453/454/454A or equivalent, with current probes

2. Screwdriver, thin-blade

B. Material Required

1. DEC-12-D7AH-UO, Basic Diagnostic Tape, including Checkerboard Low

C. Inspection

1. None

D. Voltage Checks

1. None

E. Adjustments and Maintenance

1. Primary Power

   a. While observing the oscilloscope connected to pin E02J2 (POWER OK H), turn the potentiometer on module G826 in slot EF02 slowly counterclockwise until the signal goes to +3V.

   b. Then turn the potentiometer slowly clockwise until the signal goes to ground. For revision H modules, continue clockwise for approximately 30 degrees more; for revision K modules, continue clockwise for approximately another half-turn.

2. Memory Current

   a. Attach Channel 1 probe of the oscilloscope to B16J1 and Channel 2 probe (current probe) to the current loop from C1K1 to C7T2, with the arrow toward C7T2.

   b. Adjust the rightmost potentiometer of slot EF02 on module G826 until the positive waveform is between 304 mA and 336mA, and the negative waveform is between 332 mA and 368 mA; record these values.

3. Strobe

   a. With Checkerboard Low running properly, attach Channel 1 to B16J1 and Channel 2 to E14S2 (strobe).

   b. Increase strobe slowly, M360 slot E14, until the program fails; record strobe value.

   c. Decrease strobe slowly until the program fails; record strobe value.

   d. Average the two strobe values from b. and c., and adjust the final strobe to this value; record the value.

NOTE
The strobe margins must be at least 100 ns without failing.

F. Diagnostic Testing

1. Run the memory portion of the CMDS Battery.

G. Cleaning and Touchup

1. None

XIII. MC12 PM PROCEDURE

A. Equipment Required

1. Oscilloscope, Tektronix 453/454/454A or equivalent

2. Screwdriver, thin-bladed

B. Material Required

1. DEC-12-D7AH-UO, Basic Diagnostic Tape, including Extended Memory Checkerboard Program

2. MAINDEC-12-D7DA-UO and MAINDEC-12-D7DA-D, CMDS Basic Battery LINC Tape

C. Inspection

1. With power off, ensure that the memory stack and all modules are in tightly.

D. Voltage Checks

1. None

E. Adjustment and Maintenance

1. Load and start Extended Memory Checkerboard Program, with RIGHT SWITCHES 02 and 07 set to 1. At this point, the program should be in Field 0, exercising Field 1.

2. Strobe

   a. Attach Channel 1 to B16J1 and Channel 2 to E14S2 (strobe).

   b. **Slowly** increase strobe M360 slot E15 until the TTY bell starts to ring. Record this value.

   c. **Slowly** decrease strobe until the TTY bell starts to ring. Record this value.

   d. Average the two values, and adjust the final strobe to the resulting value. Record this value.

NOTE

The Strobe must have a margin of at least 100 ns without failing.

F. Diagnostic Testing

1. Run the extended memory portion of the CMDS Battery.

G. Cleaning and Touchup

1. None

XIV. DR12 PM PROCEDURE

A. Equipment Required

1. Multimeter

B. Material Required

1. MAINDEC-12-D8AB, DR12 Relay Register Test
2. DEC-12-D7AH-UO, Basic Diagnostic Tape, including CPTST1
3. Cleaner
4. Clean cloth
5. Paint, DEC black
6. Paint, DEC light grey

C. Inspection

1. Inspect the relays on the DR12 printed circuit board to ensure that they are properly inserted in their sockets and that the hold-down clips are positioned over the relay cases.

D. Voltage Checks

1. None

E. Adjustments and Maintenance

1. Using the following toggle-in program, measure the NC (normally closed) contact resistance and the NO (normally open) contact resistance of each of the relays at the front panel:

```
        *20
0516    RSW     /GET SWITCHES
0014    ATR     /SET RELAYS
6020    JMP.-2  /DO IT AGAIN
```

When running, the program will cause relay 0 - 5 to close when its corresponding right switch, 6 - 11, is set to a 1.

Relay	Switch
0	11
1	10
2	9
3	8
4	7
5	6

Ensure that each relay operates independently of the others, and that the maximum closed contact resistance is less than 0.1 ohm, and that the minimum open contact resistance is greater than 1000 Kohm.

2. While running CPTST1, ensure that the speaker tone can be varied from a loud signal to full cutoff.

F. Diagnostic Testing

1. Run the relay test diagnostic in Fast mode (SA = 200) for two minutes.

G. Cleaning and Touchup

1. Wipe off the relay panel with spray cleaner and a soft cloth.

2. Retouch any scratches with the appropriate color DEC paint.

XV. KE12 PM PROCEDURE

A. Equipment Required

1. None

B. Material Required

1. MAINDEC-12-D7DA-D and MAINDEC-12-D7DA-UO, CMDS Basic Battery LINC Tape, including:

   a. MAINDEC-8I-D0AA, EAE Diagnostic, Part 1

   b. MAINDEC-8I-D0BA, EAE Diagnostic, Part 2

C. Inspection

1. None

D. Voltage Checks

1. None

E. Adjustments and Maintenance

1. None

F. Diagnostic Testing

1. Run the EAE Diagnostics, Parts 1 and 2, for five minutes each.

G. Cleaning and Touchup

1. None

XVI. DM12 PM PROCEDURE

A. Equipment Required

1. None

B. Material Required

1. PDP-12 System Exerciser, MAINDEC-12-D7CD, or Family-of-8 System Exerciser, MAINDEC-X8-DDQAA-B-UO, configured for LINC Tape controller.

C. Inspection

1. Performed in "Modules and Cabling PM Procedure," Section III.

D. Voltage Checks

1. None

E. Adjustments and Maintenance

1. None

F. Diagnostic Testing

NOTE

The DM12 (Data Multiplexer) option cannot be checked out unless either the KF12 and one external data break option are installed or two external data break options are installed.

1. If KF12 and one external device supported by the PDP-12 System Exerciser (RF08, DF32, TC58) are present, run MAINDEC-12-D7CD for 15 minutes with *no* errors.

2. If no KF12 and at least two external devices supported by the Family-of-8 System Exerciser are present, run MAINDEC-X8-DDQAA-B-UO for 15 minutes with *no* errors.

G. Cleaning and Touchup

1. None

XVII. KF12 PM PROCEDURE

A. Equipment Required

1. Oscilloscope and probes

B. Material Required

1. MAINDEC-12-D0SA-D, KF12B, Automatic Priority Interrupt

C. Inspection

1. Performed in "Module and Cabling PM Procedure," Section III.

D. Voltage Checks

1. None

E. Adjustments and Maintenance

1. While monitoring pin P28D2, ensure that the KF12 clock is producing 50 ns pulses 0.2 μs apart. Adjust the M401 if necessary.

F. Diagnostic Testing

1. Run MAINDEC-12-D0SA-D for 10 minutes with *no* errors.

G. Cleaning and Touchup

1. None

XVIII. SYSTEM WRAPUP PM PROCEDURE

A. Equipment Required

1. None

B. Material Required

1. MAINDEC-12-D7CD, PDP-12 System Exerciser
2. Field Service Report
3. PDP-12 PM Checklist, DEC-12-(551) 1142-N173

C. Inspection

1. Re-inspect the entire system for proper cable dress, neatness, etc.
2. Ensure that all covers and locking bolts are replaced and tightened down.

D. Voltage Checks

1. None

E. Adjustments and Maintenance

1. None

F. Diagnostic Testing

1. Load, configure, and start PDP-12 System Exerciser.
2. Complete Field Service Report and PM Checklist.

G. Cleaning and Touchup

1. Wipe off all working surfaces and return all equipment and material to its appropriate storage area.

APPENDIX A
CMDS OPERATING PROCEDURES

1. ABSTRACT

The chaining monitor diagnostic system for the PDP-12 laboratory instrument computer is based on a 128_{10} word resident program (RESMON) located at 7600_8 of field 0, which loads into core programs saved on LINC Tape and executes them. It assumes that when each program has completed its task it will transfer control to location 7700_8 in field 0 in PDP-8 mode. RESMON then looks up the next test to be run and loads it as before.

2. REQUIREMENTS

A. Hardware

1. PDP-12B or 12/20 or higher.

2. KSR-33 or equivalent.

B. Software

1. Programs to be executed by the CMDS must free at least 1 page of memory and two locations of page 0 in its instruction field and must not overlay the binary loader area (Loc 07600 to 07777) to run successfully.

2. Linc mode programs must not use RSW, LSW, or SNS instructions.

3. LOADING PROCEDURE

The CMDS is supplied on a Linc Tape; mount the tape on unit 0 with unit select ON and write enable OFF.

I/O Preset to linc mode
Set the LSW = 0700
Set the RSW = 0000
Depress the DO key

4. STARTING PROCEDURE

A. When block 0 is loaded, depress the start 20 key; monitor will bootstrap itself in and indicate that it is ready to accept commands by typing an asterisk: "*".

B. The user is expected to type in the name of a saved program followed by a carriage return (CR). The monitor then schedules this program and types an asterisk, indicating that it is ready to accept further input.

NOTE

Asking monitor to schedule a test which does not exist will result in the following error message:

IS NOT DEFINED. CONTINUE WITH CHAIN

C. The user may type in as many programs as he wishes to be scheduled (up to a maximum of 64_{10}). The programs will be executed in the order in which they were typed.

NOTE

Asking monitor to schedule more than 64 tests will result in the following error message:

TOO MANY PROGRAMS IN CHAIN

Monitor will clear all scheduled programs and restart itself.

D. The user then indicates that he has completed scheduling by responding with a carriage return (CR) when monitor types "*". Control is transferred to RESMON and the chain started.

E. The universal group ($ @) is invoked by typing carriage return in response to monitor's *first* asterisk. This is the normal mode for unsophisticated users since aside from the I/O Preset – D0 – Start 20 the user need only type one key: Carriage Return. (See Build for a definition of a group).

4.1 SWITCH OPTIONS

Sense switch 0 = 1: Print diagnostic catalog name each time program is run. Otherwise, it will only be printed if an error is detected.

Sense switch 1 = 1: Do not load the next program in the chain; continue running the current program indefinitely. Otherwise, load the next program when requested.

Sense switch 2 = 1: do not execute a diagnostic "HALT". (If a diagnostic attempts to halt, the PC, Link, and AC are typed out and the next program loaded.) Setting this switch to a 1 would allow the diagnostic to run to completion. Some programs have switch tests to avoid halts. SSW 2 sets the condition the program is looking for to avoid the "HALT".

Sense switch 3 = 1: do not print error messages. (Valid *only* if diagnostic being run tests for suitable switch conditioning to inhibit printouts).

Sense switch 4 = 1: enter scope loop mode if diagnostic being executed has scope loop capability.

Right switches 9, 10, and 11 should be set to the highest field to be tested in multi-field programs.

5. OPERATING PROCEDURE

A. The CMDS tape, as supplied to the end user, has a predefined library of programs. Several programs in the system are used for updating and duplicating the library. The following sequence demonstrates the proper procedure for marking, copying, and updating the CMDS.

After initialization, monitor types: *

The user responds by typing "MARK" (CR). Thus:

*MARK↵

* (Monitor responds with another asterisk)

The user responds by typing "COPY" (CR). Thus:

*COPY↵

* (Monitor responds with another asterisk)

The user responds by typing "BUILD" (CR). Thus:

*BUILD↵

* (Monitor responds with another asterisk).

B. The user responds to the final asterisk with another carriage return. RESMON will load and start the Mark program.

The Mark program will inform the user to:

MOUNT TAPE TO BE
MARKED ON THE RIGHT
REEL OF UNIT 1

PLACE UNIT 1 IN
REMOTE WITH
WRITE ENABLED, THEN

PRESS THE MARK SWITCH

Following these instructions will cause the tape on unit 1 to be marked and verified. At the completion of the Mark program, control is transferred to RESMON which loads and starts the next program in the chain, "Copy".

C. Copy will duplicate tape 0 onto tape 1 and compare the tapes word-for-word to ensure a good copy. At the completion of the copy/compare control is transferred to RESMON which loads and starts the next (and last) program in the chain, "Build". Turn tape 0 off, and make tape 1 tape 0.

D. Build asks the user:

CATALOG, READIN, UNSAVE, OR DEFINE?

The user responds by typing the first two letters of the desired option and striking carriage return.

A. CA↵ Types the current library catalog.

B. RE↵ Reads a binary format tape and saves it as a library program.

C. UN↵ Deletes a saved program.

D. DE↵ Accepts a group definition (series of chained programs that can be referenced by a single group name).

NOTE

Build requires DTA0 to be write enabled to alter the directory.

Typing control–C (holding down the control key and typing the character "C") will abort any build operation and restart the monitor.

E. If the user responds with "CA", Build will type the current library catalog, including defined groups.

When complete, the monitor is restarted, indicated by its typing an asterisk.

F. If the user responds with "RE", Build asks:

NAME? (User responds with up to 10 characters for program name and strikes carriage return).

NOTE

$ (dollar sign) may *not* be part of a program name; it is reserved for group definition.

Build checks that the program is not already defined and asks:

TYPE STARTING ADDRESS (4 OCTAL DIGITS)?

(User responds with starting address and strikes carriage return).

NOTE

Attempting to "READIN" a program that already exists will result in the following error message:

THAT FILE ALREADY EXISTS

Readin is terminated and monitor restarted. The file must be unsaved prior to attempting to read it in again.

Build will save the starting address and ask:

HIGH OR LOW SPEED READER?

(User responds with "HI" or "LO" and strikes carriage return. If a typing mistake is made, "LO" is the default reader).

Build responds with:

TYPE < CR > WHEN READY

(The user readies the paper tape in the appropriate reader and strikes carriage return).

The tape is read in and stored on tape. If a checksum error is encountered, the error message "checksum error" is printed and monitor restarted. Otherwise, Build will ask:

TYPE DESCRIPTION

(The user enters a one line description of the program and strikes carriage return).

Suggested Format:

MM/DD/YY (DATE) XXXXX (DESCRIPTION)

The description is saved in the catalog and monitor restarted.

G. If the user responds with "UN", Build asks:

NAME?

(User responds with program name to be deleted ans strikes carriage return).

NOTE

If the program does not exist in the library, no error is reported and the monitor is restarted.

Build will delete the program from the library, and will also unsave all groups using that program.

Groups cannot be *directly* unsaved by Build. Unsaving a program within a group will unsave that group, or the group may be redefined.

H. If the user responds with "DE", Build asks:

WHICH GROUP?

(User responds with a single letter indicating the group name and strikes carriage return).

Build responds by typing an asterisk, in much the same fashion that monitor schedules a chain:

*(User responds with the desired program name and strikes carriage return. Groups may reference other groups).

Monitor checks that the program is legal and types an asterisk, indicating that it is ready to accept further input.

NOTE

Attempting to group a nonexistent program results in the error message:

IS NOT DEFINED. CONTINUE WITH CHAIN

The user indicates group completion by typing carriage return to Build's asterisk. The group is saved in the library and monitor restarted.

NOTE

The Chain Mode Monitor tape you received from the program library has no program groups defined. It is up to you to determine how you want your groups structured.

6. MISCELLANEOUS

A. Any program may be stored on and called from the Chain Mode Monitor tape if you desire to use it for library storage. This means that you must restart the monitor after running any unmodified diagnostic.

7. PARTICULAR PROGRAM CONSIDERATIONS

A. Tape Data Test – This diagnostic requires a scratch tape write enabled on unit 1. The diagnostic will not attempt a write on unit 0 unless the controller is bad.

APPENDIX B
PDP-12 PM PROCEDURE CHECKLIST

Appendix B contains a copy of the checklist that is available as an NCR form. This form should be used to check off items as they are performed.

PDP-12 PM PROCEDURE CHECKLIST

System Number _____ Date _____

Customer Name/Location _____

Customer Representative Signature _____

FS Engineer Signature _____

This checklist is to be used with the *PDP-12 Preventive Maintenance Procedures,* DEC-12-HPMPA-A-D, as a means of recording the individual procedures performed. When the PM procedures and the checklist are completed, the Customer Representative and the FS Engineer sign the form in the above spaces. Give the white copy of the checklist to the customer and send the yellow copy to the DEC Branch Office.

Preliminary Checklist

Before the PM procedures themselves are begun, the following preliminary steps should be performed at the office:

_____ 1. Review maintenance jacket
  a. Recent problems
  b. ECO status
_____ 2. Review equipment and material required

The following preliminary steps should be performed at the site prior to beginning the PM procedures:

_____ 1. Review system history with operator
_____ 2. Review system log
_____ 3. Review site supply status
  a. TTY paper, ribbon, etc.
  b. Log forms, etc.

When these preliminary steps have been completed, the PM procedures may be performed.

I. 724 Power Supply
_____ 1. Perform inspections
_____ 2. Perform voltage checks
_____ 3. Perform cleaning and touchup

II. Console
_____ 1. Perform inspections
_____ 2. Perform adjustments and maintenance
_____ 3. Perform cleaning and touchup

III. Module and Cabling
_____ 1. Perform inspections
_____ 2. Perform cleaning and touchup

IV. TU56
_____ 1. Perform inspections
_____ 2. Perform voltage checks
_____ 3. Perform adjustments and maintenance
_____ 4. Perform diagnostics
_____ 5. Perform cleaning and touchup

V. Basic PDP-12 System
_____ 1. Perform inspections
_____ 2. Perform voltage checks
_____ 3. Perform adjustments and maintenance
_____ 4. Perform diagnostic testing
_____ 5. Perform cleaning and touchup

VI. TC12
_____ 1. Perform adjustments and maintenance
_____ 2. Perform diagnostic testing

VII. VC12
_____ 1. Perform inspections
_____ 2. Perform voltage checks
_____ 3. Perform adjustments and maintenance

VIII. VR12
_____ 1. Perform inspections
_____ 2. Perform voltage checks
_____ 3. Perform adjustments and maintenance
_____ 4. Perform cleaning and touchup

IX. VR14
_____ 1. Perform inspections
_____ 2. Perform voltage checks
_____ 3. Perform adjustments and maintenance
_____ 4. Perform cleaning and touchup

X. AD12
_____ 1. Perform adjustments and maintenance

XI. KW12
_____ 1. Perform inspections
_____ 2. Perform voltage checks
_____ 3. Perform diagnostic testing
_____ 4. Perform cleaning and touchup

XII. EM12
_____ 1. Perform adjustments and maintenance
_____ 2. Perform diagnostic testing

XIII. MC12
_____ 1. Perform inspections
_____ 2. Perform adjustment and maintenance
_____ 3. Perform diagnostic testing

XIV. DR12
_____ 1. Perform inspections
_____ 2. Perform adjustments and maintenance
_____ 3. Perform diagnostic testing
_____ 4. Perform cleaning and touchup

XV. KE12
_____ 1. Perform diagnostic testing

XVI. DM12
_____ 1. Perform inspections
_____ 2. Perform diagnostic testing

XVII. KF12
_____ 1. Perform inspections
_____ 2. Perform adjustments and maintenance
_____ 3. Perform diagnostic testing

XVIII. System Wrapup
_____ 1. Perform inspections
_____ 2. Perform diagnostic testing
_____ 3. Perform cleaning and touchup

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