

System 88 Confidence Manual

PolyMorphic
Systems

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This is Version V of the Confidence Manual and is meant to accompany Version V of the Confidence Package. See page 3 for Confidence Package part numbers. The software described in this manual was created by L. G. Danczyk, F. E. Weiss and Frank Anderson. The manual was written by L. G. Danczyk, edited by Dr. Gerald A. Bradley, and revised by Jennifer Douglas.

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SYSTEM 88 CONFIDENCE MANUAL

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INTRODUCTION

The PolyMorphic Systems User Confidence Package lets you test your System 88 computer regularly, so that you can be confident that it is working well. To use it, you insert a disk into each drive of your System 88, including each drive of your 88/MS if you have one. To run the test program, push the Load button. The Confidence Test segment runs automatically upon loading of the system. You can cause the other tests to be executed by typing CTRL S and selecting the appropriate number from the menu of tests. The results of the tests are displayed on the screen and are easy to recognize. You don't need to know anything about computers or electronics to test your system.

Computers are extremely reliable and trouble-free. There is little that can break or get out of adjustment. The infrequent problems that do arise can be identified in their early stages by confidence testing, and your dealer can make repairs before the problem has a chance to do any harm.

These confidence tests will tell you if the computer is starting to misbehave in some way. Beyond that, they will tell you in some cases which particular part is about to start causing problems, but in general they are not intended to isolate a developing problem to a particular electronic component. Once you know that a problem is developing, your dealer can perform diagnostic tests that narrow it down to a particular item inside the system.

In order to service the System 88, most dealers keep on hand spare parts that are known to be working. When the dealer's service personnel have determined which part in your system is about to start causing problems, they can insert the appropriate spare into your system and send the defective part to PolyMorphic Systems. We repair it and return it to the dealer. He then removes the spare part and replaces the repaired part. This reduces to a minimum the time that your system is not running. In the case of memory chips, the dealer can isolate the malfunction to a particular chip and replace that chip.

In cases where it is possible to isolate a developing malfunction to a particular part, users with sufficient ability can remove that part and bring it to the dealer. Some users may even want to replace memory chips themselves, and the user confidence package enables them to do so.

You should now check your confidence package to make sure that you received the right one for your System 88. The different confidence packages and their numbers are listed below. In addition to noting that your package part number is correct, make sure that the Confidence Disks are the right part number. Note that if you have a System 88 with an 88/MS add-on you need

two packages, one for your 8" drives and one for your 5" drives.

Confidence Packages

- 000538 System 88 Confidence Package, 2 drive, 5" Double Density
(2 Confidence Disks 820163)
(1 Test Connector, Printer Interface 004533)
(1 System 88 Confidence Manual 810167)
- 00537 System 88 Confidence Package, 3 drive, 5" Double Density
(3 Confidence Disks 820163)
(1 Test Connector, Printer Interface 004533)
(1 System 88 Confidence Manual 810167)
- 000528 System 88 Confidence Package, 2 drive, 5" Single Density
(2 Confidence Disks 820113)
(1 Test Connector, Printer Interface 004533)
(1 System 88 Confidence Manual 810167)
- 000511 System 88 Confidence Package, 3 drive, 5" Single Density
(3 Confidence Disks 820113)
(1 Test Connector, Printer Interface 004533)
(1 System 88 Confidence Manual 810167)
- 000548 System 88 Confidence Package, 2 drive, 8" Single-Sided
(2 Confidence Disks 820171)
(1 Test Connector, Printer Interface 004533)
(1 System 88 Confidence Manual 810167)
- 000549 System 88 Confidence Package, 4 drive, 8" Single Sided
(4 Confidence Disks 820171)
(1 Test Connector, Printer Interface 004533)
(1 System 88 Confidence Manual 810167)

Confidence testing is done with the cover of the main unit left on, and should be performed regularly, even when the system has not been malfunctioning.

In using these test procedures, you will find that the displays on the video screen are quite straightforward, needing only a little interpretation at times. Tables provided in this manual enable you to interpret the screen displays when necessary.

NOTE: Make sure you use only confidence disks that were made by PolyMorphic Systems. A confidence disk that is actually an "image" of a factory-made disk may give inaccurate test results. For instance, a disk IMAGED on a drive that is out of alignment will not reveal the faulty alignment of that drive, and may incorrectly indicate that another drive is out of alignment.



Section 2

Confidence Testing

This section describes the confidence tests and how you use them to make sure your system is in good operating condition. The next section, Repair, offers suggestions on how to use these tests to isolate a given problem to its source, whether it be hardware or software. In most cases, users will want to take their systems to the dealer for further testing and repair; don't attempt repairs yourself unless you're sure you can do them.

NOTE: Attempted repair of a system component, except for replacement of memory chips in sockets, by unauthorized personnel voids the warranty.

The section called Technical Discussion of the Tests includes a technical discussion of each test and indicates what problems each test can find. Included is a hexadecimal to bit numbers table that will help you use the condensed information provided by the Confidence Test to isolate defective memory chips, if you want to replace them yourself. We use these tables -- as opposed to having the test tell you directly which memory chip is bad -- because this lets you test memory cards made by various manufacturers.

2.2 PREVENTIVE MAINTENANCE

Preventive maintenance involves running a series of tests regularly -- once a week or once a month, depending on the test -- and examining the resulting screen displays, so that you always know the current condition of the system.

Included in the descriptions of the tests below, are sample screen displays and explanations. If the test does not even get to the point of displaying the expected display, one of the following three things may be happening:

1. The Confidence Disk itself is bad.
2. The system is malfunctioning so badly that it cannot even produce a display.
3. The problem is intermittent, and so is randomly interfering with the execution of the test.

2.2.1 Running the Tests: Which Test, How Often, and Why.

2.2.1.1 Confidence Test

The Confidence Test provides a quick way to assess the system's

condition. Except for memory errors (which it totals), the screen display indicates whether the important component areas of the system are good or bad. If a cycle of the test finds a particular area bad, that discovery is remembered: if another part of the test or another cycle of the same part of the test finds the same tested area good afterwards, the bad indication is retained. These good/bad determinations are made by comparing various test results to pre-defined levels of expected minimum performance.

It is good practice to run this test for an hour every week on a system. If this is done, for instance, the Disk Read part of the test can keep you informed about any change in the condition of the disk drives. This is important in maintaining a library of readable disks, since a disk drive that is slowly going out of alignment will often be able to read a disk that it wrote yesterday, but not a disk it wrote last month.

The test presents memory errors as a number, rather than specifying a particular item as good or bad. Any number other than 0000 indicates a problem. This test isolates memory card problems to a 1K memory block (1024 consecutive addresses). If a memory error occurs and you want to replace the defective memory chip yourself, refer to the repair section to isolate the problem to a particular chip.

Use CTRL/S (hold down the CTRL key and hit the s key) to display a list of the tests and to make a selection.

The System 88 printer driver is used with the tests. You can get a printout telling how many errors a test has found so far or one that provides a brief summary of errors (this may be selected after the display of the System 88 tests). The printer driver currently defaults to null (no output) and should be changed to default to your printer. Several other printer devices are prerecorded on the confidence disk for your use. If you have some kind of printer not included among those on the disk, you will have to add a device definition corresponding to your printer (this may take quite a bit of trial and error). See the System 88 User's Manual for more information about the printer driver. The default device and parameters may be viewed and changed by typing CTRL/Y and then Printer. Of course, the write-protect tab must be removed from the disk to edit the printer driver. After doing this, you can restart the test by typing INITIAL or pressing the Load button.

If you select the error summary printout, you will get a display summarizing the errors found on every pass of Confidence. The error printout selection prints on the printer all the error information that is presented on the scrolled display that occupies the bottom four lines of the screen.

2.2.1.2 Extensive Memory Test

The Extensive Memory Test is a thorough worst-case test for the memory of the System 88. Because it is rather long, the test may be run once a month. It takes about 90 minutes to run the test once for every 16K of memory in the system.

2.2.1.3 Printer Interface Test

This test checks out the Printer Interface Card and the serial communications circuitry on the CPU card.

2.2.1.4 Video Interface Test

The Video Interface Test displays all characters and graphic symbols of the System 88 character set. Compare this display to the correct display included in this manual.

2.3 HOW TO RUN THE TESTS

The Confidence Test runs automatically as soon as you insert the confidence disk into the System Drive and press the Load button. To run the other tests, type CTRL/S and select a test from the list of tests displayed. CTRL/S works only when interrupts are enabled; some parts of some tests disable the interrupts so as to run without interruption. You can return from any test and select any other test by typing CTRL/S. Assuming interrupts are enabled, you can also use CTRL/S to stop any test and select another.

2.3.1 Confidence Test

Simply inserting the confidence disk in the System Drive and pressing Load will run the Confidence Test. The test requires a confidence disk in every disk drive, with the write-protect tab on each disk, to test every disk drive properly. If a drive contains no disk, or if its door is left open, you may get a spurious error report.

Selecting "error printout" with this test will print the errors of the Disk Read test (and possible loading problems encountered when reloading the INITIAL file). Selecting "error summary printout" with this test will print the summary display on every pass of the test.

NOTE: The following is a Confidence Test display for a 3 drive system in good condition. The spaces for drives 4 through 7 are blank in the Motor Speed Test line. This is because there is no Motor Speed Test for drives 4 through 7. Even if the system being tested is a 7 drive system, these spaces will be blank. The word "none" will appear in all other spaces which fall in the columns of drives that you don't have.

Sample Confidence Test display for a system in good condition:

```
System 88 Confidence Test      V 5.0      Elapsed Time:00:00:02:43
CPU Test:good                  Passes Completed: 0004
Memory Test - Cumulative Errors:0000 Hex memory address blocks:
  CP 20 30 40 50 60 70 80 90 A0 B0 C0 D0 E0 F0
  ****
High:.....
Low :.....
Disk Test --           1       2       3       4       5       6       7
Motor Test:           good    good    good    bad    bad    bad    bad
Write Protect Test:  good    good    good
Read Results:        good    good    good    none   none   none   none
CTRL/S displays the confidence tests.  CTRL/Y returns to Exec
Disk Drive number 01. Cumulative errors - Soft:0000 Hard:0000
Disk Drive number 02. Cumulative errors - Soft:0000 Hard:0000
Disk Drive number 03. Cumulative errors - Soft:0000 Hard:0000
Unique Address Test. Pattern Test. Refresh Test.
-----
```

The above display reveals the following things about the progress of the test:

1. Zero days, zero hours, 2 minutes, and 43 seconds in processor interrupt enabled time have elapsed since the start of the main loop of the test. When the system runs this test, it must sometimes disable the interrupts. While interrupts are disabled, the system cannot access the real-time clock, so time is not kept during such periods. The "Elapsed Time" displayed is the total time that the test has run while the interrupts were enabled. Actual elapsed test time is always somewhat greater than the figure displayed-- how much greater depends on the number of disk drives and the number of errors found.
2. The CPU card tested good.
3. Four passes of the test has completed.
4. There were no memory errors.

5. One cycle of the Disk Read Test was run on each drive and tested good on all three drives.

6. The first three lines of the four lines at the bottom of the screen indicate the total number of soft and hard errors for each disk drive the test has accumulated since its beginning.

7. The bottom line names the last three tests performed in a pass of the test. When one of these three tests is in progress, an arrow (not shown above) points to the 1K block of memory being tested by that particular test.

8. The amount of memory in the System 88 under test is graphically represented by the line of stars and the two lines of colons and dots. The sample display above indicates that there is 56K of RAM in the system, in addition to the 1/2 K of RAM on the CPU card.

Sample Confidence Test display for a 3 drive system in poor condition:

```

System 88 Confidence Test      V 5.0      Elapsed Time:00:00:02:43
CPU Test: -- RTC                Passes Completed: 0004

Memory Test - Cumulative Errors:0017 Hex memory address blocks:
  CP 20 30 40 50 60 70 80 90 A0 B0 C0 D0 E0 F0
  *****
High:.....:7.....:.....4.....:.....
Low :.....:.....A.....:.....:.....
Disk Test --      1      2      3      4      5      6      7
Motor Test:   bad   bad   bad   bad   bad   bad   bad   bad
Write Protect Test: bad   bad
Read Results:      bad   bad   bad   none   none   none   none
CTRL/S displays the confidence tests.  CTRL/Y returns to Exec
Disk Drive number 01. Cumulative errors - Soft:0390 Hard:0001
Disk Drive number 02. Cumulative errors - Soft:001E Hard:0001
Disk Drive number 03. Cumulative errors - Soft:0192 Hard:0000
Unique Address Test.  Pattern Test.  Refresh Test.

```

Below are the less obvious things that can be said about the above display:

1. Seventeen memory words at up to 17 addresses were found to be incorrect by the two memory tests. (Since each location is tested more than once, more than one error can be reported from each address.)

2. The 1K address blocks that tested incorrect are those that start at 4400H, 6000H, and AC00H.

3. The data bits (0 - 7) that tested incorrect in the above 1K address blocks are:

- A. Bits 4, 5, and 6 in 4400H to 47FFH.
- B. Bits 1 and 3 in 6000H to 63FFH.
- C. Bit 6 in AC00H to AFFFH.

This information is obtained with help from the "Memory Data Error to Bit Number Table" at the end of the next section.

4. Disk Drive 2 Read Results is displayed bad because one hard error was read in the first pass of the Confidence Test.

5. Disk Drive 3 Read Results is displayed bad because more than 100 soft errors were read in the first pass of the Confidence Test. The actual number of errors found is 192H (302 decimal).

6. The RTC (real-time clock) on the CPU Card tested bad. (This indication is shown for display purpose only; if the RTC were bad, the memory tests would not have been completed.)

For more information, see Section 4.

2.3.2 Extensive Memory Test

This test requires the confidence disk in the System Drive (usually drive 1).

Sample Extensive Memory Test Display:

```

System 88 Extensive Memory Test v4           Elapsed= 00h00m00
Galpat Test

      20  30  40  50  60  70  80  90  A0  B0  C0  D0  E0  F0
      :.....:.....:.....:.....:.....:.....:.....:.....:.....:.....:.....:.....:.....:.....
      *****                          *****

Rfrsh :.....:.....:.....:.....:.....:.....:.....:.....:.....:.....:.....:.....:.....:.....
Bit 7  :.....:.....:.....:.....:.....:.....:.....:.....:.....:.....:.....:.....:.....:.....
Bit 6  :.....:.....:.....:.....:.....:.....:.....:.....:.....:.....:.....:.....:.....:.....
Bit 5  :.....:.....:.....:.....:.....:.....:.....:.....:.....:.....:.....:.....:.....:.....
Bit 4  :.....:.....:.....:.....:.....:.....:.....:.....:.....:.....:.....:.....:.....:.....
Bit 3  :.....:.....:.....:.....:.....:.....:.....:.....:.....:.....:.....:.....:.....:.....
Bit 2  :.....:.....:.....:.....:.....:.....:.....:.....:.....:.....:.....:.....:.....:.....
Bit 1  :.....:.....:.....:.....:.....:.....:.....:.....:.....:.....:.....:.....:.....:.....
Bit 0  :.....:.....:.....:.....:.....:.....:.....:.....:.....:.....:.....:.....:.....:.....

```

Only "error summary printout" will work with this test. When you choose this test, a summary is printed at the end of every pass.

2.3.3 Printer Interface Test

Before selecting this test, insert the printer test plug in the printer output port on the back of the System 88. If the system fails this test, see "Printer does not work" in the card isolation section of this manual.

If the test finds nothing wrong, you will see this display:

```
System 88 Printer Interface Test      V 3.0
Passes completed: 0119                Total Errors:0000
Error Baud Rate:
```

If the test finds errors, you will see a display like this:

```
System 88 Printer Interface Test      V 3.0
Passes completed: 0119                Total Errors:0177
Error Baud Rate:
   50    75    110    134.5    150    300    600    900
  1200  1800  2400   3600   4800   7200   9600
```

2.3.4 Video Interface Test

Verify the correct character set and graphic characters by visual inspection after selecting this test.

If the graphics characters are displaying correctly, the upper part of the display will look like this (white is lighted):



```
0123456789ABCDEF GHIJKL MNOPQRSTUVWXYZ [ ] ^ _ ` a b c d e f g h i j k l m n o p q r s t u v w x y z { | } ~
```

If the symbol character set is being displayed correctly, the lower part of the display will look like this:

αβγδεζηθικλμνξοπρστυφχψωΩ√→←↑÷Σ≈`!#\$%&'()*+,-./0123456789:;<->?
@ABCDEFGHIJKLMNPOQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxy{|}~

Selecting "Error Printout" with this test will print out the title of the test and the last 96 characters. Selecting "Error Summary Printout" will print out only the 96 characters. Typing any character during this test will cause the test to repeat.

2.4 Environment

The system should not be subjected to dust, corrosive gases, or airborne corrosive or conductive particles. Keep the system within the following ranges of temperature, etc., at all times:

	Operating	Shipping	Storage
Ambient Temperature:	40 to 115 F 4 to 46 C	-40 to 144 F -40 to 62 C	-8 to 117 F -22 to 47 F
Relative Humidity:	20 to 80%	1 to 95%	1 to 95%
Maximum Wet Bulb:	78 F 25 C	No Condensation	

2.5 Power

Power specifications may be obtained from the System 88 User's Manual. Although the system contains an EMI filter (electromagnetic interference filter), excessive line noise could still cause errors. An isolation transformer may be used at the power line to correct this problem.

Section 3

REPAIR

3.1 Hardware versus Software Problems

To begin isolation of a system problem, think of the system as consisting of four major areas, in any one of which a problem might exist: the user, the application or user software if any, the system operating software, and the hardware. It may be clear at the outset in which area the problem lies. Or you may have to eliminate three of the areas, one by one, on the basis of sound verification that each of those areas is trouble-free.

Let's consider why each one of them might be eliminated in tracking down a problem:

1. User error: This area cannot be completely eliminated, but it can be minimized by reviewing what the user did and consulting the System 88 User's Manual.

2. User software: This area can be eliminated if the program has worked in the past with identical System 88 hardware, operating system software, and user procedures.

3. Operating software: This area can be eliminated if the program has worked before with the same operating system software.

4. Hardware failure: Successfully running the System 88 tests can provide a high level of assurance that the hardware is working. Since it is impossible to test every possible sequence of system operation, this area cannot be absolutely eliminated.

Situations in which operator error is most likely include:

Being unfamiliar with the operating system software.

Illogical, not well thought out, and/or unattentive user operations.

Incorrect assumptions.

Situations in which problems with user software are most likely include:

New or changed software that has never run before.

Situations in which problems with operating software are most likely include:

A system command, instruction, or proper sequence of instructions that does not work according to the user's manual on all System 88s. If the same problem occurs on an identically configured System 88, this area can be highly suspected.

Situations in which problems with hardware are most likely include:

A system command, instruction, or proper sequence of instructions that does not work according to the user's manual only on the one suspected System 88.

One aid in narrowing down a problem is running a suspected program on another System 88 of the same configuration.

3.2 CARD ISOLATION

The tests provided on the System 88 Confidence Disk were designed to provide as much card isolation testing as possible without using test equipment or having the cover off the main unit with the power on.

This discussion is intended to isolate some of the more obvious problems found in the System 88 computer systems. It is not possible to document all possible problems, nor is it possible to identify ALL of the possible causes for the more common problems. This guide should prove useful if you remember the above exceptions and use standard, logical troubleshooting procedures.

Most computer problems produce obvious symptoms on the video screen, so most of this section deals with screen symptoms. We will list and number the symptoms first, then discuss the probable causes.

1. Drive 3 turns on momentarily when the system is powered up or the Load button is pressed.
2. Screen is blank.
3. Random characters on screen.
4. No alpha-numeric characters on screen; only graphic characters will appear.
5. No graphic characters on screen; only alpha-numeric characters will appear.
6. Display rolls vertically.
7. Horizontal tearing of video display.
8. Steady display with correct characters, but a grey,

horizontal band moves slowly from bottom to top on the screen (cyclic).

9. Wrong characters appear at certain screen positions. This does not include characters that the VTI is not supposed to be able to produce (see improper dot patterns).
10. Improper dot patterns. This includes any character position that has missing or extra dots.
11. Incorrect characters appear when the keyboard is used.
12. Multiple characters appear on screen when only one key is pressed.
13. Characters appear on screen when no key is pressed.
14. Greek characters or other unexplainable characters appear as part of a file name when the directory is listed.
15. The system displays the start-up messages and prompt (\$) but does not respond to the keyboard.
16. A program does not execute properly, and typing keys including CTRL-Y and CTRL-Z, does not change the display.
17. Error messages appear when the system is turned on.
18. Two or more drive lights turn on simultaneously.
19. Cassette tapes do not load or dump properly.
20. Printer does not work.

1.

SYMPTOM:

Drive 3 turns on momentarily when the system is powered up or the LOAD button is pressed.

REASON:

This is not a problem; it happens on all 8813 3-drive systems. The power-on sequence causes drive 3 to be selected until the software selects drive 1.

2.

SYMPTOM: Blank screen.

REASON:

No video signal at video monitor, monitor not adjusted properly, or defective monitor.

ISOLATION PROCEDURE:

A. Check POSSIBLE CAUSES A and B below.

B. Adjust video monitor BRIGHTNESS and CONTRAST controls. You should be able to obtain a bright screen. If not, see POSSIBLE CAUSES E. If you can get a bright rectangle on the screen, the video monitor is probably functioning correctly.

C. Check the other POSSIBLE CAUSES.

POSSIBLE CAUSES:

A. No power to the system. Check power indicator light (red light over On/Off switch), AC line cord, fuse, and On/Off switch.

B. No power to the video monitor. Check power indicator light, AC line cord, fuse, and On/Off switch.

C. Video monitor cables disconnected or defective. Check cable from VTI to rear panel of computer and cable from rear panel to video monitor.

D. Defective power supply.

E. Defective video monitor.

F. Defective VTI card.

G. Defective CPU card (unlikely).

3.

SYMPTOM: Random characters on screen.

REASON: Random characters stored in VTI memory.

POSSIBLE CAUSES

- A. Improperly addressed VTI card.
 - B. Defective VTI card.
 - C. Defective CPU card.
 - D. Defective backplane.
-

4.

SYMPTOM:

No alpha-numeric characters on screen; only graphic characters will appear.

REASON: VTI is not switching properly.

PROBABLE CAUSE: Defective VTI card.

5.

SYMPTOM:

No graphic characters on screen; only alpha-numeric characters will appear.

REASON: VTI is not switching properly

PROBABLE CAUSE: Defective VTI card.

6.

SYMPTOM: Display rolls vertically.

REASON: Loss of or inadequate vertical sync.

POSSIBLE CAUSES:

- A. Video monitor not adjusted properly (vert hold).
 - B. Defective VTI card.
 - C. Defective video monitor.
-

7.

SYMPTOM: Horizontal tearing of video display.

REASON: Loss of or inadequate horizontal sync.

POSSIBLE CAUSES:

A. Video monitor not adjusted properly (horizontal hold). B. Defective VTI card.

C. On VTI revisions 0.0, 0.1, and 1.2: No phase 2 clock from CPU card, which indicates a defective CPU or backplane.

D. Defective video monitor.

8.

SYMPTOM:

Steady display with correct characters, but a grey or black horizontal band moves slowly from bottom to top on the screen (cyclic).

REASON: Positive 5 volt supply on VTI is not pure DC.

POSSIBLE CAUSES:

A. Defective VTI card.

B. Defective power supply.

9.

SYMPTOM:

Wrong character(s) appear at certain screen position(s). This does not include characters that the VTI is not supposed to be able to produce (see improper dot patterns).

REASON: VTI is producing bad character(s).

ISOLATION PROCEDURE:

Use the software front panel mode or a program to read the bad character byte. If the video memory has the correct contents, see POSSIBLE CAUSES A&B. If not, it could be any of the POSSIBLE CAUSES. If a different hex value is displayed for the same memory location each time you update the front panel display by typing U, see possible cause F.

POSSIBLE CAUSES:

A. Defective VTI memory.

B. Defective VTI card.

C. Software problem.

D. Defective backplane.

E. Defective CPU card (unlikely).

F. If the System 88 is an upgrade from a POLY 88, it may have a memory timing problem, which can be eliminated with the VTI modification called for in the upgrade manual.

10.

SYMPTOM:

Improper dot patterns. Includes any character position that has missing or extra dots. Some early character generator ROMs do not drop the tails of lower case letters.

RELEVANT DATA:

Each character position is a 10X15 dot matrix. ASCII characters are 7X9 imbedded within the 10X15 character position. Characters with extended tails are simply imbedded lower in the 10X15 matrix.

PROBABLE CAUSE: Defective VTI card.

11.

SYMPTOM: Incorrect characters appear when the keyboard is used.

REASON:

Incorrect characters reach the final sections of the VTI card.

POSSIBLE CAUSES:

A. Defective keyboard (most probable).

B. Defective keyboard cable.

C. See also Wrong character(s) appear at certain screen position(s), Multiple characters appear on screen when only one key is pressed, or Improper dot patterns.

12.

SYMPTOM:

Multiple characters appear on screen when only one key is pressed.

REASON: VTI sees multiple keyboard strobes.

POSSIBLE CAUSES:

A. Holding down key too long. All PolyMorphic Systems keyboards except Keyboard I have an auto-repeat feature.

B. Defective keyboard.

C. Electrical noise on keyboard cable (the usual symptom for this is Characters appear on screen when no key is pressed).

13.

SYMPTOM: Characters appear on screen when no key is pressed.

REASON:

VTI card sees a strobe not produced by typing or generates an invalid interrupt.

ISOLATION PROCEDURE:

This is almost always caused by electrical noise on the keyboard strobe line. The keyboard cable acts like an antenna, and an invalid strobe pulse can be generated by electrical noise. If this problem occurs often enough, you can unplug the keyboard cable and ground the keyboard strobe input (pin 9 of the 25 pin keyboard socket). If spurious characters are still generated, the problem is in the computer. If they are not, the problem is in the keyboard or cable.

POSSIBLE CAUSES:

A. Electrical noise. Try installing a commercial line filter between the wall outlet and the power cord.

B. Defective keyboard.

C. Defective VTI card.

14.

SYMPTOM:

Greek character(s) or other unexplainable character(s) appear as part of a file name when the directory is listed.

RELEVANT DATA:

Normally, control characters do not print on the screen when typed from the keyboard. An exception is when the system is in the text edit mode. If the control characters do not perform a control function, they will be accepted and used but not displayed. control character appears as a Greek character, square root sign, up, left, and right arrows, division sign, or approximately equal sign (wavy equal sign) when printed on the screen.

REASON:

Control character(s) have been entered as part of

name.

POSSIBLE CAUSES:

A. You have typed a control character without noticing. It did not print on the screen when entered.

B. Electrical noise generated a control character when the file name was being entered. See Characters appear on screen when no key is pressed.

15.

SYMPTOM:

The system displays the start-up messages and prompt (\$) but does not respond to keyboard.

REASON:

Keyboard information does not reach CPU card, or Exec is ignoring the characters sent.

POSSIBLE CAUSES:

A: Keyboard not plugged into computer or plugged into wrong socket.

B. Keyboard interface (sometimes called parallel card) cable is not plugged into VTI card.

C. Defective keyboard.

D. Defective VTI card.

E. Defective System Disk.

F. Defective memory card.

G. Defective CPU card or CPU memory (RAM, ROM, or EPROM).

16.

SYMPTOM:

A program does not execute properly, and typing keys, including CTRL Y and CTRL Z, does not change the display.

REASON:

Program is probably caught in a loop with the interrupts disabled.

POSSIBLE CAUSES:

A. Software problem.

B. See also the POSSIBLE CAUSES for The system displays the start-up messages and prompt (\$) but does not respond to keyboard.

17.

SYMPTOM:

Error messages appear when the system is first turned on.

REASON:

See the System 88 User's Manual for a description of each error message.

POSSIBLE CAUSES:

A. Most error messages are the result of an oversight on the part of the operator; the solution is apparent when the error type is known.

B. Defective System Disk. Note: disk contents can be destroyed by magnetism (such as is generated by AC line cords) or momentary failures of the AC power at the wrong time.

C. A 0302 error can be caused by bad disk head alignment.

D. Disk drive defective or out of adjustment.

E. Defective, improperly installed, or disconnected drive cable(s).

F. Any card in the system can cause an error. (Order of significance: FDC, floppy power supply, CPU, backplane, any other bus card that is causing bus problems.)

18.

SYMPTOM: Two or more drive lights turn on simultaneously.

REASON: Multiple drives have been selected.

POSSIBLE CAUSES:

A. Program shunt (sometimes called drive select header) on the drive PC cards are configured for the same drive. See PolyMorphic Systems drawing #104417, MODIFICATION - FLOPPY DISK DRIVE.

B. Defective drive control cable.

C. Defective drive.

D. Defective FDC card.

19.

SYMPTOM: Cassette tapes do not load or dump properly.

ISOLATION PROCEDURE:

A. Check that the recorder's volume and tone controls are set to recommended levels.

B. Check to see that all cables are hooked up properly.

C. Run the printer interface test. If the system fails, see Printer does not work.

D. Check to see that JMP2 on the cassette card is connected from center pad to minus.

E. On upgrades, check to see that the Byte/Poly switch is set correctly (or correctly eliminated).

F. Check the adjustment of R26 and R27 (see cassette card manual).

G. Test the CPU USART.

H. Substitute working tape, cables, recorder, and cassette card into the system one at a time.

POSSIBLE CAUSES:

A. User error.

B. Bad tape or tape recorder.

C. Hardware failure.

20.

SYMPTOM: Printer does not work.

ISOLATION:

A. Check cables, printer header, and printer switches.

B. Use a printer routine that is known to be working.

C. Run the printer interface test. If the system fails, the problem is probably on the CPU card or serial I/O card. On upgrades, make sure that the K jumper on the CPU card is connected and that the CPU card has all necessary modifications. Check the jumpers on the serial I/O card.

3.3 MEMORY CHIP ISOLATION

This section explains how to isolate a problem to a particular memory chip and make the required repair. Use this section when you find memory errors.

3.3.1 Common Considerations and Techniques

To insure that the indicated chip is actually causing the problem, it is a good practice to swap the chip with another identical chip, predict the test results by going through the steps below in reverse sequence, then running the test again and seeing if in fact the problem swaps to its new location. If the same results occur as before, chances are the problem is elsewhere than in the chip you selected.

Since it is easy to put a chip in wrong by rotating it 180 degrees, it is important to note the pin 1 indication (often a notch) in one end of the chip and make sure it goes in exactly as it came out. The correct method to remove a chip by hand is to pry out one end a little, then the other, repeating alternately. An incorrect method that will almost always result in bent pins is to try to pull the chip out by holding it with one finger on each end of the chip.

3.3.2 CPU Card Memory Chips

There are four memory chips located on the CPU card, numbered 21 through 24. Please see the CPU card layout in the package of drawings appended to this manual to locate these chips. A memory error in one of these chips will be designated by data under one of the four marks under "CP" in the Confidence Test memory error summary display. The four marks from left to right correspond directly to chip numbers 21 through 24. The data represented is not as important here, since each memory chip is used for four bits of a word. It does in any case represent what bits were incorrect.

3.3.3 Video Terminal Interface Card

There are eight memory chips located on the VTI card, numbered 21 through 28. See the VTI card layout in the package of drawings appended to this manual to locate these chips. A memory error in one of these chips will be displayed directly on the video screen. The program displays this in four places on the screen and stops, so you have a good chance of getting the message.

3.3.4 The Basic Steps for Isolating Chips on Memory Cards

There are essentially four steps to take to find the bad memory chip after knowing the incorrect data and corresponding address block:

1. Isolate the memory problem to one memory card.
2. Find the address of the memory problem relative to where all memory on that card is addressed. This will isolate the problem to a portion of the memory card.
3. Find the bit number(s) of the problem. This may be obtained directly from the Extensive Memory Test. Use the following table to find the bit number(s) from the Confidence Test Data.

Memory Data Error to Bit Number Table

Data Error Hex Digit **	Memory Bit	
	Low *	High *
0	none	none
1	0	4
2	1	5
3	0, 1	4, 5
4	2	6
5	0, 2	4, 6
6	1, 2	3, 4
7	0, 1, 2	4, 5, 6
8	3	7
9	0, 3	4, 7
A	1, 3	5, 7
B	0, 1, 3	4, 5, 7
C	2, 3	6, 7
D	0, 2, 3	4, 6, 7
E	1, 2, 3	5, 6, 7
F	0, 1, 2, 3	4, 5, 6, 7

* As displayed in the Confidence Test screen display.

** As displayed to the right of "low" or "high" in the Confidence Test display.

4. Isolate the memory chip.

As an aid in locating a particular memory problem on memory cards, a procedure is provided below for both the 8K RAM and 16K RAM memory cards.

3.3.5 PolyMorphic Systems 16K RAM Memory Chip Isolation.

1. Find the memory card with the memory problem.

If the System 88 contains more than one memory card, you must determine which card the problem is in. To do this, you must know or figure out what part of the whole address spectrum is made up by a particular memory card. If the memory error occurred within that part of the spectrum, the problem will usually be in that card. The portion of the address spectrum

for one 16K card ends at an address 3FFFH greater than its starting address. The starting address is the beginning of its part of the spectrum.

To isolate a defective memory card:

First, pull out the memory cards and examine their address DIP switches.

Using the starting address table below, write down the starting addresses of each memory card in ascending order.

Then select the card in whose address section the bad memory is located. For instance, if the starting addresses are 2000 and 6000, a fault at 4C00 is in the card with the starting address 2000.

Below is a table you can use in conjunction with the switch positions of the DIP (dual in-line package) switch located near the edge connector of the memory card to figure out the starting address of the memory card.

Starting Address versus Possible Switch Settings

Starting Address	Switches				
	1	2	3	4	5, 6, 7 not used
0000H	off	off	off	off	
1000H	on	off	off	off	
2000H	off	on	off	off	
3000H	on	on	off	off	
4000H	off	off	on	off	
5000	on	off	on	off	
6000H	off	on	on	off	
7000H	on	on	on	off	
8000H	off	off	off	on	
9000H	on	off	off	on	
A000H	off	on	off	on	
B000H	on	on	off	on	
C000H	off	off	on	on	
D000H	on	off	on	on	
E000H	off	on	on	on	
F000H	on	on	on	on	

2. Find the address of the memory problem relative to the starting address of the card.

This relative address will isolate the problem to one of four areas on the memory card. From the Confidence Test summary display of incorrect memory data, each of these areas is represented by four stars under "20 30 40," etc. You need to know if the error is in the first, second, third, or fourth

area from the starting address. These areas correspond to rows 2, 3, 1, and 4 respectively of the following table of the memory chip number and placement on the board.

3. Find the bit number(s) of the problem.

This can be obtained from the Memory Data Error to Bit Number Table in section 3.3.4.

4. Find the memory chip.

The IC numbers in the table below correspond to the typical placement of the chips on the card when looked at from the front of the card with the edge connector down.

16K Memory Card IC Number and Placement Table

Address Range *	2	0	1	5	6	7	3	4
+2000H to 2FFFH	42	43	44	45	46	47	48	49
+0000H to 0FFFH	34	35	36	37	38	39	40	41
+1000H to 1FFFH	26	27	28	29	30	31	32	33
+3000H to 3FFFH	18	19	20	21	22	23	24	25

* Relative to the starting address of the board-- add the appropriate number to the card's starting address.

3.3.6 PolyMorphic Systems 8K RAM Memory Chip Isolation.

If the System 88 contains more than one memory card, you must determine which card the problem is in. To do this, you must know or figure out what part of the whole address spectrum a memory card occupies in the system. If the memory error occurred within that part of the memory spectrum, the problem will usually be in that card. The address region for an 8K card ends at an address 1FFFH (eight stars) greater than its starting address. The starting address is the beginning of its part of the spectrum. Below is a table you can use in conjunction with the switch positions of the DIP (dual-in-line-package) switch located near the edge connector of the memory card to figure out the starting address of the memory card.

To isolate a defective card:

First, pull out the memory cards and examine their DIP address switches.

Using the table below, write down the starting address of each memory card in ascending order.

Then select the card in whose address section the bad memory is located. For instance, if the starting addresses are 2000, 4000, and 6000, a fault at 4C00 is in the card starting at 4000.

Starting Address versus Possible Switch Settings

Starting Address	Switches			
	1	2	3	4 [not used]

0000H	on	on	on	
2000H	off	on	on	
4000H	on	off	on	
6000H	off	off	on	
8000H	on	on	off	
A000H	off	on	off	
C000H	on	off	off	
E000H	off	off	off	

2. Find the address of the memory problem relative to where all memory on that card is addressed.

This relative address will isolate the problem to one of eight areas on the memory board. In the Confidence Test summary display of incorrect memory data, each of these areas is represented by one mark under "20 30 40," etc. You must know what area from the starting address (first, second, third, ..., eighth) the error is in. These areas correspond to rows 1 through 8 respectively of the following table of the memory chip number and placement on the board.

3. Find the bit number(s) of the problem.

This can be obtained from the Memory Data Error to Bit Number Table in the Appendix at the end of this section.

4. Find the memory chip.

The table below corresponds directly to the placement of the chips on the card when looked at from the front of the card with the edge connector down.

8K Memory Card IC Number and Placement Table

Address Range *	0	1	2	3	4	5	6	7
+0000H to 03FFH	1	2	3	4	5	6	7	8
+0400H to 07FFH	9	10	11	12	13	14	15	16
+0800H to 0BFFH	17	18	19	20	21	22	23	24
+0C00H to 0FFFH	25	26	27	28	29	30	31	32
+1000H to 13FFH	33	34	35	36	37	38	39	40
+1400H to 17FFH	41	42	43	44	45	46	47	48
+1800H to 1BFFH	49	50	51	52	53	54	55	56
+1C00H to 1FFFH	57	58	59	60	61	62	63	64

* Relative to the starting address of the card-- add the appropriate number to the card's starting address.

3.4 DOUBLE DENSITY CONROLLER CHIP ISOLATION

The Double Density Controllers perform self-diagnosis when the system is booted. As a part of this procedure, error messages may be sent to the screen during the booting of the system. These error messages are explained in the following two sections.

3.4.1 88/MS Double Density Controller Chip Isolation

The following table lists the possible 88/MS Double Density Controller error messages and notes what problem they indicate. When appropriate the bad IC and bit numbers are provided.

Memory Error to Integrated Circuit Table

Message	Problem	Bit No.	IC No.
Error 0380	Bad Disk Controller ROM		(IC33}
Error 0381	Self Test Failure In SDLC		(IC43)
Error 0382	Memory Error	(Bit 0)	(IC22)
Error 0383	Memory Error MS controller	(Bit 1)	(IC23)
Error 0384	Memory Error MS controller	(Bit 2)	(IC24)
Error 0385	Memory Error MS controller	(Bit 3)	(IC25)
Error 0386	Memory Error MS controller	(Bit 4)	(IC26)
Error 0387	Memory Error MS controller	(Bit 5)	(IC27)
Error 0388	Memory Error MS controller	(Bit 6)	(IC28)
Error 0389	Memory Error MS controller	(Bit 7)	(IC29)
Error 038A	Data Loop Failure on MS Controller		

The Bit indicated by a memory error message is the first bad bit. There is a possibility that other, greater bit numbers are also bad.

Single Density systems do not generate the above messages. Therefore there occurrence on a Single Density System with an attached 88/MS definitely indicates a problem on the 88/MS controller board.

However, if you have a Double Density 8813 with an 88/MS add-on then you have two controller boards which perform boot time self-diagnosis that can result in some of the same error messages. This means that you will not know which board has the problem. If this occurs, your dealer will be able to determine which board is responsible for the error message. If it is determined that the faulty board is not the 88/MS controller but the 8813 controller board, then the following section can be consulted for chip isolation instructions.

3.4.2 Double Density 5" Chip Isolation

Error message 0382 indicates a bad memory chip on the 5" Double Density Controller board. When this message occurs, type a Control Z to see front panel. Location 1C06H contains the bad byte (type L1C06 and the right arrow will point at the bad byte). Use the following table to determine the bit which corresponds to the characters provided for the bad byte.

For instance, if the right arrow points at byte 8A, you would determine that Bits 1, 3, and 7 are bad.

Memory Data Error to Bit Number Table

Data Error Hex Digit	First Character	Last Character
0	none	none
1	4	0
2	5	1
3	4, 5	0, 1
4	6	2
5	4, 6	0, 2
6	3, 4	1, 2
7	4, 5, 6	0, 1, 2
8	7	3
9	4, 7	0, 3
A	5, 7	1, 3
B	4, 5, 7	0, 1, 3
C	6, 7	2, 3
D	4, 6, 7	0, 2, 3
E	5, 6, 7	1, 2, 3
F	4, 5, 6, 7	0, 1, 2, 3

Once you have determined which bit is bad, you can consult the Bad Bit to Integrated Circuit table below.

Bad Bit to Integrated Circuit

Bit	IC
0	IC22
1	IC21
2	IC20
3	IC19
4	IC18
5	IC17
6	IC16
7	IC15

The following table shows other error codes which indicate malfunctions of the Double Density 5" controller.

Table of Double Density 5" Controller Errors

Message	Problem
Error 0380	IC33 is bad
Error 038A	Phase Lock Loop tested bad
Error 030C	Controller Self-check error
Error 0307	Controller does not exist (Controller circuitry may be malfunctioning so severely that CPU ROMs can not tell if it exists.)
Error 0308	Checksum error -- memory error on controller board
Error 030A	Controller Error
Error 030B	Head positioning mechanism on the selected drive did not get to where it was directed by the controller (Controller circuitry to perform this may be at fault.)
Error 0309	Bad track 0 switch on the selected drive (Circuitry to detect this may be at fault)

Section 4

TECHNICAL DISCUSSION OF TESTS

Except where the sequencing of a test is self-evident, the discussion of each test below is followed by a block diagram flow chart of the test program.

4.1 CONFIDENCE TEST

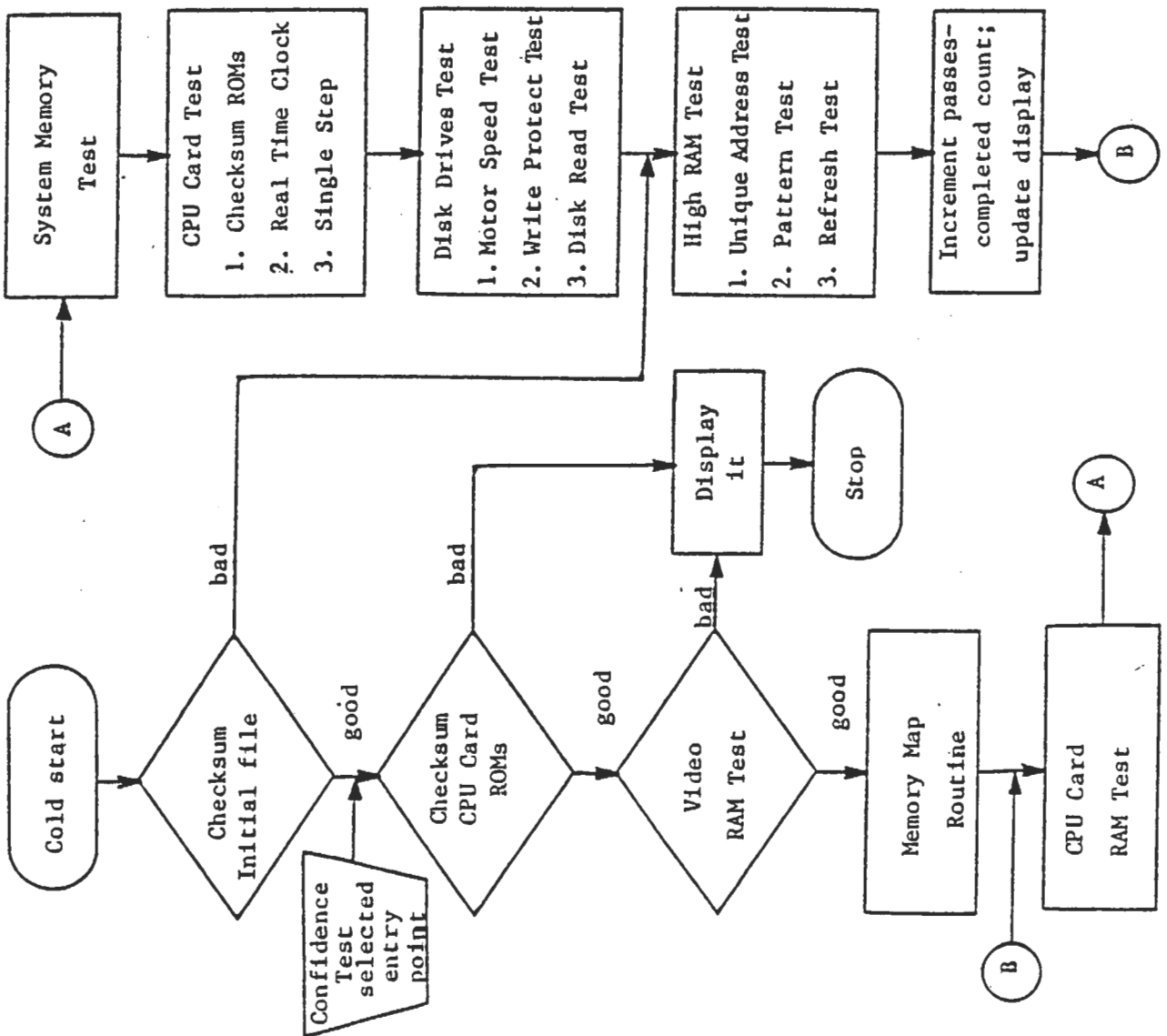
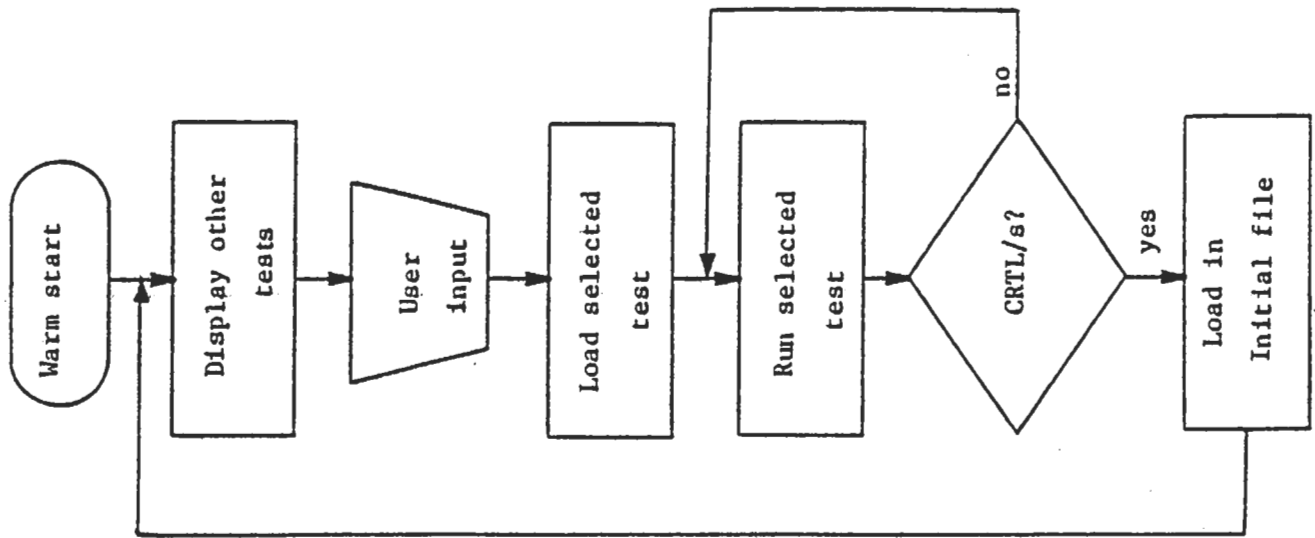
The Confidence Test is made up of two files on the disk which depend on each other to complete. The first file is the INITIAL file. It is the supervisor for all tests in addition to containing most of the three tests below. This structure enables Confidence to test all of the memory of the system and also take precautions such as doing a checksum on itself before running.

Three parts of Confidence are executed on the first pass only. They are the checksum of the test itself, the Memory Map routine, and the Video Memory Test. If the checksum of itself is not correct, it will abort normal sequence and load and execute the High Memory Test overlay, which tests memory addressed greater than 3200H. After these first three tests, Confidence cycles through three other tests: the CPU card test, the disk drives test, and the memory test.

The Memory Map routine searches the address spectrum above 1000H and reports the amount of memory it sees and what address this memory starts at. This is displayed in the bottom four lines of the screen. A graphic representation of this is displayed below the address blocks in the summary display. A star is displayed for every 1K block seen addressed greater than 2000H.

Necessary for any display is proper addressing of the Video Terminal Interface Card.

The Sequence of Tests for the Confidence Test



4.1.1 CPU Card Test

The CPU card must pass four tests before a good indication will be displayed on the summary display. The three ROMs are 16-bit checksummed individually and identified directly if incorrect. The four memory chips are tested and identified in the memory error summary display (see Repair section, CPU Card). The Real Time Clock is tested for an accuracy of 18 ± 3 milliseconds. This includes allowance for 50 Hertz operation. The failure modes of this circuitry merit the above. Lastly, a single-step instruction is simulated to test the single step logic. All of the above except the real time clock test must work every time for a good indication of the CPU Card Test to be displayed. Improper operation of the real time clock gets displayed directly on the summary error screen, since the problem could be some place other than the CPU card. If the real time clock tested incorrect, "bad - RTC" is displayed next to "CPU Test."

4.1.2 Disk Read Test

The Disk Read Test does three tests every pass of the Confidence Test on each drive of a System 88. A motor speed test is done and checked for a variance of no more than $\pm 5\%$. The status of the write-protect switch is read in and reported good if it is write protected. The test then reads the last 100 sectors of each disk of the system and keeps a cumulative total (expressed as a hexadecimal number) of the soft and hard errors for each drive. This information is scrolled and displayed on the bottom four lines of the screen.

A bad indication will be displayed in the Read Results area of the summary display if 100 total soft errors or one hard error is read on a disk during a pass of the test.

This test will try to read a disk three times (three cycles of the Confidence Test) before giving up due to a "No disk or door open" error.

4.1.3 Memory Tests

The memory test portion of the Confidence Test is actually three separate tests.

The first, a Unique Address Test, stores the least significant byte of the address of the location into the location. It then checks these locations for the correct contents. The test is then repeated with the most significant byte of the address.

The second test is a checkerboard test. This test writes a pattern into the odd numbered locations and the complement of the pattern into the even numbered locations. This is done with three different pattern lengths which correspond to what it takes to accomplish a checkerboard pattern in a memory card designed with a 1K, 4K, or 16K memory chip. This test is done

with the data patterns of 00H, FFH, 55H, and AAH. Memory data errors are bit accumulated within a 1K block by way of a buffer which designates a word for each block. This buffer is saved after every pass of Confidence.

The third test is a refresh test. After verifying the storage of a number of instructions in a 1K block, the test synchronizes itself with the real-time clock and executes those instructions. Proper execution of these known instructions constitutes an error-free test. Failure of this test is indicated by an R being displayed below the corresponding 1K address block. Because of the way the display is created, the R could conceivably be blotted out by a blank in a subsequent pass of the test, or replaced by a hex digit indicating a data error.

This test is run on all memory blocks addressed greater than 3400H.

Because of the way it executes, in an extreme case this test could stop executing and cause the system to re-load, in turn causing the test to start over.

4.2 EXTENSIVE MEMORY TEST

In addition to the three memory tests above, this test performs a "galloping pattern" test. The galloping pattern test zeros out a 4K memory block and then stores one different bit in each memory chip within the memory block. It then checks every address of the memory chip to see if there were any changes. The test then complements the pattern and does it again. The test does this to every location of the memory block and to every memory block (except video card memory) of the system.

4.3 PRINTER INTERFACE TEST

The printer interface card must be configured for RS-232 in order for you to test it.

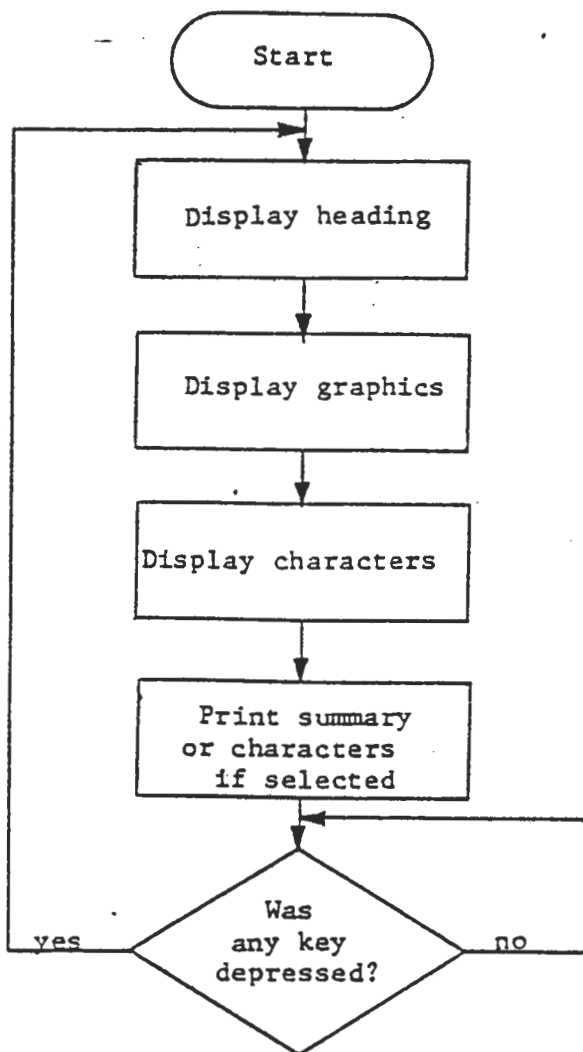
If the test reveals a problem, and if you have the technical ability, make sure that the header on the printer interface card has these pins connected to each other: 1 to 15; 2 to 16.

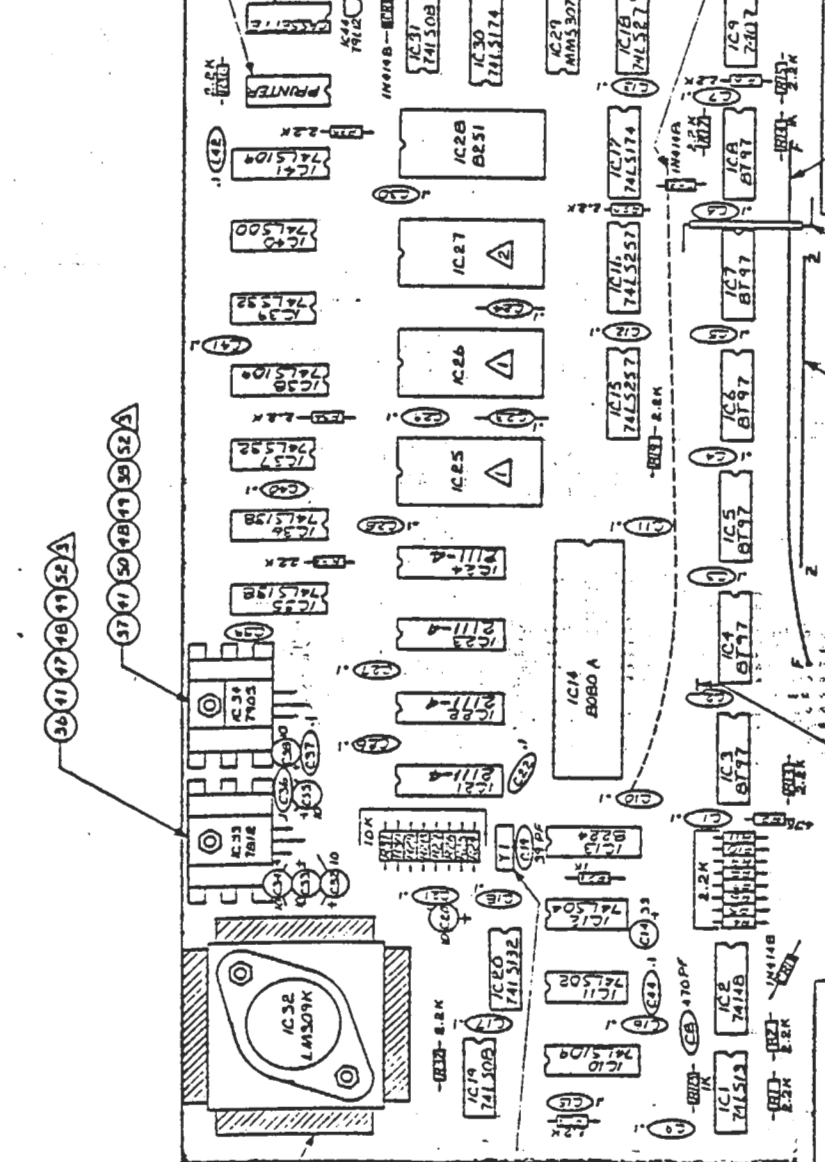
This test sends data through a loop by way of a test plug inserted in the printer port on the back of the System 88. The test does this in asynchronous mode at baud rates from 50 to 9600 baud.

4.4 VTI TEST

This test displays all graphics characters (twice) and all ASCII characters on the screen.

The Sequence of Tests for the Video Interface Test





TO BE INSTALLED AFTER FLOW SOLDER OPERATION.

IC12: MONITOR RYM P/N 035020

FOR DISK SYSTEM:

A. IC25- ROOT ROM 100 P/N 035025

B. IC26- ROOT ROM 100 P/N 035030

NOTES: UNLESS OTHERWISE SPECIFIED

POLYMORPHIC SYSTEMS

ASSY-CPU BOARD

QTY	1
DATE	12/12/71
DESIGNED BY	JLL
CHECKED BY	JLL
DRAWN BY	JLL
DATE	12/12/71
WORK ORDER NO.	001062
REV	1
REV BY	JLL
REV DATE	12/12/71
REV DESCRIPTION	
REV	
REV DATE	
REV DESCRIPTION	

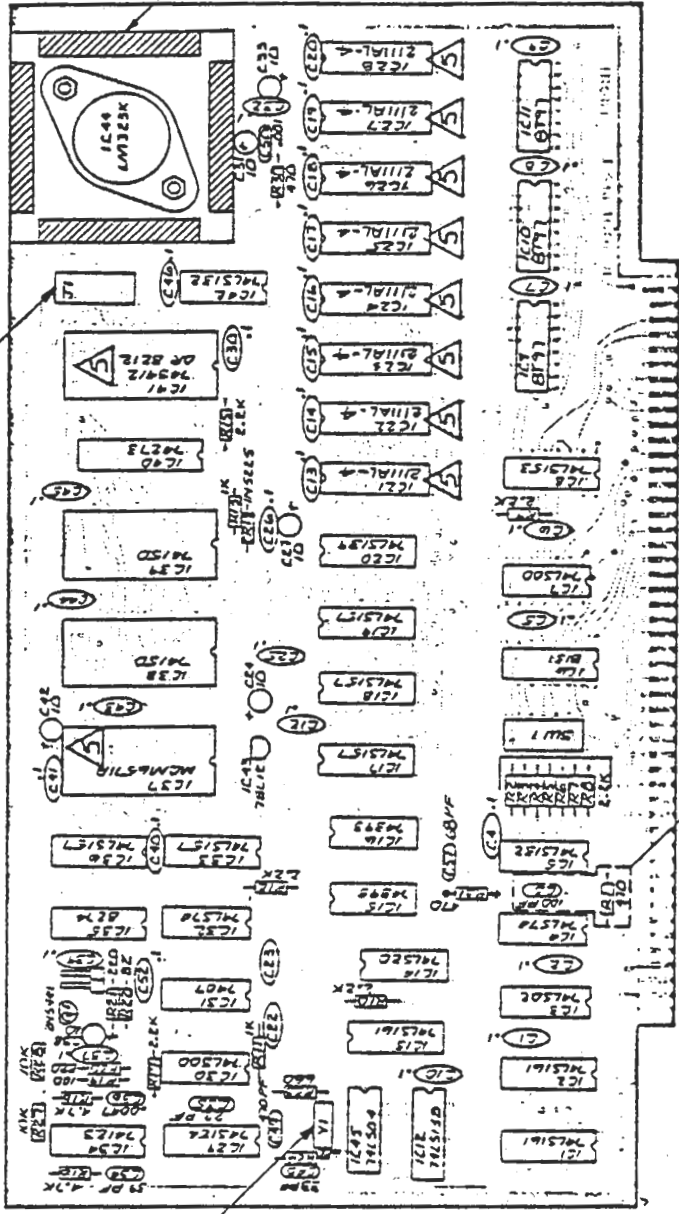
MATERIAL

FINISH

UNLESS OTHERWISE SPECIFIED:
 DIMENSIONS ARE IN INCHES AND DECIMALS THEREOF.
 DIMENSIONS IN PARENTHESES INDICATE PRELIMINARY DIMENSIONS.
 DIMENSIONS IN SQUARE BRACKETS INDICATE DIMENSIONS OF THE PART.
 DIMENSIONS IN TITLES INDICATE DIMENSIONS OF THE PART.

1 2 3 4 5 6 7 8

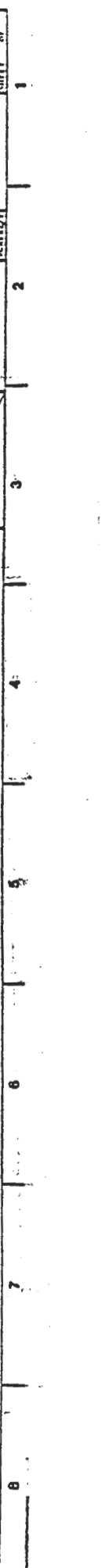
REV	BY	DATE	DESCRIPTION
1	WXT	10/28/70	REDRAWN DCR 001026
2	WXT	10/28/70	DCR 10026-14
3	WXT	11/24/70	DCR 10026-14
4	WXT	12/22/70	DCR 10026-14
5	WXT	1/17/71	DCR 10026-14
6	WXT	2/12/71	DCR 10026-14
7	WXT	3/12/71	DCR 10026-14
8	WXT	4/12/71	DCR 10026-14
9	WXT	5/12/71	DCR 10026-14
10	WXT	6/12/71	DCR 10026-14



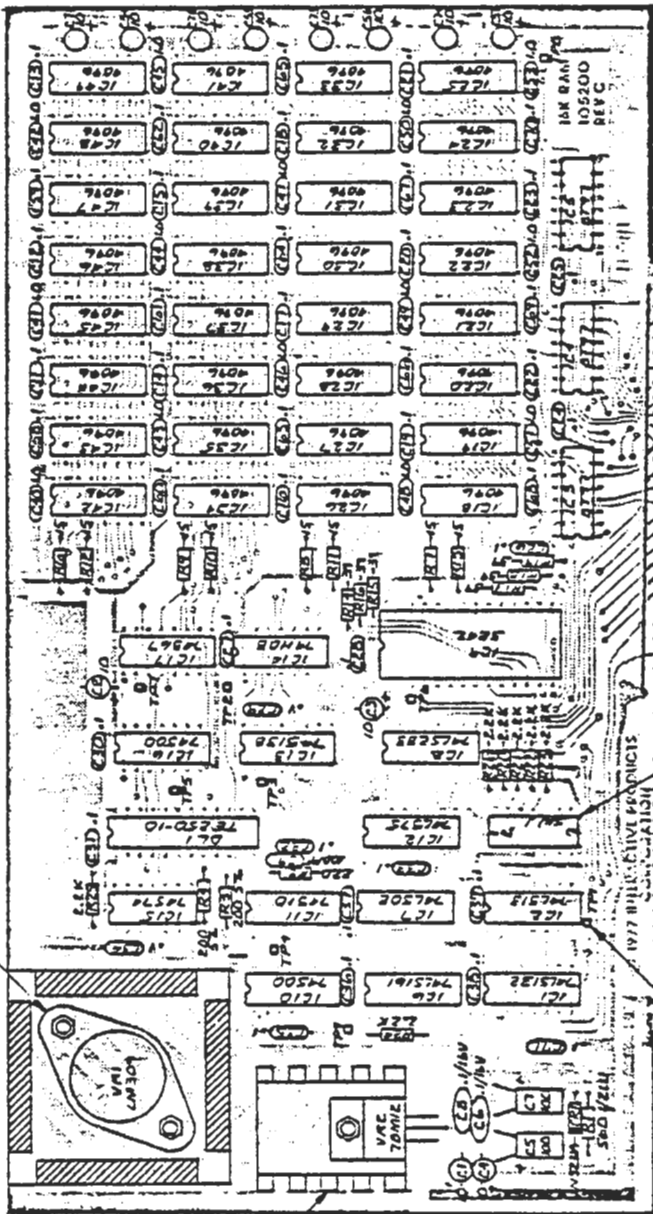
- △ IC SOCKET REQD.
- △ OMIT R1 AND C9 FOR USE WITH DISK SYSTEM.
- △ TO BE INSTALLED AFTER FLOW SOLDER OPERATION.
- E. MODIFY PER DWG 130146.
- △ FOR 50HZ OPERATION:
 - A. CUT TRACE FROM CENTER PAD TO 60 HZ AT JMP 3 JMP 5 & JMP 6
 - B. JUMPER FROM CENTER PAD TO 50 HZ AT JMP 3 JMP 5 & JMP 6
 - C. ITEM 63 (CRYSTAL) SHOULD BE RN 019053.

SEE PARTS LIST 001026

POLYMORPHIL SYSTEMS	
ASSY-VIDEO BOARD	
REV	A
DRAWING NUMBER	001026
DATE	11/24/70
SCALE	1:1



REV	DESCRIPTION	DATE
A	RELEASED DCR 10004E	7/18/71
B	DCR 100134	10/8/71
C	DCR 100160	4/11/71
D	DCR 100265	2/2/71
E	DCR 100314	2/2/71
F	DCR 100330	5/2/71
G	DCR 100730	4/17/71



JUMPER AS SHOWN
USING #18 INSULATED
WIRE

7 REQD (4)
TPI TRKU TP9

1. 4 POSITION DIP SWL MAY BE SUBSTITUTED FOR 1 POS. SWITCH MOUNT IN UPPER B HOLES
2. MODIFY PER DWG 130140.
3. TO BE INSTALLED AFTER FLOW SOLDER OPERATION.

NOTE: UNLESS OTHERWISE SPECIFIED

REV	DESCRIPTION	DATE
A	RELEASED DCR 10004E	7/18/71
B	DCR 100134	10/8/71
C	DCR 100160	4/11/71
D	DCR 100265	2/2/71
E	DCR 100314	2/2/71
F	DCR 100330	5/2/71
G	DCR 100730	4/17/71

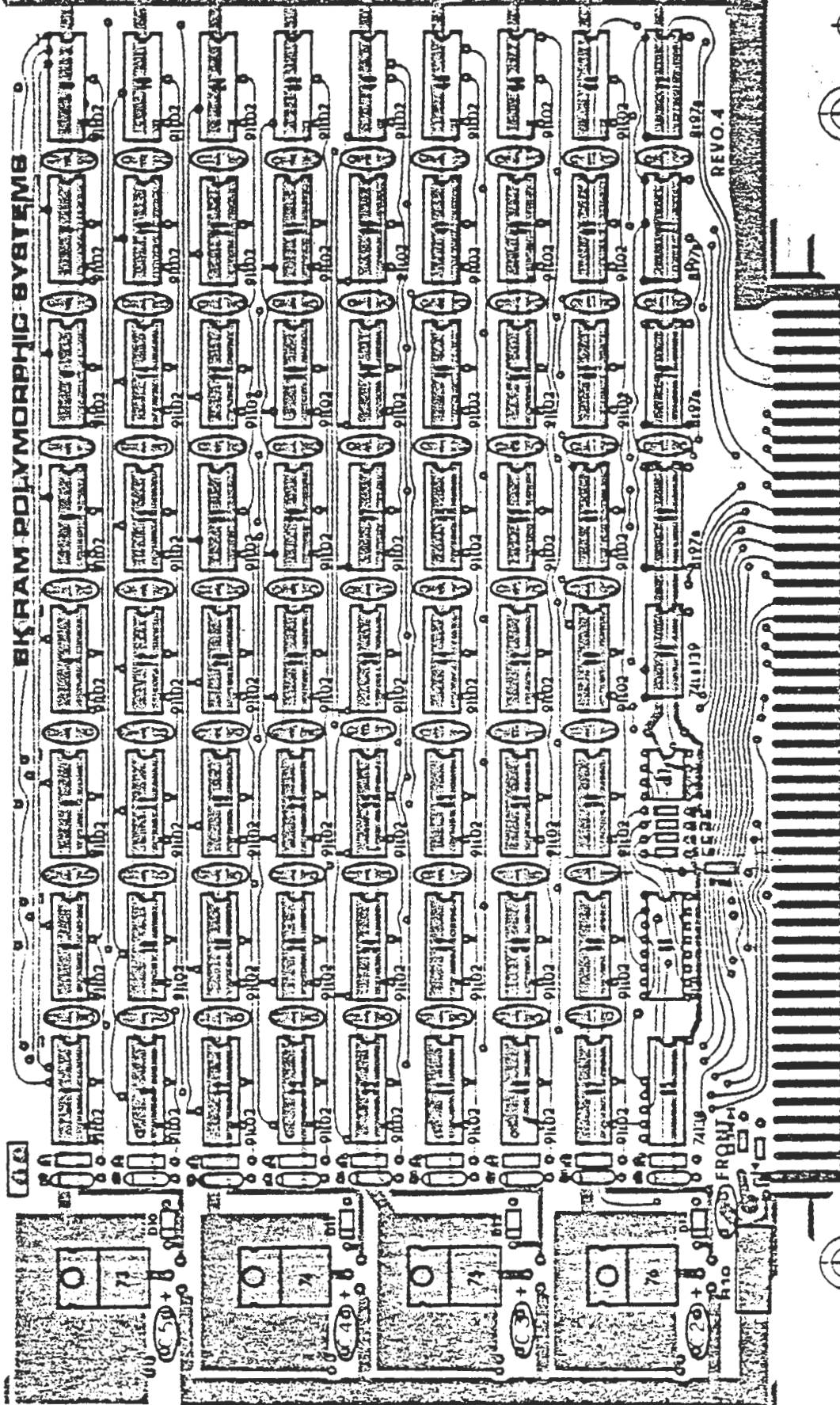
005100
POLYMERIC SYSTEMS

ASSY-16K RAM

REV	DESCRIPTION	DATE
A	RELEASED DCR 10004E	7/18/71
B	DCR 100134	10/8/71
C	DCR 100160	4/11/71
D	DCR 100265	2/2/71
E	DCR 100314	2/2/71
F	DCR 100330	5/2/71
G	DCR 100730	4/17/71

005100
POLYMERIC SYSTEMS

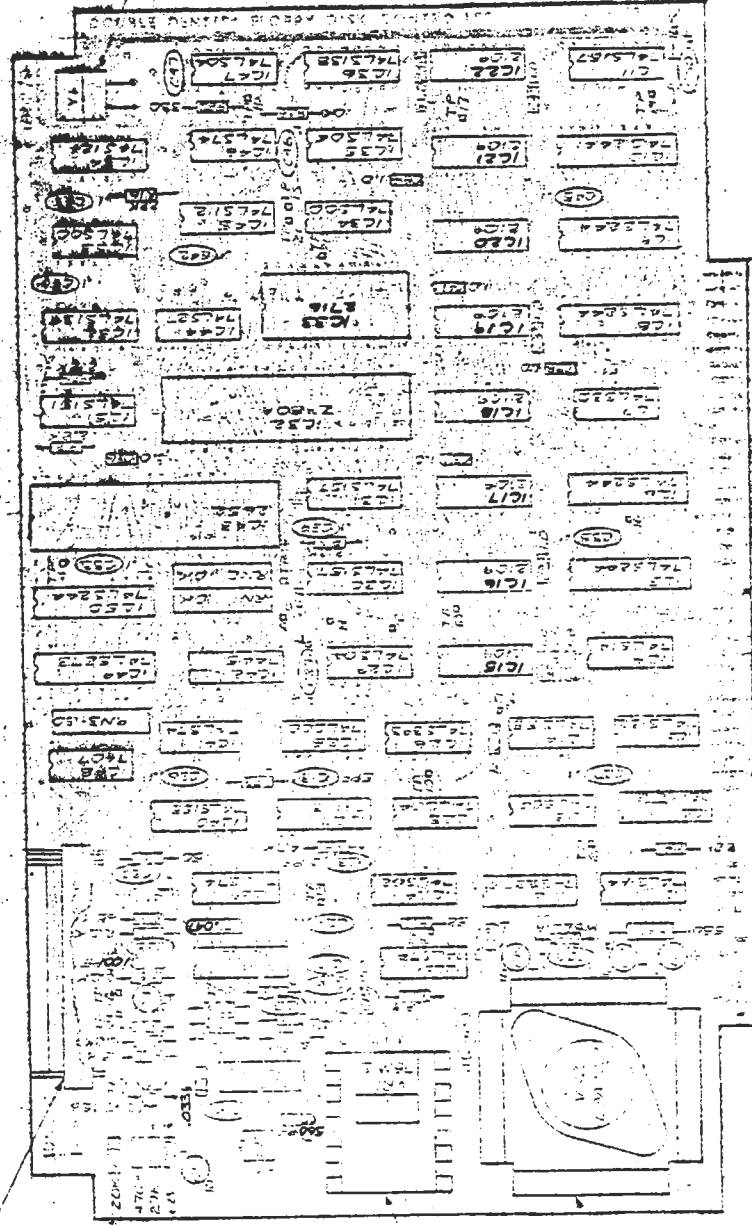
BK RAM POLYMORPHIC SYSTEMS



REV. 4

FRONT

REV	DATE	BY
1	12/15/72	WJ
2	12/15/72	WJ
3	12/15/72	WJ
4	12/15/72	WJ
5	12/15/72	WJ



- 1. IC 20, 21 MUST BE SAME MANUFACTURER & DATE CODE.
- 2. IC 22, 23, 24, 25, 26, 27 ARE IN PAIR.
- 3. X AND Y JUMPER R. CONTIGUOUS JUMPS:
A. INTEL 8000'S, 8001'S OR 2100'S
B. SERIES 74-L JUMPER 2 TO 11
C. TOL
- 4. IC 20, 21 MUST BE SAME MANUFACTURER & DATE CODE.
- 5. VERIFY PER DIMS 13066, 13065, 13052.
- 6. TO BE INSTALLED AFTER FLOW SOLDER GENERATION.
- 7. NO SOCKET'S REQUIRED EXCEPT ON IC 2.

NOTES: UNLESS OTHERWISE SPECIFIED

POLYMORPHIC SYSTEMS	
ASSY - DOUBLE DENSITY 5" DISK CONTROLLER	
DATE	REV
12/15/72	1
12/15/72	2
12/15/72	3
12/15/72	4
12/15/72	5
12/15/72	6
12/15/72	7
12/15/72	8
12/15/72	9
12/15/72	10
12/15/72	11
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12/15/72	97
12/15/72	98
12/15/72	99
12/15/72	100