OPERATION MANUAL

AUTOMATIC

PC BOARD CHECKER

MODEL APC-2000

KIKUSUI ELECTRONICS CORPORATION

Power Requirements of this Product

Power requirements of this product have been changed and the relevant sections of the Operation Manual should be revised accordingly.
(Revision should be applied to items indicated by a check mark ☑.)

☐ Input voltage

The input voltage of this product is _____ VAC,
and the voltage range is _____ to _____ VAC. Use the product within this range only.

☐ Input fuse

The rating of this product's input fuse is _____A, _____VAC, and _____.

WARNING

- To avoid electrical shock, always disconnect the AC power cable or turn off the switch on the switchboard before attempting to check or replace the fuse.
- Use a fuse element having a shape, rating, and characteristics suitable for this product. The use of a fuse with a different rating or one that short circuits the fuse holder may result in fire, electric shock, or irreparable damage.

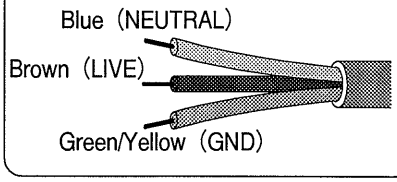
☐ AC power cable

The product is porvided with AC power cables described below. If the cable has no power plug, attach a power plug or crimp-style terminals to the cable in accordance with the wire colors specified in the drawing.

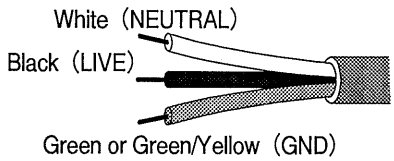
WARNING

- The attachment of a power plug or crimp-style terminals must be carried out by qualified personnel.

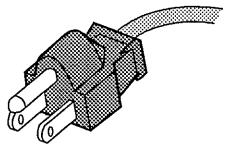
☐ Without a power plug



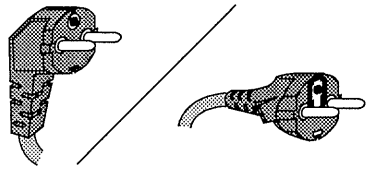
☐ Without a power plug



☐ Plugs for USA



☐ Plugs for Europe



☐ Provided by Kikusui agents

Kikusui agents can provide you with suitable AC power cable.
For further information, contact your Kikusui agent.

☐ Another Cable _____

 Kikusui Part No. Z9-000-027 IB001681

KIKUSUI

CONTENTS

CONTENTS (cont'd)

1. GENERAL DESCRIPTION

The APC-2000 tests a PC board in units of the electronic parts mounted on it and reports defective portions by a printer and display unit immediately after finding them.

In addition to the short circuit caused by solder bridges and pattern cut, the APC-2000 can check for the mislocation, missing, and poor characteristics of the mounted parts momentarily without applying power to the board.

The reference data can be generated in a short time even for a board with a large number of parts because an automatic data learning function is provided. This function enables the APC-2000 to learn the reference data from good boards by use of a program executed through conversation with the operator.

To test a board, the operator needs to put it on the fixture and press the start button only; the defective portions, if found, are reported on the printer and display unit automatically. Thus, the APC-2000 can be handled by anybody.

Since a vacuum method is adopted for the fixture section, PC boards of high mounting density can be tested, and because the fixture section has no moving elements on its surface, even an unskilled operator can use it with ease.

The following are the features of the APC-2000:

1.1 Capability of being Developed into In-line System

To increase the inspection efficiency, the APC-2000 is designed to be developed into an in-line system at any time.

1.2 Stable Measuring Precision

To assure high measuring precision, the APC-2000 uses a phase detection method for measuring impedance, executes the shield drive measuring which is not affected by the cable length, and adopts an effective guarding method.

1.3 High Speed Measuring

For the efficient operation, the time required for testing has been reduced greatly.

1.4 Improved Fixture Section

With the vacuum-type fixture section, the APC-2000 can test small and compact boards and the boards with chip parts.

1.5 Reliable all-pin short/open test

Since the all-pin short-circuit test (1 - 15Ω) and all-pin open-circuit test (100kΩ) are executed separately, not only the solder bridges but also the poor contact of pins can be detected for sure.

1.6 Map Display

If a board is found to be defective as a result of its test, the defective portion is displayed on the CRT so that the user can know the defective portion immediately. Also, the information about the defective portion can be printed out either during or after test execution.

1.7 Intelligent Printer

The user can select FAIL PRINT, ALL PRINT, or NON PRINT as the print format. Since the printer has a built-in buffer memory, it can print out the test result without affecting the test time. Further, the printer section can be separated from the main frame like the fixture section.

1.8 Self-check Function

The APC-2000 has a powerful self-check function for its RAMs, measuring circuits, and multiplexer cards. With this function and good maintenance services, the user can place full reliance on the system.

2. SPECIFICATIONS

Basic Instrumentation Section

Testing pins: Standard: 256 pins
Maximum : 768 pins
(The number of testing pins may be increased in units of 16.)

Test steps: 3,840 steps

Measurable ranges:

Resistance	:	1.00Ω - 15.00Ω
		10.0Ω - 150.0Ω
		100Ω - 1500Ω
		1.00kΩ - 15.00kΩ
		10.0kΩ - 150.0kΩ
		100kΩ - 1500kΩ
		1.00MΩ - 6.00MΩ
Capacitance	:	10.0pF - 150.0pF
		100pF - 1500pF
		1.00nF - 15.00nF
		10.0nF - 150.0nF
		100nF - 1500nF
		1.00μF - 15.00μF
		10.0μF - 150.0μF
		100μF - 1500μF
		1.00mF - 6.00mF
Inductance	:	10.0μH - 150.0μH
		100μH - 1500μH
		1.00mH - 15.00mH
		10.0mH - 150.0mH
		100mH - 600mH
Diode	:	000mV - 1500mV
Light-emitting diode	:	000mV - 2500mV
Transistor	:	000mV - 1500mV
Jumper check	:	Constant current 30mA
		Judgement level 1 - 15Ω

Short circuit check:

Constant current	30mA
Judgement level	1 - 15Ω

DC voltage measurement: 000mV - 1500mV
0.00V - 15.00V
0.0V - 30.0V

All-pin short check:

Constant current	30mA
Judgement level	1 - 15Ω
	(to be set by user)

All-pin open check:

Constant current	3μA
Judgement level	100kΩ

Criterion for judgement: ±1% to ±99%

Instrumentation delay : 100 types
Max. 990 ms at 10 ms intervals i.e. 0, 10, 20, 30, ..., 980, 990 ms

Guarding : Max. 2 points (each step)

CPU Section

Host computer : UPIOE MODEL 10 or MBC-225

Display : 12" green CRT

Floppy disk drive: Two drives for 5-1/4 inch double-sided, double-density, double-track diskettes

Keyboard : Full keyboard plus function keyboard

Interface : RS-232C, Centronics, or parallel I/F

Printer Section

Print format : 24 characters per line on 5 x 7 dot matrix

Print form : Roll paper with the diameter of 60 mm and width of 57 mm

Fixture Section

Maximum board size	:	FX-01-APC	180mm x 250mm (Max. 512 pins)
		FX02-APC	300mm x 450mm (Max. 768 pins)
Weight	:	FX01-APC	
		FX02-APC	Approx. 10 kg

Vacuum Pump Section (option)

Working degree of vacuum:		Less than 450 mmHg
Exhaust speed	:	575 l/min (50Hz), 685 l/min (60Hz)
Power requirements	:	AC 200V (3 phases), 1.5kW, 4P
Weight	:	Approx. 45 kg

Power Supply

Power requirements	:	AC 100V ±10%, 50/60Hz	
		Approx. 220VA	
Fuse	:	Main frame	5A
		Host computer	2A

Dimensions and Weight

Outer dimensions (max.)	:	Main frame		
		(W)615 x (H)730 x (D)660 mm		
		Jig table		
		(W)720 x (H)730 x (D)500 mm		
Weight	:	Main frame	:	Approx. 86 kg (256 pins)
		Jig table	:	Approx. 50 kg (without jigs)
		Host computer:		Approx. 15 kg

Environmental Conditions

Operating temperature	:	5°C to 35°C
Operating humidity	:	Not more than 75% RH

Accessories

Operation manual
Multiplexer board (One for every 256 pins)

8620059

3. PREPARATION

3.1 Receiving and Handling

Before the tester is shipped from the factory, it is carefully tested in both mechanical and electrical terms to confirm and guarantee correct operation. On receiving the tester, check if it has sustained any damage during transportation. Should any objectionable points be found, contact your dealer immediately.

3.2 Checking Supply Voltage

The tester is designed to operate on a line voltage of AC 100V ±10%, 50/60Hz. To ensure trouble-free operation for a long period of time, use the above line voltage not contaminated with noise.

3.3 Operating Temperature and Sitting

To maintain the initial performance of the tester for an extended period of time, be sure to use the tester in the specified operating temperature and humidity ranges. The tester should be installed in a place where it will not be exposed to excessive dust or oil-born air.

3.4 Installation

3.4.1 External appearance

See Figure 3.1 for the external appearance of the tester.

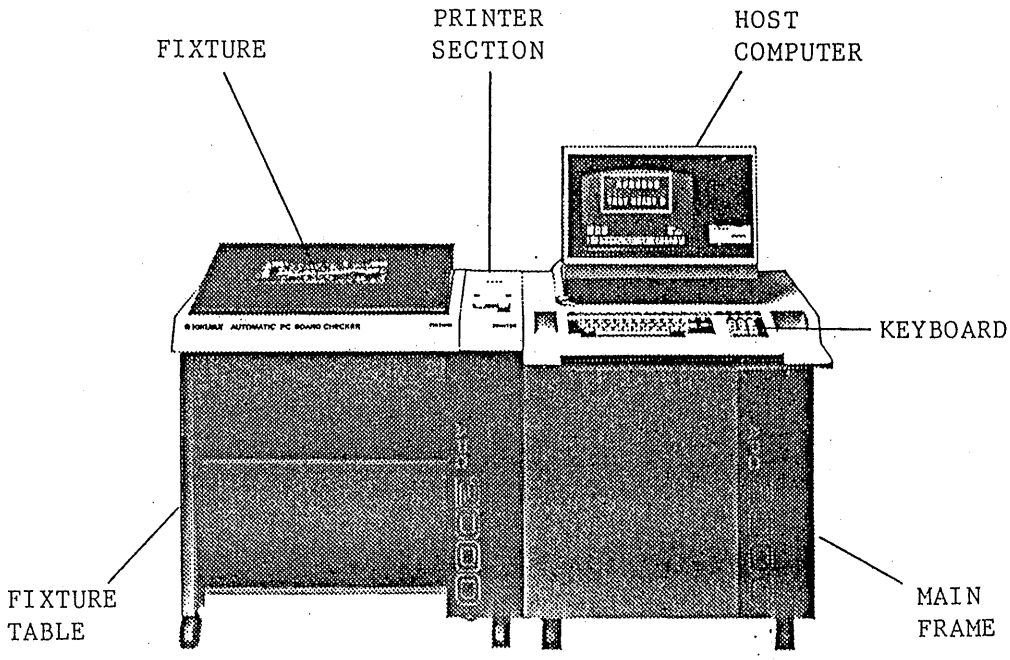
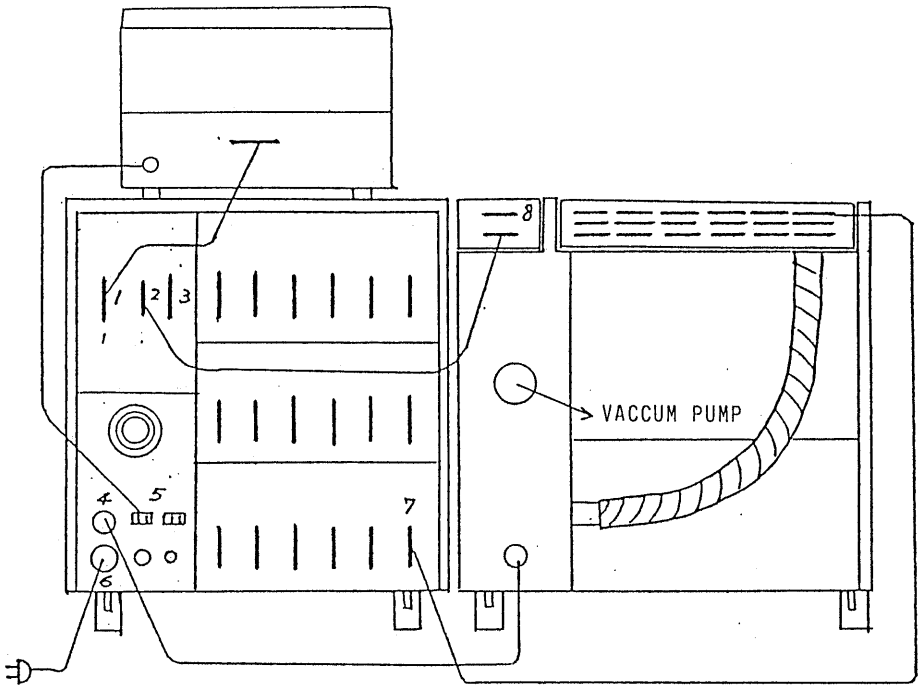


Fig. 3.1 External Appearance

The cables to connect the main frame, fixture, printer section, fixture table, and host computer have sufficient length so that these units can be set apart from one another.

Figure 3.2 shows the cable connection diagram.



1.	CONTROL I/O	(50P)
2.	PRINTER AND SIGNAL I/O	(36P)
3.	EXT CONTROL	(50P)
4.	SOLENOID	(4P)
5.	SWITCHED AC OUTLET 100V MAX 2.5A	(2P)
6.	AC 100V 50/60Hz	(3P)
7.	J1 - J18	(50P)
8.	AUX SIGNAL I/O	(36P)

Fig. 3.2 Cable Connection Diagram

4. OPERATOR PANEL DESCRIPTION

4.1 Printer Panel Description

See the illustration of the printer-section panel in Figure 4.1.

① TEST switch: Place the board to be tested on the fixture, and press this switch to start test execution.

② PASS : If the board has passed the test, this lamp goes on. Once it goes on, it remains on till the next test sequence is started.

③ RESET : Press this switch to stop testing and printing. Release the switch after confirming the RESET operation.

④ FEED : Use this switch to feed the print form. The printer's self print check can be initiated the following operation:

[RESET] ON → [FEED] ON → [RESET] OFF

⑤ Printer : Prints out the test result.

⑥ Print form : Roll paper of 57 mm wide and 60 mmϕ used for the printer. Open the lid and set the roll on the paper holder.

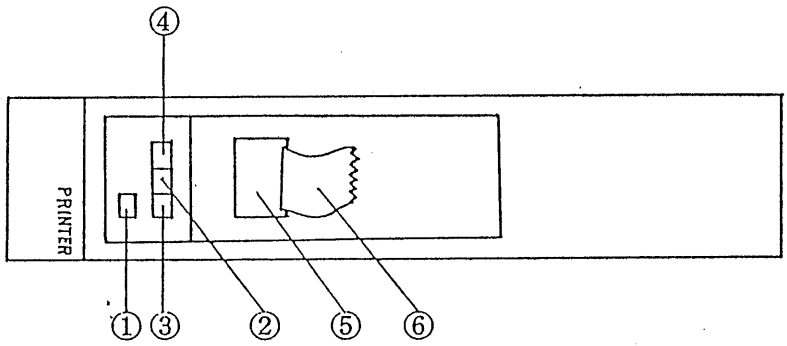


Fig. 4.1 Printer-section Panel

4.2 Host Computer Panel Description

The host computer for the APC-2000 Tester is the UNIVAC UP10E Model 10 or MBC-225 with two floppy disk drives. For the details of the host computer, refer to the separate user's manual.

When the UNIVAC UP10E or MBC-225 is used as the host computer of the APC-2000, the operator needs to manipulate only the rear POWER switch, front BRIGHT control, floppy disk drives A and B, and keybord.

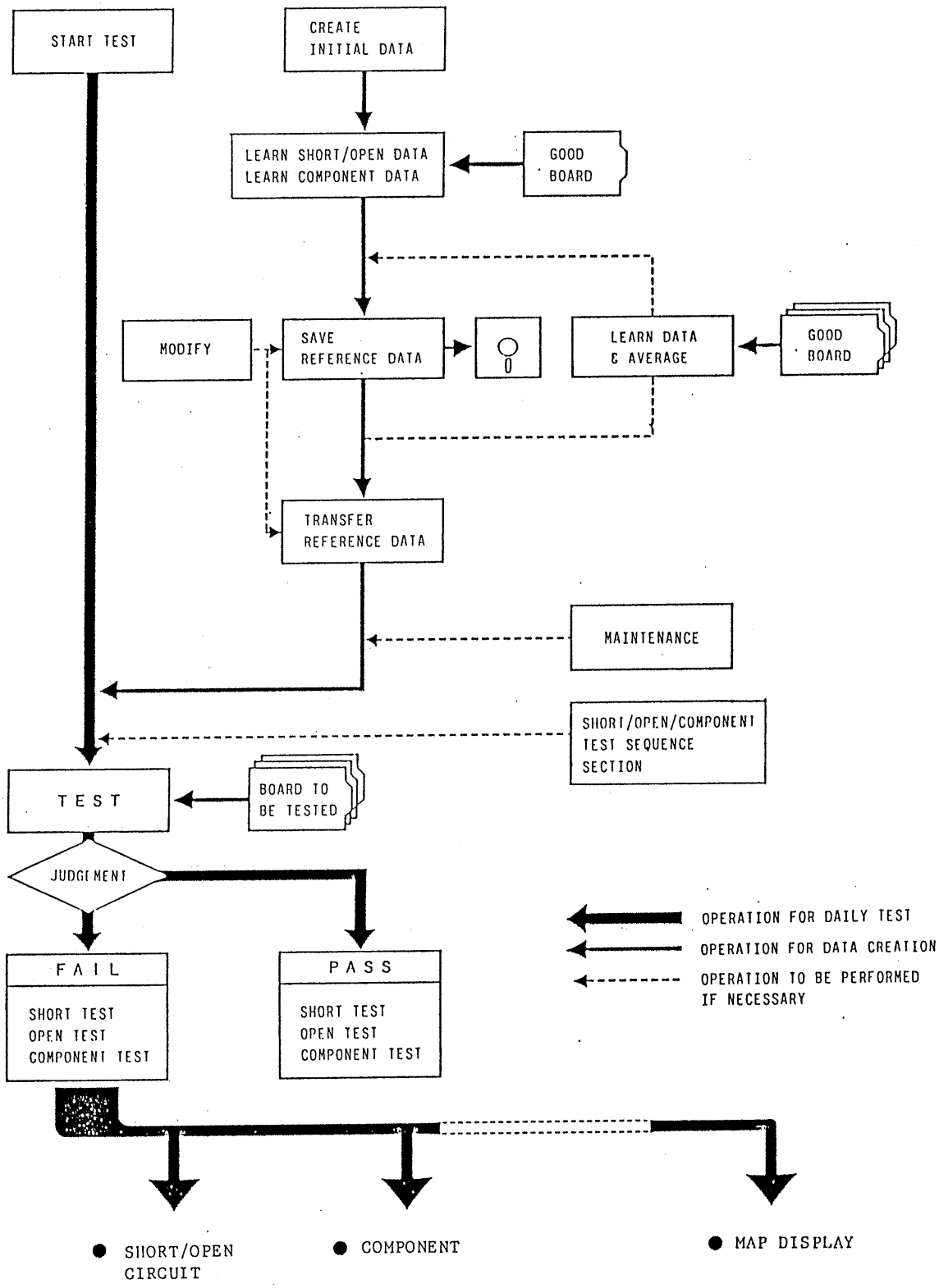
Insert the supplied APC2000 AUTOMATIC PC BOARD CHECKER WORK FILE diskette into floppy disk drive B and SYSTEM diskette into drive A. Be sure to turn on the power before inserting these diskettes.

Do not take out a diskette from disk drive nor turn off the power switch when the disk drive is operating.

5. OPERATION PROCEDURES

5.1 Overview

5.1.1 Operation flowchart



5.2 Initial Operation

5.2.1 Power-on operation

Confirm that no floppy disks are inserted in the host computer and turn the key switch in the upper right-hand corner of the main frame front section by 90 degrees clockwise; then, a green LED in the upper left-hand corner of the main frame front section and the one on the host computer go on and the cursor (_) flickers in the upper left-hand corner of the host computer CRT screen. Insert the supplied floppy disk "APC2000 AUTOMATIC PC BOARD CHECKER SYSTEM DISK" into drive A, and the host computer is activated. If no errors are found as a result of self-check (see Section 5.4 (1)), the next information is displayed on the CRT. At same time, insert the floppy disk "WORK FILE" into drive B.

5.2.2 Paper loading

Open the lid of the paper compartment in the printer section, put the supplied roll paper shaft through the core of the supplied roll paper (57 mm wide, 50 mmϕ), and set it on the paper holder in the compartment.

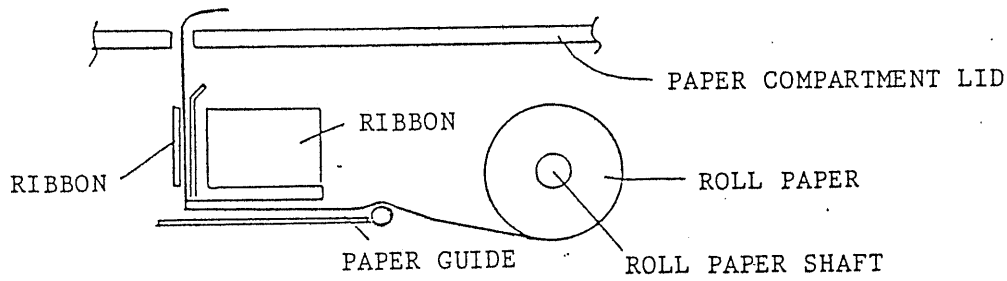


Fig. 5.2

Insert the leading edge of the paper into the paper guide. Thread the paper as shown in Figure 5.2 using the FEED switch on the printer section.

5.3 Function Description

Press a function key (PF1 - PF7) or numeric key (1 - 7) on the keyboard when the system is in the TEST READY mode after the power-on operation, and the program that corresponds to the pressed key is executed.

The selected function branches as shown in Figure 5.3.1.

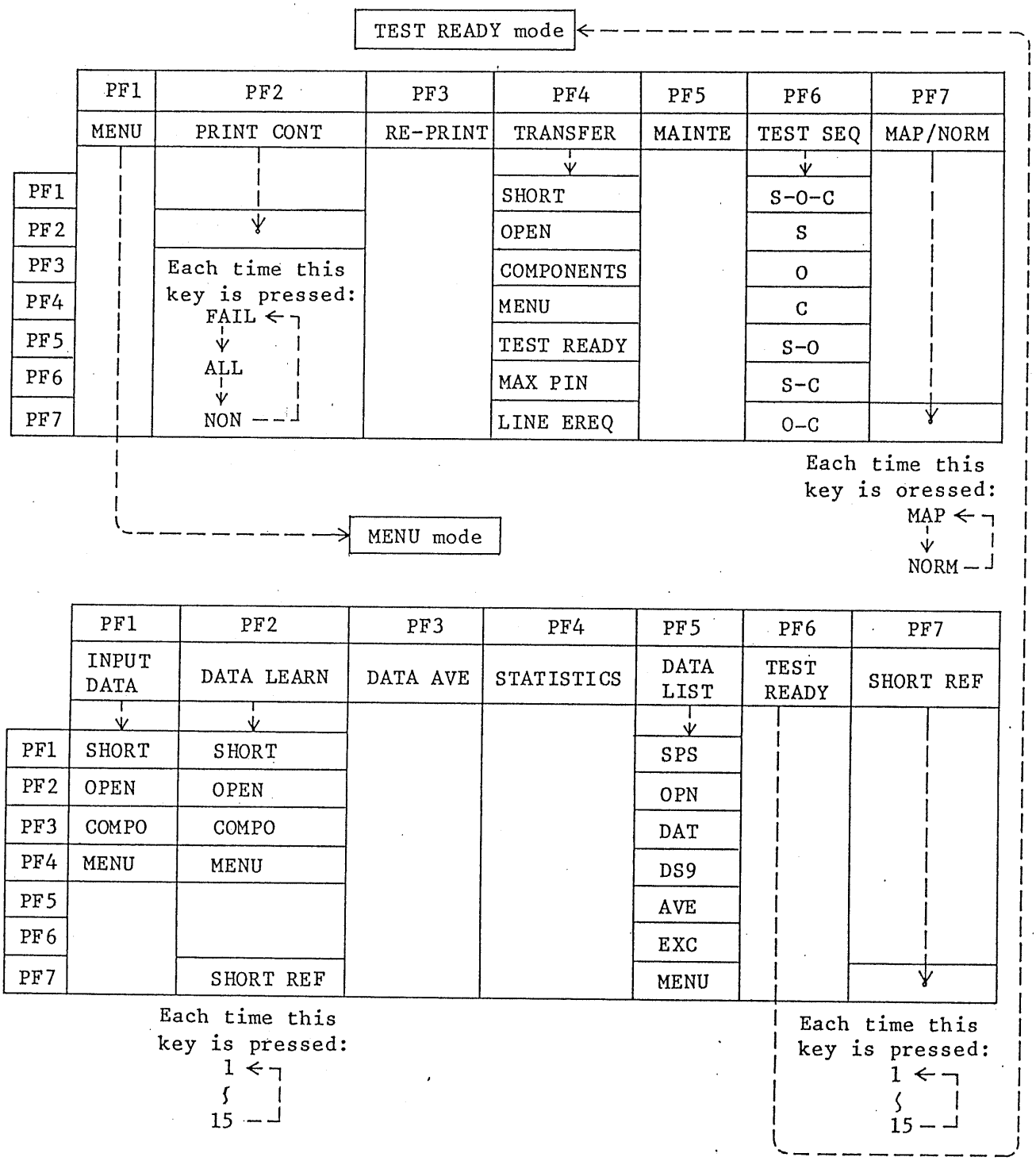


Fig. 5.3-1

If the ESC key is pressed in the TEST READY mode, the numbers and contents of functions are changed. PF8 to PF14 are used as exclusive keys.

TEST READY mode

PF1	PF2	PF3	PF4	PF5	PF6	PF7
MENU	PRINT	RE-PRINT	TRANSFER	MAINTE	TEST SEQ	MAP/NORM

These groups of functions replace each other each time the ESC key is pressed

PF8	PF9	PF10	PF11	PF12	PF13	PF14
INPUT DATA	DATA LEARN	DATA AVE	STATISTICS	DATA LIST	FAIL RE-PR	SHORT REF

Fig. 5.3-2

FAIL RE-PR (PF13) prints out only the information about defective boards regardless of the setting (NON, FAIL, or ALL) for PRINT CONT.

If a failure is found as a result of all-pin short check or all-pin open check, the system does not proceed to component test but terminates the test operation.

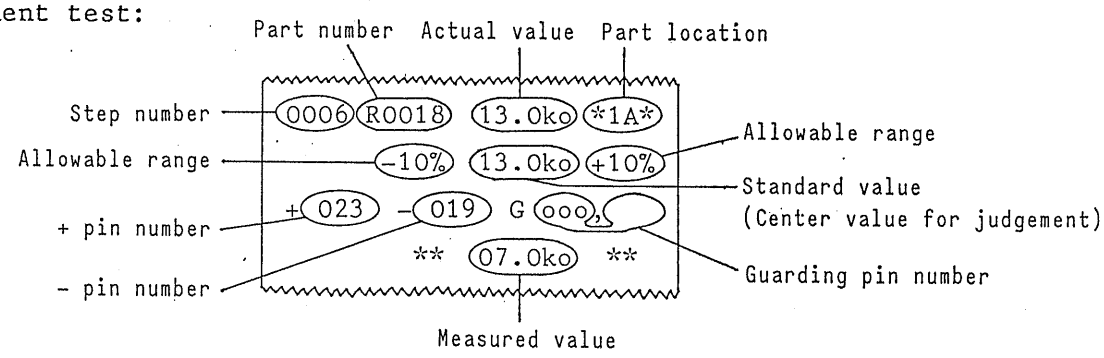
For failures found by all-pin short check:

```
SHORT FAIL PINS
        001
        023
```

For failures found by all-pin open check:

```
OPEN FAIL PINS
        299
```

For failure found by component test:



5.3.1 Functions in TEST READY mode

SHORT DATA NAME : CHKJIG
OPEN DATA NAME : CHKJIG
COMP DATA NAME : CHKJIG

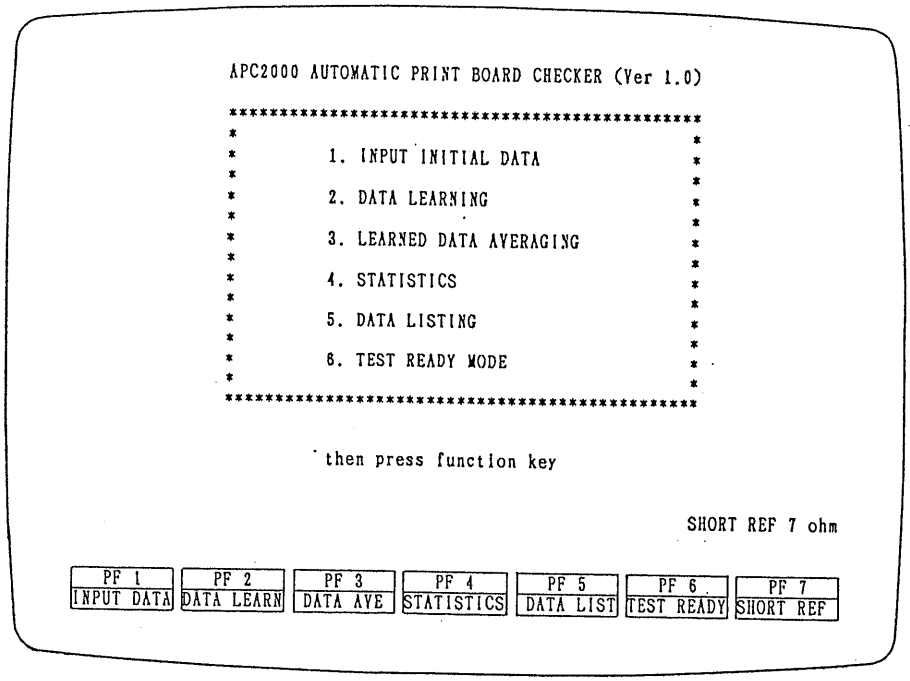
DISPLAY NORM
SHORT REF 5 ohm
FAIL PRINT

PF 1	PF 2	PF 3	PF 4	PF 5	PF 6	PF 7
MENU	PRINT CONT	RE PRINT	TRANSFER	MAINTE	TEST SEQ	MAP/NORM

Refer to page 17.
Refer to page 18.
Refer to page 25.
Refer to page 57.

(1) MENU (Menu) PF1

Use the MENU program mainly for creating a program for a new PC board. The control branches to the functions explained in Section 5.3.2.



(2) PRINT CONT (Built-in printer output control) PF2

Each time PF2 is pressed, the printing mode is switched among ALL, FAIL, and NON (displayed in the lower right-hand corner of the screen).

ALL PRINT : Information on all the tested parts, whether PASS or FAIL, is printed out. (For the all-pin short/open test, however, only the FAIL PIN information is printed out.)

FAIL PRINT: Only the information on defective parts is printed out.

NON PRINT : No information is printed out whether the test result is PASS or FAIL.

Note that the information output to the printer when ALL PRINT or FAIL PRINT is specified can be monitored by the host computer screen at the same time.

When NON PRINT is specified, only the information on defective parts is displayed on the host computer screen.

(3) RE-PRINT (Re-print) PF3

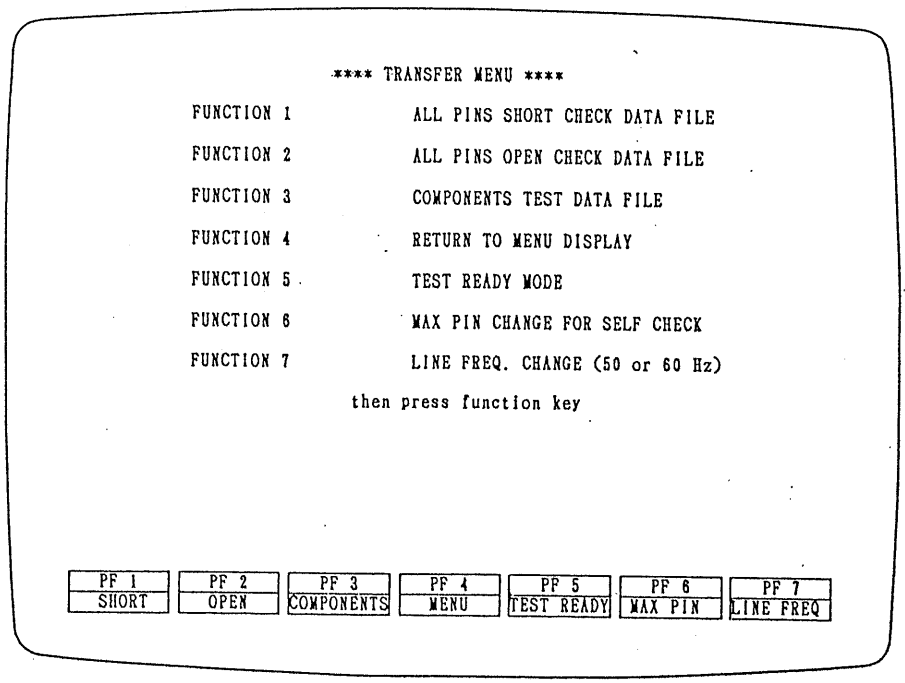
The test result can be printed out again according to the mode specified by PF2.

Note: If the mode specified by PF2 (PRINT CONT) is NON PRINT, no information is printed even if RE-PRINT is specified. If the mode specified by PF2 is FAIL or ALL PRINT, the result of the preceding test is printed when PF3 is pressed.
To print only the information on defective parts, press PF13 (FAIL RE-PR); the defective-part information can be re-printed without changing the printing mode specified by PF2.

(4) TRANSFER (Execution program transfer) PF4

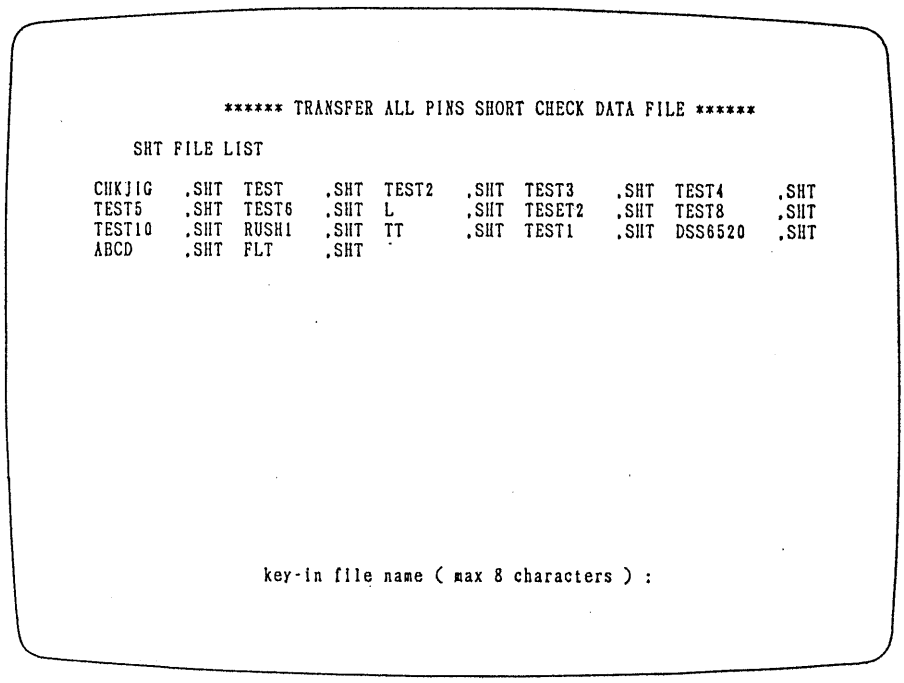
The TRANSFER program transfers execution programs from the work files on a floppy disk in the host computer to the APC-2000 main frame.

PF1: Transfers the all-pin short check program.
PF2: Transfers the all-pin open check program.
PF3: Transfers the component test program.
PF4: To MENU mode
PF5: To TEST READY mode
PF6: When the number of testing pins for APC-2000 has been increased or decreased (MPX boards have been increased or decreased), key in the maximum number of testing pins. The SELF CHECK operation will be performed for the newly specified number of testing pins automatically.
PF7: When the line frequency for APC-2000 has been changed because the Tester has been moved to a different location, use this key for selecting the frequency (50Hz or 60Hz).

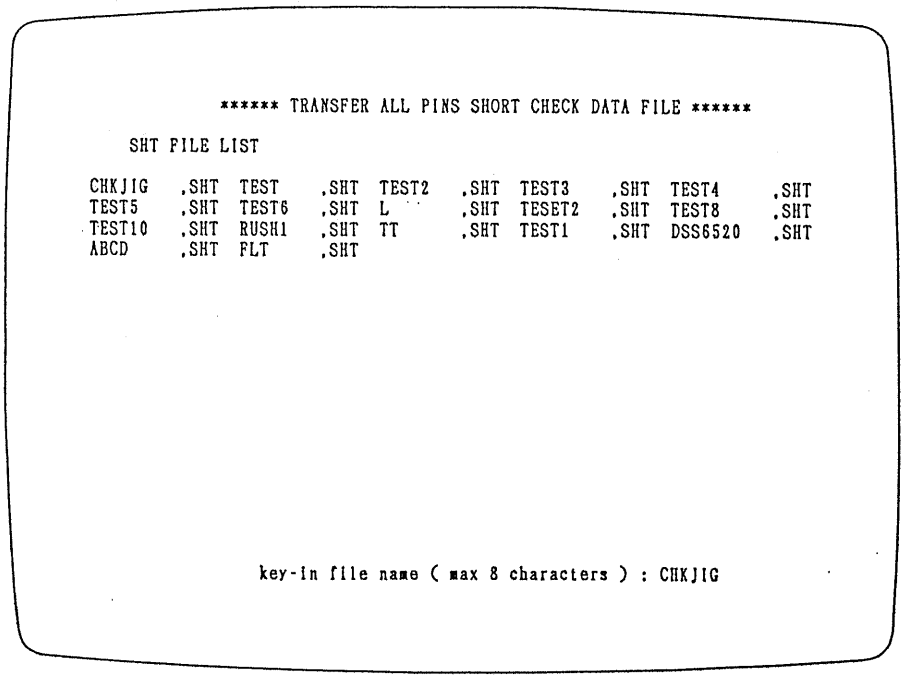


When PF1 is selected, the information below appears on the screen.

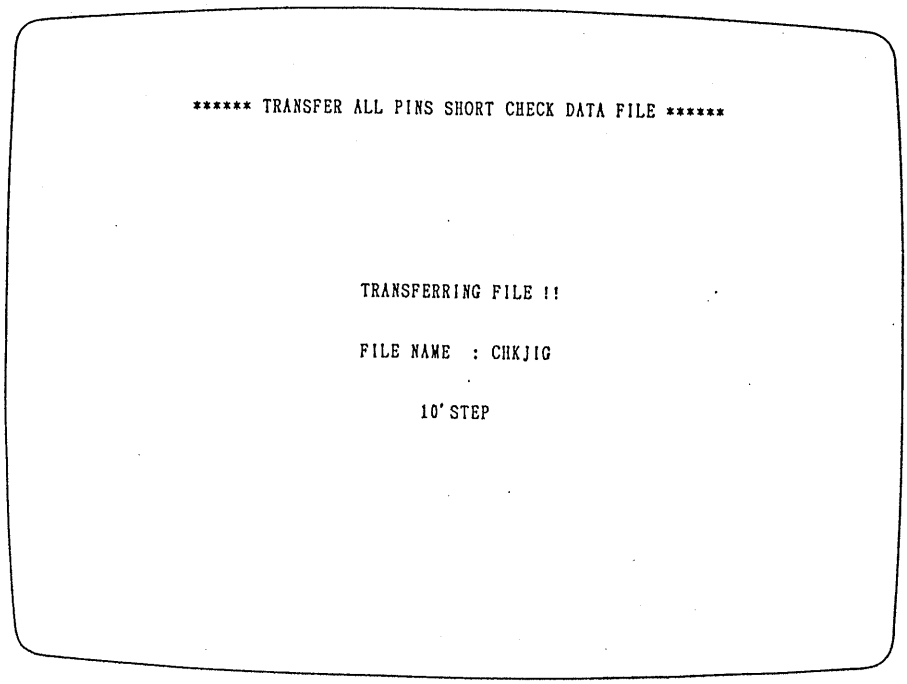
PF1



C H K J I G

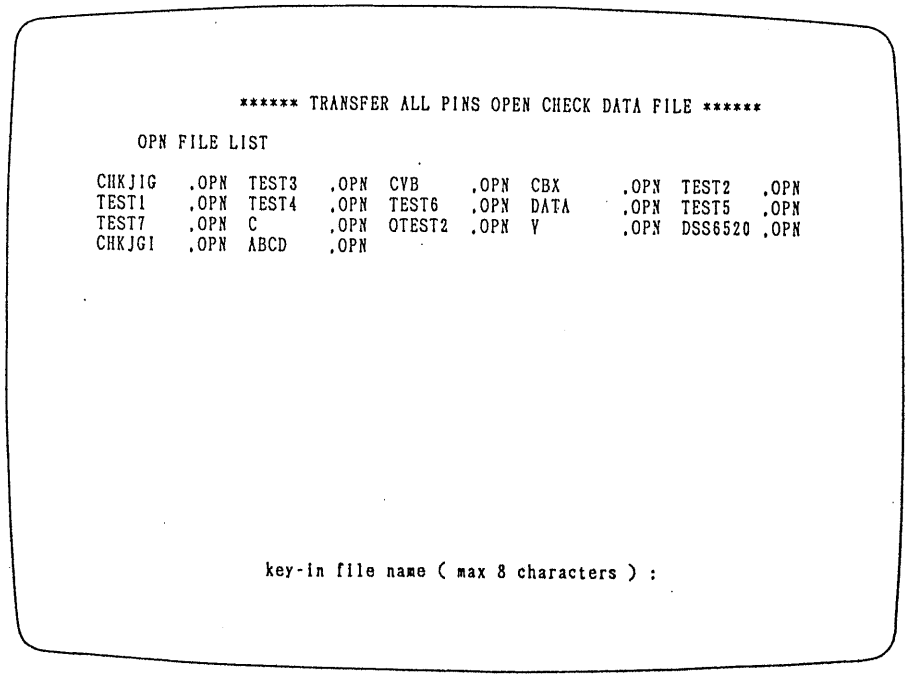


CR CR: RETURN or ENTER switch

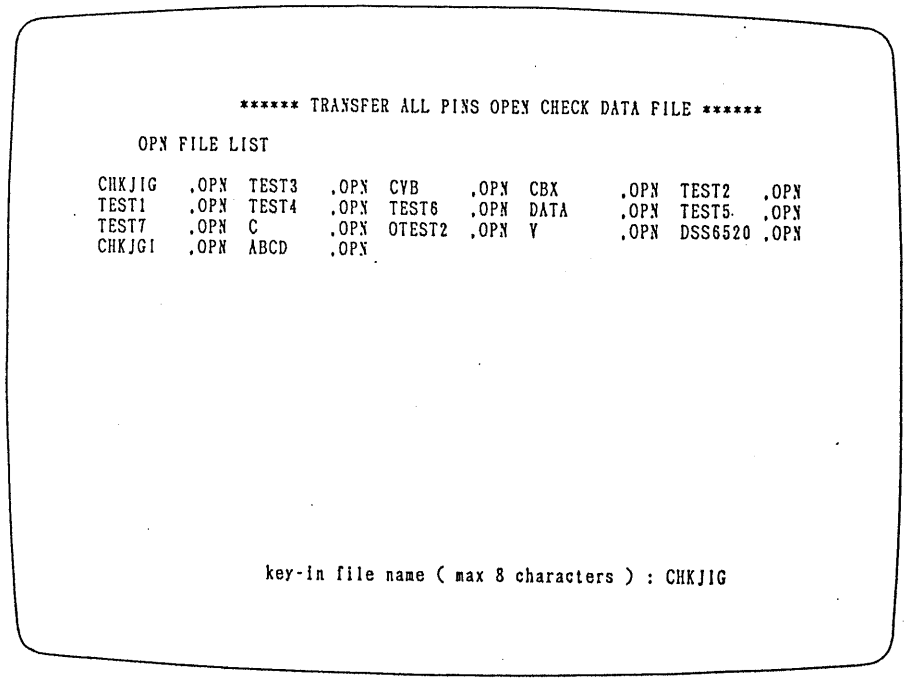


When the file has been transferred, the control returns to TRANSFER MENU.
Then, select PF2.

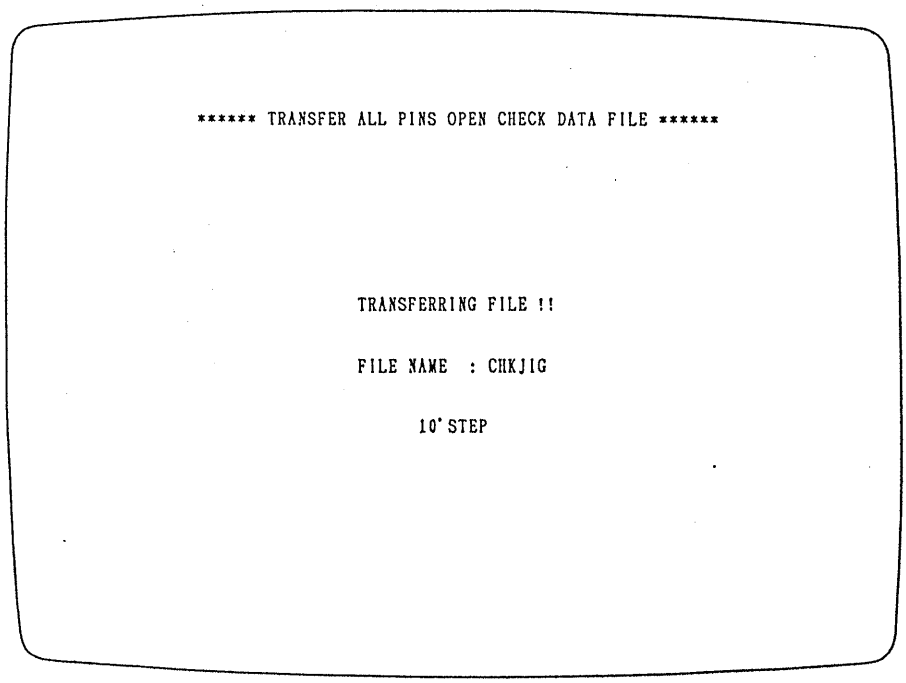
PF2



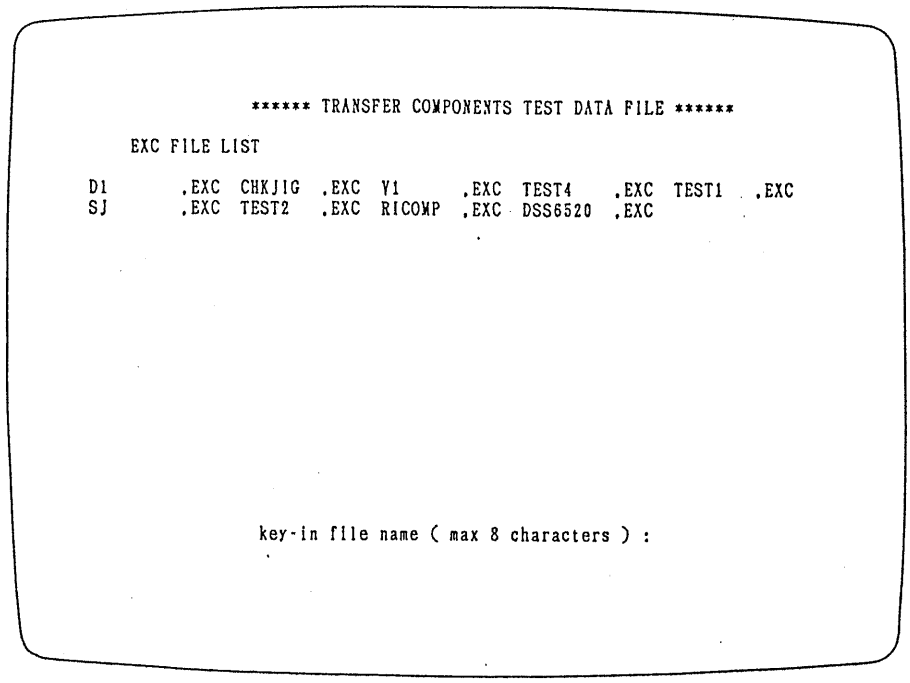
C H K J I G



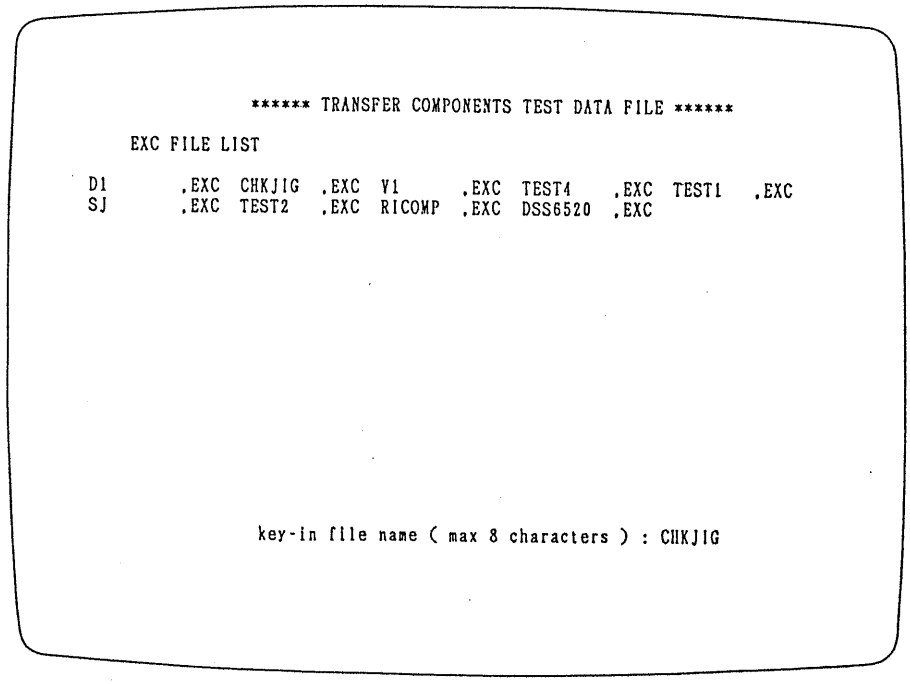
CR



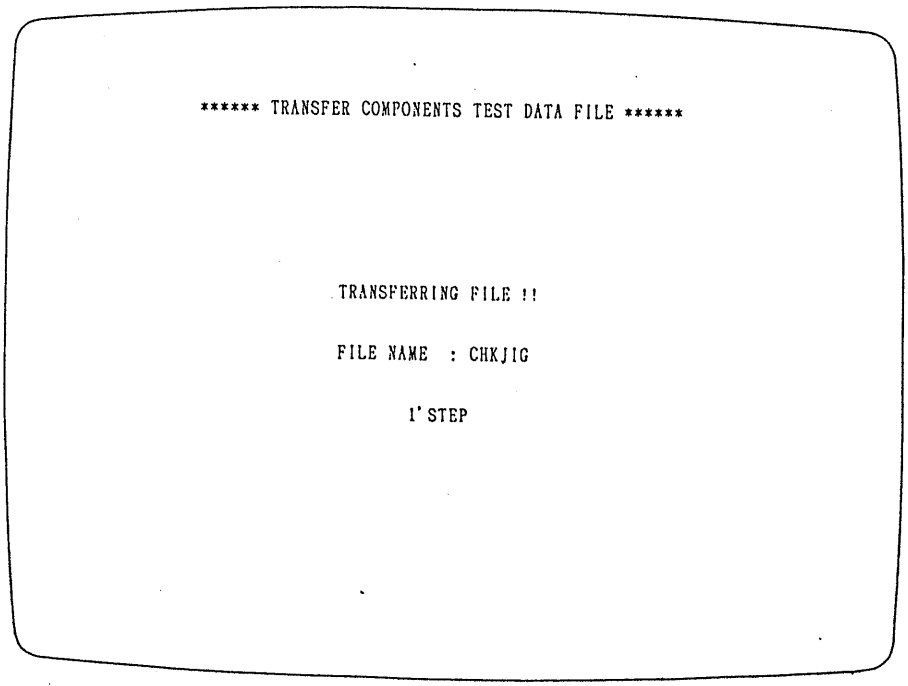
When the file has been transferred, the control returns to TRANSFER MENU.
PF3



C H K J I G



CR



When the file has been transferred, the control returns to TRANSFER MENU.

If PF5 is selected from the TRANSFER MENU, the system is set in the TEST READY mode again.

PF5	TEST READY mode
↓	
PF5	MAINTENANCE & MODIFY

(5) MAINTE (Maintenance and modification) PF5

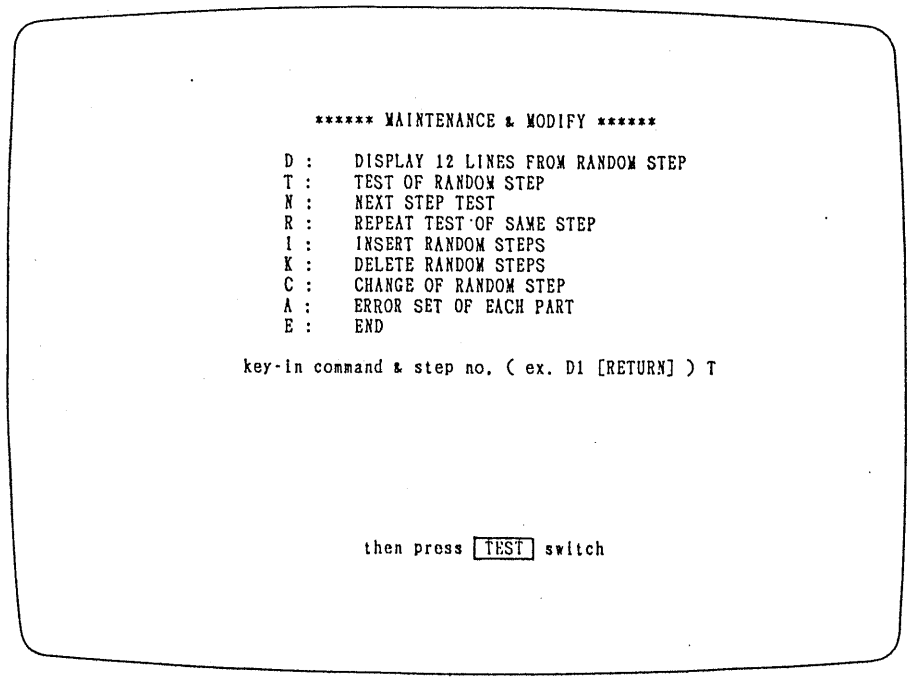
The MAINTE program can display, modify, or execute any desired steps of an execution program. It is useful for debugging the execution program because the user can monitor the program step execution by the host computer screen.

```
                    ****** MAINTENANCE & MODIFY ******

                    D :   DISPLAY 12 LINES FROM RANDOM STEP
                    T :   TEST OF RANDOM STEP
                    N :   NEXT STEP TEST
                    R :   REPEAT TEST OF SAME STEP
                    I :   INSERT RANDOM STEPS
                    K :   DELETE RANDOM STEPS
                    C :   CHANGE OF RANDOM STEP
                    A :   ERROR SET OF EACH PART
                    E :   END

                key-in command & step no, ( ex. D1 [RETURN] ) D1

                                          Actual Standard Parts  +   -
STEP  PARTS  +PIN -PIN GND1 GND2 Value    Value  Location err err delay EXT

0001  R0001  001  000          1.24 o  1.41 o    1A     10  10   00    0
0002  R0002  002  003          7.48 o  7.54 o    1A     10  10   00    0
0003  R0003  004  005          9.95 o 10.34 o    1A     10  10   00    0
0004  R0003  005  004          99.0 o  10.0 o    1A     10  10   00    0
0005  R0004  006  007          33.3 o  33.0 o    1A     10  10   00    0
0006  R0005  009  008          69.7 o  69.5 o    1A     10  10   00    5
0007  R0006  011  010          62.1 o  81.7 o    1A     10  10   00    6
0008  R0007  012  013          99.9 o  99.6 o    2A     10  10   00    7
0009  R0007  012  013          100. o  096. o    2A     10  10   00    8
0010  R0008  014  015          340. o  333. o    2A     10  10   00    9
0011  R0009  017  016          677. o  668. o    2A     10  10   00    A
0012  R0010  019  018          817. o  888. o    2A     10  10   00    B
```

Twelve program steps are displayed starting from the step number specified after D.

D 1 CR

If only D and CR are pressed as "D CR", the next page is displayed.



Any desired steps can be executed. Press T, and the message "then press TEST switch" is displayed. In response to this message, press the TEST switch on the printer section.

```
****** MAINTENANCE & MODIFY ******

    D :   DISPLAY 12 LINES FROM RANDOM STEP
    T :   TEST OF RANDOM STEP
    N :   NEXT STEP TEST
    R :   REPEAT TEST OF SAME STEP
    I :   INSERT RANDOM STEPS
    K :   DELETE RANDOM STEPS
    C :   CHANGE OF RANDOM STEP
    A :   ERROR SET OF EACH PART
    E :   END

        key-in command & step no, ( ex. D1 [RETURN] ) T1,4

                                  Actual Standard Parts   +   -
STEP  PARTS  +PIN -PIN GND1 GND2 Value   Value  Location err err delay EXT

0001  C0001  001  000           10.0nF  11.0nF    1A     10  10   00    0
                    Measured Value    00.0nF  ***** FAIL
0002  R0002  002  003            7.48 o  7.54 o    1A     10  10   00    0
                    Measured Value,   7.54 o  ***** GOOD
0003  R0003  004  005            9.95 o 10.34 o    1A     10  10   00    0
                    Measured Value   10.10 o  ***** GOOD
0004  R0003  005  004           99.0 o 100.0 o    1A     10  10   00    0
                    Measured Value    89.9 o  ***** GOOD
```

The steps indicated by the figures input after T are executed. If "T1, 4" is input, for example, steps 1 - 4 are executed.

T 1 , 4 CR

```
****** MAINTENANCE & MODIFY ******

    D :   DISPLAY 12 LINES FROM RANDOM STEP
    T :   TEST OF RANDOM STEP
    N :   NEXT STEP TEST
    R :   REPEAT TEST OF SAME STEP
    I :   INSERT RANDOM STEPS
    K :   DELETE RANDOM STEPS
    C :   CHANGE OF RANDOM STEP
    A :   ERROR SET OF EACH PART
    E :   END

        key-in command & step no, ( ex. D1 [RETURN] ) N

                                  Actual Standard Parts   +   -
STEP  PARTS  +PIN -PIN GND1 GND2 Value   Value  Location err err delay EXT

0002  R0002  002  003            7.48 o  7.54 o    1A     10  10   00    0
                    Measured Value    7.53 o  ***** GOOD
```

Input N, and the next step is executed.

N

```
                    ****** MAINTENANCE & MODIFY ******

                        D :    DISPLAY 12 LINES FROM RANDOM STEP
                        T :    TEST OF RANDOM STEP
                        N :    NEXT STEP TEST
                        R :    REPEAT TEST OF SAME STEP
                        I :    INSERT RANDOM STEPS
                        K :    DELETE RANDOM STEPS
                        C :    CHANGE OF RANDOM STEP
                        A :    ERROR SET OF EACH PART
                        E :    END

                  key-in command & step no. ( ex. D1 [RETURN] ) R10

                                          Actual Standard Parts   +   -
STEP  PARTS  +PIN -PIN GND1 GND2 Value    Value  Location err err delay EXT

0002  R0002  002  003          7.48 o  7.54 o    1A     10  10   00     0
                    Measured Value    7.56 o  ····· GOOD
                    Measured Value    7.55 o  ····· GOOD
                    Measured Value    7.55 o  ····· GOOD
                    Measured Value    7.55 o  ····· GOOD
                    Measured Value    7.55 o  ····· GOOD
                    Measured Value    7.55 o  ····· GOOD
                    Measured Value    7.55 o  ····· GOOD
                    Measured Value    7.55 o  ····· GOOD
                    Measured Value    7.55 o  ····· GOOD
                    Measured Value    7.55 o  ····· GOOD
```

The steps specified for T or C can be executed repeatedly. The steps are executed the number of times indicated by the figures after R.

R 1 0 CR

```
****** MAINTENANCE & MODIFY ******

        D :    DISPLAY 12 LINES FROM RANDOM STEP
        T :    TEST OF RANDOM STEP
        N :    NEXT STEP TEST
        R :    REPEAT TEST OF SAME STEP
        I :    INSERT RANDOM STEPS
        K :    DELETE RANDOM STEPS
        C :    CHANGE OF RANDOM STEP
        A :    ERROR SET OF EACH PART
        E :    END

      key-in command & step no, ( ex. D1 [RETURN] ) I1

                                  Actual Standard Parts   +   -
STEP  PARTS  +PIN -PIN GND1 GND2 Value   Value  Location err err delay EXT

0001  R0002  002  003           7.48 o  7.54 o    1A     10  10   00    0

0001  R0001  000  001           1.24 o  1.24 o    1A     10  10   00    0

 PF 1   PF 2   PF 3   PF 4   PF 5   PF 6   PF 7
 SPACE    k      M      p      n      u      m
```

New steps can be inserted between desired steps.

I 1 CR

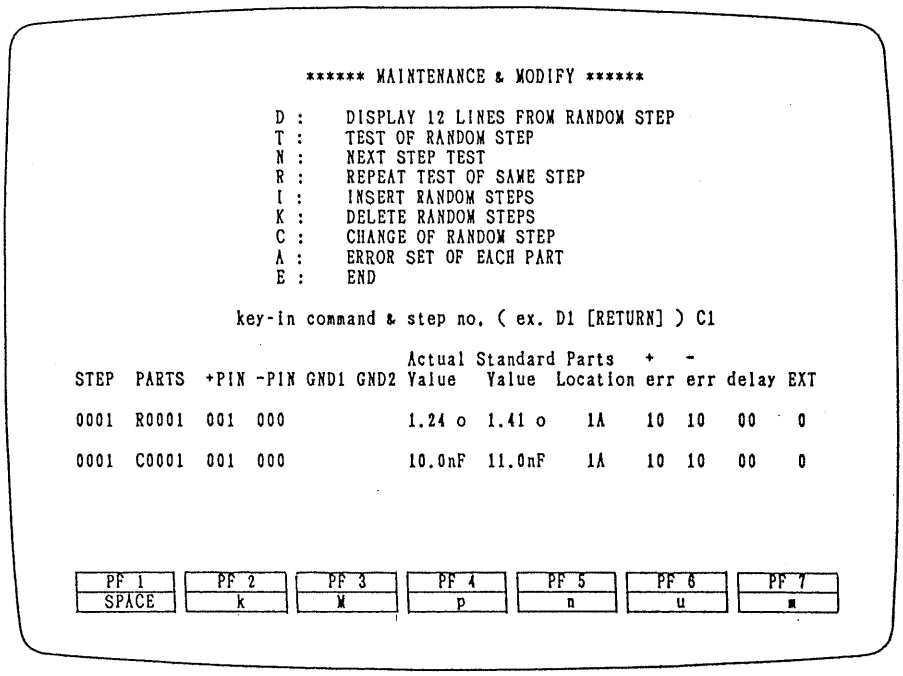
After the steps have been inserted, press E (E).

```
****** MAINTENANCE & MODIFY ******

        D :    DISPLAY 12 LINES FROM RANDOM STEP
        T :    TEST OF RANDOM STEP
        N :    NEXT STEP TEST
        R :    REPEAT TEST OF SAME STEP
        I :    INSERT RANDOM STEPS
        K :    DELETE RANDOM STEPS
        C :    CHANGE OF RANDOM STEP
        A :    ERROR SET OF EACH PART
        E :    END

      key-in command & step no, ( ex. D1 [RETURN] ) K


      key-in start step-number for delete ? 115


      key-in end step number for delete   ? 116
```

Any desired steps can be deleted.

To delete steps 115 - 116, for example, key in as follows:

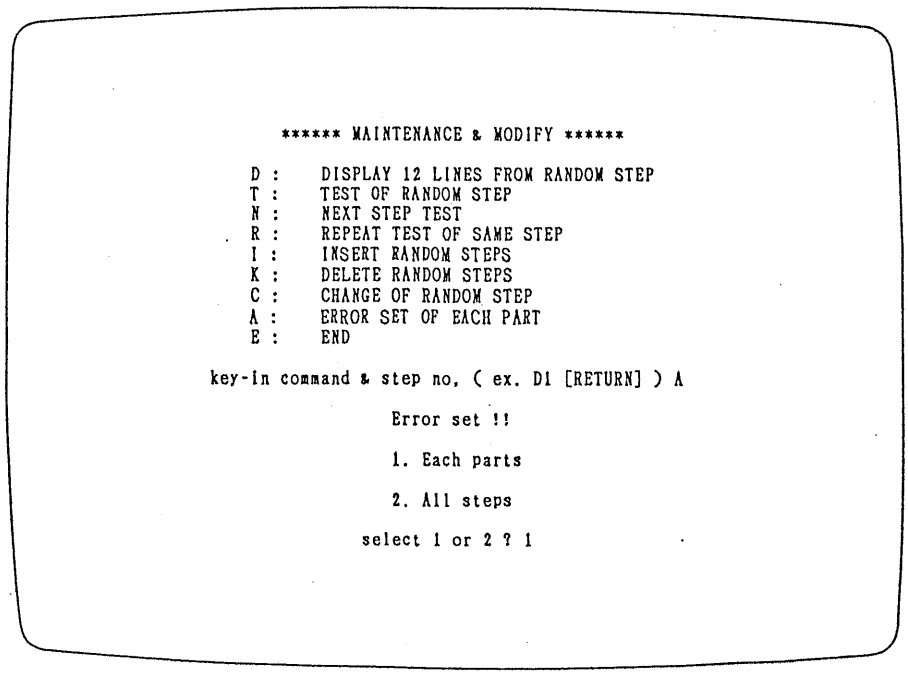
K 1 1 5 CR 1 1 6 CR



Any desired steps can be changed.

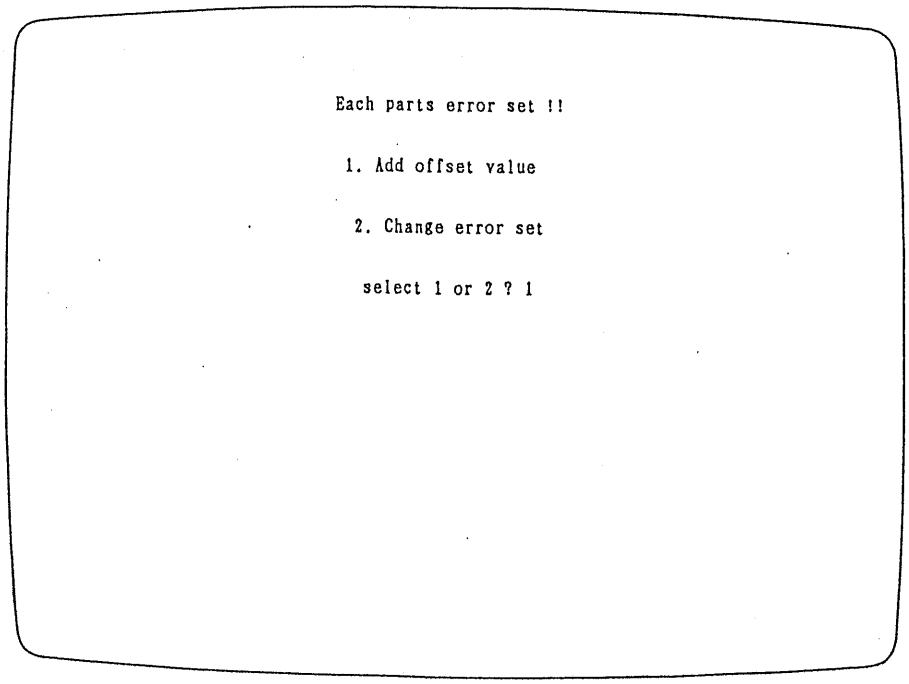
C1 CR

Press CR for the item not to be changed. Press the ESC key after entering a standard value, and the mark "*" appears to suppress execution of the pertinent step. The "*" disappears when the ESC key is pressed again.

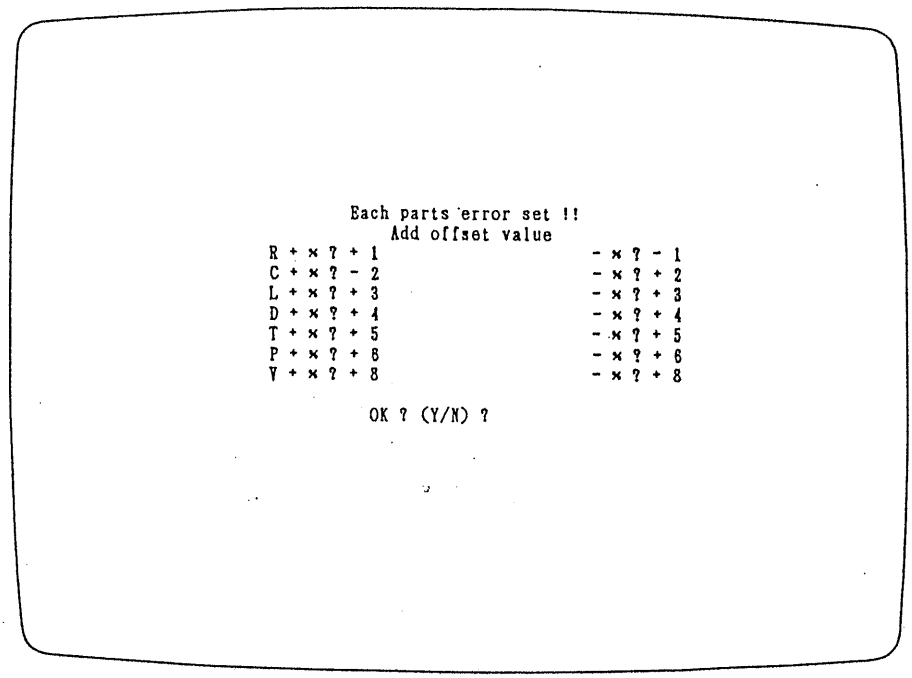


All the tolerance ranges of a desired type of parts can be changed at a time.

A
↓
1

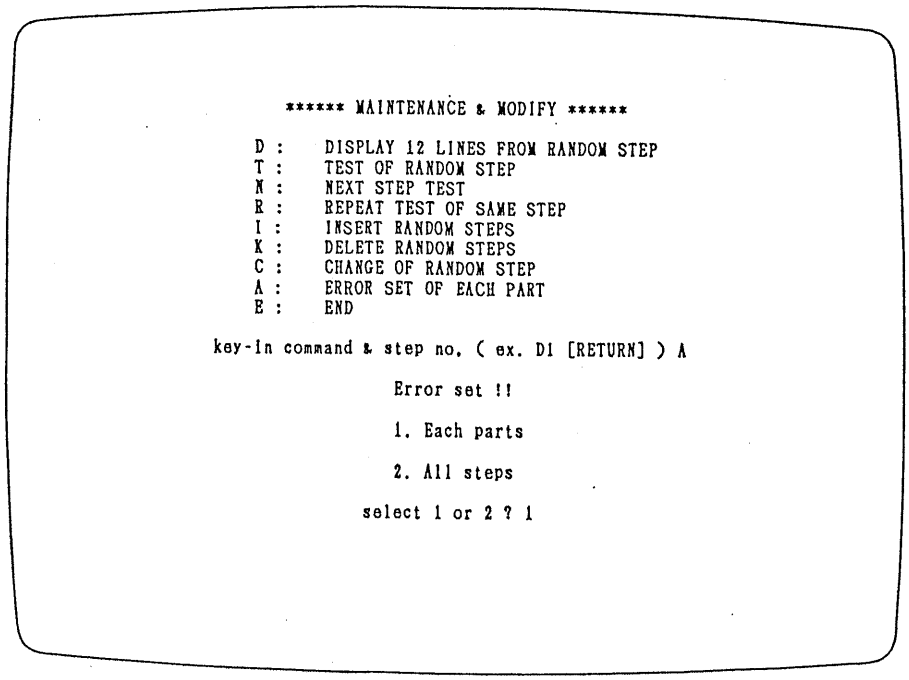


1



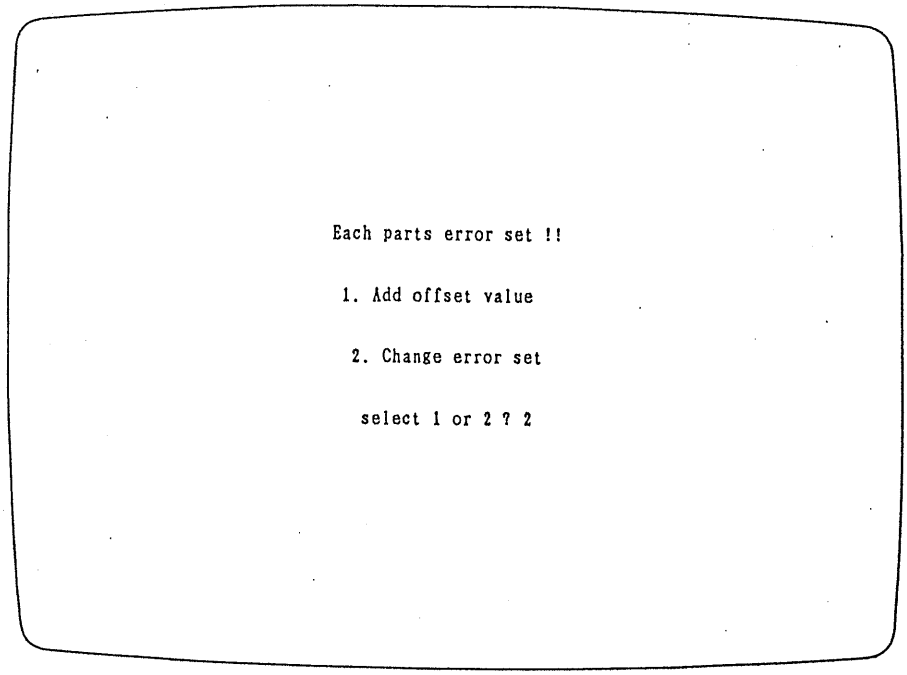
+1CR　-1CR
-2CR　+2CR

+8CR　+8CR
Y

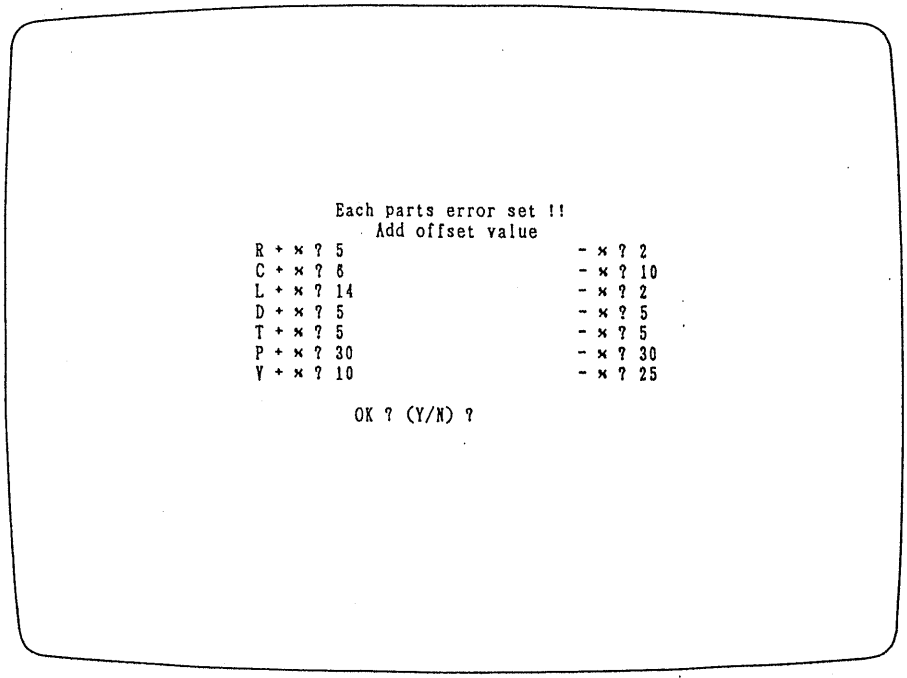


Select A again and set the tolerance range for each type of parts.

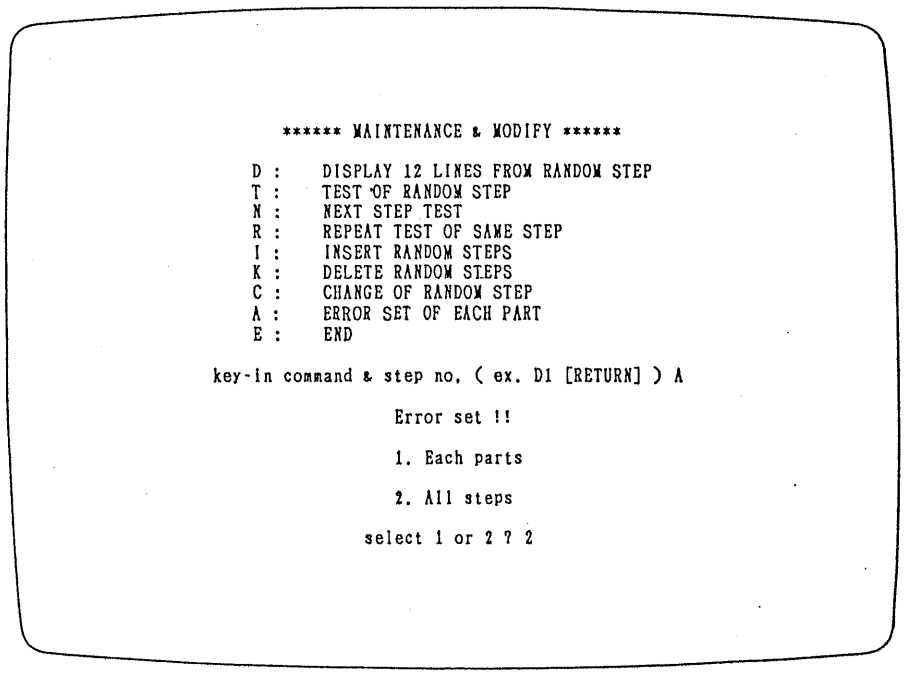
A　1



2

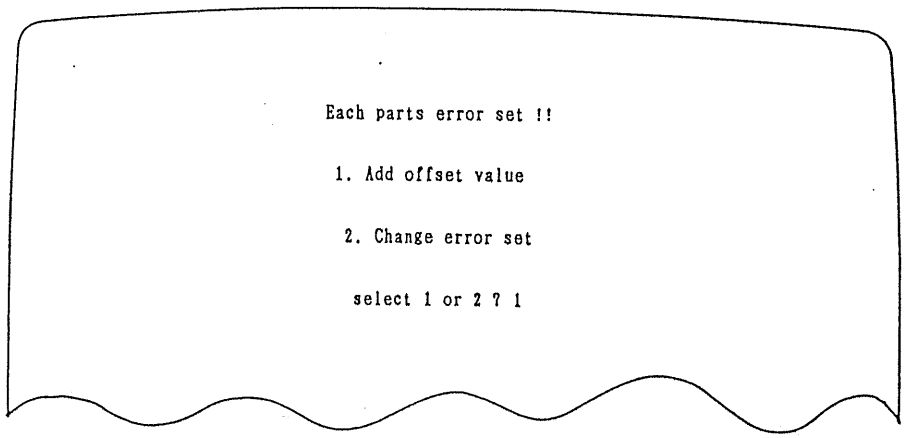


5 CR　　2 CR
6 CR　　1 CR
⋮　　⋮
1 CR　　2 CR
Y

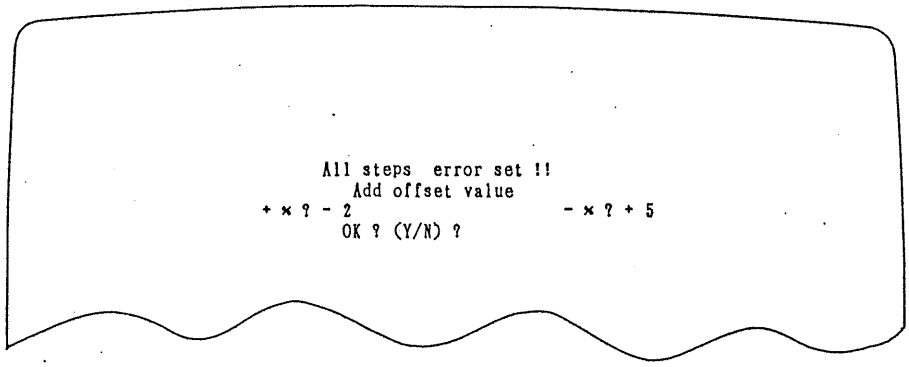


The tolerance ranges for all steps can be changed at a time.

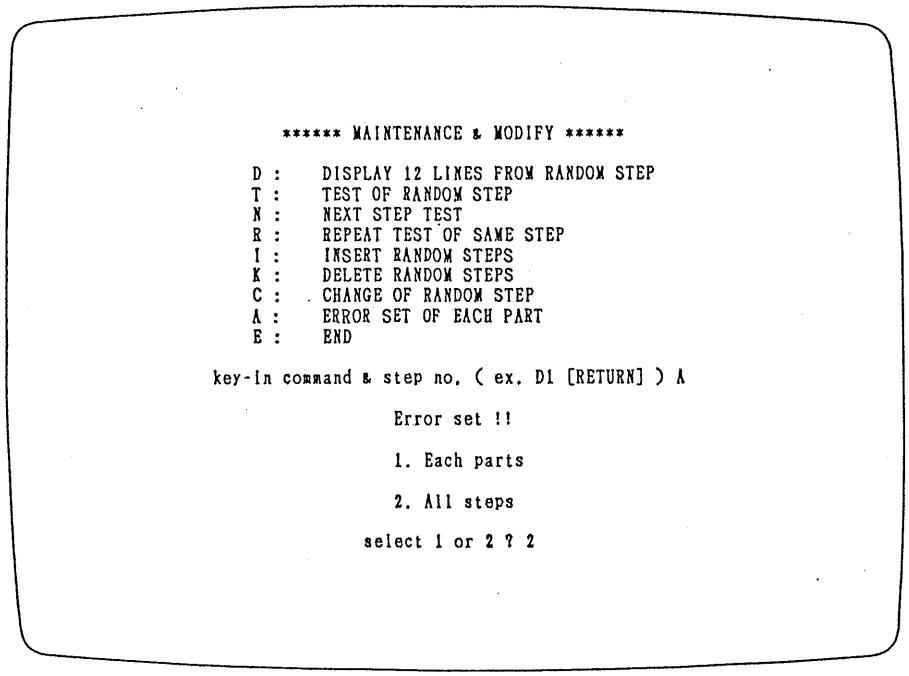
A 2



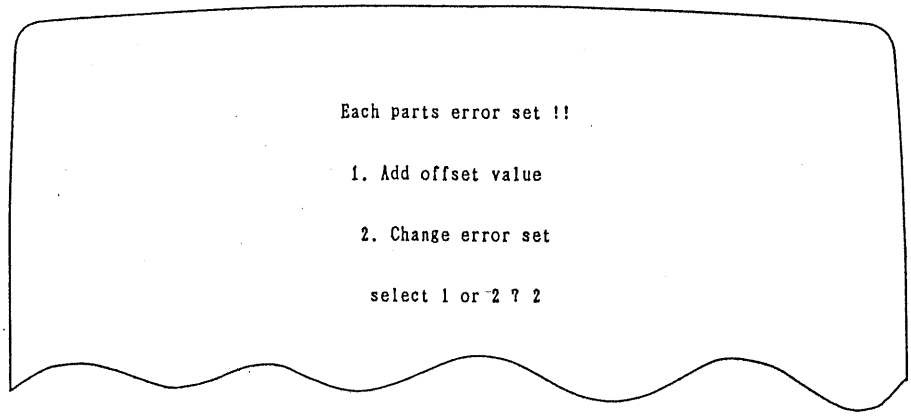
1



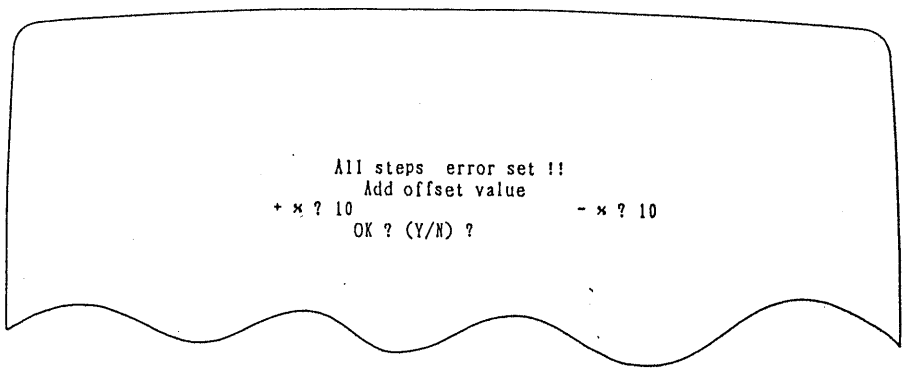
-2 CR +5 CR Y



A 2

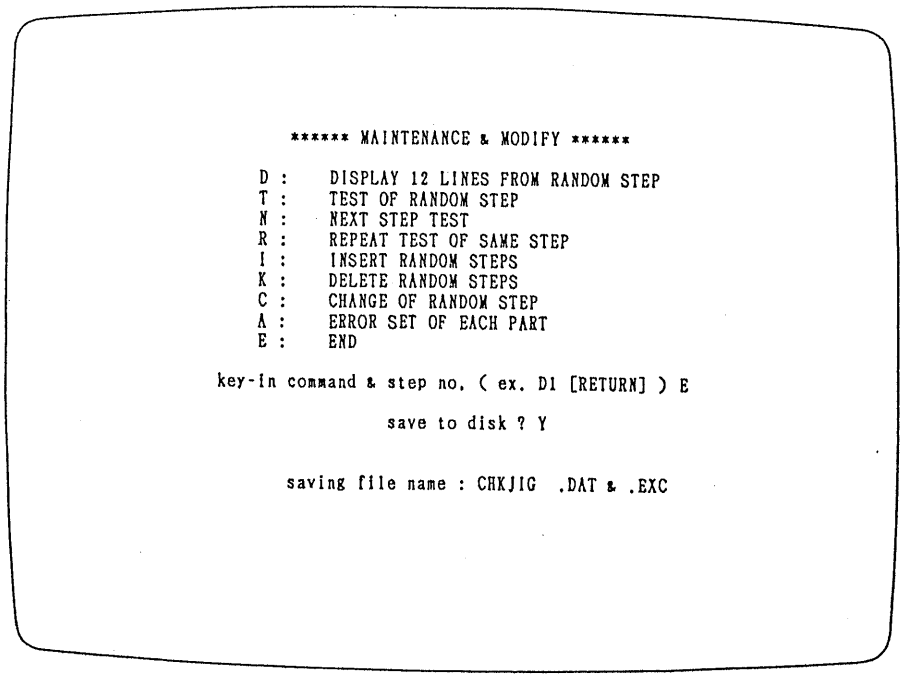


2



1 0 CR 1 0 CR Y

8620088



To terminate the maintenance operation, press E. Then the message "save to disk?" is displayed. Respond to this message with "Y" if the execution program in the floppy disk is to be replaced by the program on which the maintenance operation has been performed. When Y is pressed, the pin information in the initial data is also replaced by that in the execution program.

Note: It takes some time to save the program because the entire program is replaced (about 5 minutes for a program of 300 steps). Normally, the content of the floppy disk need not be replaced each time an item is modified; save the program by pressing Y only when debugging of the entire program is completed.

E Y

If the program in the floppy disk need not be replaced, press N.

E N

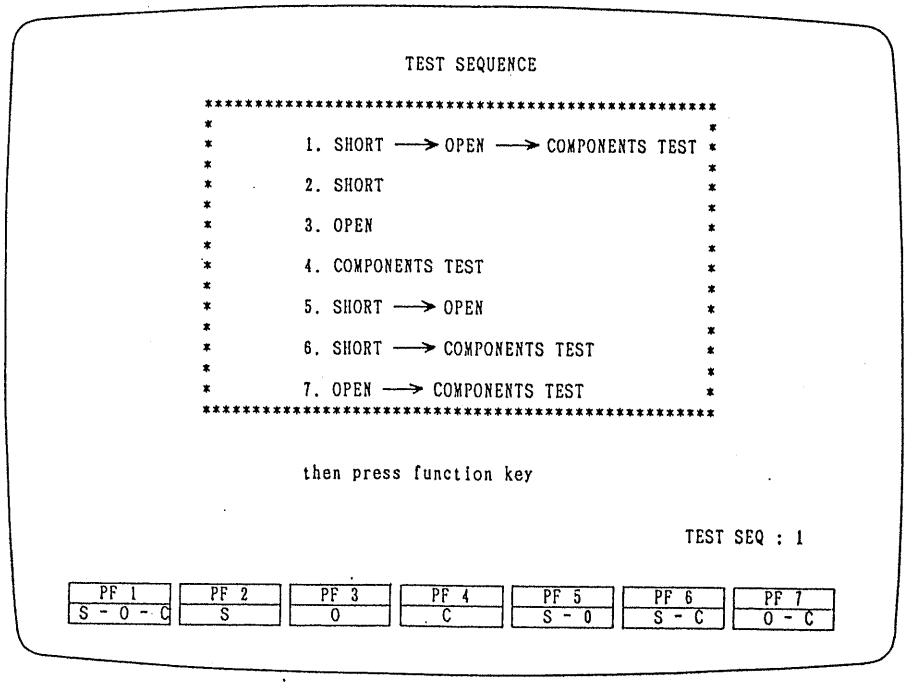
1

(6) TEST SEQ (Test sequence) PF6

Three types of tests can be executed.

(1) SHORT : All-pin short check
(2) OPEN : All-pin open check
(3) COMPONENT TEST: Test in units of components parts

The types of the tests to be executed and their execution order can be specified by the user.



PF6

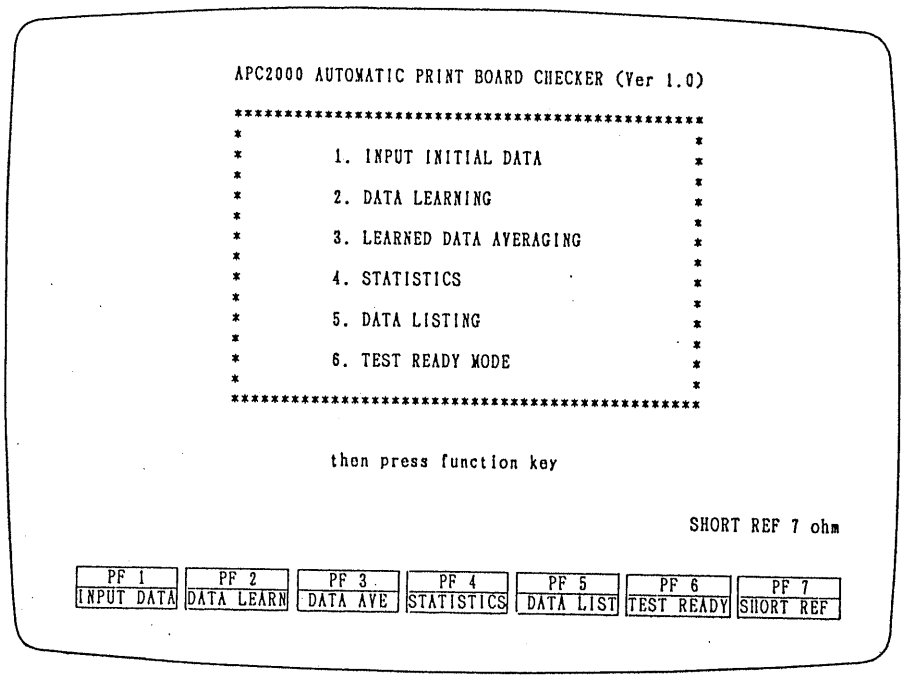
(7) MAP/NORM (Map/normal display switching) PF7

Each time PF7 is pressed, the screen display mode is switched between MAP mode and NORM mode (the current mode is displayed in the lower right-hand corner of the screen).

The measuring speed with the MAP mode is higher than that with the NORM mode because the amount of the information displayed in the MAP mode is less than that displayed in the NORM mode. Switch the mode according to the user's requirement.

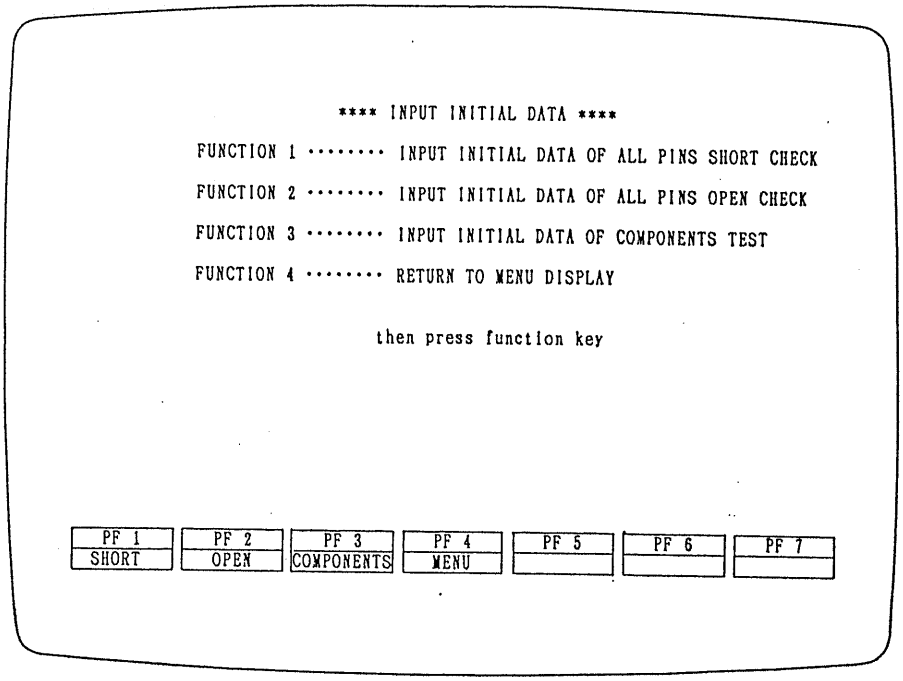
PF7

5.3.2 Functions in MENU mode



(1) INPUT INITIAL DATA (Initial data creation)

PF1



1

```
****** INPUT INITIAL DATA OF PINS SHORT CHECK ******

   SPS FILE LIST

TT       .SPS  TEST6   .SPS  TEST1   .SPS  TESET2   .SPS  TEST2   .SPS
TEST3    .SPS  TEST10  .SPS  TEST8   .SPS  CHKJIG   .SPS  RUSH1   .SPS
DATA     .SPS  DSS6520 .SPS  ABCD    .SPS


                key-in file name ( max 8 characters ) : FLT
```

Specify the file name with the maximum of eight characters (starting with a letter).

F L T CR

```
****** INPUT INITIAL DATA OF PINS SHORT CHECK ******

   SPS FILE LIST

TT       .SPS  TEST6   .SPS  TEST1   .SPS  TESET2   .SPS  TEST2   .SPS
TEST3    .SPS  TEST10  .SPS  TEST8   .SPS  CHKJIG   .SPS  RUSH1   .SPS
DATA     .SPS  DSS6520 .SPS  ABCD    .SPS  FLT      .SPS


                key-in file name ( max 8 characters ) : FLT
                generate from first step ? (Y/N)
```

If the same file name exists, whether or not to replace the existing file is asked.

F L T CR Y

```
            ****** INPUT INITIAL DATA OF PINS SHORT CHECK ******

MAX PIN ····· 767    ( MAX PIN OF FILE [FLT] IS 0 )

REF PIN    PASS PIN

000 ····· 001, 002, 003, 004, 005, 006, 007, 008
001 ····· 000, 002, 003, 004, 005, 006, 007, 008
002 ····· 000, 001, 003, 004, 005, 006, 007, 008
003 ····· 000, 001, 002, 004, 005, 006, 007, 008
004 ····· 000, 001, 002, 003, 005, 006, 007, 008
005 ····· 000, 001, 002, 003, 004, 006, 007, 008
006 ····· 000, 001, 002, 003, 004, 005, 007, 008
007 ····· 000, 001, 002, 003, 004, 005, 006, 008
008 ····· 000, 001, 002, 003, 004, 005, 006, 007
```

Specify the maximum number of pins and generate data.

7 6 7 CR

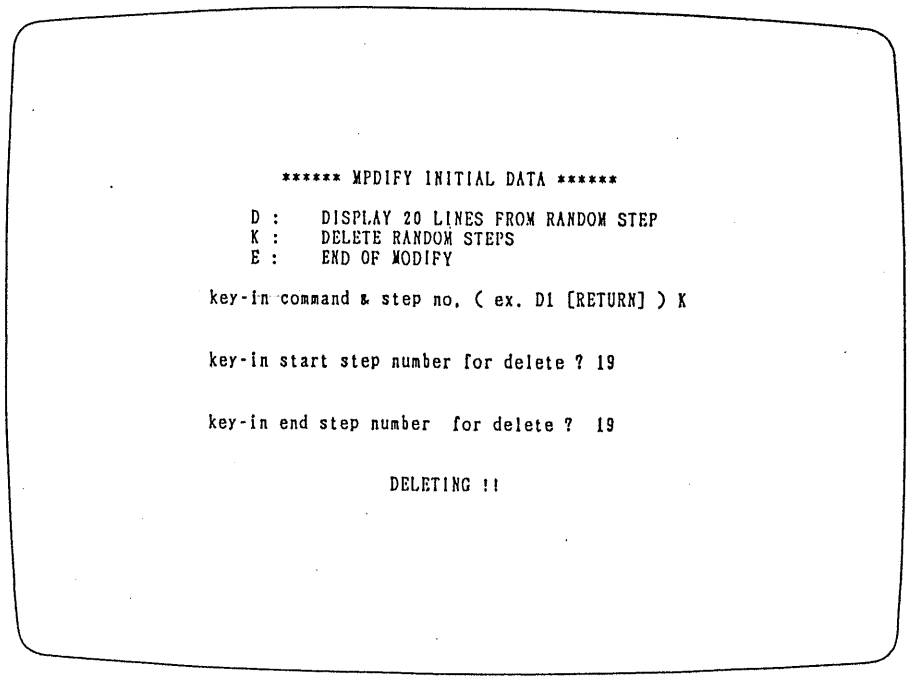
0 , 0 , ---- CR

To modify the input data, press the ESC key.

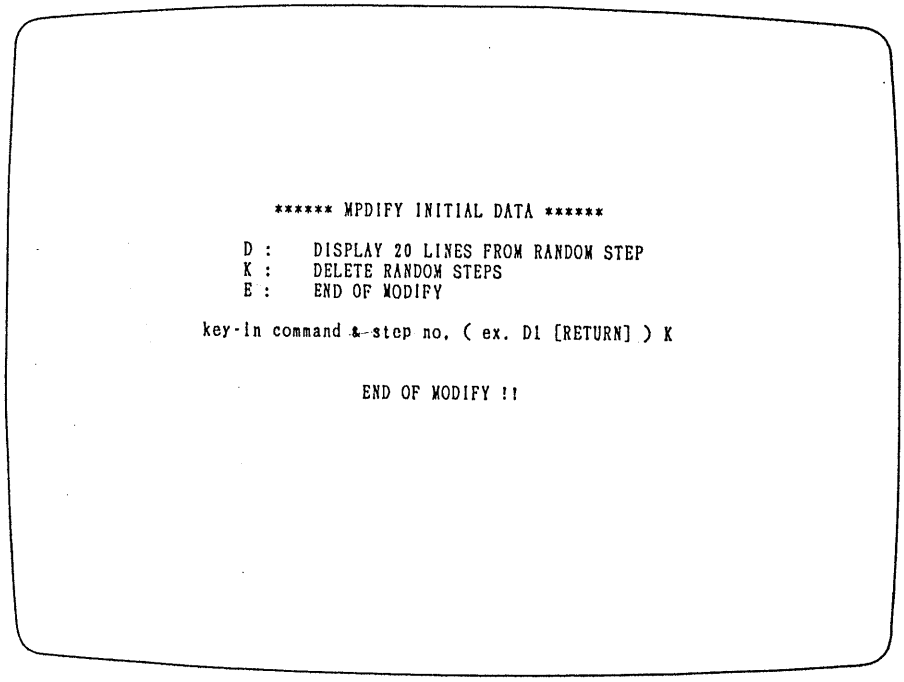
ESC

```
                ****** MODIFY INITIAL DATA ******

                   D :   DISPLAY 20 LINES FROM RANDOM STEP
                   K :   DELETE RANDOM STEPS
                   E :   END OF MODIFY

              key-in command & step no. ( ex. D1 [RETURN] ) D1

STEP REF PIN    PASS PIN
0001 000 ····· 001, 002, 003, 004, 005, 006, 007, 008
0002 001 ····· 000, 002, 003, 004, 005, 006, 007, 008, 009, 010
0003 002 ····· 000, 001, 004, 005, 006, 007, 008
0004 003 ····· 000, 001, 002, 004, 005, 006, 007, 008, 009
0005 004 ····· 000, 001, 002, 003, 005, 006, 007, 008
0006 005 ····· 000, 001, 002, 003, 004, 006, 007, 008, 009, 010
0007 005 ····· 011
0008 006 ····· 000, 001, 002, 003, 004, 005, 007, 008
0009 007 ····· 000, 001, 002, 003, 004, 005, 006, 008, 009, 010
0010 007 ····· 011, 012, 013
0011 008 ····· 000, 001, 002, 003, 004, 005, 006, 007, 009
0012 009 ····· 001, 003, 005, 007, 008
0013 010 ····· 001, 005, 007
0014 011 ····· 007, 005
0015 012 ····· 007
0016 013 ····· 007
0017 014 ····· 077, 066, 055, 044, 033, 022, 011
0018 015 ····· 123, 456
0019 016 ····· 013, 034, 046, 068
```

D 1 CR



K 19 CR 19 CR



When the initial data has been modified, press E.
E

```
****** INPUT INITIAL DATA OF PINS OPEN CHECK ******

   OPN FILE LIST

CHKJIG   .OPN  TEST3   .OPN  CVB     .OPN  CBX      .OPN  TEST2   .OPN
TEST1    .OPN  TEST4   .OPN  TEST6   .OPN  DATA     .OPN  TEST5   .OPN
TEST7    .OPN  C       .OPN  CTEST2  .OPN  V        .OPN  DSS6520 .OPN
CHKJGI   .OPN  ABCD    .OPN

                key-in file name ( max 8 characters ) :
```

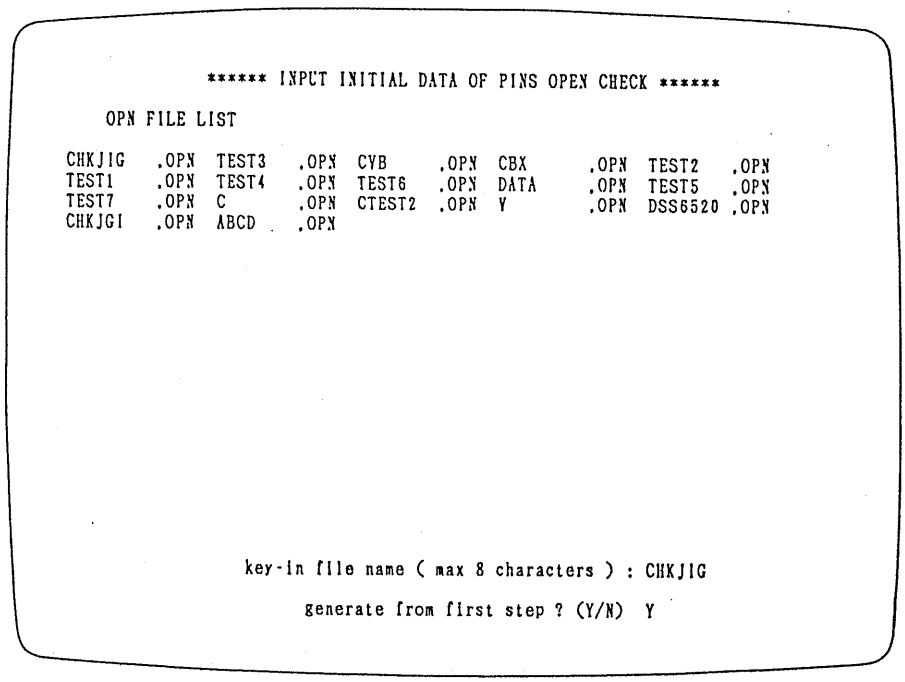
The initial data for the all-pin open check is created by the same operation flow as the initial data for the all-pin short check.

Select "2" from the INPUT INITIAL DATA screen as follows:

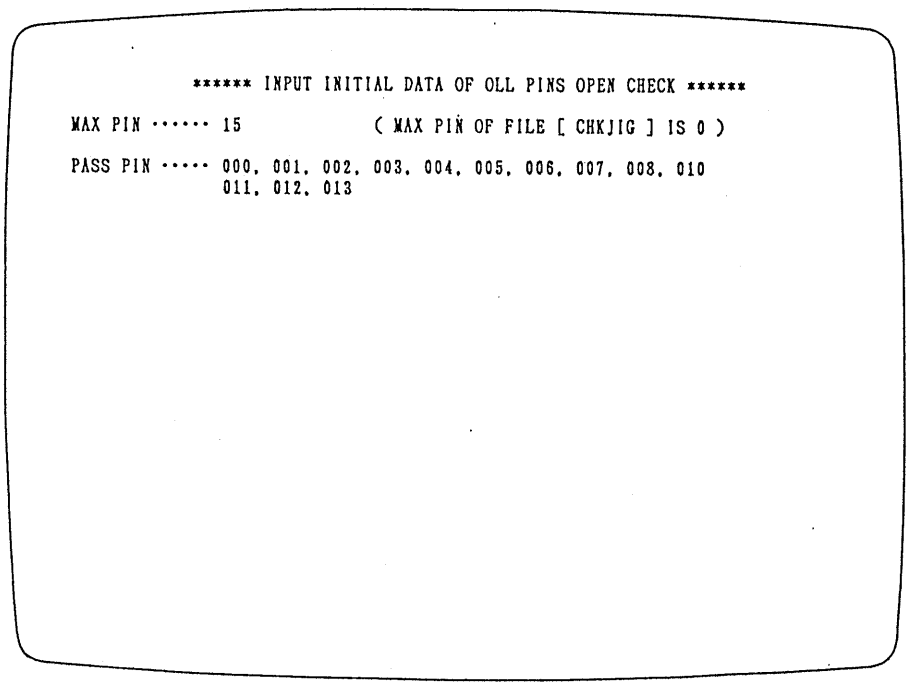
2 CR

```
****** INPUT INITIAL DATA OF PINS OPEN CHECK ******

   OPN FILE LIST

CHKJIG   .OPN  TEST3   .OPN  CVB     .OPN  CBX      .OPN  TEST2   .OPN
TEST1    .OPN  TEST4   .OPN  TEST6   .OPN  DATA     .OPN  TEST5   .OPN
TEST7    .OPN  C       .OPN  CTEST2  .OPN  V        .OPN  DSS6520 .OPN
CHKJGI   .OPN  ABCD    .OPN

                key-in file name ( max 8 characters ) : CHKJIG
```

C H K J I G CR



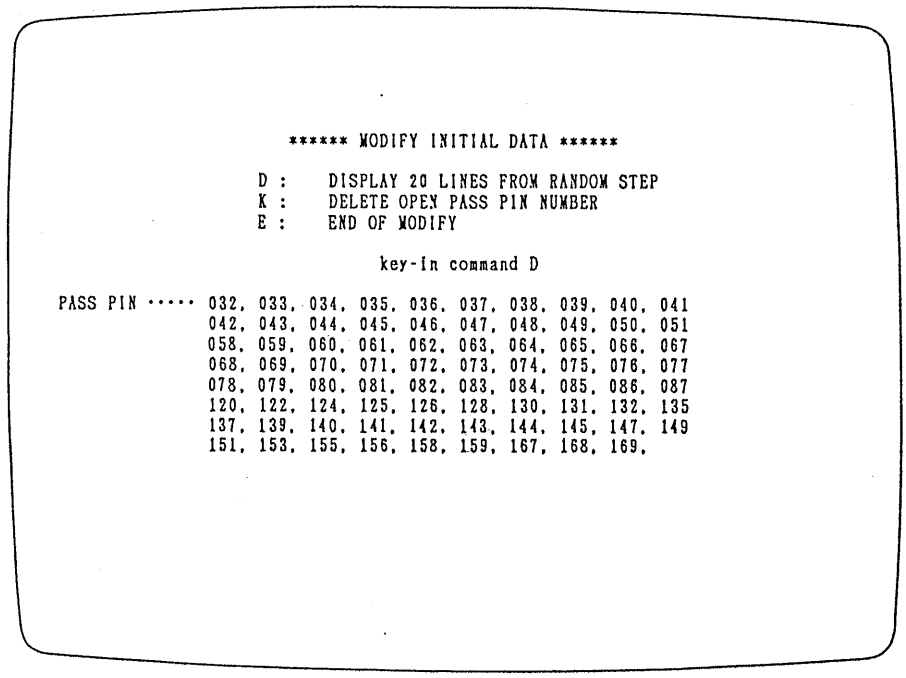
Y



1 5 CR

0 CR 1 CR ---- 1 3 E

8620097

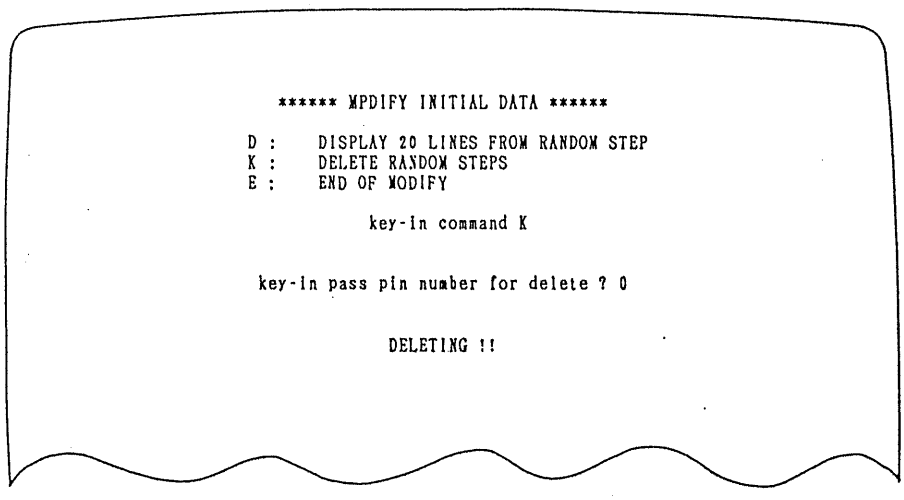


To transfer control to the modification mode:

ESC

To display the contents of the file:

D

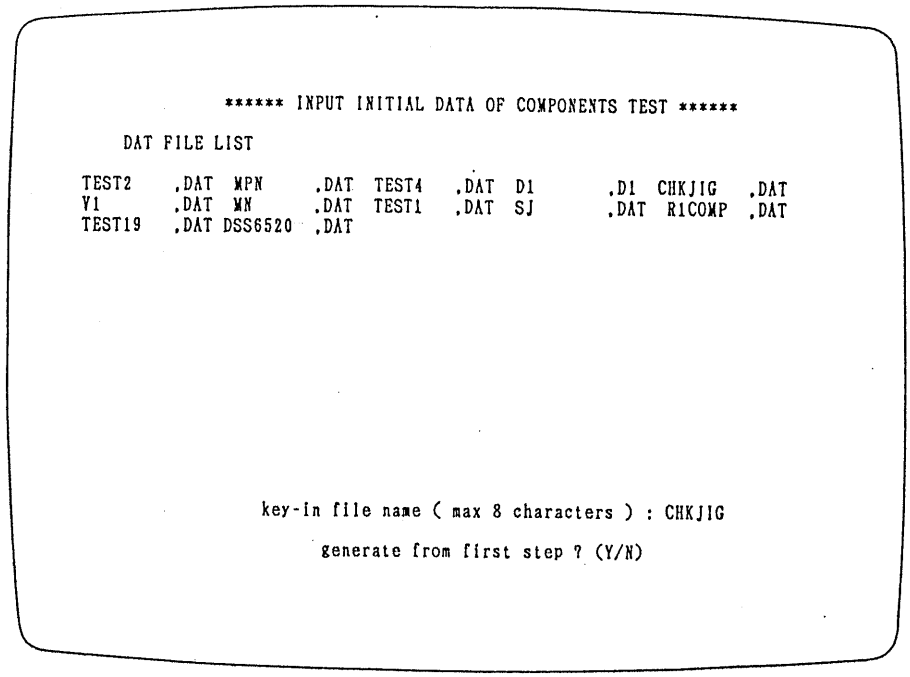


To delete steps:

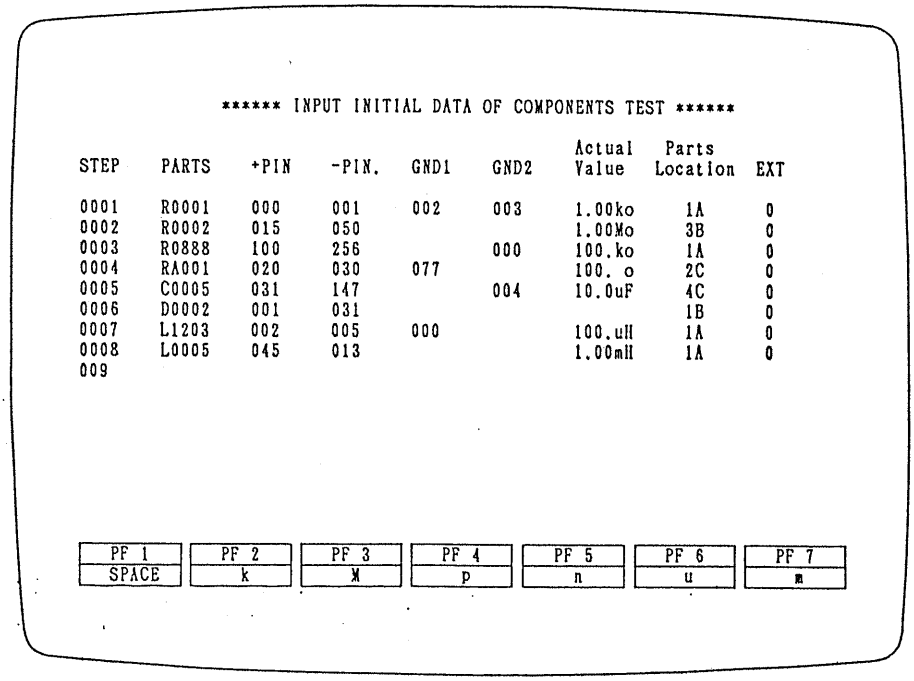
K 8 CR

To create initial data for the component test, select "3" from the INPUT INITIAL DATA screen as follows:

3 CR



```
****** INPUT INITIAL DATA OF COMPONENTS TEST ******

   DAT FILE LIST

TEST2    .DAT  MPN     .DAT  TEST4   .DAT  D1       .D1  CHKJIG   .DAT
V1       .DAT  MN      .DAT  TEST1   .DAT  SJ       .DAT  R1COMP  .DAT
TEST19   .DAT DSS6520  .DAT

                key-in file name ( max 8 characters ) : CHKJIG

                generate from first step ? (Y/N)
```



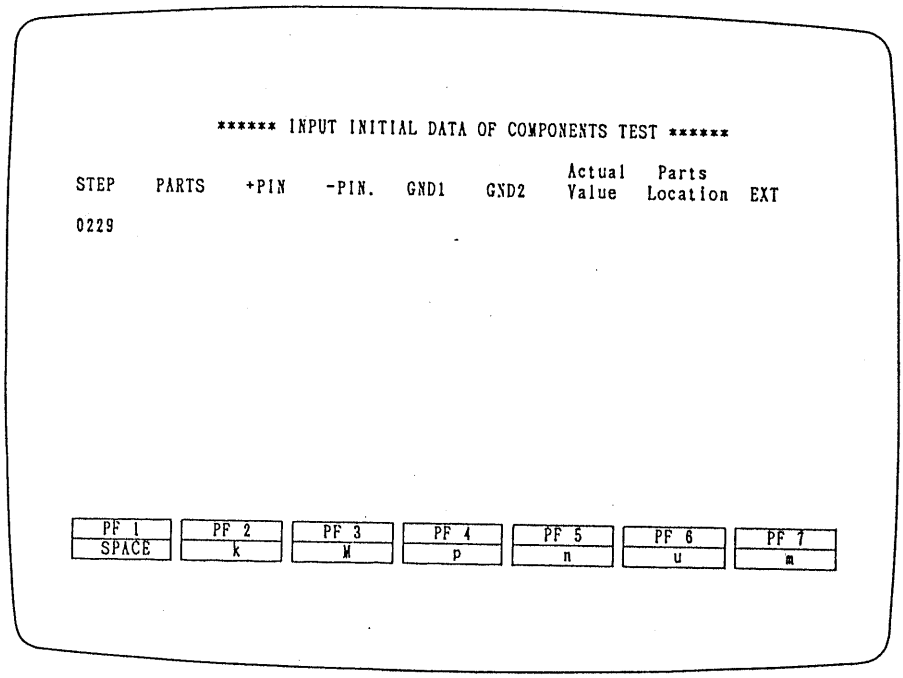
```
****** INPUT INITIAL DATA OF COMPONENTS TEST ******

STEP   PARTS   +PIN   -PIN.  GND1  GND2  Actual Value  Parts Location  EXT

0001   R0001   000    001    002   003   1.00ko       1A              0
0002   R0002   015    050                1.00Mo       3B              0
0003   R0888   100    256          000   100.ko       1A              0
0004   RA001   020    030    077         100. o       2C              0
0005   C0005   031    147          004   10.0uF       4C              0
0006   D0002   001    031                             1B              0
0007   L1203   002    005    000         100.uH       1A              0
0008   L0005   045    013                1.00mH       1A              0
009

| PF 1 | PF 2 | PF 3 | PF 4 | PF 5 | PF 6 | PF 7 |
| SPACE | k | M | p | n | u | m |
```

If the program having the specified file name does not exist yet, the initial data is created from the first step. If it exists already, whether or not to replace the existing file is asked.

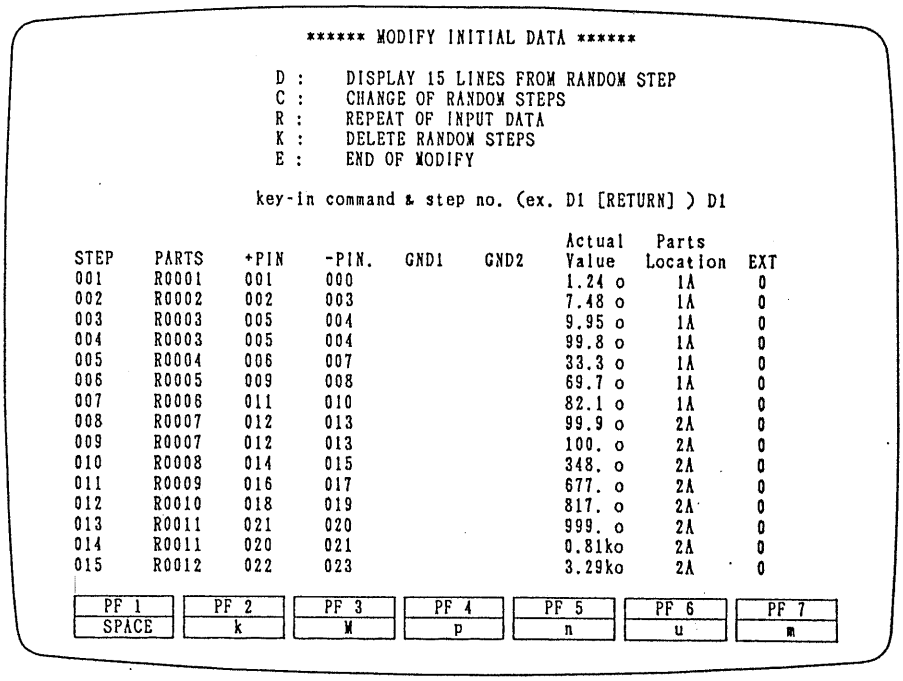
C H K J I G CR Y

If the program having the specified file name exists but is not to be replaced, input N for the message "generate from first step?".

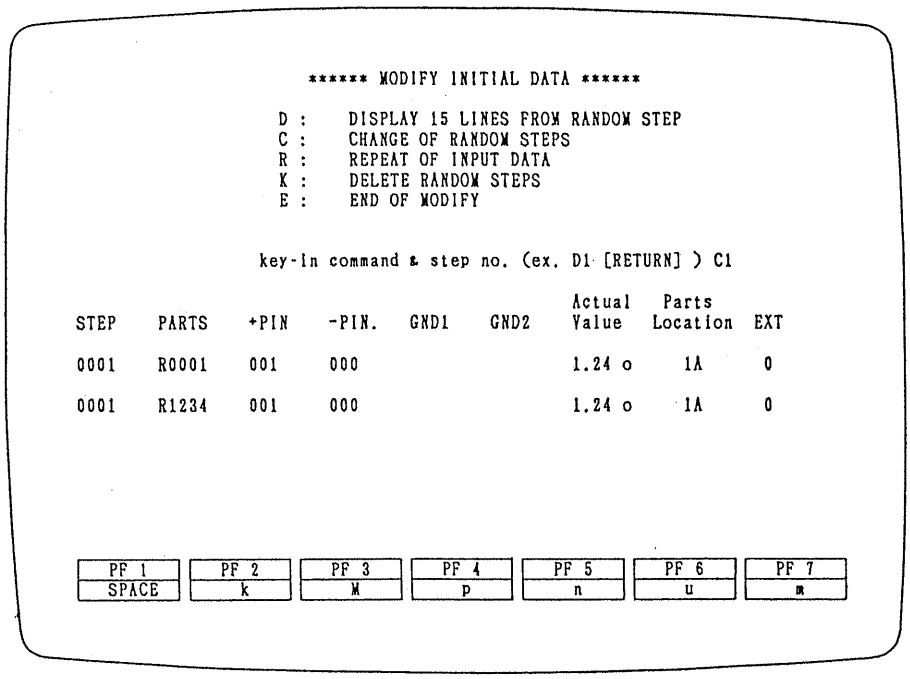
N



To modify the input data, press the ESC key.

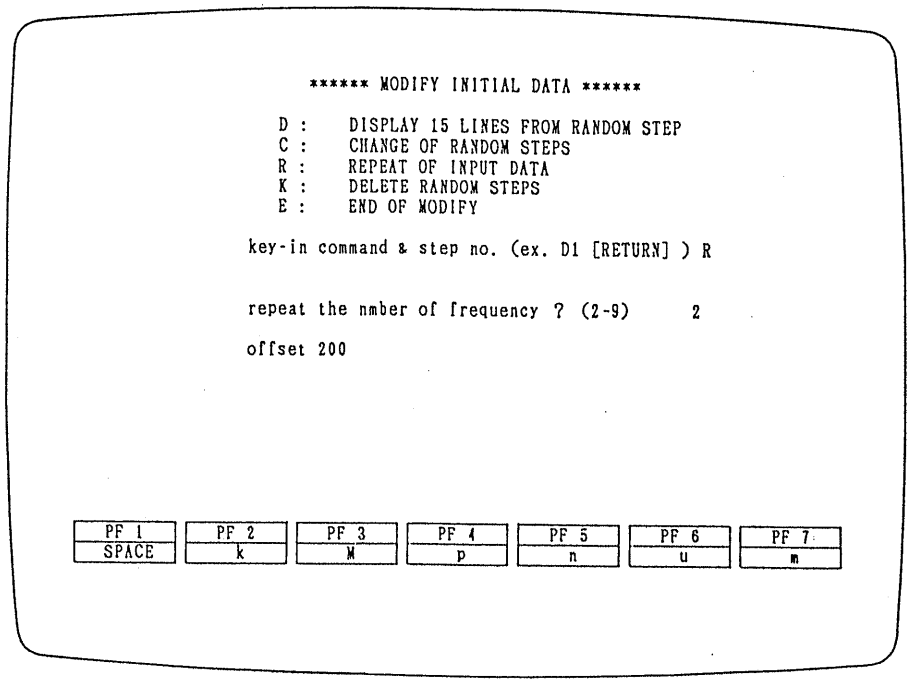


D 1 CR



C 1 CR

R 1 2 3 4 CR ----

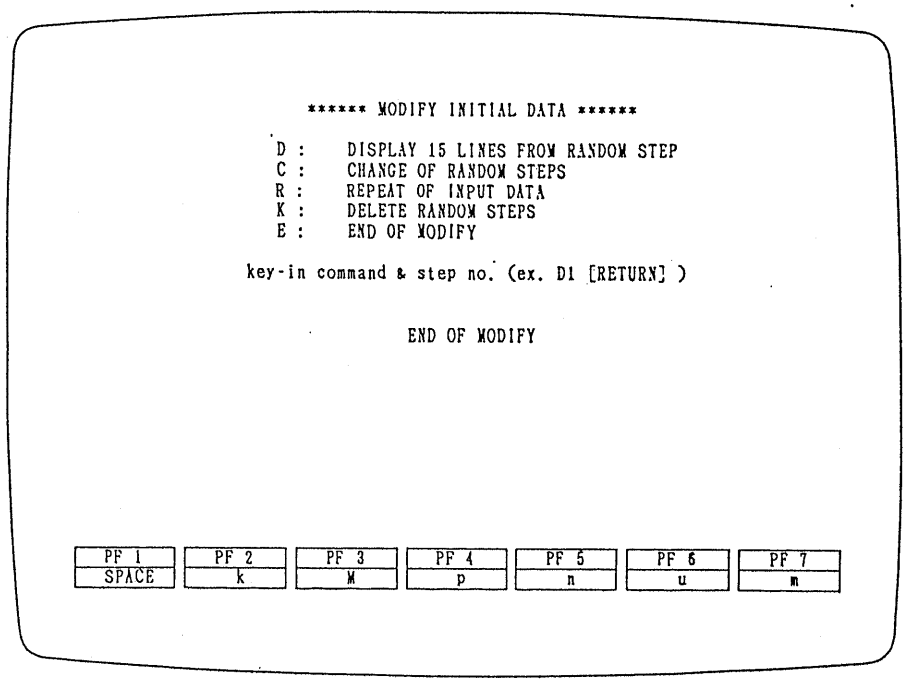


Use the R command for testing a number of PC boards of the same type. Input the offset values for pin numbers by the initial data menu, and the initial data for the parts having the same part number and different pin numbers is generated automatically.

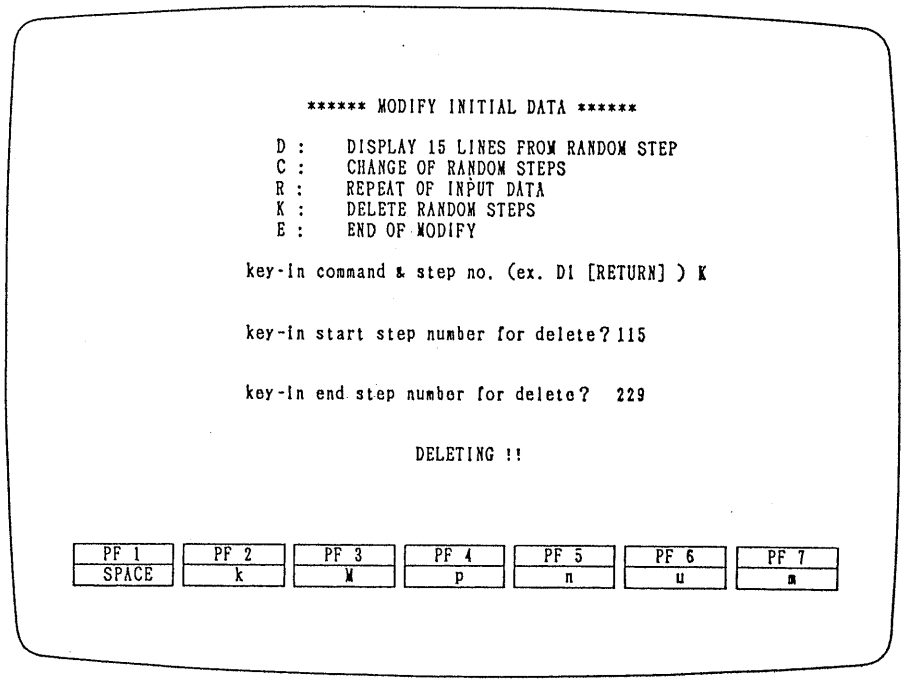
R 2

2 0 0 CR

8621.01



E



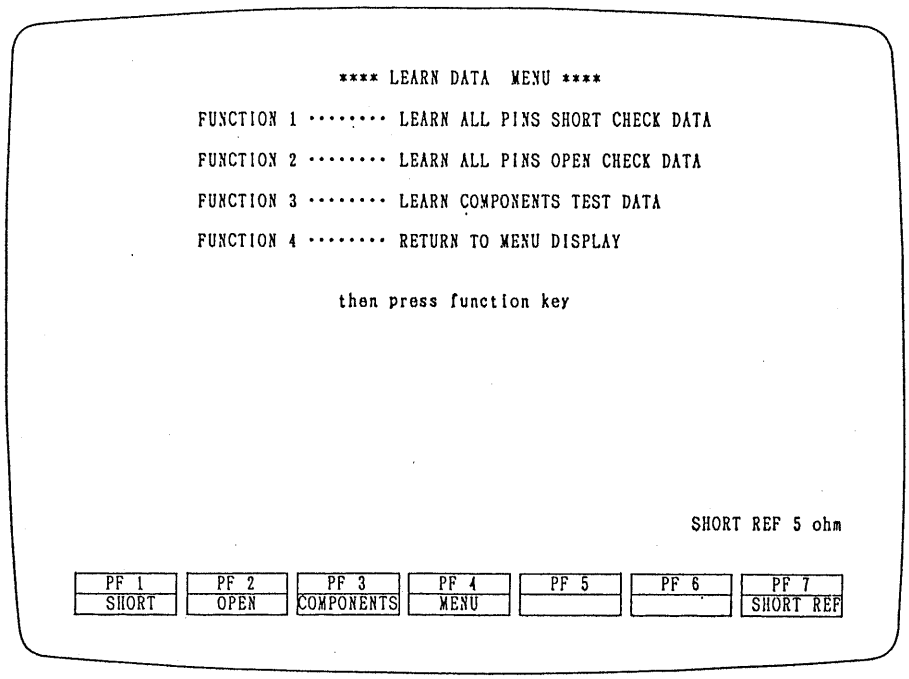
K

1 5 5 CR

2 2 9 CR

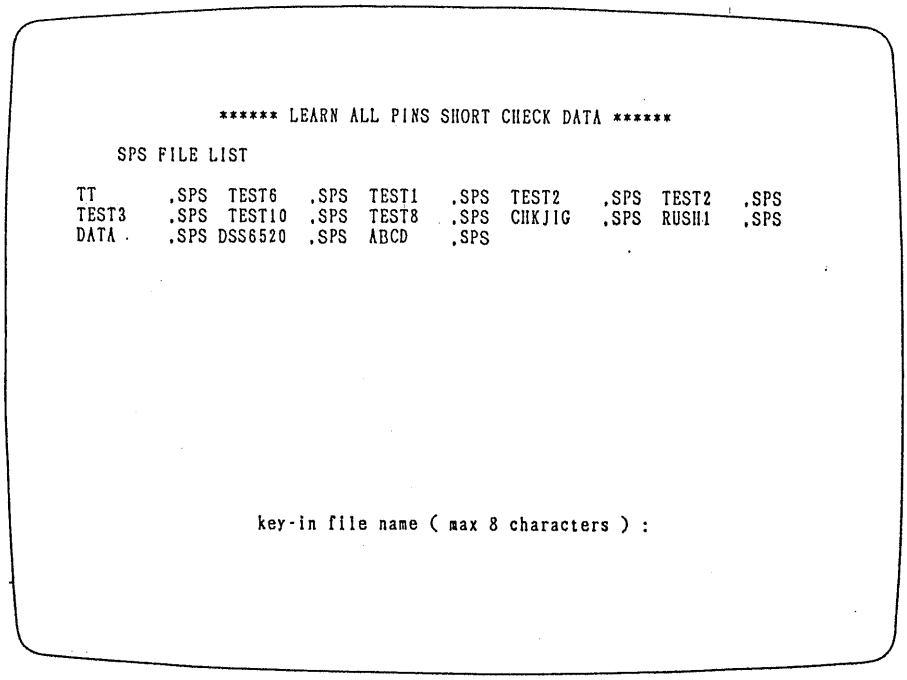
(2) DATA LEARN (Reference data learning) PF2

This program learns the reference data from a good board. The programs for all-pin short and open checks are generated automatically by the input of file names and maximum pin numbers.



To learn the data for all-pin short check:

PF1



Key in the file name for all-pin short check.

```
****** LEARN ALL PINS SHORT CHECK DATA ******

   SPS FILE LIST

TT       .SPS  TEST6   .SPS  TEST1   .SPS  TEST2    .SPS  TEST2   .SPS
TEST3    .SPS  TEST10  .SPS  TEST8   .SPS  CHKJIG   .SPS  RUSH1   .SPS
DATA     .SPS DSS6520  .SPS  ABCD    .SPS

                key-in file name ( max 8 characters ) : CHKJIG
```

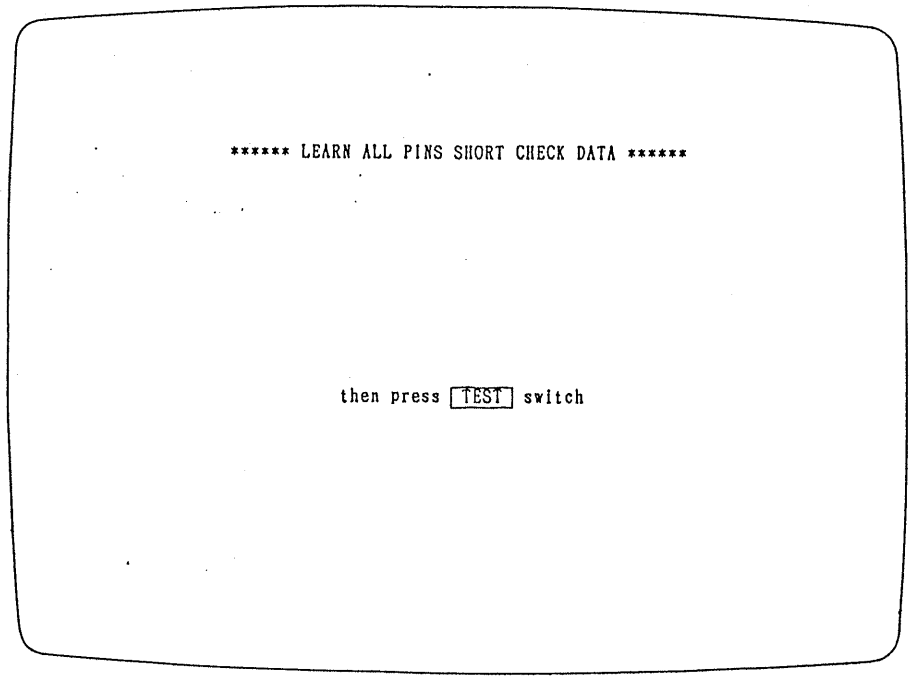
C H K J I G CR

```
****** LEARN ALL PINS SHORT CHECK DATA ******

   SPS FILE LIST

TT       .SPS  TEST6   .SPS  TEST1   .SPS  TEST2    .SPS  TEST2   .SPS
TEST3    .SPS  TEST10  .SPS  TEST8   .SPS  CHKJIG   .SPS  RUSH1   .SPS
DATA     .SPS DSS6520  .SPS  ABCD    .SPS

                key-in file name ( max 8 characters ) : CHKJIG
                try to learn the afresh ? (Y/N)
```

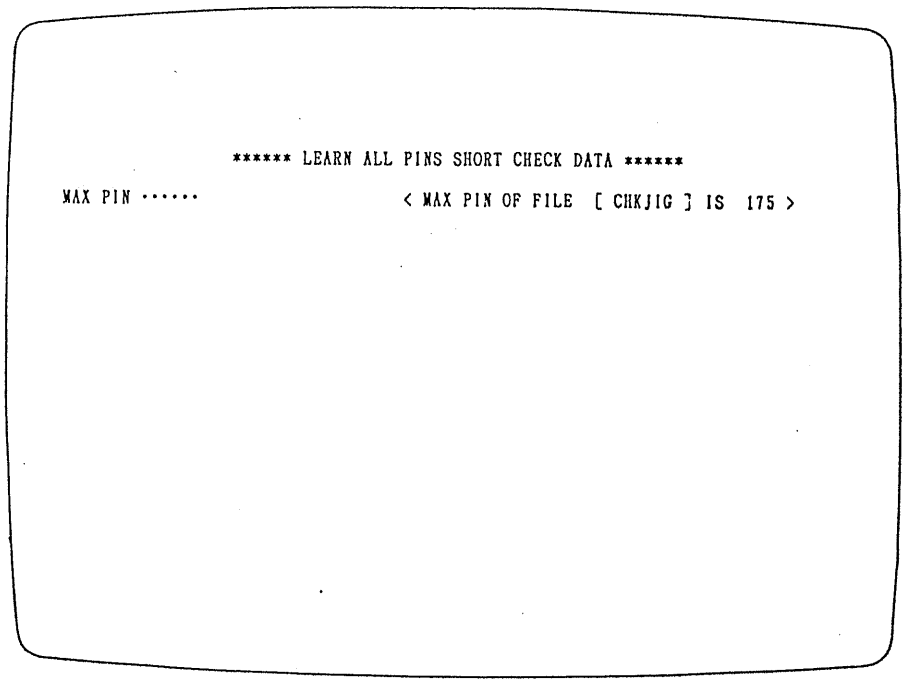
If the specified file name exists already, the system asks whether the existing file is to be replaced or not.

To replace it:

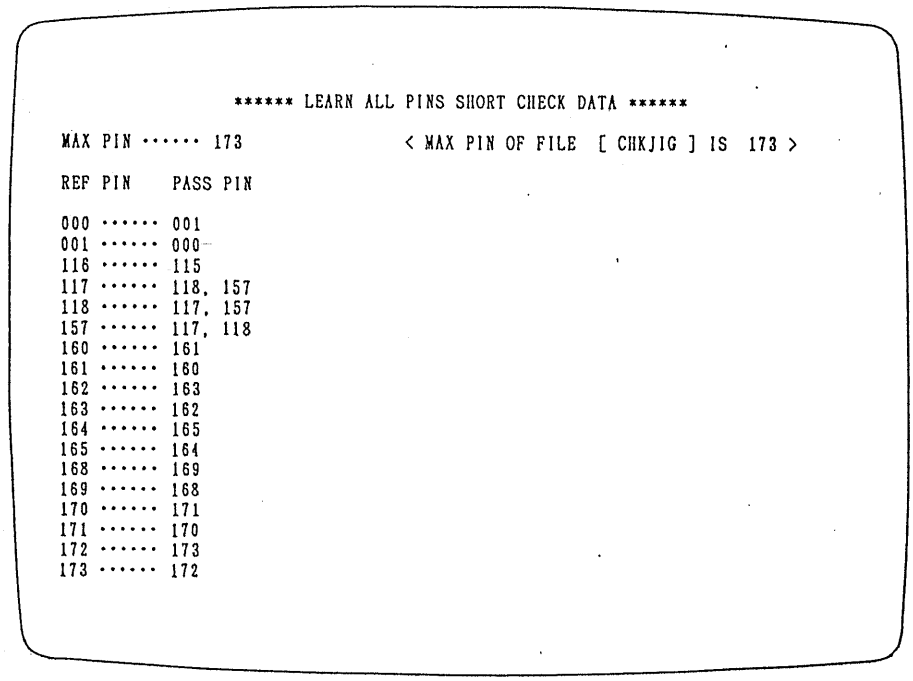
Y



Press the TEST switch on the printer section.



Key in the maximum pin number.



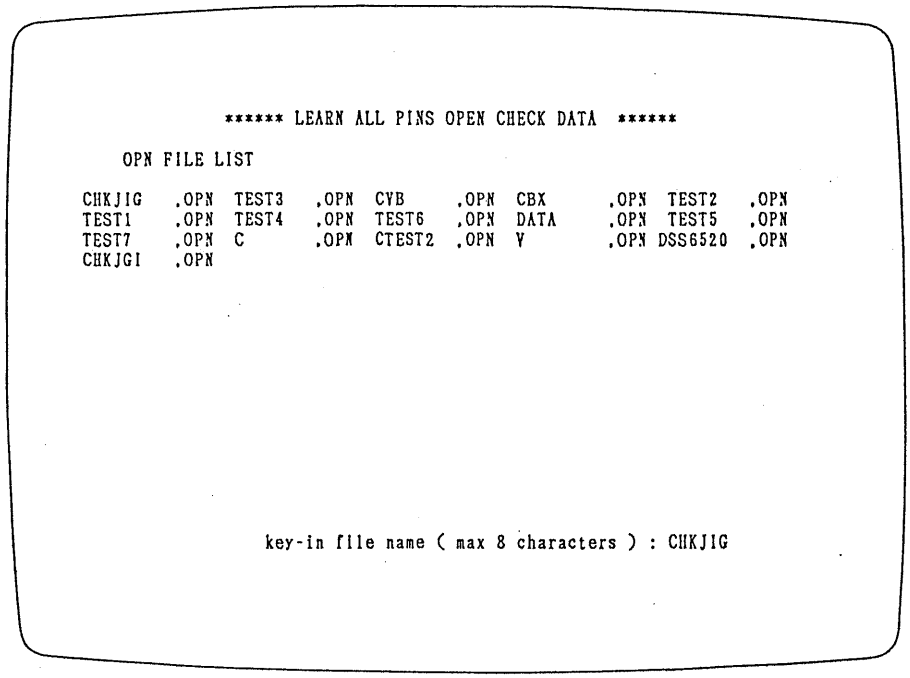
The all-pin short check program is generated automatically, using the SHORT REF resistance value in the lower right-hand corner of the LEARN DATA MENU screen as the threshold level.

1 7 3 CR

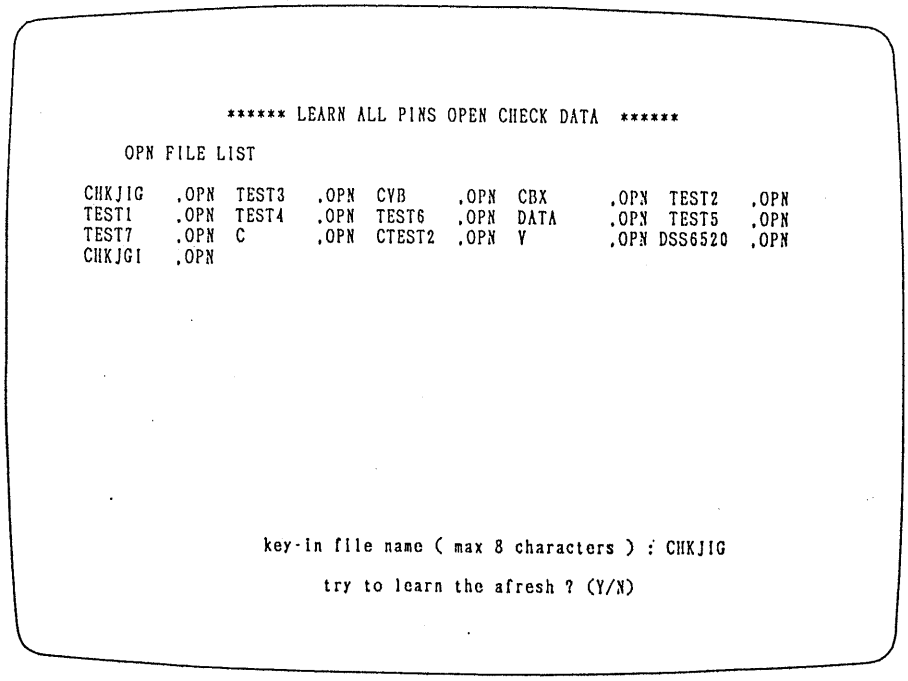
To learn the data for all-pin open check, select PF2 from the LEARN DATA MENU screen.

PF2

Then, key in the file name for the all-pin open check.



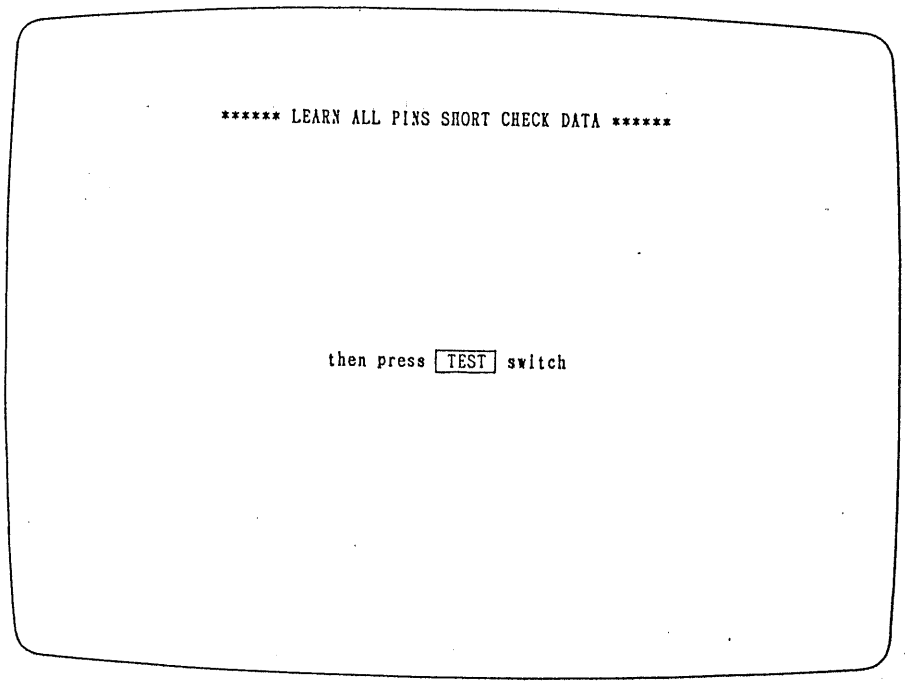
C H K J I G CR



If the specified file name exists already, the system asks whether the existing file is to be replaced or not.

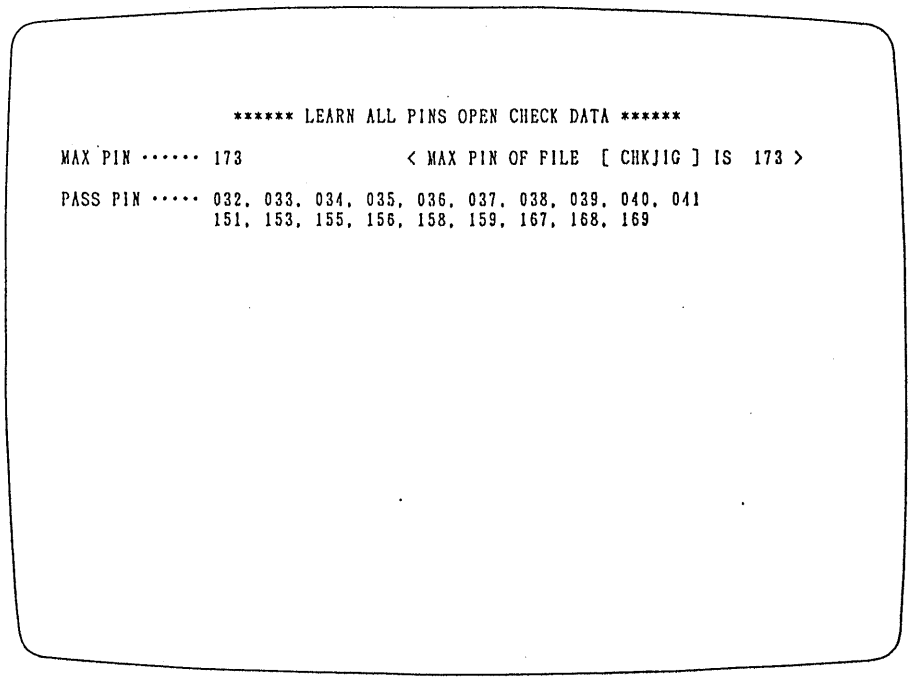
To replace it:

Y



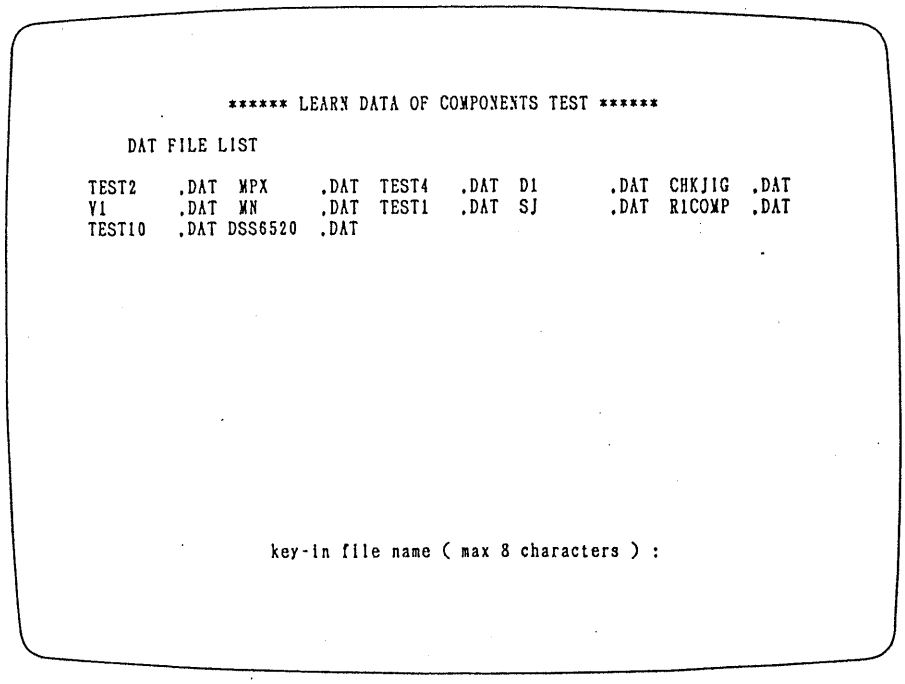
Press the TEST switch on the printer section.

Key in the maximum pin number.



The all-pin open check program is generated automatically, adopting 100k as the threshold level.

1 7 3 CR



To learn the data for component test, select PF3 from the LEARN DATA MENU screen.

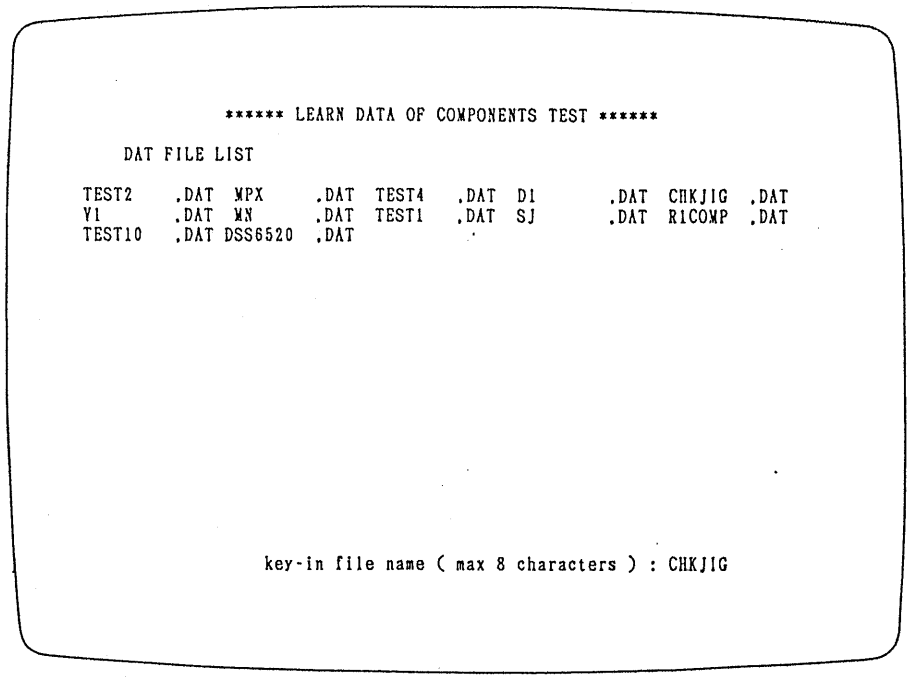
PF3

Then, key in the component test file name.

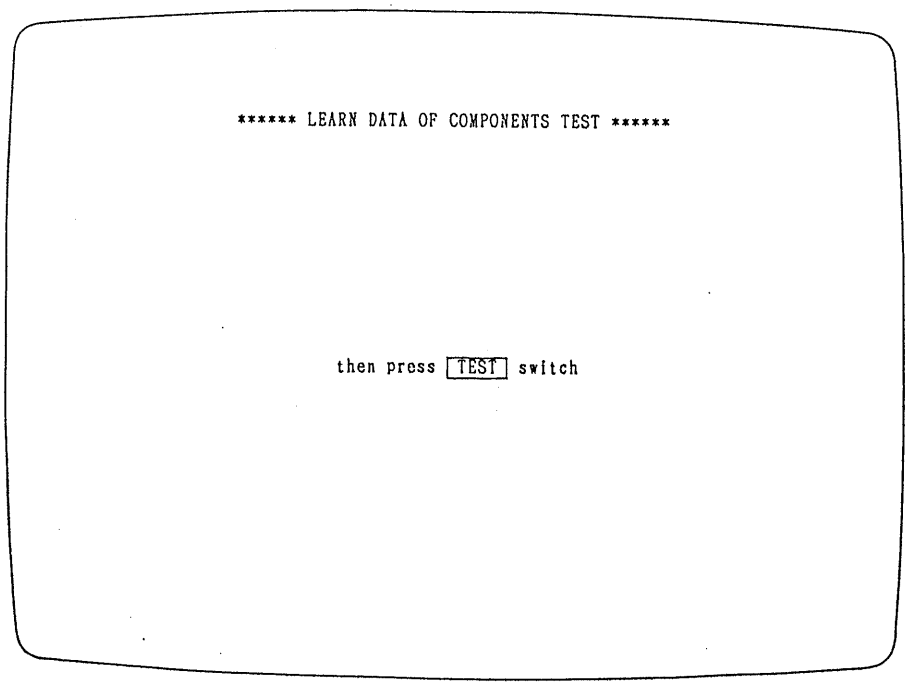
The data for the component test is learned from a good board in the order of the steps of the initial data program which is filed in advance. The data learned first becomes the reference data (EXC data) automatically.

At this time, the automatic polarity setting function works to optimize the polarities of the testing pins.

Press the TEST switch on the printer section, and the program is generated automatically.



C H K J I G CR



Press the TEST switch on the printer section, and the program is generated automatically.

J (jumper check) and S (short check) are programmed automatically, using the SHORT REF resistance value in the lower right-hand corner of the LEARN DATA MENU screen as the threshold level. After the data has been learned, the generated program is stored in a floppy disk as an execution program (EXC FILE).

****** LEARN DATA OF COMPONENTS TEST ******

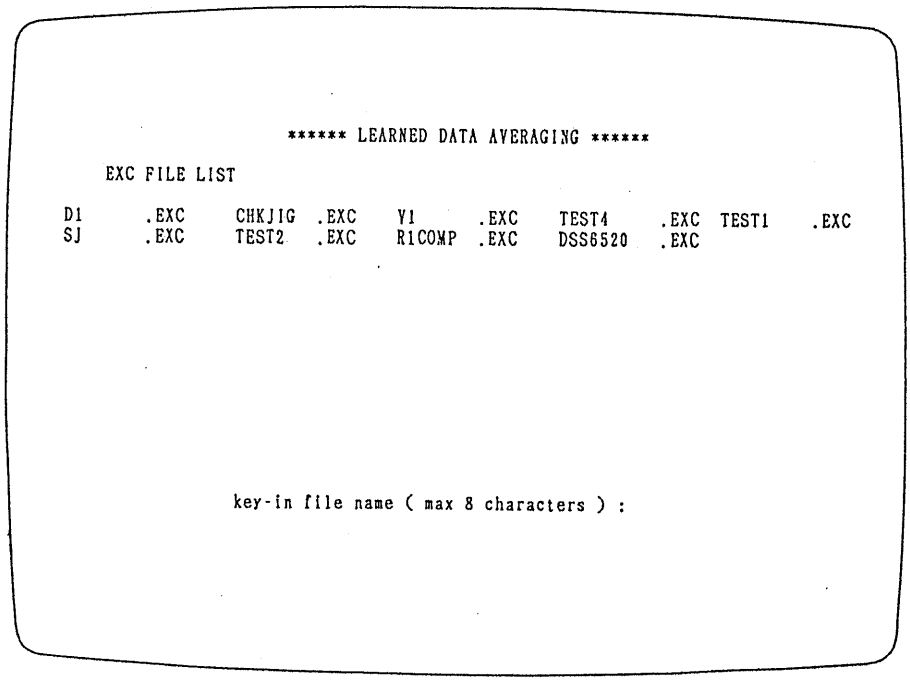
STEP	PARTS	+PIN	-PIN	GND1	GND2	Actual Value	Masured Value	Parts Location	EXT
0105	S0001	156	157				Short good	2B	0
0106	S0002	158	159				Short good	2B	0
0107	J0001	160	161				Jumper good	2B	0
0108	L0001	163	162			12.0uH	20.6uH	1C	0
0109	L0002	164	165			80.0uH	49.6uH	1C	0
0110	L0003	166	167			142.uH	000.uH	1C	0
0111	L0004	169	168			450.uH	109.uH	1C	0
0112	L0005	170	171			160.uH	026.uH	2C	0
0113	L0006	172	173			800.uH	050.uH	3C	0
0114	L0007	175	174			30.0mH	00.0mH	3C	0
0095	D0004	125	126				Overflow	1B	0
0096	D0005	127	128				745.mV	1B	0
0097	D0006	129	130				791.mV	1B	0
0098	T0001	133	131				727.mV	2B	0
0099	T0002	133	132				723.mV	2B	0
0100	P0001	146	147				1783.mV	1B	0
0101	P0002	148	149				1792.mV	1B	0
0102	P0003	150	151				1783.mV	1B	0
0103	P0004	152	153				1789.mV	1B	0
0104	P0005	154	155				1782.mV	1B	0

(3) DATA AVE (Learned data averaging) PF3

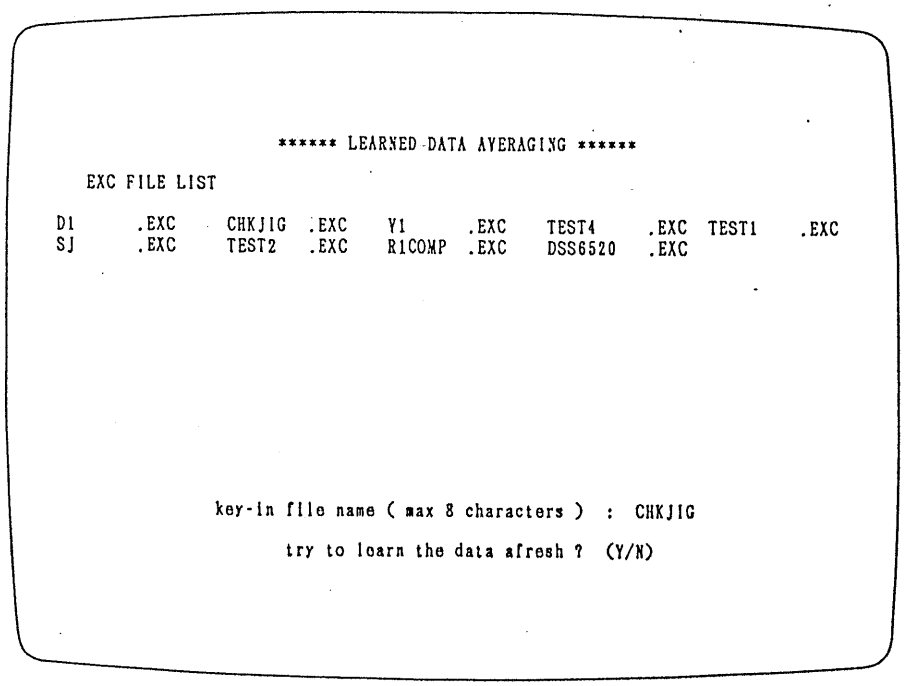
This program learns data from up to nine good boards in the order of the initial data program steps. Then, it averages the data of up to ten boards including the board used for DATA LEARN (PF2).

In the course of averaging, the operator can monitor the maximum, minimum, and mean values of learned data for each step by the host computer screen. If he finds a file not adequate for averaging, he may delete it and execute the averaging operaton again.

The averaged data file is stored in a floppy disk as an execution reference data file.

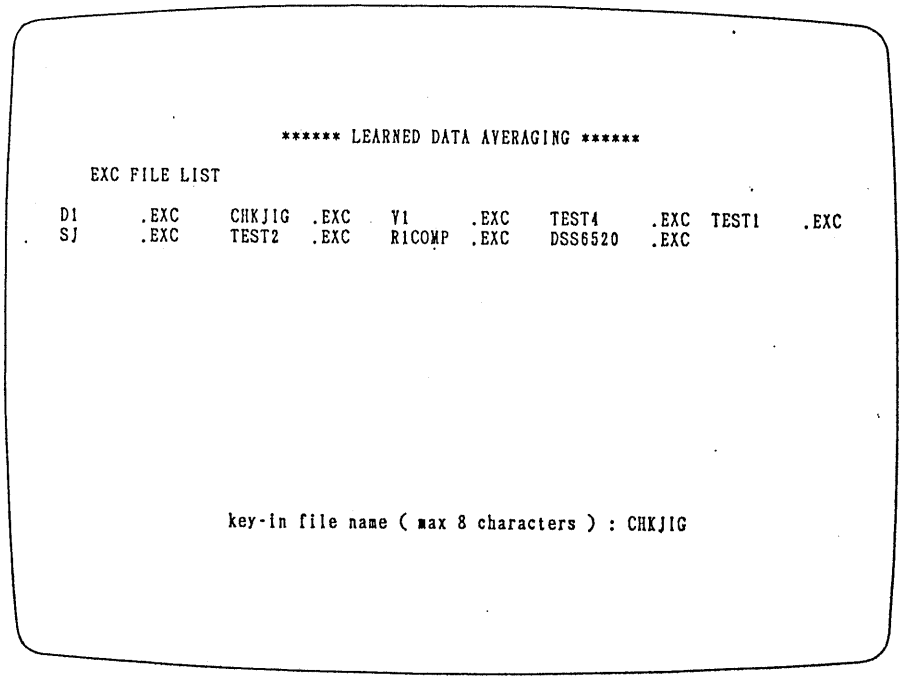


Key in the file name in response to the message in the above screen.

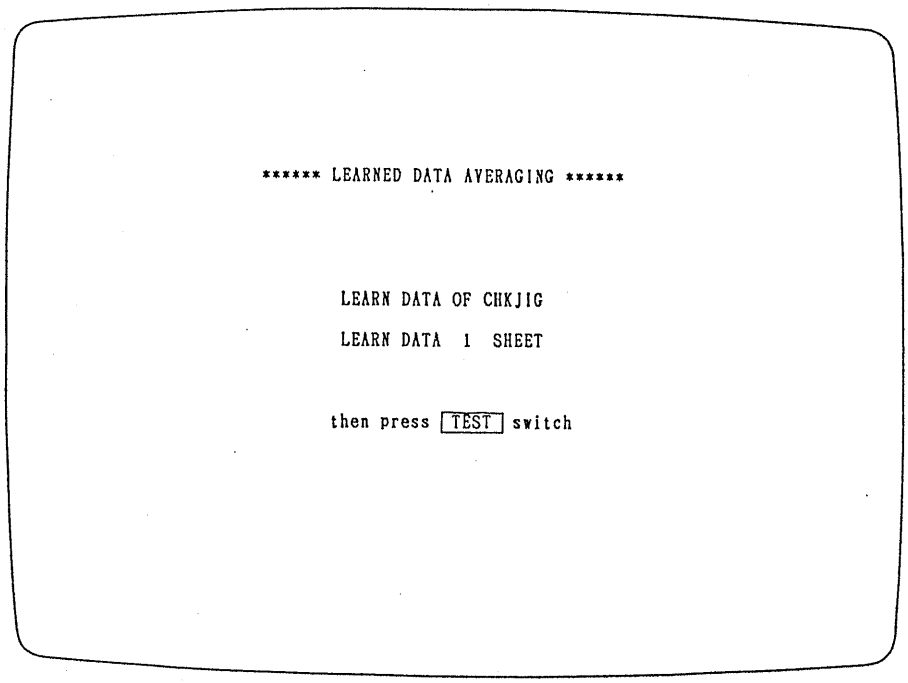


If the specified file name exists already, indicate whether or not to replace the existing file.

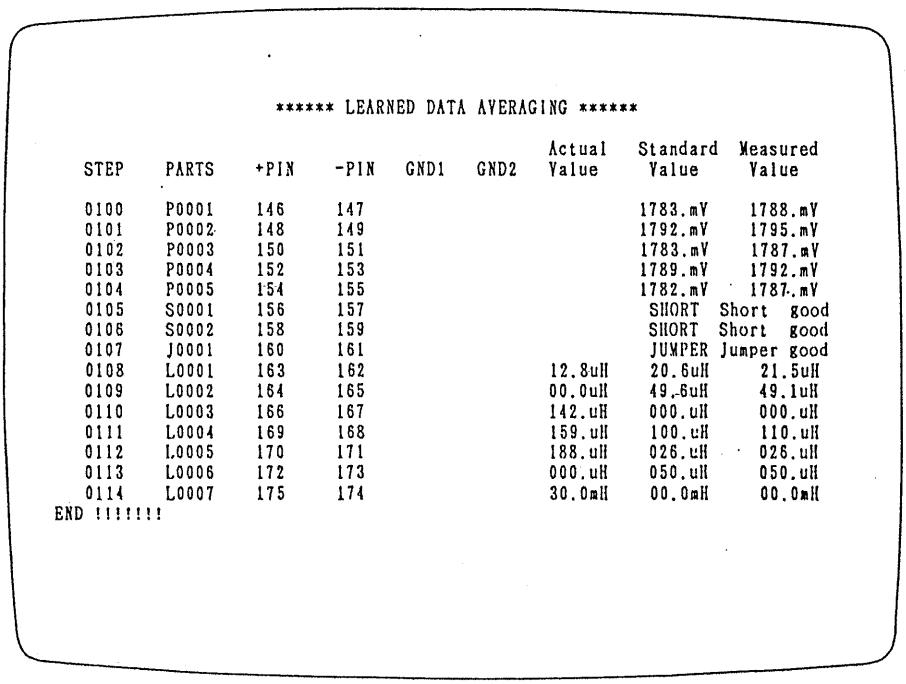
Y



C H K J I G CR



Place the first PC board on the fixture and press the TEST switch.

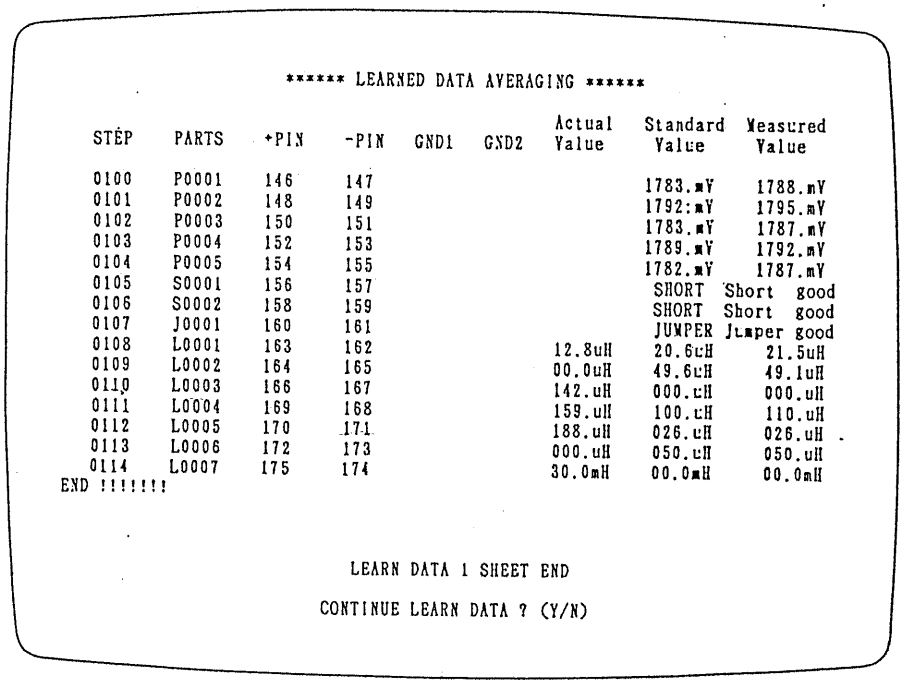


****** LEARNED DATA AVERAGING ******

STEP	PARTS	+PIN	-PIN	GND1	GND2	Actual Value	Standard Value	Measured Value
0100	P0001	146	147				1783.mV	1788.mV
0101	P0002	148	149				1792.mV	1795.mV
0102	P0003	150	151				1783.mV	1787.mV
0103	P0004	152	153				1789.mV	1792.mV
0104	P0005	154	155				1782.mV	1787.mV
0105	S0001	156	157				SHORT	Short good
0106	S0002	158	159				SHORT	Short good
0107	J0001	160	161				JUMPER	Jumper good
0108	L0001	163	162			12.8uH	20.6uH	21.5uH
0109	L0002	164	165			00.0uH	49.6uH	49.1uH
0110	L0003	166	167			142.uH	000.uH	000.uH
0111	L0004	169	168			159.uH	100.uH	110.uH
0112	L0005	170	171			188.uH	026.uH	026.uH
0113	L0006	172	173			000.uH	050.uH	050.uH
0114	L0007	175	174			30.0mH	00.0mH	00.0mH

END !!!!!!!

Data is learned according to the initial data of the same file name created in advance.



****** LEARNED DATA AVERAGING ******

STEP	PARTS	+PIN	-PIN	GND1	GND2	Actual Value	Standard Value	Measured Value
0100	P0001	146	147				1783.mV	1788.mV
0101	P0002	148	149				1792:mV	1795.mV
0102	P0003	150	151				1783.mV	1787.mV
0103	P0004	152	153				1789.mV	1792.mV
0104	P0005	154	155				1782.mV	1787.mV
0105	S0001	156	157				SHORT	Short good
0106	S0002	158	159				SHORT	Short good
0107	J0001	160	161				JUMPER	Jumper good
0108	L0001	163	162			12.8uH	20.6uH	21.5uH
0109	L0002	164	165			00.0uH	49.6uH	49.1uH
0110	L0003	166	167			142.uH	000.uH	000.uH
0111	L0004	169	168			159.uH	100.uH	110.uH
0112	L0005	170	171			188.uH	026.uH	026.uH
0113	L0006	172	173			000.uH	050.uH	050.uH
0114	L0007	175	174			30.0mH	00.0mH	00.0mH

END !!!!!!!

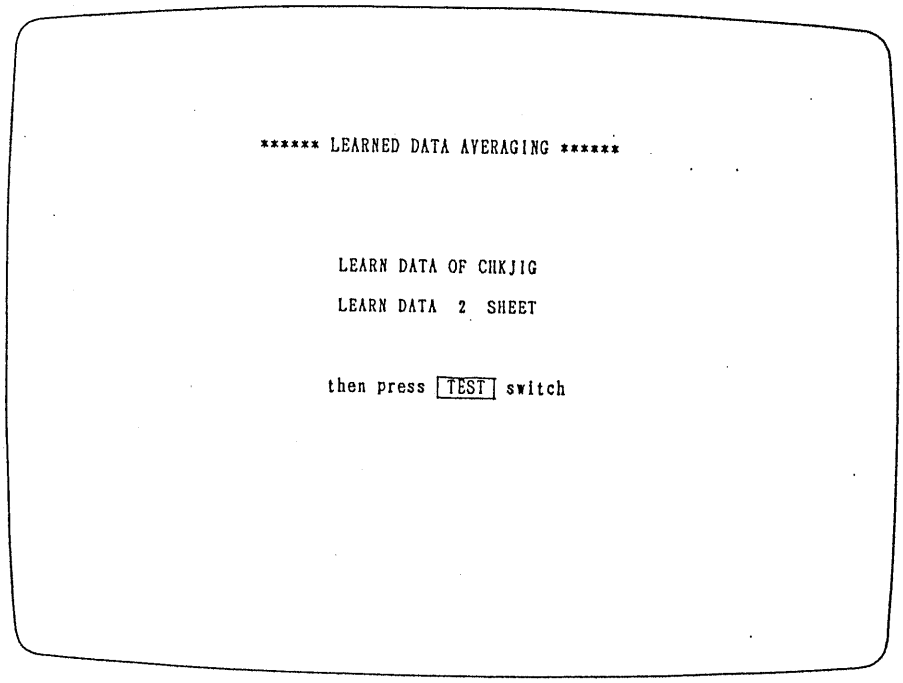
LEARN DATA 1 SHEET END

CONTINUE LEARN DATA ? (Y/N)

When the data for all the program steps has been learned, the system asks whether or not to continue the data learning.

If data is to be learned from two PC boards, for example, select Y.

Y



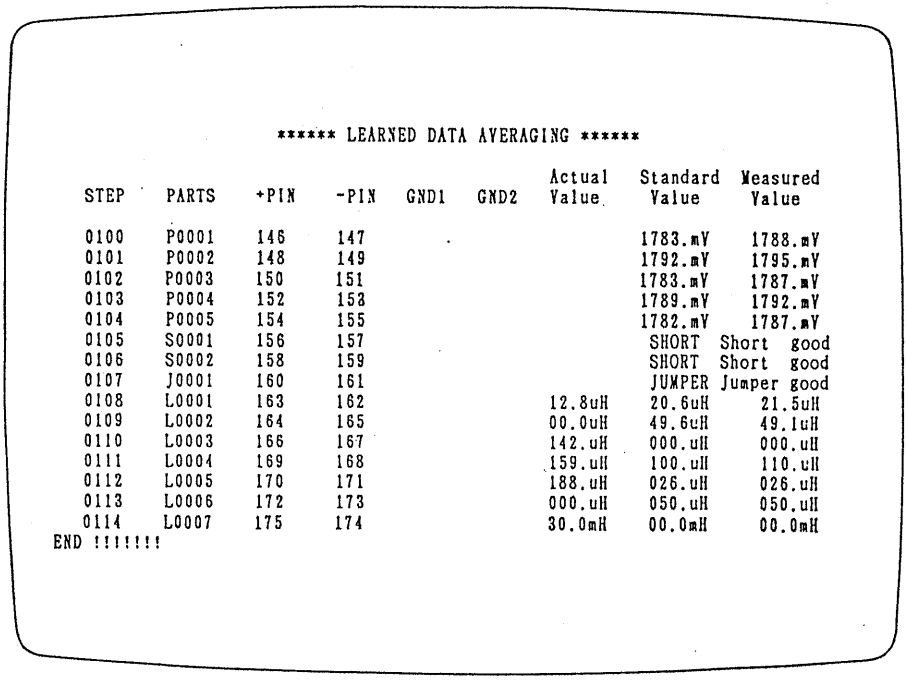
****** LEARNED DATA AVERAGING ******

LEARN DATA OF CHKJIG

LEARN DATA 2 SHEET

then press [TEST] switch

Replace the first board with the second one, and press the TEST switch again.

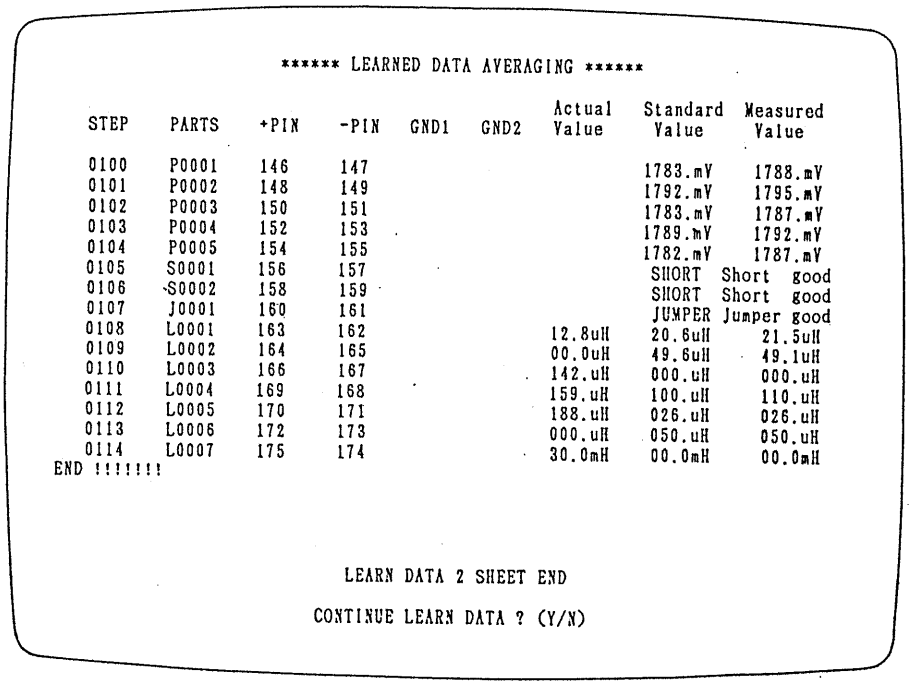


****** LEARNED DATA AVERAGING ******

STEP	PARTS	+PIN	-PIN	GND1	GND2	Actual Value	Standard Value	Measured Value
0100	P0001	146	147				1783.mV	1788.mV
0101	P0002	148	149				1792.mV	1795.mV
0102	P0003	150	151				1783.mV	1787.mV
0103	P0004	152	153				1789.mV	1792.mV
0104	P0005	154	155				1782.mV	1787.mV
0105	S0001	156	157				SHORT	Short good
0106	S0002	158	159				SHORT	Short good
0107	J0001	160	161				JUMPER	Jumper good
0108	L0001	163	162			12.8uH	20.6uH	21.5uH
0109	L0002	164	165			00.0uH	49.6uH	49.1uH
0110	L0003	166	167			142.uH	000.uH	000.uH
0111	L0004	169	168			159.uH	100.uH	110.uH
0112	L0005	170	171			188.uH	026.uH	026.uH
0113	L0006	172	173			000.uH	050.uH	050.uH
0114	L0007	175	174			30.0mH	00.0mH	00.0mH

END !!!!!!!

The system starts learning data from the second board.



****** LEARNED DATA AVERAGING ******

STEP	PARTS	+PIN	-PIN	GND1	GND2	Actual Value	Standard Value	Measured Value
0100	P0001	146	147				1783.mV	1788.mV
0101	P0002	148	149				1792.mV	1795.mV
0102	P0003	150	151				1783.mV	1787.mV
0103	P0004	152	153				1789.mV	1792.mV
0104	P0005	154	155				1782.mV	1787.mV
0105	S0001	156	157				SHORT	Short good
0106	S0002	158	159				SHORT	Short good
0107	J0001	160	161				JUMPER	Jumper good
0108	L0001	163	162			12.8uH	20.6uH	21.5uH
0109	L0002	164	165			00.0uH	49.6uH	49.1uH
0110	L0003	166	167			142.uH	000.uH	000.uH
0111	L0004	169	168			159.uH	100.uH	110.uH
0112	L0005	170	171			188.uH	026.uH	026.uH
0113	L0006	172	173			000.uH	050.uH	050.uH
0114	L0007	175	174			30.0mH	00.0mH	00.0mH

END !!!!!!!

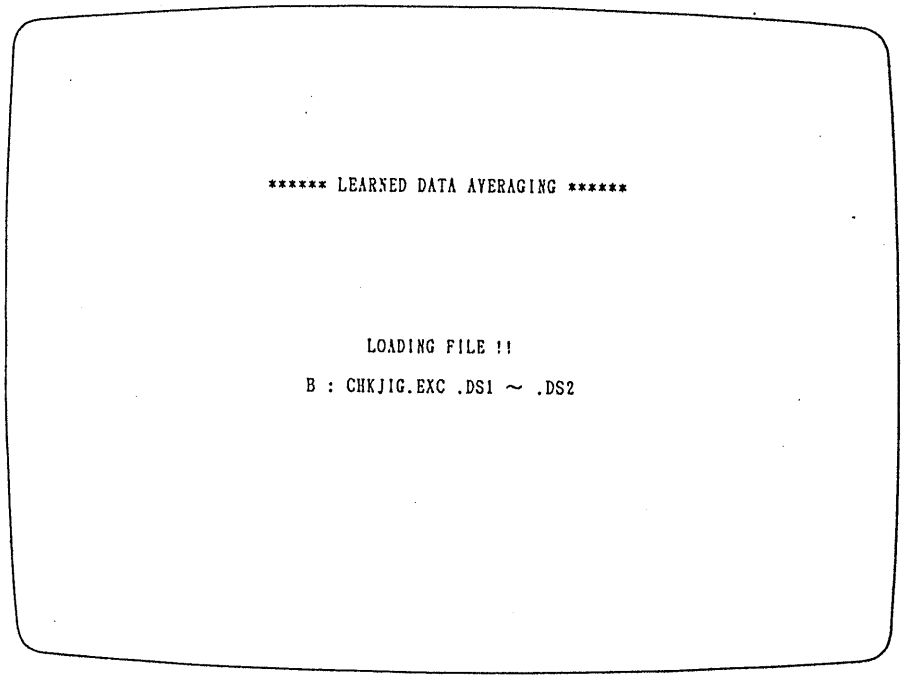
LEARN DATA 2 SHEET END

CONTINUE LEARN DATA ? (Y/N)

When the data has been learned from the second board, the system asks whether or not to continue the data learning. Since the data is to be learned from two boards in this example, press N.

Then, the data in three files in total is averaged; the three files are the EXC file generated by DATA LEARN (PF2) and the two files generated by DATA AVE (PF3).

N



The above screen indicates that data has been learned from two boards.

```
****** LEARNED DATA AVERAGING ******


                LOADING FILE !!

          B : CHKJIG.EXC .DS1 ~ .DS2



          display average file ? (Y/N)
```

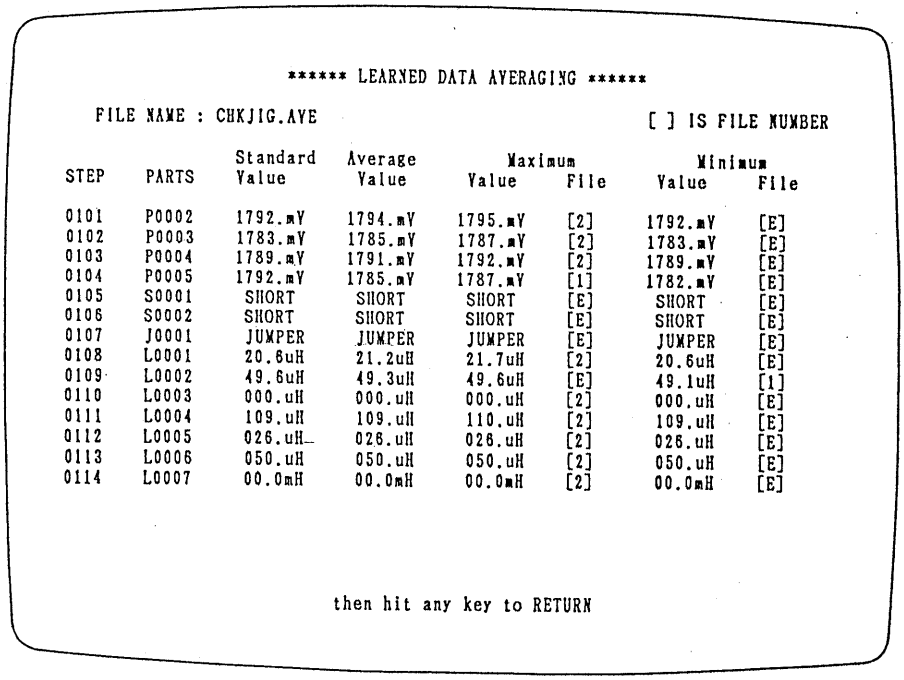
To see the contents of the averaged data file:
Y

```
                ****** LEARNED DATA AVERAGING ******

     FILE NAME : CHKJIG.AVE                                  [ ] IS FILE NUMBER

                        Standard  Average      Maximum          Minimum
STEP    PARTS           Value     Value     Value     File   Value     File

0001    R0001     1.41 o    1.39 o    1.41 o    [1]    1.35 o    [2]
0002    R0002     7.53 o    7.54 o    7.56 o    [2]    7.53 o    [E]
0003    R0003    10.58 o   10.26 o   10.58 o    [E]   10.11 o    [1]
0004    R0003     10.2 o    10.0 o    10.2 o    [E]    09.9 o    [1]
0005    R0004     32.9 o    33.1 o    33.3 o    [2]    32.9 o    [E]
0006    R0005     69.1 o    69.3 o    69.5 o    [2]    69.1 o    [E]
0007    R0006     81.4 o    81.5 o    81.6 o    [2]    81.4 o    [E]
0008    R0007     99.4 o    99.4 o    99.5 o    [2]    99.4 o    [E]
0009    R0007     098. o    098. o    099. o    [2]    098. o    [E]
0010    R0008     337. o    337. o    338. o    [2]    337. o    [E]
0011    R0009     672. o    672. o    672. o    [2]    672. o    [E]
0012    R0010     812. o    812. o    812. o    [2]    812. o    [E]
0013    R0011    1000. o    999. o   1000. o    [E]    999. o    [1]
0014    R0011    1.02ko    1.02ko    1.02ko    [2]    1.02ko    [E]
0015    R0012    3.29ko    3.29ko    3.30ko    [2]    3.29ko    [E]
0016    R0013    6.78ko    6.78ko    6.78ko    [2]    6.78ko    [E]
0017    R0014    8.19ko    8.19ko    8.19ko    [2]    8.19ko    [E]
0018    R0015    9.98ko    9.98ko    9.98ko    [2]    9.98ko    [E]
0019    R0015    10.1ko    10.1ko    10.1ko    [2]    10.1ko    [E]
0020    R0016    33.2ko    33.1ko    33.2ko    [E]    33.1ko    [1]

                then hit any key to NEXT PAGE :
```

The letter "E" in the brackets [ ] after a maximum or minimum value in the above screen indicates that the value was obtained from the EXC file (execution data file) generated by PF2, and a number in

the brackets represents the ordinal number of the board from which the value was learned by PF3.

To display the next page, press an arbitrary key on the keyboard.



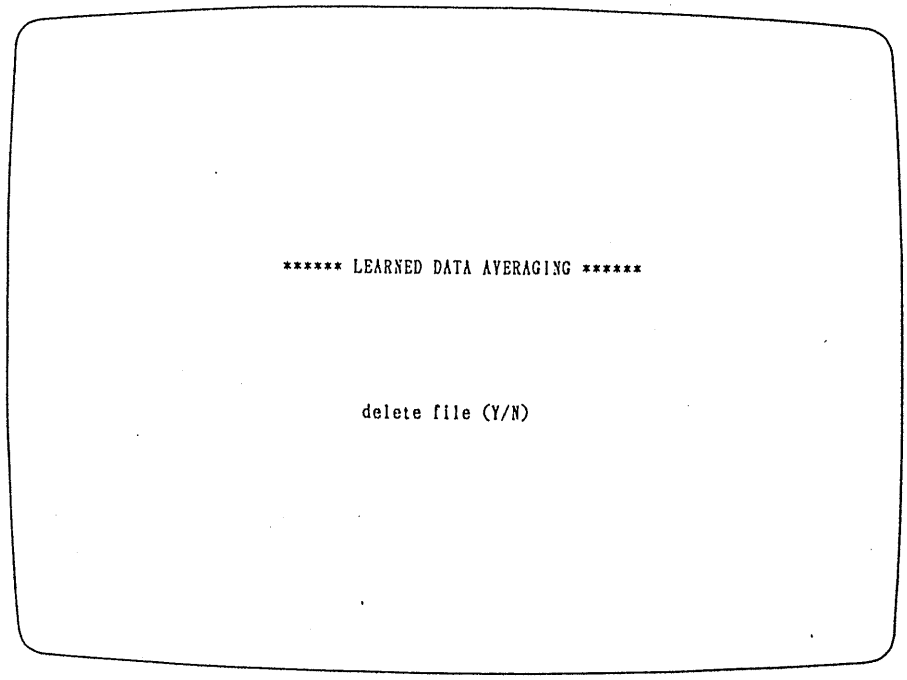
****** LEARNED DATA AVERAGING ******

FILE NAME : CHKJIG.AVE [ ] IS FILE NUMBER

STEP	PARTS	Standard Value	Average Value	Maximum Value	Maximum File	Minimum Value	Minimum File
0101	P0002	1792.mV	1794.mV	1795.mV	[2]	1792.mV	[E]
0102	P0003	1783.mV	1785.mV	1787.mV	[2]	1783.mV	[E]
0103	P0004	1789.mV	1791.mV	1792.mV	[2]	1789.mV	[E]
0104	P0005	1792.mV	1785.mV	1787.mV	[1]	1782.mV	[E]
0105	S0001	SHORT	SHORT	SHORT	[E]	SHORT	[E]
0106	S0002	SHORT	SHORT	SHORT	[E]	SHORT	[E]
0107	J0001	JUMPER	JUMPER	JUMPER	[E]	JUMPER	[E]
0108	L0001	20.6uH	21.2uH	21.7uH	[2]	20.6uH	[E]
0109	L0002	49.6uH	49.3uH	49.6uH	[E]	49.1uH	[1]
0110	L0003	000.uH	000.uH	000.uH	[2]	000.uH	[E]
0111	L0004	109.uH	109.uH	110.uH	[2]	109.uH	[E]
0112	L0005	026.uH	026.uH	026.uH	[2]	026.uH	[E]
0113	L0006	050.uH	050.uH	050.uH	[2]	050.uH	[E]
0114	L0007	00.0mH	00.0mH	00.0mH	[2]	00.0mH	[E]

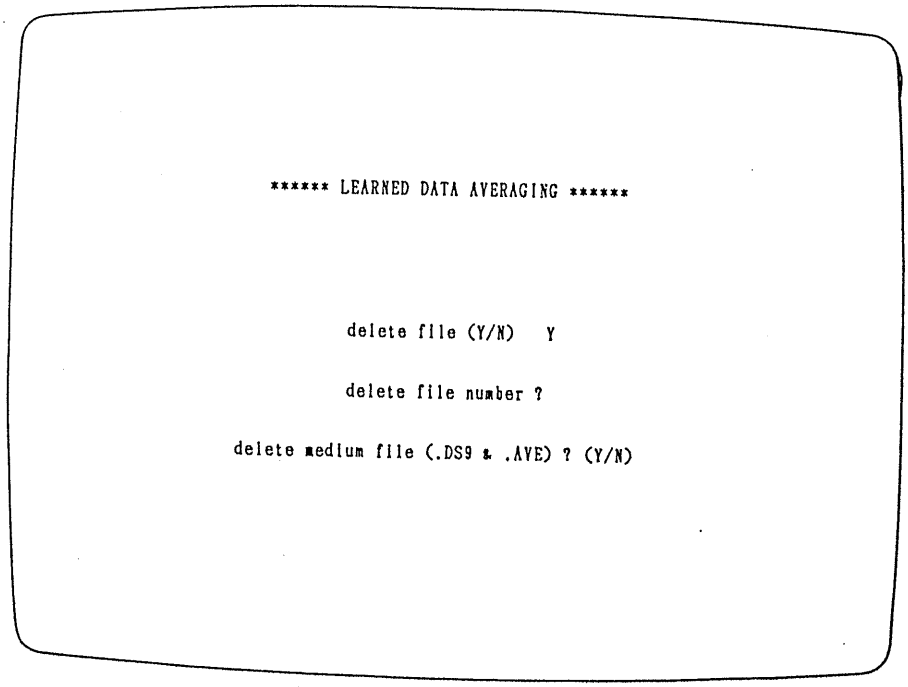
then hit any key to RETURN

When all the pages have been displayed, the following message appears on the screen:

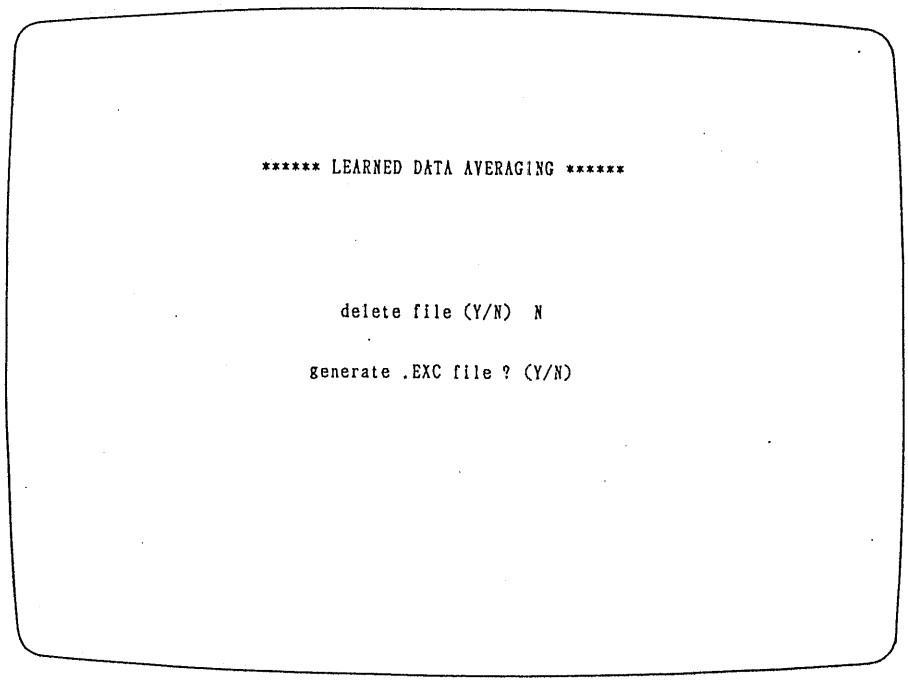


The above message asks if any of the learned data files are inadequate for averaging. To delete the inadequate files:

Y



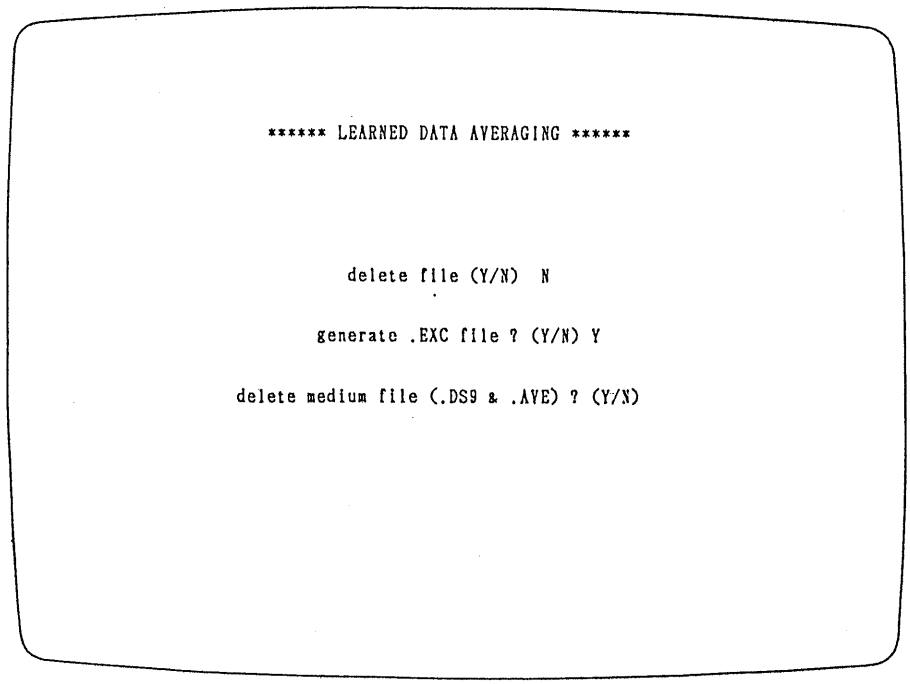
Key in the numbers of the files to be deleted, and the averaging is executed again without the specified files.



When no files need be deleted any more, convert the averaged data file into execution data file (EXC) by the following operation:

N

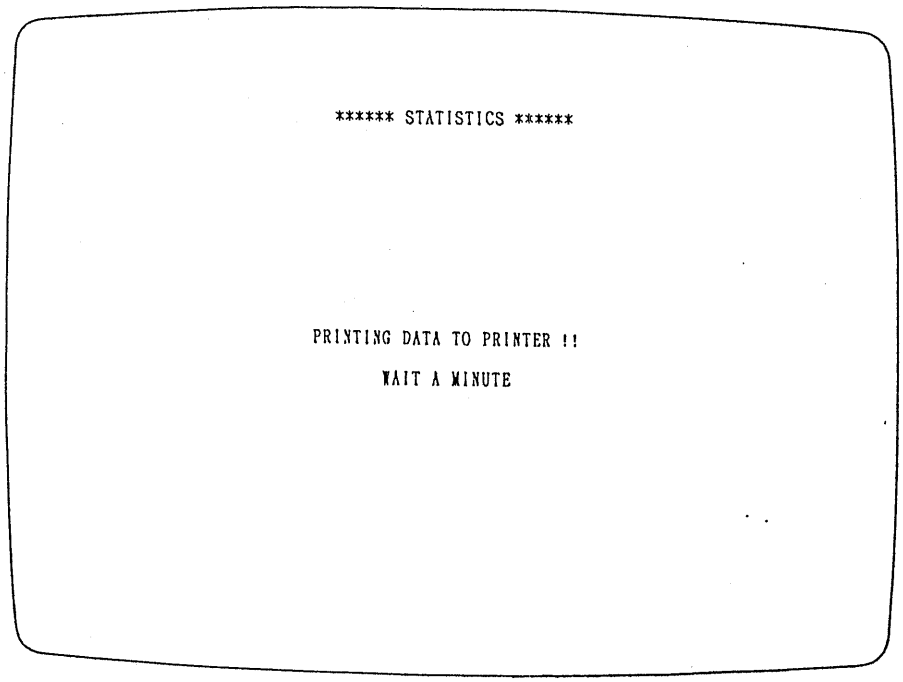
Y



If the learned data files and averaged data file are not necessary any more, delete them.

(4) STATISTICS (Statistical data processing) PF4

This is the statistical data processing program for the daily test operation. Since it prints such information as the number of tested boards, that of failed ones, and the failure counts classified by step number, it can be used for obtaining the statistical data by lot, day, week, etc.

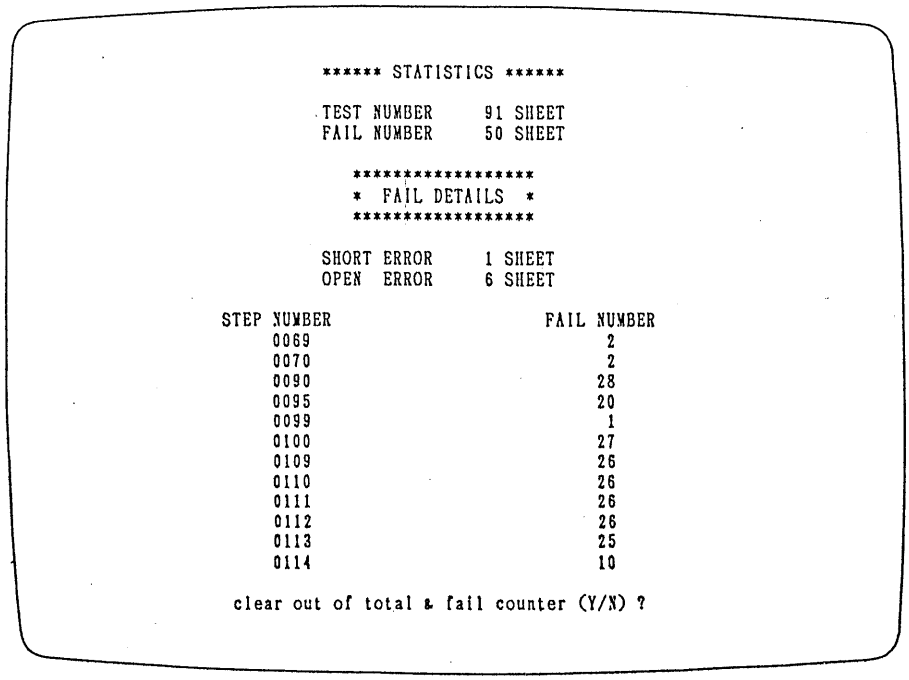


```
****** STATISTICS ******

TEST NUMBER      91 SHEET
FAIL NUMBER      50 SHEET

   ******************
   *  FAIL DETAILS  *
   ******************

SHORT ERROR       1 SHEET
OPEN  ERROR       6 SHEET

STEP NUMBER                    FAIL NUMBER
     0029                           13
     0030                            4
     0031                            3
     0032                            3
     0037                           33
     0038                           33
     0045                           32
     0046                            1
     0062                            2
     0063                            2
     0064                            2
     0065                            2
     0066                            2
     0067                            2
     0068                            2

then hit any key to NEXT PAGE:
```

The statistical data is output not only to the APC-2000 printer but also to the computer screen.

```
****** STATISTICS ******

TEST NUMBER      91 SHEET
FAIL NUMBER      50 SHEET

   ******************
   *  FAIL DETAILS  *
   ******************

SHORT ERROR       1 SHEET
OPEN  ERROR       6 SHEET

STEP NUMBER                    FAIL NUMBER
     0069                            2
     0070                            2
     0090                           28
     0095                           20
     0099                            1
     0100                           27
     0109                           26
     0110                           26
     0111                           26
     0112                           26
     0113                           25
     0114                           10

clear out of total & fail counter (Y/N) ?
```

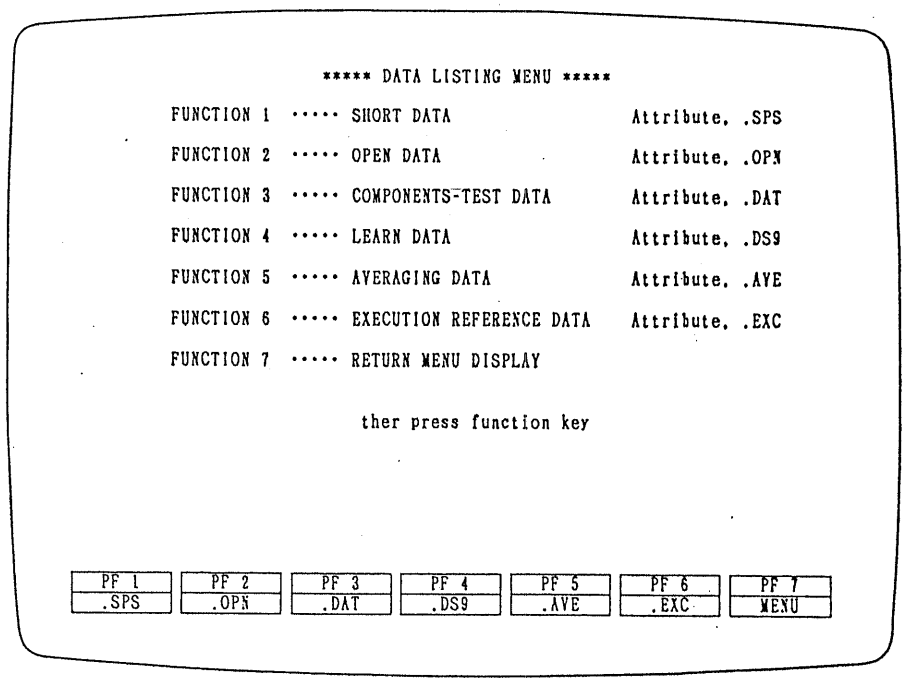
To reset the number of tested boards and that of failed ones to 0, press Y.



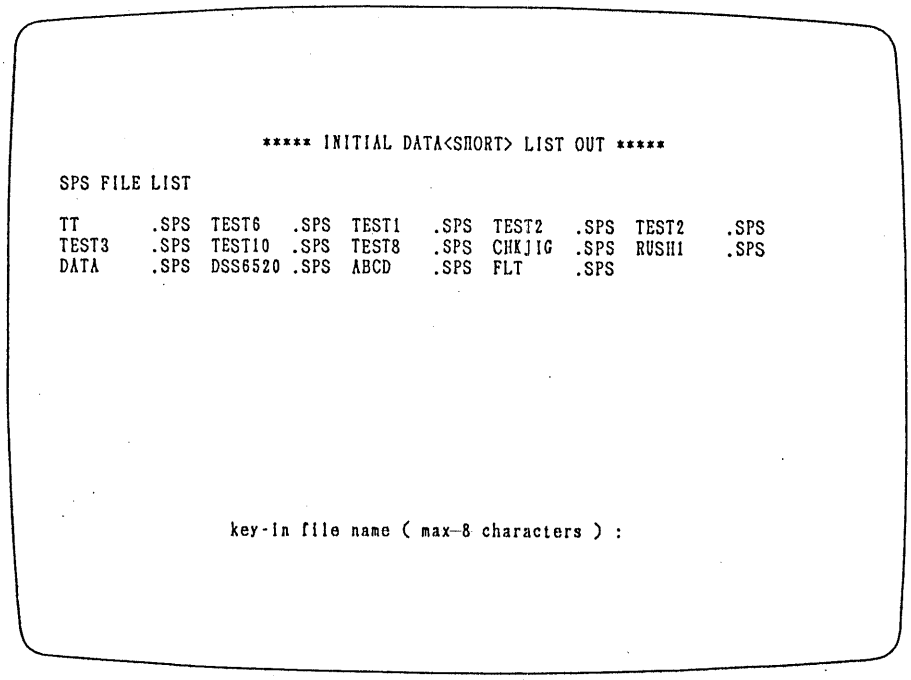
To clear all the details of failure steps (FAIL DETAILS), press Y.

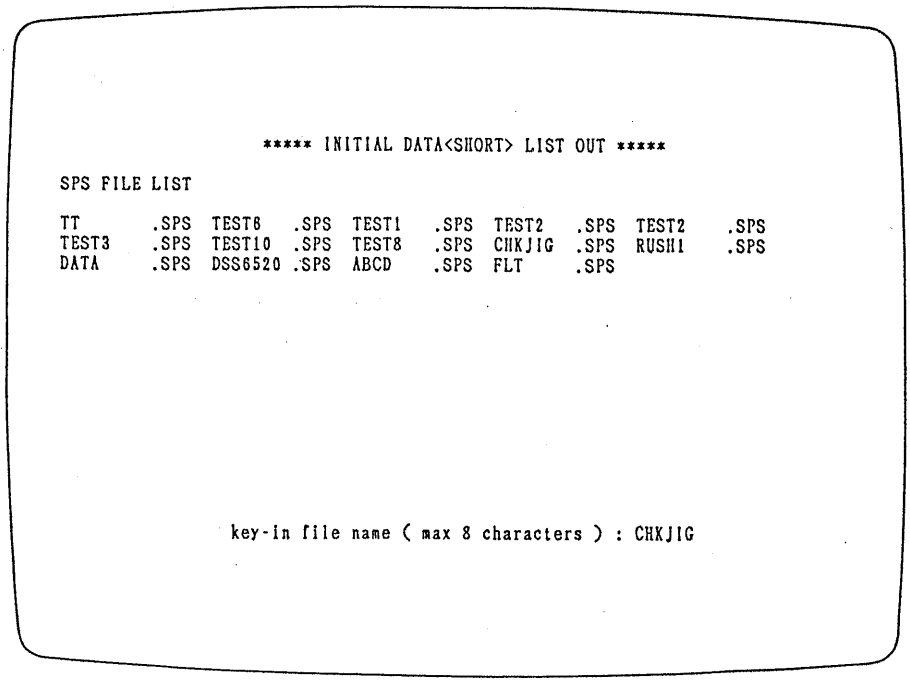
(5) DATA LIST (Listing on external printer) PF5

Since the host computer UNIVAC UP10E contains a standard Centronics printer interface, an external printer having the Centronics interface can be connected to it.
Depending on the type of the printer, however, the interface connector pin configuration may not match with that on the host computer. Check the pin assignment on the printer connector.
The data and programs output to the external printer can also be displayed on the computer screen.



To output the all-pin short check data:
PF1





C H K J I G CR

8621127

```
                ***** INITIAL DATA<SHORT> LIST OUT *****

SPS FILE LIST

TT       .SPS  TEST6   .SPS  TEST1   .SPS  TEST2   .SPS  TEST2    .SPS
TEST3    .SPS  TEST10  .SPS  TEST8   .SPS  CHKJIG  .SPS  RUSH1    .SPS
DATA     .SPS  DSS6520 .SPS  ABCD    .SPS  FLT     .SPS



              key-in file name ( max 8 characters ) : CHKJIG

                   Select device ? (C=crt/P=printer)
```

Indicate whether the all-pin short check data is to be displayed on the computer screen or to be printed on the external printer.

```
                ***** INITIAL DATA<SHORT> LIST OUT *****

          FILE NAME : CHKJIG.SPS

          MAX PIN ------ 173

    STEP  REF PIN    PASS PIN

    0001  000 ------ 001
    0001  001 ------ 000
    0003  116 ------ 115
    0004  117 ------ 118, 157
    0005  119 ------ 117, 157
    0006  157 ------ 117, 118
    0007  160 ------ 161
    0008  161 ------ 160
    0009  162 ------ 163
    0010  163 ------ 162
    0011  164 ------ 165
    0012  165 ------ 164
    0013  160 ------ 169
    0014  169 ------ 168
    0015  170 ------ 171
    0016  171 ------ 170
    0017  172 ------ 173
    0018  173 ------ 172

                        then hit any key to RETURN :
```

```
****** INITIAL DATA<OPEN> LIST OUT ******
OPN FILE LIST

CHKJIG   .OPN  TEST3   .OPN  CVB     .OPN  CBX     .OPN  TEST2    .OPN
TEST1    .OPN  TEST4   .OPN  TEST6   .OPN  DATA    .OPN  TEST5    .OPN
TEST7    .OPN  C       .OPN  CTEST2  .OPN  V       .OPN  DSS6520  .OPN
CHKJGI   .OPN  ABCD    .OPN

key-in file name ( max 8 characters ) :
```

Select PF2, and the all-pin open check file names are displayed.

```
****** INITIAL DATA<OPEN> LIST OUT ******
OPN FILE LIST

CHKJIG   .OPN  TEST3   .OPN  CVB     .OPN  CBX     .OPN  TEST2    .OPN
TEST1    .OPN  TEST4   .OPN  TEST6   .OPN  DATA    .OPN  TEST5    .OPN
TEST7    .OPN  C       .OPN  CTEST2  .OPN  V       .OPN  DSS6520  .OPN
CHKJGI   .OPN  ABCD    .OPN

key-in file name ( max 8 characters ) : CHKJIG
```

C H K J I G CR

8621129

```
                ****** INITIAL DATA<OPEN> LIST OUT ******

OPN FILE LIST

CHKJIG   .OPN  TEST3   .OPN  CVB     .OPN  CBX     .OPN  TEST2    .OPN
TEST1    .OPN  TEST4   .OPN  TEST6   .OPN  DATA    .OPN  TEST5    .OPN
TEST7    .OPN  C       .OPN  CTEST2  .OPN  V       .OPN  DSS6520  .OPN
CHKJGI   .OPN  ABCD    .OPN

                key-in file name ( max 8 characters ) : CHKJIG

                     Select device ? (C=crt/P=printer)
```

Indicate whether the all-pin open check list is to be displayed on the computer screen or to be printed on the external printer.

```
                ****** INITIAL DATA<OPEN> LIST OUT ******

FILE NAME   CHKJIG.OPN

MAX PIN ····· 173

PASS PIN ···· 032, 033, 034, 035, 036, 037, 038, 039, 040, 041
              042, 043, 044, 045, 046, 047, 048, 049, 050, 051
              058, 059, 060, 061, 062, 063, 064, 065, 066, 067
              068, 069, 070, 071, 072, 073, 074, 075, 076, 077
              078, 079, 080, 081, 082, 083, 084, 085, 086, 087
              120, 112, 124, 125, 126, 128, 130, 131, 132, 135
              137, 139, 140, 141, 142, 143, 144, 145, 147, 149
              151, 153, 155, 156, 158, 159, 167, 168, 169

                     then hit any key to RETURN :
```

8621130

```
****** INITIAL DATA<COMPONENTS TEST> LIST OUT ******
DAT FILE LIST

TEST2    .DAT  MPX     .DAT  TEST4   .DAT  D1      .DAT  CHKJIG   .DAT
Y1       .DAT  MN      .DAT  TEST1   .DAT  SJ      .DAT  NONTA    .DAT
R1COMP   .DAT  TEST10  .DAT  DSS6520 .DAT

key-in file name ( max 8 characters ) :
```

Select PF3, and the initial data (DAT) file names are displayed.

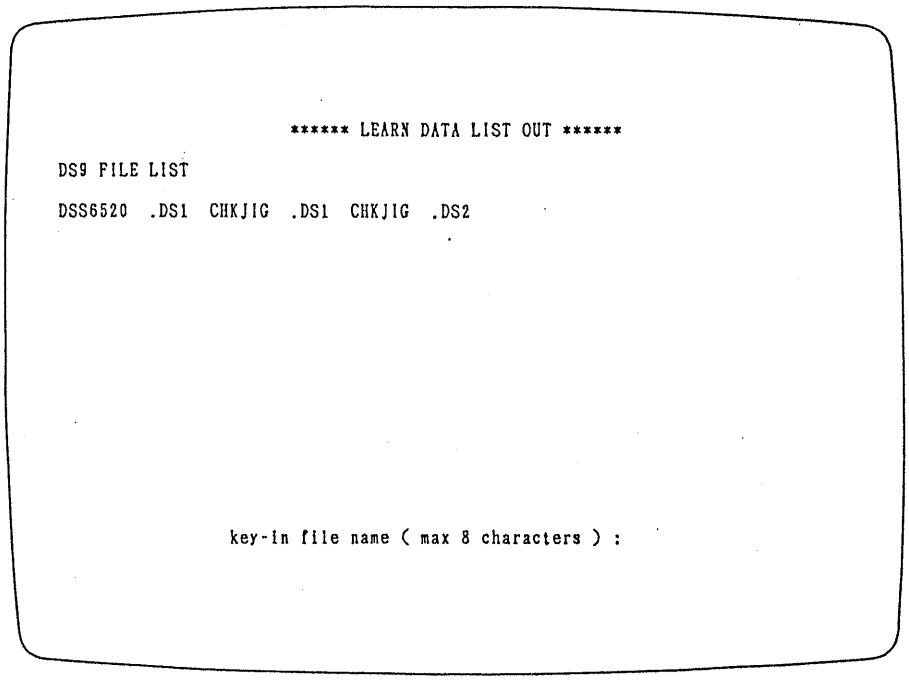
```
****** INITIAL DATA<COMPONENTS TEST> LIST OUT ******
DAT FILE LIST

TEST2    .DAT  MPX     .DAT  TEST4   .DAT  D1      .DAT  CHKJIG   .DAT
Y1       .DAT  MN      .DAT  TEST1   .DAT  SJ      .DAT  NONTA    .DAT
R1COMP   .DAT  TEST10  .DAT  DSS6520 .DAT

key-in file name ( max 8 characters ) : CHKJIG
```

C H K J I G CR

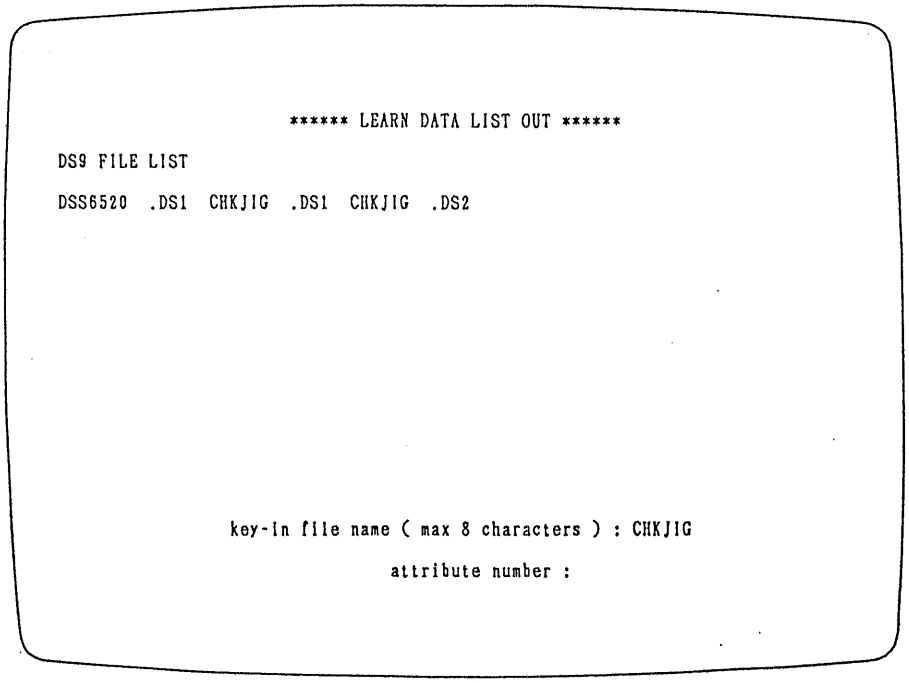
```
****** INITIAL DATA<COMPONENTS TEST> LIST OUT ******
DAT FILE LIST

TEST2    .DAT  MPX     .DAT  TEST4   .DAT  D1      .DAT  CHKJIG   .DAT
V1       .DAT  MN      .DAT  TEST1   .DAT  SJ      .DAT  NONTA    .DAT
R1COMP   .DAT  TEST10  .DAT  DSS6520 .DAT

key-in file name ( max 8 characters ) : CHKJIG
Select device ? (C=crt/P=printer)
```

Indicate whether the initial data list is to be displayed on the computer screen or to be printed on the external printer.

```
****** INITIAL DATA<COMPONENTS TEST> LIST OUT ******
FILE NAME : CHKJIG.DAT

STEP    PARTS     +PIN   -PIN   GND1   GND2   Actual Value   Parts Location   EXT
0001    01234     000    001                  1.00nF         1A               0
0002    R0002     002    003                  7.48 o         1A               0
0003    R0003     005    004                  9.95 o         1A               0
0004    R0003     005    004                  99.0 o         1A               0
0005    R0004     006    007                  33.3 o         1A               0
0006    R0005     009    008                  69.7 o         1A               0
0007    R0006     011    010                  82.1 o         1A               0
0008    R0007     012    013                  99.9 o         2A               0
0009    R0007     012    013                  100. o         2A               0
0010    R0008     014    015                  340. o         2A               0
0011    R0009     016    017                  677. o         2A               0
0012    R0010     018    019                  817. o         2A               0
0013    R0011     021    020                  999. o         2A               0
0014    R0011     020    021                  1.01ko         2A               0
0015    R0012     022    023                  3.29ko         2A               0
0016    R0013     024    025                  6.79ko         2A               0
0017    R0014     026    027                  8.21ko         2A               0
0018    R0015     028    029                  9.99ko         3A               0
0019    R0015     029    028                  10.0ko         3A               0
0020    R0016     031    030                  33.2ko         3A               0

then hit any key to NEXT PAGE :
```

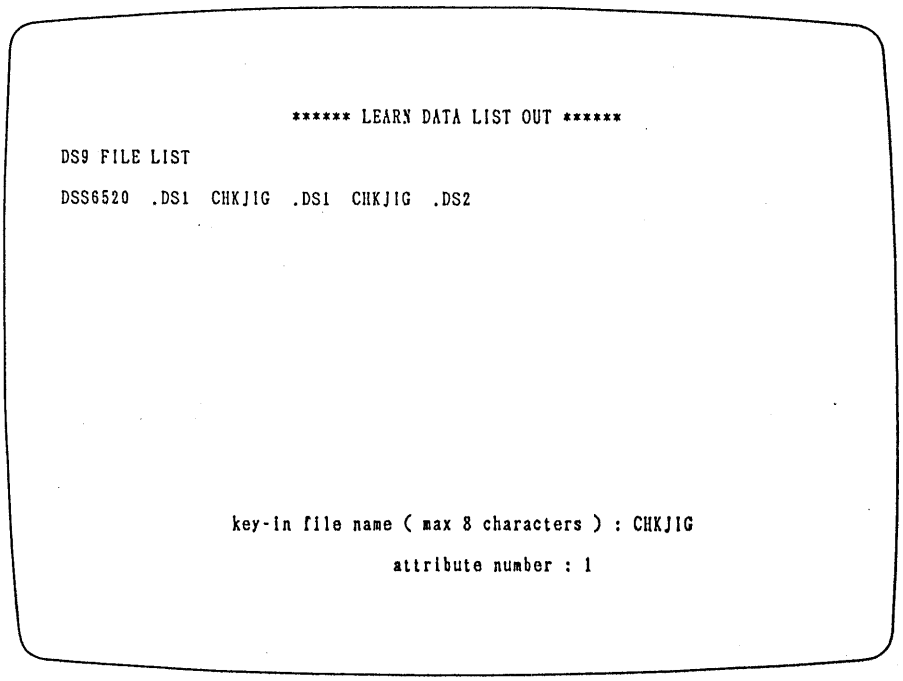


Select PF4, and the learned data (DS1 - DS2) file names are displayed.

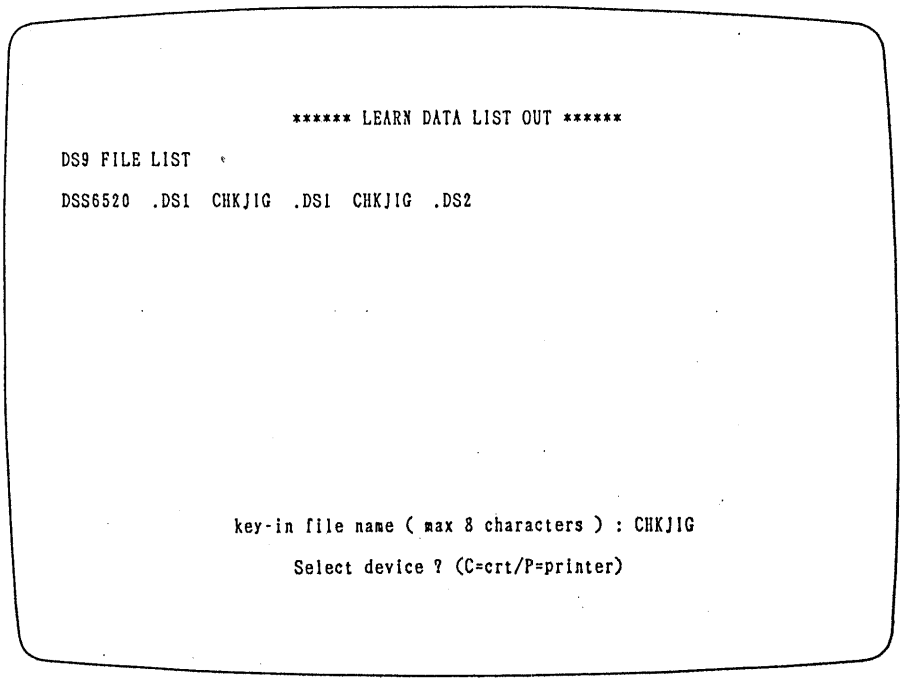


C H K J I G CR

Key in the ordinal number of the board whose data is to be listed.



1

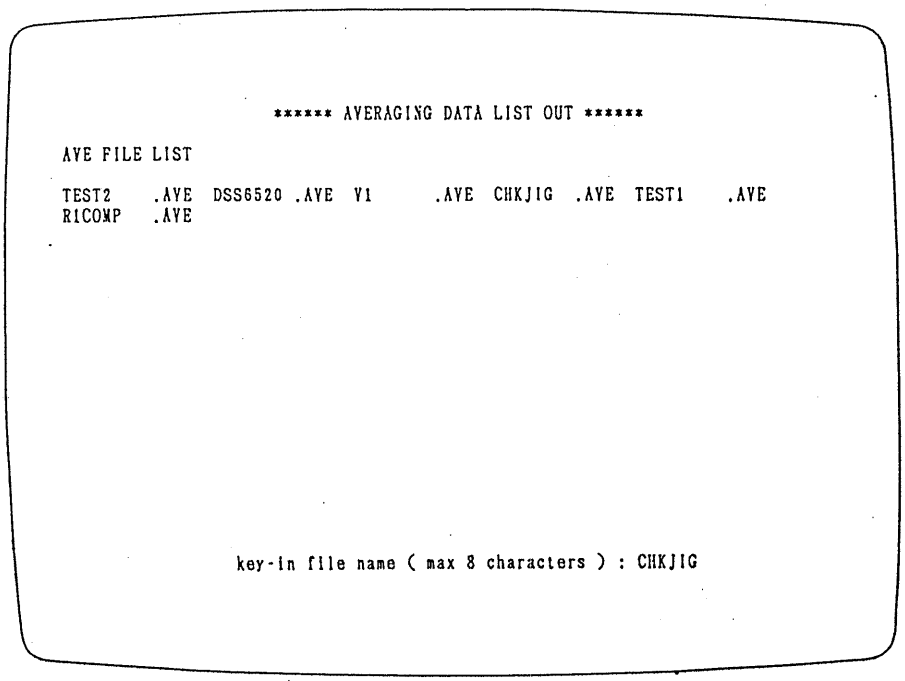


Indicate whether the learned data list is to be displayed on the computer screen or to be printed on the external printer.

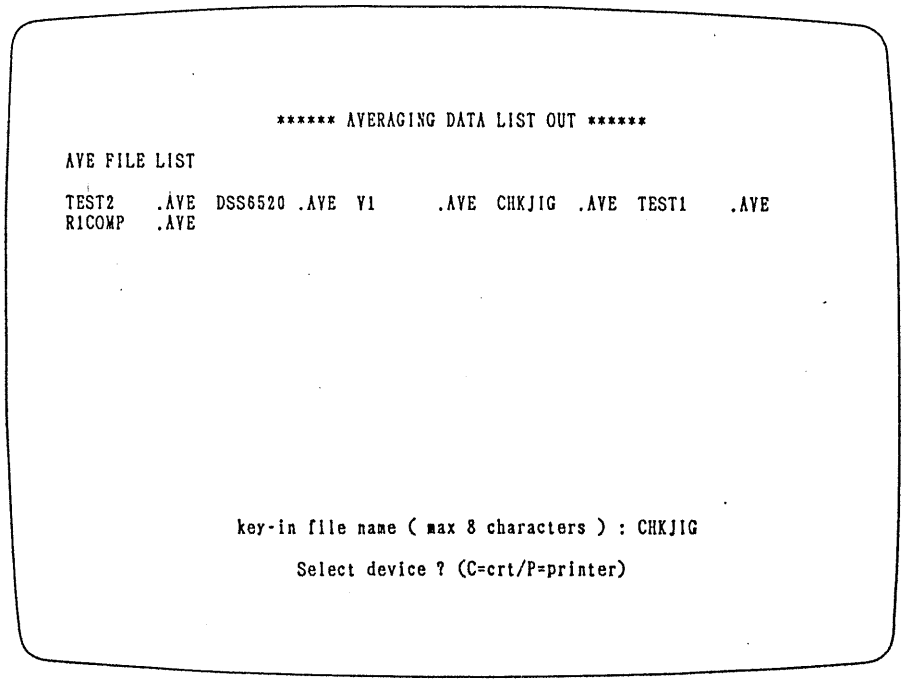
```
                    ****** LEARN DATA LIST OUT ******

     FILE NAME : CHKJIG.DS1

                                                    Actual   standard   Messured
STEP      PARTS     +PIN     -PIN     GND1     GND2  Value    Value      Value
0001      R0001     001      000                     1.24 o    1.41 o     1.41 o
0002      R0002     002      003                     7.48 o    7.53 o     7.55 o
0003      R0003     004      005                     9.95 o   10.58 o    10.11 o
0004      R0003     005      004                     99.0 o    10.2 o     09.9 o
0005      R0004     006      007                     33.3 o    32.9 o     33.1 o
0006      R0005     009      008                     69.7 o    69.1 o     69.5 o
0007      R0006     011      010                     82.1 o    81.4 o     81.6 o
0008      R0007     012      013                     99.9 o    99.4 o     99.5 o
0009      R0007     012      013                     100. o    098. o     099. o
0010      R0008     014      015                     340. o    337. o     337. o
0011      R0009     016      017                     677. o    672. o     672. o
0012      R0010     018      019                     817. o    812. o     812. o
0013      R0011     021      020                     999. o   1000. o     999. o
0014      R0011     020      021                    1.01ko    1.02ko     1.02ko
0015      R0012     022      023                    3.29ko    3.29ko     3.29ko
0016      R0013     024      025                    6.78ko    6.78ko     6.78ko
0017      R0014     026      027                    8.21ko    8.19ko     8.19ko
0018      R0015     028      029                    9.99ko    9.99ko     9.99ko
0019      R0015     029      028                    10.0ko    10.1ko     10.1ko
0020      R0016     031      030                    33.2ko    33.2ko     33.1ko

                    then hit any key to NEXT PAGE :
```

```
                    ****** AVERAGING DATA LIST OUT ******

AVE FILE LIST

TEST2    .AVE  DSS6520 .AVE  Y1       .AVE  CHKJIG  .AVE  TEST1    .AVE
R1COMP   .AVE


                    key-in file name ( max 8 characters ) :
```

Select PF5, and the averaged data file names are displayed.



C H K J I G CR



Indicate whether the averaged data list is to be displayed on the computer screen or to be printed on the external printer.

```
                    ****** AVERAGING DATA LIST OUT ******

     FILE NAME : CHKJIG.AVE                                  [ ] IS FILE NUMBER

                    Actual     Average          Maximum              Minimum
STEP    PARTS       Value      Value      Value      File      Value      File
0001    R0001     1.41 o     1.41 o     1.41 o     [1]     1.41 o     [E]
0002    R0002     7.53 o     7.54 o     7.55 o     [1]     7.53 o     [E]
0003    R0003     0.58 o     0.34 o     0.58 o     [E]     0.11 o     [1]
0004    R0003     10.2 o     10.8 o     10.2 o     [E]     09.9 o     [1]
0005    R0004     32.9 o     33.0 o     33.1 o     [1]     32.9 o     [E]
0006    R0005     69.1 o     69.3 o     69.5 o     [1]     69.1 o     [E]
0007    R0006     81.4 o     81.5 o     81.6 o     [1]     81.4 o     [E]
0008    R0007     99.4 o     99.4 o     99.5 o     [1]     99.4 o     [E]
0009    R0007     098. o     098. o     099. o     [1]     098. o     [E]
0010    R0008     337. o     337. o     337. o     [1]     337. o     [E]
0011    R0009     672. o     672. o     672. o     [1]     672. o     [E]
0012    R0010     812. o     812. o     812. o     [1]     812. o     [E]
0013    R0011     000. o     999. o     000. o     [E]     999. o     [1]
0014    R0011    1.02ko     1.02ko     1.02ko     [1]    1.02ko     [E]
0015    R0012    3.29ko     3.29ko     3.29ko     [1]    3.29ko     [E]
0016    R0013    6.78ko     6.78ko     6.78ko     [1]    6.78ko     [E]
0017    R0014    8.19ko     8.19ko     8.19ko     [1]    8.19ko     [E]
0018    R0015    9.98ko     9.99ko     9.98ko     [1]    9.98ko     [E]
0019    R0015    10.1ko     10.1ko     10.1ko     [1]    10.1ko     [E]
0020    R0016    33.2ko     33.2ko     33.2ko     [E]    33.1ko     [1]

                    then hit any key to NEXT PAGE :
```

```
                    ****** COMPONENT EXECUTION DATA LIST OUT ******

EXC FILE LIST

D1      .EXC  CHKJIG  .EXC  V1      .EXC  TEST4   .EXC  TEST1    .EXC
SJ      .EXC  TEST2   .EXC  R1COMP  .EXC  DSS6520 .EXC


                    key-in file name ( max 8 characters ) :
```

Select PF6, and the execution data file names are displayed.

```
****** COMPONENT EXECUTION DATA LIST OUT ******
EXC FILE LIST

D1      .EXC  CHKJIG  .EXC  Y1      .EXC  TEST4   .EXC  TEST1    .EXC
SJ      .EXC  TEST2   .EXC  R1COMP  .EXC  DSS6520 .EXC

key-in file name ( max 8 characters ) : CHKJIG
```

C H K J I G CR

```
****** COMPONENT EXECUTION DATA LIST OUT ******
EXC FILE LIST

D1      .EXC  CHKJIG  .EXC  Y1      .EXC  TEST4   .EXC  TEST1    .EXC
SJ      .EXC  TEST2   .EXC  R1COMP  .EXC  DSS6520 .EXC

key-in file name ( max 8 characters ) : CHKJIG
Select device ? (C=crt/P=printer)
```

Indicate whether the execution data list is to be displayed on the computer screen or to be printed on the external printer.

****** COMPONENT EXECUTION DATA LIST OUT ******

FILE NAME : CHKJIG.EXC

STEP	PARTS	+PIN	-PIN	GND1	GND2	Actual Value	Standard Value	Parts Location	+ err	- err	delay	EXT
0001	R0001	001	000			1.24 o	1.41 o	1A	10	10	00	0
0002	R0002	002	003			7.40 o	7.54 o	1A	10	10	00	0
0003	R0003	004	005			9.95 o	10.34 o	1A	10	10	00	0
0004	R0003	005	004			99.0 o	10.0 o	1A	10	10	00	0
0005	R0004	006	007			33.3 o	33.0 o	1A	10	10	00	0
0006	R0005	009	008			69.7 o	69.3 o	1A	10	10	00	0
0007	R0006	011	010			82.1 o	81.5 o	1A	10	10	00	0
0008	R0007	012	013			99.9 o	99.4 o	2A	10	10	00	0
0009	R0007	012	013			100. o	098. o	2A	10	10	00	0
0010	R0008	014	015			340. o	337. o	2A	10	10	00	0
0011	R0009	016	017			677. o	672. o	2A	10	10	00	0
0012	R0010	018	019			817. o	812. o	2A	10	10	00	0
0013	R0011	021	020			999. o	999. o	2A	10	10	00	0
0014	R0011	020	021			1.01ko	1.02ko	2A	10	10	00	0
0015	R0012	022	023			3.29ko	3.29ko	2A	10	10	00	0
0016	R0013	024	025			6.78ko	6.78ko	2A	10	10	00	0
0017	R0014	026	027			8.21ko	8.19ko	2A	10	10	00	0
0018	R0015	028	029			9.99ko	9.98ko	3A	10	10	00	0
0019	R0015	029	028			10.0ko	10.1ko	3A	10	10	00	0
0020	R0016	031	030			33.2ko	33.1ko	3A	10	10	00	0

then hit any key to NEXT PAGE :

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5.4 Daily Operation Procedures

This section explains the daily operation procedures for testing the same model PC boards everyday for a certain period of time.

(1) Turn on the power for the vacuum pump and set the power key switch of the main frame to ON. Then, insert APC2000 SYSTEM DISK into drive A. When the floppy disk is locked, the self-check operation is performed automatically, and if no errors are found, the system is set in the TEST READY mode.
If errors are found, the error items are displayed on the screen. To proceed with the initially intended operation even if the errors are reported, press the RETURN key.
If a RAM CHECK error is reported by the self-check operation executed after termination of the maintenance operation without pressing the "E" key, transfer the execution data (EXC FILE) according to the procedure explained in Section 5.3.1 (4) and execute the self-check operation again by pressing the CTRL and RESET keys at the same time.
If the power switch is turned on immediately after it is turned off, the APC-2000 may operate incorrectly. Therefore, turn on the power switch at least several seconds after it is turned off. Note that this condition also applies to the case of momentary power failure.

(2) Since not only the modes specified for DISPLAY (MAP/NORM), SHORT REF (1 - 15), PRINT CONT (FAIL, ALL, NON), and TEST SEQ (S-O-C, etc.) but also the execution programs (all-pin short check, all-pin open check, and component test) are preserved by the backup feature, the operator only needs to set a PC board on the jig and press the START switch on the printer section for the daily test operation.

(3) The PC board is tested according to the predetermined sequence, and if it is found to be a good board, the PASS lamp on the printer section is turned on with a melolodious note and the message "PASS" is displayed on the host computer screen.

(4) If defective portions are found by the all-pin short check or all-pin open check in the S-O-C, S-C, O-C, or S-O sequence, information on the defective portions is displayed and the measuring is terminated. The tested PC board can be removed from the jig when the measuring is terminated.

(5) If FAIL is specified as the printer output mode (PRINT CONT) for the component test, the failure step information is output to both screen and printer in realtime mode. Note that the test on the next PC board can be started when the message "TEST READY" is displayed on the screen even if the information is still being output to the printer.
When the printer output mode is NON, the failure step information is displayed on the host computer screen only. To print out this information after the test has finished, specify FAIL for PRINT CONT and press the RE-PRINT function key. It can also be printed out if PF13 is pressed.
When the printer output mode is ALL, information on all steps is output regardless of the test results.

(6) When a large number of PC boards are tested, the pins may be warn away or soiled with flux, the filter in the jig may become dirty, and the solenoid valve filter in the jig table and vacuum pump filter may be clogged. These parts must be cleaned and replaced regularly.

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5.5 Switching the Board Model to be Tested

The explanation in this section is based on the assumption that the execution programs for the new model are already completed.

(1) Replace jig

Disconnect the vacuum hose and 50-pin Amphenol connector from the jig, replace the jig with the one designed for the new PCB model, and reconnect the hose and connector. Be sure to reconnect cables in the correct order.

(2) Transfer execution programs

Insert the floppy disk (WORK FILE) containing the execution programs for the new PCB model into floppy disk drive B. Select the TRANSFER function key in the TEST READY mode, and transfer the execution programs from the host computer to APC-2000.

After the execution programs have been transferred, set the system in the TEST READY mode again and specify the DISPLAY, SHORT REF, PRINT CONT, and TEST SEQ modes for the new PCB model. Then, the new model PC boards can be tested by the daily operation procedures explained in Section 5.4.

5.6 WORK FILE Creation Procedure

The contents of the supplied floppy disks are as follows:

APC 2000 AUTOMATIC PC BOARD CHECKER SYSTEM	This floppy disk contains all the programs for APC-2000. Normally, it is inserted into drive A.
APC 2000 AUTOMATIC PC BOARD CHECKER WORK FILE	This is a WORK FILE floppy disk to contain the APC-2000 initial data, learned data, execution reference data, and other data Normally, it is inserted into drive B.
SYSTEM DISK CP/M. Ver. 2.2 SBASIC III Ver. 3.0	This is the system disk for the host computer. It is an original disk containing CP/M and SBASIC, etc.

To create a WORK FILE floppy disk from a new floppy disk, the floppy disk must be initialized (formatted).

Formatting method

Insert CP/M SYSTEM DISK into drive A and press the CTRL and RESET keys simultaneously. Then, the prompter "A >" appears.
After executing "A > FORMAT RETURN", insert a new floppy disk into drive A and key in "Y". Then, the formatting is started. When the formatting has finished, the message "FORMATTING---" is displayed and the floppy disk is tested (approximately 2 minutes).

When the test has finished, the message "DISK TEST COMPLETED---" is displayed, indicating the completion of formatting. After this more floppy disks may be formatted if the operator wishes.
The next step is to load the system program into the formatted floppy disk (SYSGEN).

SYSGEN procedure

Insert CP/M SYSTEM DISK into drive A and press the CTRL and RESET keys simultaneously; then, the prompter "A>" appears.
After executing "A > SYSGEN RETURN", key in "A" in response to the message "SOURCE DRIVE NAME?", and press the RETURN key in response to the message "SOURCE ON A THEN TYPE RETURN". Then, insert the formatted new floppy disk into drive B.
Key in "B" in response to the message "DESTINATION DRIVE NAME", and press the RETURN key in response to the message "DESTINATION ON DRIVE B---". When the SYSGEN operation is completed, the message "FUNCTION COMPLETE" appears. In this stage, the operator may start the SYSGEN operation for another floppy disk if he wishes.
To return to the prompter A > of CP/M, press the CTRL and RESET switches.
After the SYSGEN operation, write a PIP command into this WORK FILE.

Writing PIP command

Insert CP/M SYSTEM DISK into drive A and press the CTRL and RESET keys simultaneously; then the prompter "A >" appears.
Insert the WORK FILE floppy disk, for which formatting and SYSGEN have been completed, into drive B. Execute "A > PIP B:=PIP.COM RETURN", and the PIP command is written into the WORK FILE.

A new WORK FILE floppy disk is created by the above operations. It is advisable that all the available floppy disks should be formatted at a time.
The PIP command written into the WORK FILE is used for the WORK FILE backup operation explained in the next section. Refer to the computer operation manual for details.

5.7 Floppy Disk Backup Methods

To protect precious information from accidental damage or destruction, it is advisable to make a backup copy of every floppy disk containing important data.

As the backup floppy disk, prepare a new floppy disk which has been formatted according to the formatting procedure. (If the floppy disk is to be used as a backup floppy disk for WORK FILE or CP/M, both the formatting and SYSGEN must have been completed for it.)

The backup method varies by the content of the supplied disk as follows:

WORK FILE backup method

Insert the WORK FILE floppy disk into drive A, and the floppy disk for which the formatting and SYSGEN has been completed into drive B. Press the CTRL and RESET keys simultaneously, and the prompter "A > " appears.
Execute "A > PIP B:=A:*.*RETURN", and the entire WORK FILE is copied from drive A to drive B.

APC 2000 system disk backup method

Insert CP/M SYSTEM DISK into drive A. Press the CTRL and RESET keys simultaneously, and the prompter "A >" appears.
After executing "A > DCOP RETURN", insert the APC 2000 system disk into drive A in place of the UP10E CP/M SYSTEM DISK, and a formatted backup floppy disk into drive B. Execute "S RETURN" in response to the message "Type S or V", and the copy operation is started. When the copy operation is completed, the message "FUNCTION COMPLETED" is displayed.

CP/M SYSTEM DISK backup method

Insert the CP/M SYSTEM DISK into drive A.
Press the CTRL and RESET keys simultaneously, and the prompter "A >" appears.
Insert the floppy disk for which the formatting and SYSGEN has been completed into drive B.
Execute "A > PIP B:=A:*.*", and all the contents of CP/M SYSTEM DISK in drive A are copied to the floppy disk in drive B.
The APC 2000 System Disk causes both the SBASIC on CP/M and the programs in the APC-2000 program menu to be started automatically.
For more details on floppy disk copy and file name alteration, refer to the host computer operation manual.

5.8 Increasing Pins (MPX Boards)

To increase the testing pins, the following devices are required according to the number of the pins:

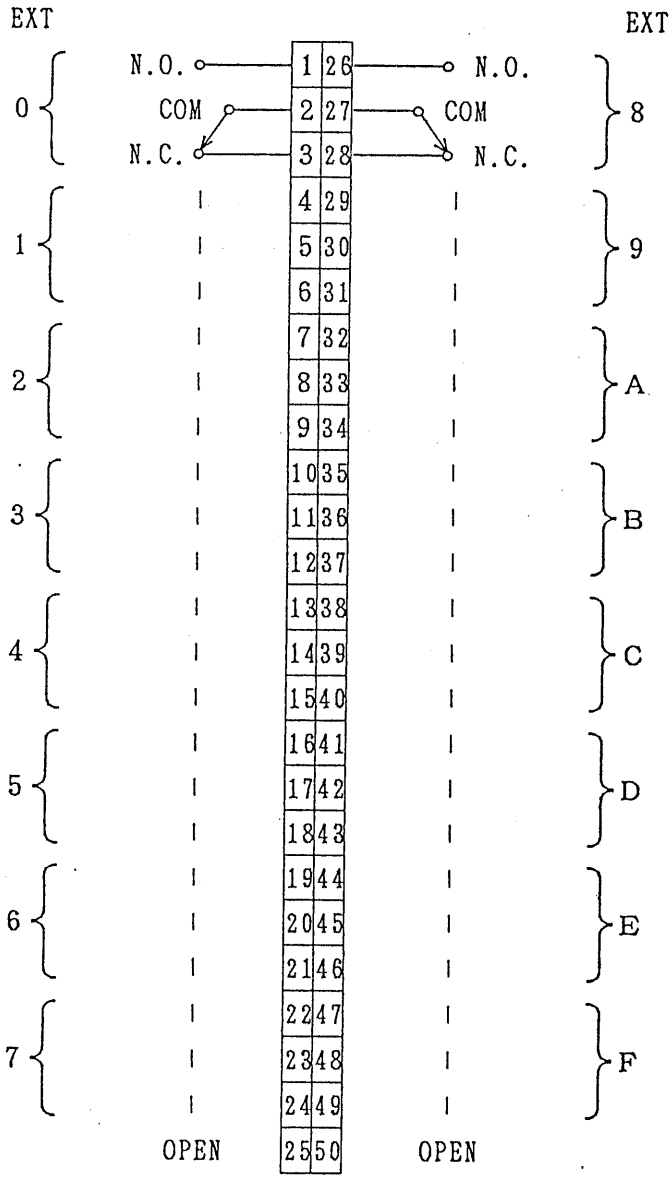
MX01-APC: Multiplexer card on which relays are mounted. Sixteen pins can be added by one MX01-APC card.

CA01-APC: Multiplexer cable to connect the main frame to the jig. One CA01-APC cable is required for every 48 additional pins.

MB01-APC: Mother board required when the maximum number of testing pins is 513 or more.

When the multiplexer cards have been increased or decreased, change the maximum number of pins for SELF CHECK, referring to Section 5.3.1 (4).

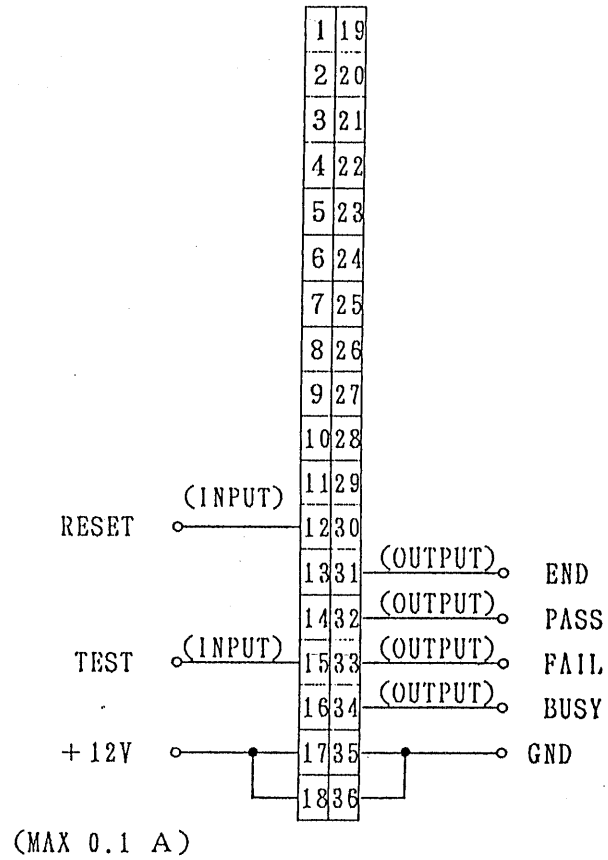
5.9 EXT CONTROL (External Control)

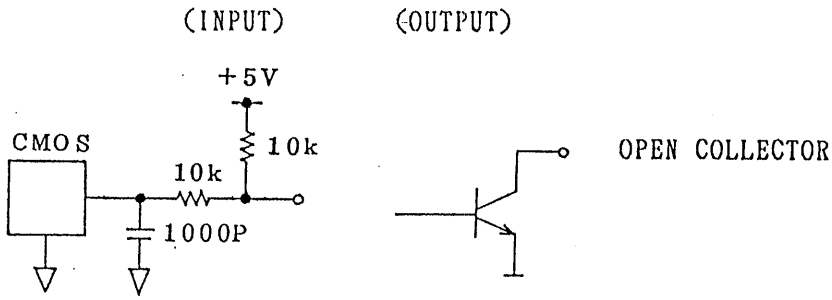


Key in 0 - F for the item of EXT at the time of initial data creation or maintenance, and only the step specified by one of the 16 relays in APC-2000 can be executed.

Apply voltage to a test board by connecting the APC-2000 to an external power supply unit, and the voltage distribution can be measured and the board quality can be judged (see Section 7.4).

5.10 AUX SIGNAL I/O





Use this connector for making a system by connecting the APC-2000 to an external unit.

6. THEORY OF OPERATION

6.1 Block Diagram

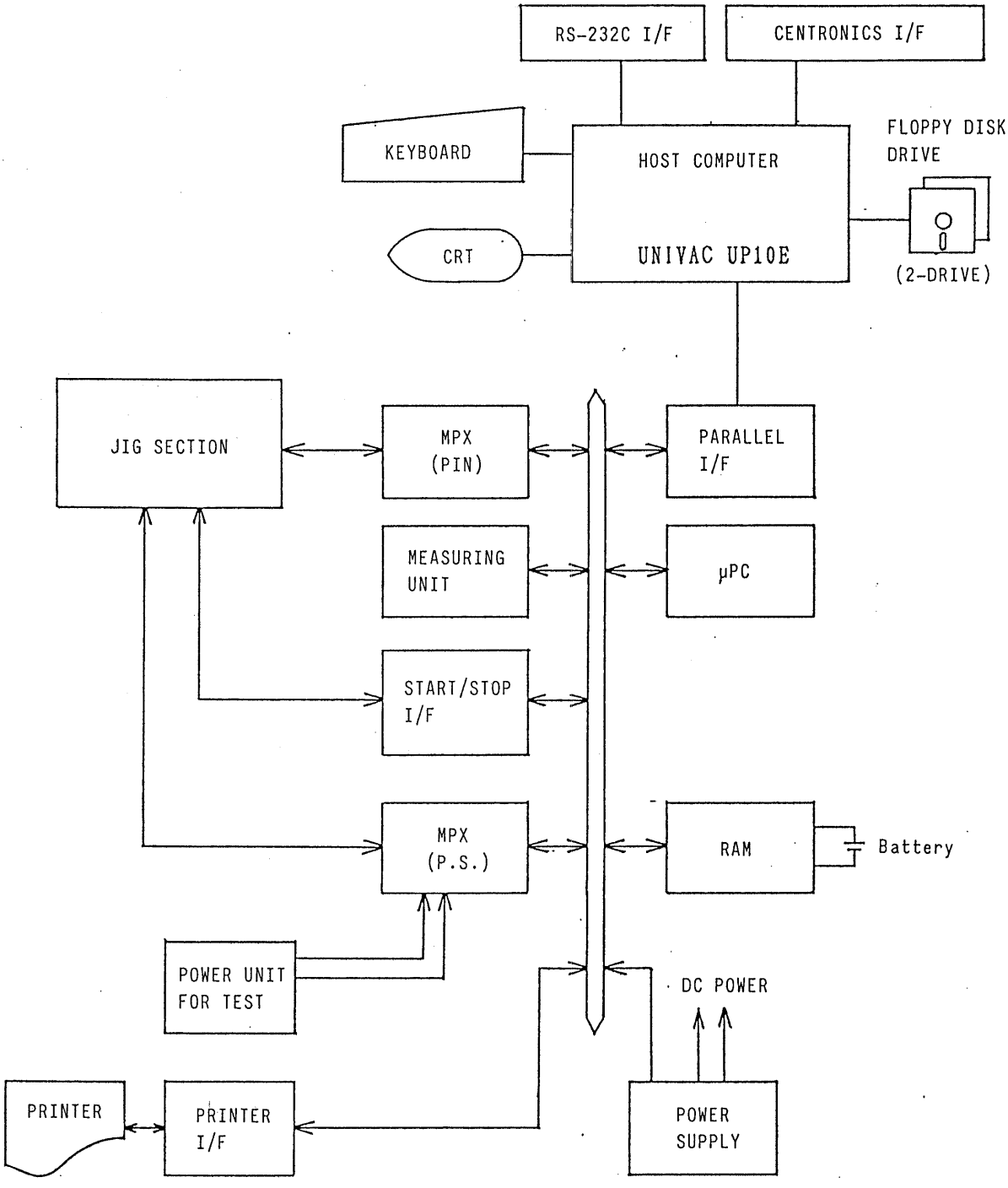
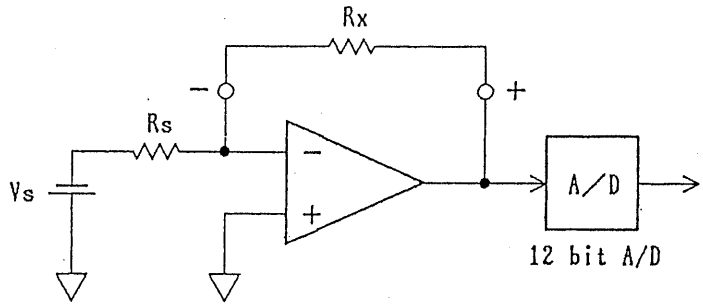


Fig. 6.1 Block diagram

6.2 Theory of Measurement

6.2.1 Measurement of resistance



Vs: Reference voltage
Rs: Reference resistance
Rx: Measured resistance

Fig. 6.2 Resistance measurement theory

Rx range	Measuring range	Rs	Vs	Over-resistance display
10.00Ω	1.00 - 15.00 Ω	10 Ω	0.3V	20.00Ω or higher
100.0Ω	10.0 - 150.0 Ω	100 Ω	0.3V	200.0Ω or higher
1000.Ω	100 - 1500 Ω	1 kΩ	0.3V	2000Ω or higher
10.00 kΩ	1.00 - 15.00 kΩ	10 kΩ	0.3V	20.00kΩ or higher
100.0 kΩ	10.0 - 150.0 kΩ	100 kΩ	0.3V	200.0kΩ or higher
1000. kΩ	100 - 1500 kΩ	1 MΩ	0.3V	2000kΩ or higher
4.00 MΩ	1.00 - 6.00 MΩ	1 MΩ	0.1V	6.00MΩ or higher

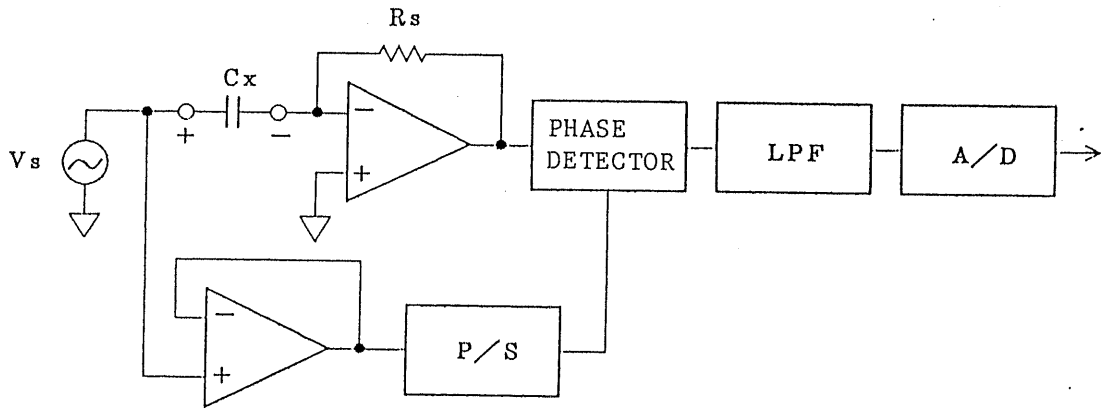
When Rx is infinite, the application voltage is suppressed to abvout 0.7V by an over-voltage protection circuit.

Short-circuit check (S) and jumper conduction check (J) are executed in a fixed range of 10.00Ω.

6.2.2 Measurement of capacitance

The capacitance of a condenser is measured by two different methods. This section explains the phase detection method to measure the capacitance of up to 15.00μF and the TC method to measure the capacitance of more than 10.0μF separately.

(1) Phase detection method



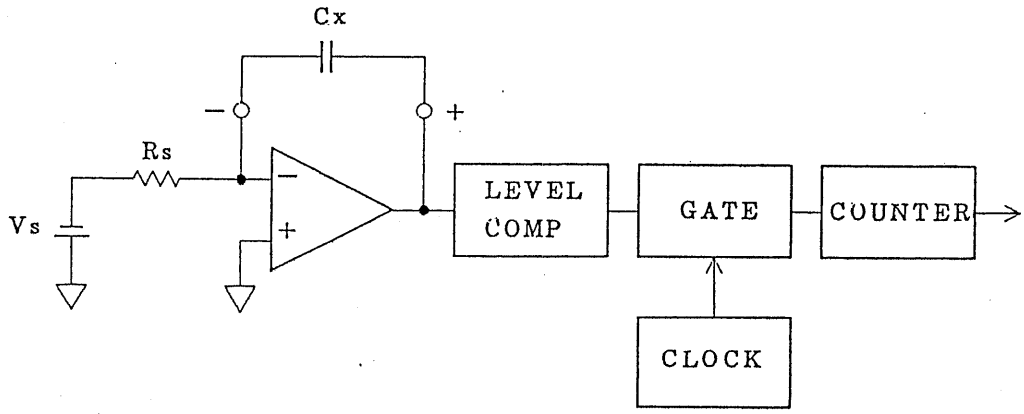
Vs: Reference AC voltage source
Rs: Reference resistance
Cx: Measured capacitor

Fig. 6.3 Theory of phase detection method for measuring capacitance

Cx range	Measuring range	Rs	Vs	Over-capacitance display
10.00 pF	10.0 - 15.00 pF	1 MΩ	10kHz	200.0pF or higher
1000. pF	100 - 1500 pF	100 kΩ	10kHz	2000pF or higher
10.00 nF	1.00 - 15.00 nF	10 kΩ	10kHz	20.00nF or higher
100.0 nF	10.0 - 150.0 nF	1 kΩ	10kHz	200.0nF or higher
1000. nF	100 - 1500 nF	1 kΩ	1 kHz	2000nF or higher
10.00 μF	1.00 - 15.00 μF	100 Ω	1 kHz	20.00μF or higher

The application voltage to Cx is suppressed to about 0.7Vp-p by an overvoltage protection circuit.

(2) TC method



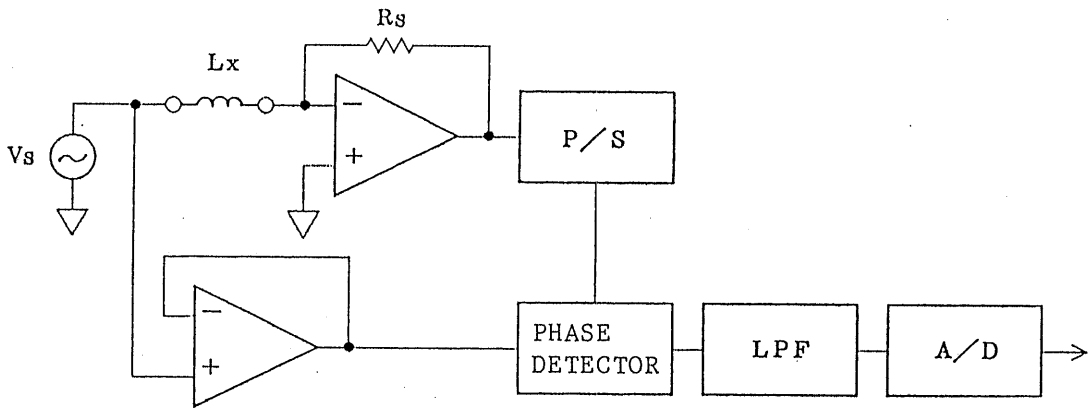
Vs: Reference voltage
Rs: Reference resistance
Cx: Measured capacitor

Fig. 6.4 Theory of TC method for measuring capacitance

Cx range	Measuring range	Rs	Vs	CLOCK	Over-capacitance display
100.0 μF	10.0 - 150.0 μF	1 kΩ	0.3V	20kHz	200.0μF or higher
1000 μF	100 - 1500 μF	100 Ω	0.3V	20kHz	2000μF or higher
4.00 mF	1.00 - 6.00 mF	100 Ω	0.3V	2 kHz	20.00mF or higher

The application voltage to Cx is suppressed to about 0.7V by an overvoltage protection circuit.

6.2.3 Measurement of inductance



Vs: Reference AC voltage
Rs: Reference resistance
Lx: Measured inductance

Fig. 6.5 Inductance measurement theory

Lx range	Measuring range	Rs	Vs	Over-inductance display
100.0 µH	10 - 15.00 µH	10 Ω	10kHz	200.0µH or higher
1000 µH	100 - 1500 µH	100 Ω	10kHz	2000µH or higher
10.00 mH	1 - 15.00 mH	1 kΩ	10kHz	20.00mH or higher
100.0 mH	10 - 150.0 mH	10 kΩ	10kHz	200.0mH or higher
400 mH	100 - 600 mH	100 kΩ	10kHz	2000mH or higher

The application voltage to Lx is suppressed to about 2Vp-p by an overvoltage protection circuit.

6.3 Guarding Method

When a complex circuit of a part is measured simply by two terminals, high measurement accuracy cannot be guaranteed due to round-about impedance.

To avoid the effect of roud-about impedance as mush as possible, the APC-2000 allows the user to program a guarding method.

Figure 6.6 shows an example of the guarding method based on the theory diagrams in Section 6.2.

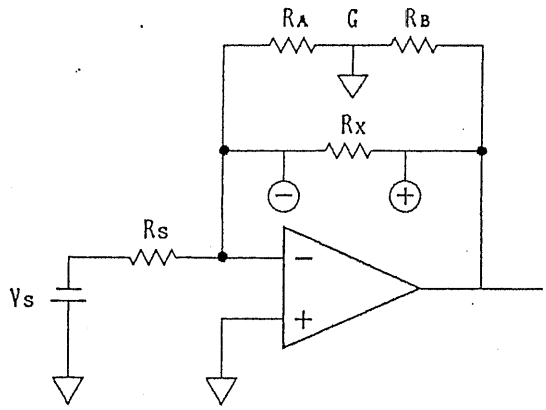


Fig. 6.6 Guarding method

In Figure 6.6, serial registors R_A and R_B are connected in parallel with the resistor (Rx) to be measured. Since good measurement accuracy cannot be obtained only by the measurement accross Rx (+ and -), node G between R_A and R_B is grounded so that it may be on the same level as the imaginary ground of the aplifier. Consequently, no current flow through R_A and only the current passing through Rx can be measured. This means that the measurement of Rx is not affected by the impedance of R_A and R_B.

On the APC-2000, up to two points may be grounded per step for any pins.

This guarding method is effective for the complex circuits of capacitors, inductors, and resistors.

6.4 Measurement Delay

When measuring a resistance in a circuit network wherein the resistor to be measured is connected in parallel with a capacitor, it is preferable that the measurement be started after the capacitor is fully charged up.

To enable this, a measurement delay can be specified for resistance measurement, as follows:

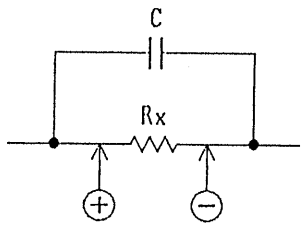


Fig. 6.7 R/C parallel circuit

<Measurement delay> A value from 00 to 99 may be specified for the item "DELAY" in the maintenance mode (100 types delays by the step of 10ms are available).

00 : 0m sec	20 : 200m sec
01 : 10m sec	:
02 : 20m sec	:
03 : 30m sec	50 : 500m sec
04 : 40m sec	:
:	:
10 : 100m sec	99 : 990m sec
11 : 110m sec	
:	

For the parallel circuit as shown in Figure 6.8, measurement delay need not be specified if the G terminal is grounded according to the theory of guarding method.

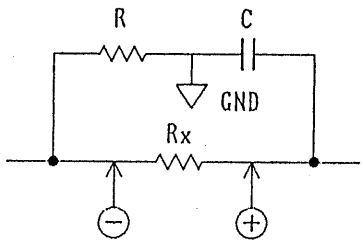


Fig. 6.8 R/C serial-parallel circuit

6.5 Judgement Criterion Error

When the execution reference data is created from the data learned from a good board, the default values of the tolerance error ranges are set as follows:

R : ±10%	T : ±10%
C : ±20%	P : ±10%
L : ±20%	
D : ±10%	V : ±10%

The above ranges may be altered by use of the MAINTENANCE program menu.

The alteration may be done for each test step or for each part type.

For the short check (S) and jumper conduction check (J), the value of SHORT REF is used as the criterion.

A transistor with resistance (M) is judged as PASS if the measured value is greater than the standard value and as FAIL if it is smaller than the standard value.

6.6 All-Pin Short Check Algorithm

The short circuit caused by a solder bridge or some other reason ranks first among the factors to bring about failures of the PC boards on which parts are mounted.

Since the APC-2000 generates a short check program automatically and checks all pins, the short circuit at even unexpected portions can be detected in a few seconds.

For the all-pin short check, the program which recognizes the pins short-circuited from the beginning (by jumper wire, etc.) as pass pins and checks all the remaining pins must be generated from a good board.

6.6.1 Data learning procedure

(1) If pins 0-150 are used on the jig, for example, key in the information "150".

(2) Pins 0-150 are tested one by one sequentially, and if the value obtained from a test step is smaller than the value of SHORT REF (1-15Ω), that step and pertinent pin numbers are memorized.

0 ←→ 1-150 all short-circuited
1 ←→ 0 and 2-150 all short-circuited
:
:

(3) Each one of the pins memorized in step (2) is tested with each one of the remaining pins, and the short-circuit pins are memorized as the learned data.

REF PIN	PASS PIN
0	1.3
1	0.3
3	0.1
15	17.140
:	:
:	:

6.6.2 Execution program transfer

(1) The data obtained in step (3) of Section 6.6.1 is transferred.

6.6.3

(1) The all-pin short check is executed according to TEST SEQ. If an error is found, the test is terminated without proceeding to the measuring of resistance or capacitance.

6.7 All-Pin Open Check Algorithm

To judge if a PC board is good or not, the testing pins mist be brought into good contact with the PC board.

The APC-2000 can find the poor pin contact caused by flux or pin abrasion within a few seconds.

For the all-pin open check, a program to recognize the pins originally having high impedance against other pins as pass pins and to check all the remaining pins must be generated from a good board.

6.7.1 Data learning procedure

(1) If pins 0-150 are used on the jig, for example, key in the information "150".

(2) Pins 0-150 are tested one by one sequentially, and the pins whose impedance values exceed the value of OPEN REF (100kΩ) are memorized as pass pins (pins not to be tested).

```
  0 <--> 1-150 all short-circuited
  1 <--> 0 and 2-150 all short-circuited
  :          :
  :          :
150 <--> 0-149 all short-circuited

PASS PIN:  5, 20, 142
```

6.7.2 Execution program transfer

(1) The data obtained in step (2) of Section 6.7.1 is transferred.

6.7.3

(1) The all-pin open check is executed according to TEST SEQ. If an error is found, the test is terminated without proceeding to the measuring of resistance, capacitance, etc.

7. FIXTURE DESIGNING

To design the fixture for a PC board to be tested, at least the following items must be prepared: The bare board on which parts are to be mounted, the in-circuit board on which parts have been mounted and soldered, pattern diagram, circuit diagram, and parts list.

7.1 Pin Positioning and Numbering

For a circuit as shown in Figure 7.1, for example, the user must determine the position at which to set a probe in each pattern on the corresponding PC board, assign a serial number to the probe, and write the number on the circuit diagram.

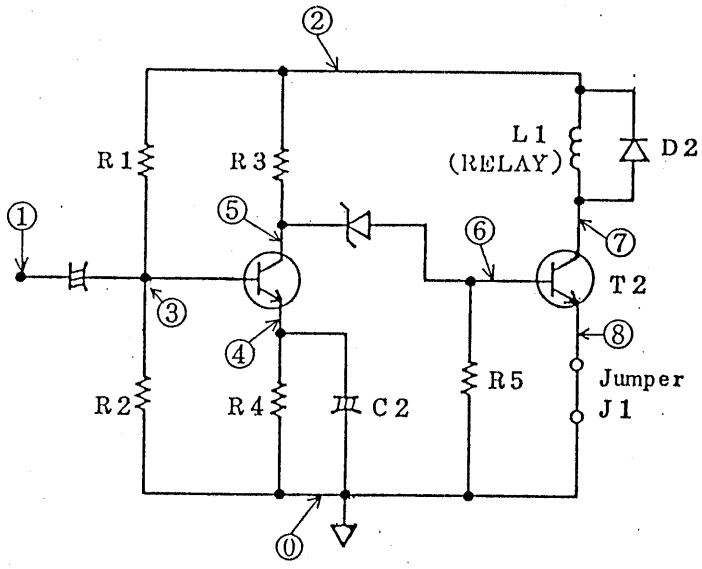


Fig. 7.1 Circuit example

7.2 Initial Data Creation

Make a list as shown in Figure 7.2, and input data according to the initial data creation procedure explained in Section 5.3.2 (1).

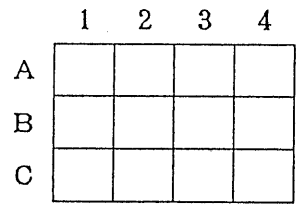
o The parts names for APC-2000 are abbreviated as follows:

Resistor = R
Capacitor = C
Inductor = L
Diode = D
Transistor = T
Light emitting diode = P
Transistor with resistance = M
Voltage measuring point = V
Jumper check point = J
Short-circuit check point = S
Variable resistor = RV
Variable capacitor = CV
Assembled-type resistor = RA

o The GND pins need not be specified unless required definitely.

o The value for each mounted part must be specified with three digits (four characters including decimal point).
Example: 100. kΩ

o To specify a position on a PC board, split the board into four parts (1-4) vertically and three parts (A-C) horizontally and give a pair of coordinates.



o Specify a value for EXT when external power is to be applied to the relevant step. The value may be selected from 0-F.

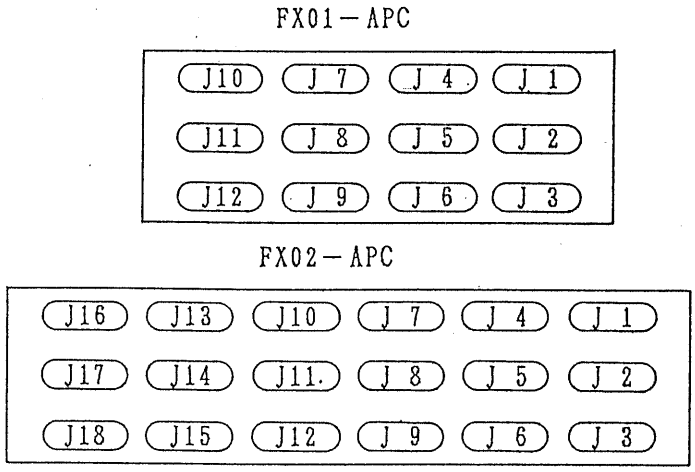
STEP NO.	PARTS	+PIN	-PIN	GND1	GND2	VALUE	POSITION	EXT	REMARKS
1	J1	0	8				3C		
2	R1	2	3			100kΩ	2A		
3	R2	3	0			120kΩ	1A		
4	R3	2	5			820Ω	1A		
5	R4	4	0			1.00kΩ	2A		
6	R5	6	0			10.0kΩ	3B		
7	C1	1	3			4.70μF	2A		
8	C2	4	0			100μF	2C		
9	D1	6	5				2B		
10	D2	7	2				3A		
11	T1	3	4				1A		
12	T1	3	5				1A		
13	T2	6	8				2C		
14	T2	6	7				2C		
15	L1	2	7			100mH	2B		

Fig. 7.2 Initial data creation table

7.3 Connection between Pins and Connectors and Program Numbers

Connector to be used: Amphenol 50-pin connector (57-40500) Number of required connectors:

6 (for the standard 256 pins)
18 (12 additional connectors) (for the extended 768 pins)



(Rear view)

Fig. 7.3 Connector number diagram

Note that the signal having the same phase as that applied to the - pin is applied to pins 25 and 50 on each connector so that the effect of wiring may be reduced as much as possible.

APC2000 〔PIN ASSIGNMENT 1〕

CONNECT TERMI NO.	PIN NO J 1	J 2	J 3	J 4	J 5	J 6	J 7	J 8	J 9	J 10	J 11	J 12
1	0	48	96	144	192	240	256	304	352	400	448	496
2	1	49	97	145	193	241	257	305	353	401	449	497
3	2	50	98	146	194	242	258	306	354	402	450	498
4	3	51	99	147	195	243	259	307	355	403	451	499
5	4	52	100	148	196	244	260	308	356	404	452	500
6	5	53	101	149	197	245	261	309	357	405	453	501
7	6	54	102	150	198	246	262	310	358	406	454	502
8	7	55	103	151	199	247	263	311	359	407	455	503
9	8	56	104	152	200	248	264	312	360	408	456	504
10	9	57	105	153	201	249	265	313	361	409	457	505
11	10	58	106	154	202	250	266	314	362	410	458	506
12	11	59	107	155	203	251	267	315	363	411	459	507
13	12	60	108	156	204	252	268	316	364	412	460	508
14	13	61	109	157	205	253	269	317	365	413	461	509
15	14	62	110	158	206	254	270	318	366	414	462	510
16	15	63	111	159	207	255	271	319	367	415	463	511
17	16	64	112	160	208		272	320	368	416	464	
18	17	65	113	161	209		273	321	369	417	465	
19	18	66	114	162	210		274	322	370	418	466	
20	19	67	115	163	211		275	323	371	419	467	
21	20	68	116	164	212		276	324	372	420	468	
22	21	69	117	165	213		277	325	373	421	469	
23	22	70	118	166	214		278	326	374	422	470	
24	23	71	119	167	215		279	327	375	423	471	
25	GUARD	----------	----------	----------	----------	GUARD	----------	----------	----------	----------	----------	GUARD
26	24	72	120	168	216		280	328	376	424	472	
27	25	73	121	169	217		281	329	377	425	473	
28	26	74	122	170	218		282	330	378	426	474	
29	27	75	123	171	219		283	331	379	427	475	
30	28	76	124	172	220		284	332	380	428	476	
31	29	77	125	173	221		285	333	381	429	477	
32	30	78	126	174	222		286	334	382	430	478	
33	31	79	127	175	223		287	335	383	431	479	
34	32	80	128	176	224		288	336	384	432	480	
35	33	81	129	177	225		289	337	385	433	481	
36	34	82	130	178	226		290	338	386	434	482	
37	35	83	131	179	227		291	339	387	435	483	
38	36	84	132	180	228		292	340	388	436	484	
39	37	85	133	181	229		293	341	389	437	485	
40	38	86	134	182	230		294	342	390	438	486	
41	39	87	135	183	231		295	343	391	439	487	
42	40	88	136	184	232		296	344	392	440	488	
43	41	89	137	185	233		297	345	393	441	489	
44	42	90	138	186	234		298	346	394	442	490	
45	43	91	139	187	235		299	347	395	443	491	
46	44	92	140	188	236		300	348	396	444	492	
47	45	93	141	189	237		301	349	397	445	493	
48	46	94	142	190	238		302	350	398	446	494	
49	47	95	143	191	239		303	351	399	447	495	
50	GUARD	----------	----------	----------	----------	GUARD	----------	----------	----------	----------	----------	GUARD

APC2000 〔PIN ASSIGNMENT 2〕

CONNEC TERMI NO.	PIN NO.T J 13	J 14	J 15	J 16	J 17	J 18
1	512	560	608	656	704	752
2	513	561	609	657	705	753
3	514	562	610	658	706	754
4	515	563	611	659	707	755
5	516	564	612	660	708	756
6	517	565	613	661	709	757
7	518	566	614	662	710	758
8	519	567	615	663	711	759
9	520	568	616	664	712	760
10	521	569	617	665	713	761
11	522	570	618	666	714	762
12	523	571	619	667	715	763
13	524	572	620	668	716	764
14	525	573	621	669	717	765
15	526	574	622	670	718	766
16	527	575	623	671	719	767
17	528	576	624	672	720	
18	529	577	625	673	721	
19	530	578	626	674	722	
20	531	579	627	675	723	
21	532	580	628	676	724	
22	533	581	629	677	725	
23	534	582	630	678	726	
24	535	583	631	679	727	
25	GUARD					
26	536	584	632	680	728	
27	537	585	633	681	729	
28	538	586	634	682	730	
29	539	587	635	683	731	
30	540	588	636	684	732	
31	541	589	637	685	733	
32	542	590	638	686	734	
33	543	591	639	687	735	
34	544	592	640	688	736	
35	545	593	641	689	737	
36	546	594	642	690	738	
37	547	595	643	691	739	
38	548	596	644	692	740	
39	549	597	645	693	741	
40	550	598	646	694	742	
41	551	599	647	695	743	
42	552	600	648	696	744	
43	553	601	649	697	745	
44	554	602	650	698	746	
45	555	603	651	699	747	
46	556	604	652	700	748	
47	557	605	653	701	749	
48	558	606	654	702	750	
49	559	607	655	703	751	
50	GUARD					

7.4 Voltage Measuring

The APC-2000 can not only check the mounted parts without applying power to them but also check the quality of the PC board with applying power to it and measuring the voltage distribution. Use the EXT CONTROL terminal (50p Amphenol Connector) for applying the power. The relay contact rating is DC 24V and 2A or DC 120V and 0.1A (resistance load). When applying external power to the jig, attach a protective resistor (normally about 10kΩ) between the voltage measuring pin and jig connector.

After a PC board has been tested by the APC-2000 with the power application or before the PC board that has been tested by a different tester with the power application is to be tested by the APC-2000, be sure to wait till the electricity is discharged from the PC board spontaneously or discharge the electricity from it forcibly.

8. DEBUGGING

8.1 Necessity of Debugging

8.1.1 What is debugging

After the data learned from good boards is averaged and made into reference data, the good boards are tested again with the reference data to check if (1) they can be tested stably, (2) failure parts can be detected for sure, (3) the relationship between the measuring speed and judgement criterion ranges is optimum, and (4) the pin jig has no problems. The debugging for the APC-2000 means to check and modify the reference data through the repetition of the above test and to create the ultimate reference data file.

8.1.2 How is debugging required

The degree of necessity for debugging varies by the size of the tested board, complexity of circuit, types of circuit elements, measuring precision, number of good boards, and various other factors, but the debugging is required for at least one good board. If a large number of good boards are not available, execute the debugging with one good board as an immediate measure and check the reference data again when testing a large number of boards. Also, the debugging operation is required when the parts mounted on the board are changed because their lots are changed.

Since the APC-2000 measures objects on the basis of relative values and not on the basis of absolute values, different values may be obtained if the main frame used for the testing is different from the one used for debugging. In this case, the reference data must be debugged in accordance with the main frame to be used for the testing, but this debugging operation is not difficult.

8.1.3 When is debugging required

Execute the debugging when:

(1) The jig has been designed and created for the first time.

(2) Only a small number of good boards were used for debugging insufficiency of debugging was found when a large number of boards were tested.

(3) The measured values deviate or apt to deviate from the judgement criterion ranges because the lots ot the mounted parts have been changed.

(4) The main frame to be used for testing is different from the one used for debugging.

(5) The measuring section of the main frame has been replaced.

(6) The values to be obtained from the mounted parts have been changed.

(7) The contents of the reference data (especially the delay time and judgement precision) have been changed.

The debugging for all the above occasions except (1) is rather easy because the reference data is already created for them.

8.2 Notes on Debugging

First of all, the circuit diagram must correspond to the actual in-circuit board. Since the actual circuit network, deffering from a single part, consists of quite complicated complex circuits, the user may spend unnecessary labor on the debugging without noticing the disagreement between the circuit diagram and actual board configuration. Also, the jig pin connection numbers and circuit diagram pin numbers must be correct. (Check the contact of pins, too.)

When a portion of the in-circuit board cannot be measured well, execute the debugging after sufficiently understanding the function of that portion. The user may find that the particular portion need not be measured or the judgement criterion range for it should be expanded.

When using the guarding function for measuring a complex circuit stably at high precision, understand this function completely and ground the optimum point.

Note that the high precision and stable result cannot be obtained from the measuring of a digital IC or operational amplifier whose internal circuit is unknown or from the testing of the part connected to the IC whose internal resistance is not fixed.

Thus, the user may have to give a clear-cut solution of not measuring some portions or expanding the judgement criterion ranges because not all the mounted parts can be measured or judged for a complex circuit.

APC-2000

SYSTEM DISK Ver. 1.5

OPERATION MANUAL

KIKUSUI ELECTRONICS CORPORATION

APC-2000 SOFTWARE UPDATE

The version of the system disk for APC-2000 has been raised from 1.2 to 1.5.

1. In TEST READY Mode

1.1 "TEST SEQ" is displayed in the lower right-hand corner of the screen as follows:

Example: TEST SEQ: S-C

"S", "O", "C", or their combination is displayed

1.2 The version is displayed in the lower left-hand corner of the screen.

Example: file name
Ver. 1.5

8645222

2. In INPUT INITIAL DATA (Initial Data Creation) Mode

2.1 An item that allows a change in the SHORT REF value (judgement criterion value) memorized at the time of data learning has been added to the all-pin short check modification menu.

```
        *** MODIFY INITIAL DATA ***

D:
K:
R:  SHORT REF CHANGE            Added
E:
```

Input a resistance value in conversational mode, and the SHORT REF value for all-pin short check in the floppy disk will be changed.

2.2 Since "M" is displayed instead of "R" (Repeat of input data) in the component file modification mode, parts location can also be changed at a time.

```
        *** MODIFY INITIAL DATA ***

D
C
M:  MULTIPLY INITIAL DATA          Changed
K
E
```

Select "M", and the following message is displayed:

```
Number of Multiplication (2-9)?_
```

Enter "2", and the following information is displayed

```
        LOCATION
        (X)  (Y)
NO.1    ___  ___
NO.2    ___  ___
```

Specify the location, and then enter the offset value.

3. In TRANSFER (Execution Program Transfer) Mode

An item that allows the batch transfer of the SHORT, OPEN, and COMP files having the same file name has been added to the menu.

*** TRANSFER MENU ***

FUNCTION 1		
2		
3		
4		
5		
6	ALL PINS SHORT/OPEN & COMP FILE	Added
7		

then press function key 6

As the SHORT REF resistance value, the value recorded in the ALL PIN SHORT file is transferred.

If the specified file does not exist, the message "NO FILE" is displayed and the old file is preserved.

4. In MAINTENANCE & MODIFY (Maintenance and Modification) Mode

4.1 "M" (MULTIPLY EXECUTION DATA) has been added to the menu.

```
        *** MAINTENANCE & MODIFI ***

    D
    T
    N
    R
    I:(I)
    K:(K)
    C
    M:    MULTIPLY EXECUTION DATA          Added
    A
    E
```

Select "M", and the following message is displayed:

Number of Multiplication (2-9)?

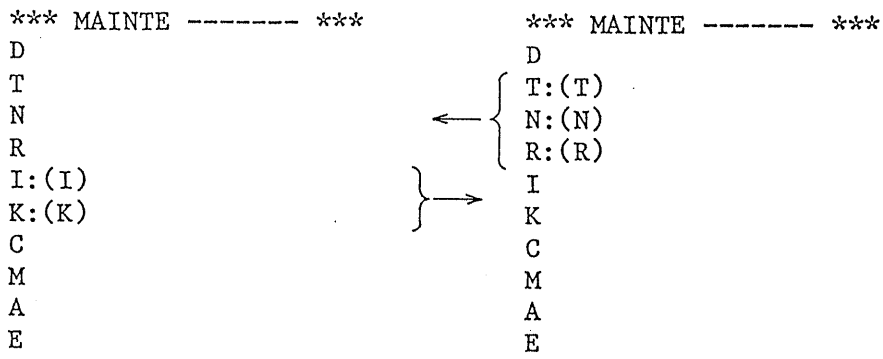
Enter "2", and the following information is displayed:

```
          LOCATION
          (X)  (Y)
NO.1      ___  ___
NO.2      ___  ___
```

Specify the location, and then enter the offset value.

4.2 "CN: CHANGE NEXT STEP" (changing of next step) has been newly added to the "C" mode.

4.3 For the items followed by parentheses in the menu, press the key twice. (Since the number of the maintenance mode programs has been increased, the maintenance menu has been divided into two parts. Press the key once, and the control is transferred from one part to the other; press it again after the screen is changed, and the desired item is selected.)



4.4 If the operator responds to the message "Save to Disk?" with "Y" after selecting "E", he can determine whether to save both the initial data (DAT) and execution data (EXC) or only the execution data.

```
EXC ONLY ----- 1
DAT & EXC ---- 2?_
```

4.5 If "Overflow" or "Unstable" is reported for the "Standard Value" of the EXC data (execution standard data) to be changed in C mode, the operator can shift the control to the next item ("Parts Location") by pressing the RETURN key. Therefore, the operator can specify the mark "*" (no execution) when "Overflow" or "Unstable" is displayed.

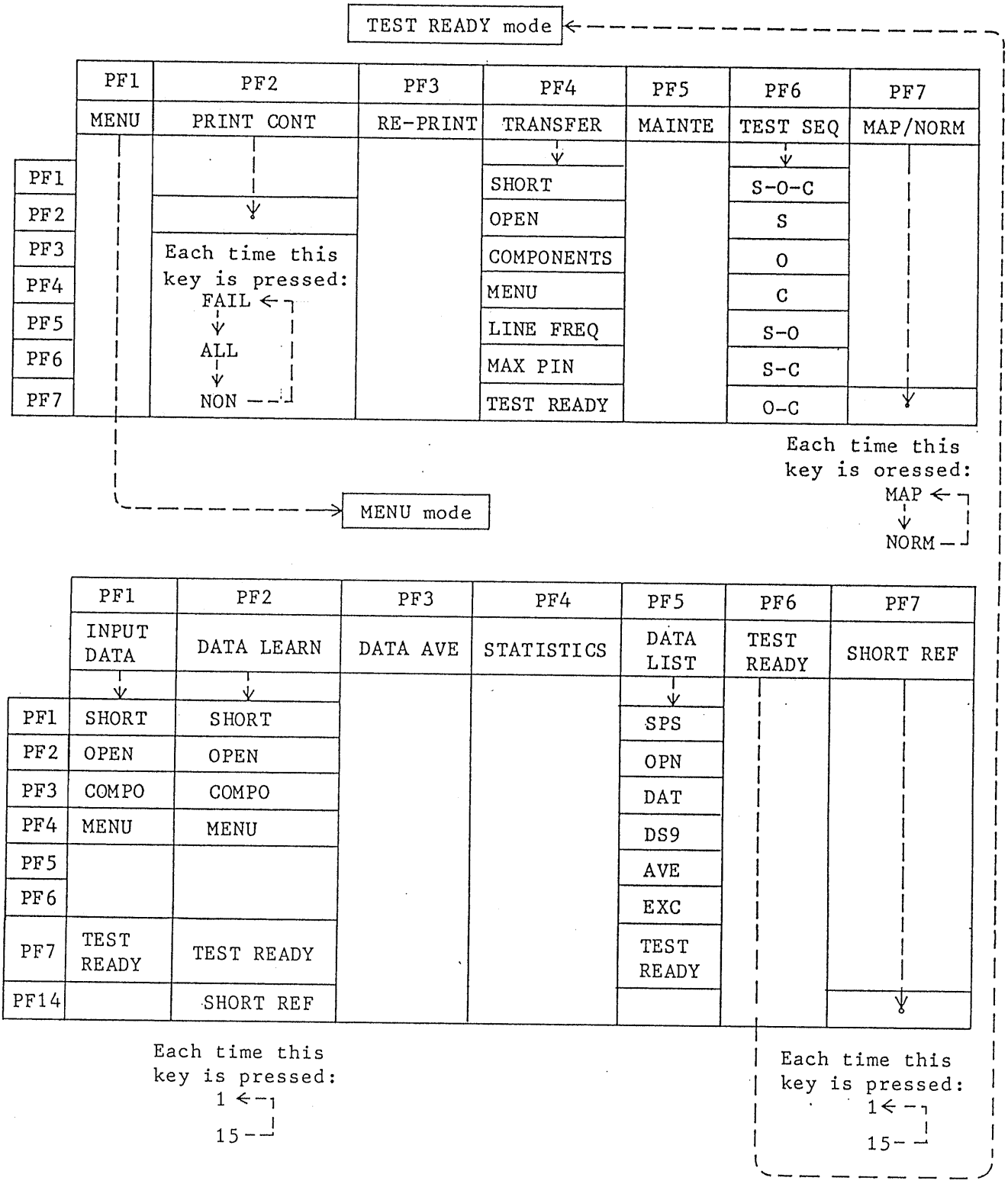
5. In DATA LEARN (Reference Data Learning) Mode

The data of "10" or less has been eliminated from the judgement condition of the automatic polarity setting function that optimizes the polarities of the testing pins used for data learning. The message "Unstable" is displayed when (1) the learned data is "10" or less and it is still "10" or less even after the + and - pins are replaced or (2) the repetition precision of the learned data is not stable.

Further, the flowchart to determine the + and - pins has been improved so that more reliable reference data may be created.

6. Explanation of Functions

6.1 To return control to the TEST READY mode from any screen, press the function key PF7 or numeric key 7.



6.2 Function Key PF15

The file name input for the message "Key in file name?" is stored for PF15.

The file name, however, is cleared when the power is turned off or the CTRL and RESET keys are pressed at a time to start the operation from SELF CHECK.