HEWLETT PACKARD

FOURIER ANALYZER SYSTEM
and Options

5451C

C O N T E N T S

5451C INSTALLATION/OPERATION DEMO NOTE

INTRODUCTION

This note provides installation procedures and an operational demonstration of the standard 5451C Fourier Analyzer and common hardware options. Detailed operator training is NOT a function of the installer or of this note. The sole purpose of this note is to demonstrate that the hardware and software is operating properly. For detailed operating instructions see the 5451C Operating Manual supplied with the system.

INSTALLATION

The system, before shipment from the factory, was tested as a completely integrated system. This includes all Fourier operating system tests and Q.A. testing of the system and all peripherials. Running the following operational demonstration will verify system operation. Processor and peripherial diagnostics should only be run if the system fails one of the following tests.

MATERIAL LIST

The System Configuration Notice included with the system contains a complete list of all material shipped with the system. This material list should be checked to verify the shipment of all items ordered as well as verifying the serial numbers of all hardware. In the System Configuration Notice is the index as to binder location of all documentation.

CABLING

Standard 5451C systems are rack-mounted with all interface cards and cables installed. The System Configuration Notice contains the I/O configuration of the system.

If the system was ordered without a rack, it is the users responsibility to install the system and cabling as shown in the 5451C Service Manual, Section 1 (System Interconnection Diagram), and the System Configuration Notice.

NOTE

For all rack-mounted systems, the user must provide the mains power cable hook-up. Variations in local electrical safety codes prevent standardization of mains connections. At all times a proper ground must be connected to all system hardware. Refer to the Installation and Service Manual for the 29402B Cabinet for complete wiring information.

OPERATIONAL CHECK

EQUIPMENT REQUIRED

o   HP 3311B (or equivilant) Audio Oscillator;
    Sinewave: 1 Hz to 100 kHz, +/-5V

o   Configured Fourier Analyzer System Disk Pack;
    P.N. 54451-10001 or 54451-10101 for systems with the 7906A
    disc drive or 54451-10102 for systems with a mag tape.

SETUP PROCEDURE

1. Turn power on to all equipment and ready the disc or
   mag tape with the system pack.

2. Set up the Terminal to Alphanumeric. (Press STOP and SHIFT G DSP)

3. Set 54451A Processor S-Register to 101701.

4. Press Store.

5. Press Preset, IBL/Test, RUN.
        (should get HALT 76)

6. Press Run.
        (should get HALT 77)

7. Press Run.

8. The System should come up with a display on the CRT.

Set up front panel switches as follows:

5460A DISPLAY	All lever switches	to middle position
	VERTICAL GAIN	CAL
	VERTICAL MODE	REAL MAGNITUDE
	VERTICAL SCALE	to 12 o´clock position
	ARM/PLOT	ARM
5466B ADC	TRIGGER SOURCE	to INTERNAL (A)
	TRIGGER LEVEL	to 12 o´clock
	Rotary switches A and B	to 1 volt
	INPUT SELECTOR and DISPLAY ...	to A positions
	SAMPLE MODE	to kHz/us
5475A KEYBOARD	REPEAT/SINGLE	to REPEAT
	STEP/RUN	to RUN

Press the following keyboard keys to set a blocksize of 128 and to begin the analog input and display cycle:

PRESS: BLOCK SIZE, 1 2 8   ENTER

ANALOG IN, ENTER

NOTE

In the following procedures, the ADC SAMPLE MODE and MULTIPLIER positions are listed left to right as they appear on the front panel (e.g., TIME/HZ/ms and 5/10/100). Remember that color codes under the SAMPLE MODE switch correspond to the same color under the MULTIPLIER switch. Time is in BLACK lettering, maximum frequency is in BLUE, and frequency spacing is in white.

ADC ΔF SAMPLING DEMO

SET: 5466B   SAMPLE MODE .... ΔFREQ/HZ ms
               MULTIPLIER 50/100/10
               TRIGGER SOURCE .... INTERNAL (A)
               SLOPE .... +
               Rotary switch A .... CHECK
               TRIGGER LEVEL .... adjust for pulse on
                                              left of display

SET: 5460A DISPLAY TYPE TO CONT
OBSERVE: .... pulse 1.7 cm high by 1.1 cm
                                     wide, approximately.

SAMPLING DEMO

SET: 5466B   MULTIPLIER 25/50/20
                 INPUT SELECTOR & DISPLAY ...... A
                 Rotary switch A .... CHECK

OBSERVE: .... 2 pulses 1.7 cm high or one
                                      full pulse for 50 Hz power mains.

ADC ΔT SAMPLING DEMO

SET: 5466B   SAMPLE MODE .... ΔTIME/kHz us
                 MULTIPLIER 1K/1/.5

OBSERVE: ...... string of pulses (one or two dots per pulse is normal).

SET: 5466B   SAMPLE MODE .... ΔTIME/HZ ms
                 MULTIPLIER 10/20/50

OBSERVE: .... 1 pulse on left of display 1.7 cm high
                            (may be more pulses depending on trigger
                            level and mains frequency; will take
                            several seconds for a full sweep).

BLOCKSIZE/SAMPLING DEMO

SET: 5466B   SAMPLE MODE .... ΔFREQ/HZ ms
                 MULTIPLIER 10/20/50

OBSERVE: .... position of pulses on display

PRESS: RESTART key .... (observe BUSY light goes
                                              off, READY goes on)

         BLOCK SIZE 2,5,6, ENTER .... (observe blocksize
                                              light 256 goes on)

PRESS: ANALOG IN, ENTER .... (observe BUSY and
                                              TRIGGERING lights
                                              go on)

OBSERVE: .... position of pulses same as
                                      above.

PRESS & REPEAT .... from RESTART for all blocksizes
                                   up to 4096. (Note for some systems
                                   blocksize 2048 is the maximum
                                   available. Press RESTART when done.)

2-CHANNEL ADC INPUT COMPARISON DEMO

This check demonstrates that the inputs on the ADC are matched
within +/-.4%.

KEYBOARD PROGRAM

Load the following keyboard program before this checkout is begun.
Note the minus "-" Key below is in the DATA OPERATIONS Keys, not
the ENTRY Keys.

```
RPLAC   0   ENTER
LABEL   10   ENTER
BLOCK SIZE   1024   ENTER
JUMP   1   ENTER
-   1   ENTER
POLAR   ENTER
DSPLY   0   ENTER
JUMP   10   ENTER
LABEL   11   ENTER
JUMP   1   ENTER
LOAD   1   ENTER
-   2   ENTER
POLAR   ENTER
DSPLY   0   ENTER
JUMP   11   ENTER
LABEL   12   ENTER
JUMP   1   ENTER
LOAD   2   ENTER
-   3   ENTER
POLAR   ENTER
DSPLY   0   ENTER
JUMP   12   ENTER
LABEL   1   ENTER
ANALG   IN   ENTER
F   0   SPACE   1   ENTER
F   2   SPACE   3   ENTER
SUB   RTRN   ENTER
END   ENTER
TERM   ENTER
```

After entry, the resident keyboard program can be checked by pressing "LIST ENTER" and comparing the results with the following:

1	L	10		55	L	12	
5	BS	1024		59	J	1	
9	J	1		63	X<	2	
13	A-	1		67	A-	3	
17	TP			71	TP		
20	D	0		74	D	0	
24	J	10		78	J	12	
28	L	11		82	L	1	
32	J	1		86	RA		
36	X<	1		89	F	0	1
40	A-	2		94	F	2	3
44	TP			99	<		
47	D	0		102	.		
51	J	11					

SET: 5466B SAMPLE MODE .... INT, kHz us
MULTIPLIER 25/50/20
INPUT SELECTOR .... AB
TRIGGER SOURCE .... FREE RUN
Rotary switches A and B .... as specified in test table (e.g., .125)

3311B Frequency dial .... 10 kHz
Set output to .... see test table below
Output connected to .... INPUT CHANNEL A and B
FUNCTION .... ∿

5475A REPEAT/SINGLE .... SINGLE

TEST FOR ADC CHANNELS

The voltages below do not have to be exact and the system can be used to measure them by doing the following:

Set: REPEAT/SINGLE switch to REPEAT
5466B Rotary Switch A as in Test Table below
Display switch to A

Press: ANALG IN ENTER

Now set the oscillator output voltage as per Test Table. Note: each centimeter on the CRT is one-fourth of the OVERLOAD VOLTAGE (A) switch setting.

TEST TABLE FOR CHANNELS A,B,C,D

| 5466B Rotary Switches	3311B Output Voltage Sinewave	Maximum Voltage Permissible on 5460A Display
.125 volt	60 mV rms (170 mV P-P)	+/-2 X 10E -4 volt
1 volt	.5 V rms (1.4 V P-P)	+/-2 X 10E -3 volt
8 volts	3 V rms (8.5 V P-P)	+/-2 X 10E -2 volt

Once the oscillator output voltage has been set, return the REPEAT/SINGLE switch to SINGLE.

PRESS: JUMP 10 ENTER .... (compares channels A and B)

OBSERVE: .... maximum voltage shown in test table. Repeat JUMP 10 ENTER command for each voltage change in column 1.

The maximum output voltage on the 5460A Display will be the value shown in column 3 of the Test Table. (Disregard leftmost point. This point is the dc offset difference and does not affect dynamic measurements.)

Read the display by multiplying the number of cm deflection on CRT by scale factor on readout tubes, e.g., 2 X 10E -4 volts per cm.
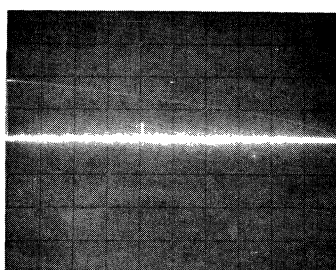
Typical result with Channel A to B comparison. 5460A Display Plug-In indicates 2 x 10-004 volts/cm.

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4-CHANNEL ADC INPUT COMPARISON DEMO

Perform this check only if the system contains a 4-channel ADC option (refer to the system configuration NOTICE).

To Check Channels B and C, SET:

       5466B   INPUT SELECTOR .... ABCD
              Rotary switches B & C .... as specified in Test
                                                    Table for A,B,C,D.

       3311B   AMPLITUDE .... as specified in
                                                        Test Table.
              Connect output to .... INPUT CHANNELS B and C

PRESS: JUMP 11 ENTER .... compares channels B & C

OBSERVE: .... Maximum output voltage not to
                                     exceed any values shown in
                                     previous test table.

To Check Channels C and D SET:

       5466 INPUT SELECTOR .... ABCD
          Rotary Switches C & D .... as specified in Test Table
                                            for A,B,C,D.

       3311 AMPLITUDE .... as specified in Test Table
          Connect output to .... INPUT CHANNELS C & D

Press JUMP 12 ENTER .... compares channels C and D

Observe .... maximum output voltage not
                                     to exceed any values shown
   in previous test table.

FOURIER TRANSFORM DEMO

SET: 5460A   MODE .... REAL MAGNITUDE
                  SCALE .... 12 o′clock
                  DISPLAY TYPE .... CONT

PRESS: BLOCK SIZE 1024 ENTER
       CLEAR 1 ENTER
       CLEAR ENTER
       KEYBOARD 1 SPACE 1 SPACE 1 ENTER   (These keyboard operations
       KEYBOARD 0 SPACE 4 ENTER   manually enter 2V cosine
       2 SPACE -2 ENTER   and -2V sine values into
                                      frequency domain data
                                      block)

NOTE: Use "-" in the ENTRY(numeric) key group, not the DATA
   OPERATIONS(arithmetic) "-".

OBSERVE: .... A single spike on the left of
the CRT, as shown in the photo
below. Read the 5460A indicators
to determine the volts per cen-
timeter (i.e., 5460 indicates
1 X 10 | 0 | 0 | 0 | = 1 volt per cm).
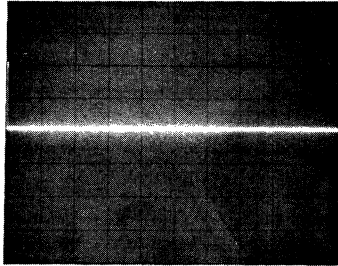
The spike in this example is
2 cm high times 1 volt per cm
equals 2 volts peak.

Set 5460A MODE switch to IMAGINARY PHASE.

OBSERVE: .... A single negative spike on left
of the CRT (see below).
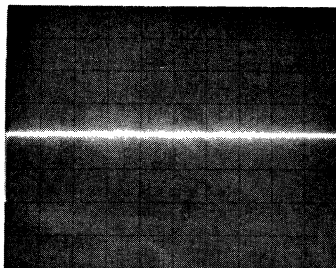
PRESS: LOAD 1 ENTER
         F ENTER

NOTE

The above frequency domain spectrum of $2\omega\cos t -$
i 2 sine t is fourier transformed into the phase
shifted sine wave below. Peak to peak amplitude is:

$$V_{p-p} = 4\sqrt{(2)^2 + (2)^2} = 11.3V$$

The Fourier transform algorithm takes advantage of
the properties of spectral symmetry centered at DC
of real time functions and calculates and displays
only the positive frequencies in a spectrum. To
account for displaying only 1/2 the total spectral
energy the the amplitude values displayed are 1/2
the amplitude of the corresponding time domain
periodic components. For example a single 2 volt
peak point in the real frequency domain display
represents the Fourier transform of a 4 volt peak
cosine function.

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OBSERVE: .... A sine waveform with an amplitude of 11.3 volts peak-to-peak, and a phase of 45 degrees. See waveform. Use the 5460A SCALE switch to expand the vertical display.
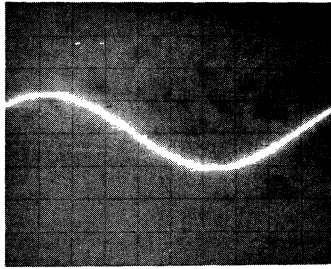
Perform this test to check that the disc is working correctly. Data will be stored in record 0 of File 1 on the disc. This check should be done immediately after the Fourier Transform Demo because use is made of the sine wave generated at that time.

PRESS: MASS STORE   31   ENTER ....to position disc to
                                                File 1 and Record 0

PRESS: MASS STORE   21   ENTER ....to write data block 0
                                                to disc

PRESS: CLEAR   ENTER ....to clear data block 0
                                                in memory

PRESS: MASS STORE   31   ENTER ....to position disc to
                                                read back data

PRESS: MASS STORE   11   ENTER ....to read previous data
                                                stored on disc

OBSERVE .... The sine wave previously on the
                                      CRT should now be displayed.

By performing the above steps we have shown that information can be written and retrieved from the disc.

This ends the operational demonstration of the base 5451C system. If, for any reason, one of the procedures did not work, check the appropriate Service Manual for further information.

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MODEL 5440B PLUG-IN MAINFRAME MODULE (PIMM)

(Option 600 and 601)

INTRODUCTION

This section provides installation and/or connection procedures for
the 5440B Main Frame. Because the 5440B can not be operated as a
standalone unit, see the appropriate section of this note for the
installation/operational demonstration of the plug-in(s) to be used
with the 5440B.

INSTALLATION

If the PIMM was a factory-integrated option, then skip this section
and go directly to the section(s) on the plug-in(s) to be used with
the PIMM.

Install the PIMM (Option 600 or 601) in a convenient rack location.
Install the 05451-60025 I/O card into the Processor's select code 13
unless otherwise specified in the System Configuration Notice. Refer
to the Table below for the proper strapping. Connect the Mainframe
Input/Output Bus (MIOB) cable and/or MIOB Link cable to Jl as in the
5440B cabling diagram below.

DESCRIPTION

None of the signals carried in the MIOB Cable are used by the 5440B
itself. The signals carried by this cable are solely for the purpose
of communicating between a Module plugged into a 5440B and the
processor in which the 05451-60025 is operating.

In module-processor communication, the 5440B is "transparent",
serving, in effect, as merely an additional length of cable. The
signals are routed through the 5440B's Al card, which contains some
circuitry to enhance the waveshape of the Command and Flag signals
carried between a module and the processor.

The ribbon connector end of the MIOB cable is connected to Jl of the
5440B. (In the case of concatenated 5440B's, the ribbon connector end
of the cable is connected to the available mating connector of any
MIOB LINE cable connected to the Jl connector of any of the 5440B's,
as illustrated in the interface block diagram below. In this case, the
signals at the 5440B end of the cable are connected, in parallel, to
all of the 5440B's.)

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05451-60025 Strapping

W1 to C	W9 to A
W2 to B	W10 to Pin D of W1
W3 to B	W11 to A
W4 to B	W12 installed
W5 thru W8 installed	W13 removed

5440-to-5451-60025 Interface
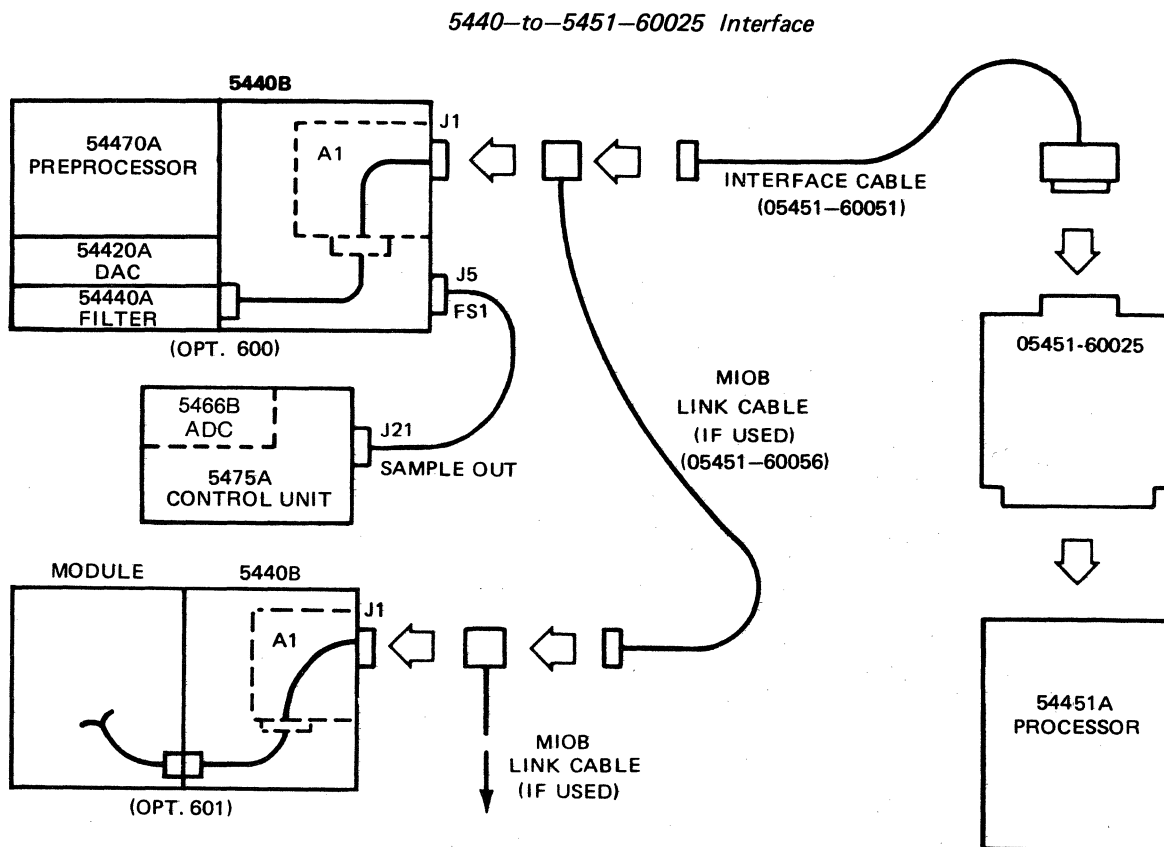
NOTE

Because of the combination of modules which can be used in the 5440B, see the appropriate section for internal jumper connections.

MODEL HP 54420A DIGITAL-TO-ANALOG CONVERTER (DAC)

(Option 620)

INTRODUCTION

This section provides installation procedures and an operational dem-
onstration for the installer of Option 620, Model 54420A DAC. The
operation demonstration portion of this note demonstrates that the DAC
is functioning properly. To verify the specifications, refer to the
DAC Module Manual. If the Plug-In Mainframe Module is also an add-on
option with the DAC, see Option 600/601 installation in this note
before proceeding.

INSTALLATION

Before instaling the DAC into Plug-In Mainframe Module, verify that
the switches on the internal DAC cards are in the proper position (see
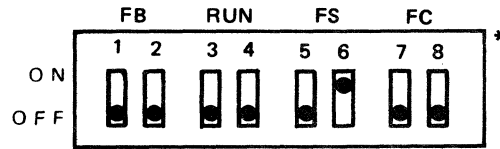DAC Switch Setting Table below).

Connect a BNC cable from J21 Sample Out on the rear of the 5475A
Control Unit to the J5 (Fs1) connector on the rear of the 5440B con-
taining the DAC.

NOTE

If there is more than one 5440B Mainframe in the
system, then the DAC should be plugged into the
1st Mainframe, NOT into the concatinated 5440B.

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DAC SWITCH SETTING TABLE

The switches between card A5 and A6 on the DAC motherboard should be set as follows:

```
              FB       RUN       FS        FC
             1   2    3   4     5   6     7   8        *
       ON   ┌─┐ ┌─┐  ┌─┐ ┌─┐   ┌─┐ ┌█┐   ┌─┐ ┌─┐
            │ │ │ │  │ │ │ │   │ │ │ │   │ │ │ │
       OFF  └█┘ └█┘  └█┘ └█┘   └█┘ └─┘   └█┘ └█┘
```

The Address switches on the A7 and A8 cards are set for address 15 octal. All switches up toward top of board equal 15 octal.

```
         ↑ TOP OF BOARD
        ┌──────────────────┐  *
        │ ┌█┐ ┌█┐ ┌█┐ ┌█┐ │
        │ │ │ │ │ │ │ │ │ │
        │ └─┘ └─┘ └─┘ └─┘ │
        └──────────────────┘
```
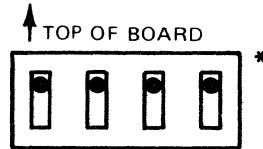
*NOTE: Dot represents rocker switch down.

Remove the 5440B top cover and check the position of the MIOB connector between the A1 and A2 board of the 5440B. If there is NOT a 54470A pre-processor in the PIMM then the jumper should be in position A so the DAC can be plugged into any slot. See the MIOB Jumper Table below if a 54470A is in the System before plugging in the DAC.
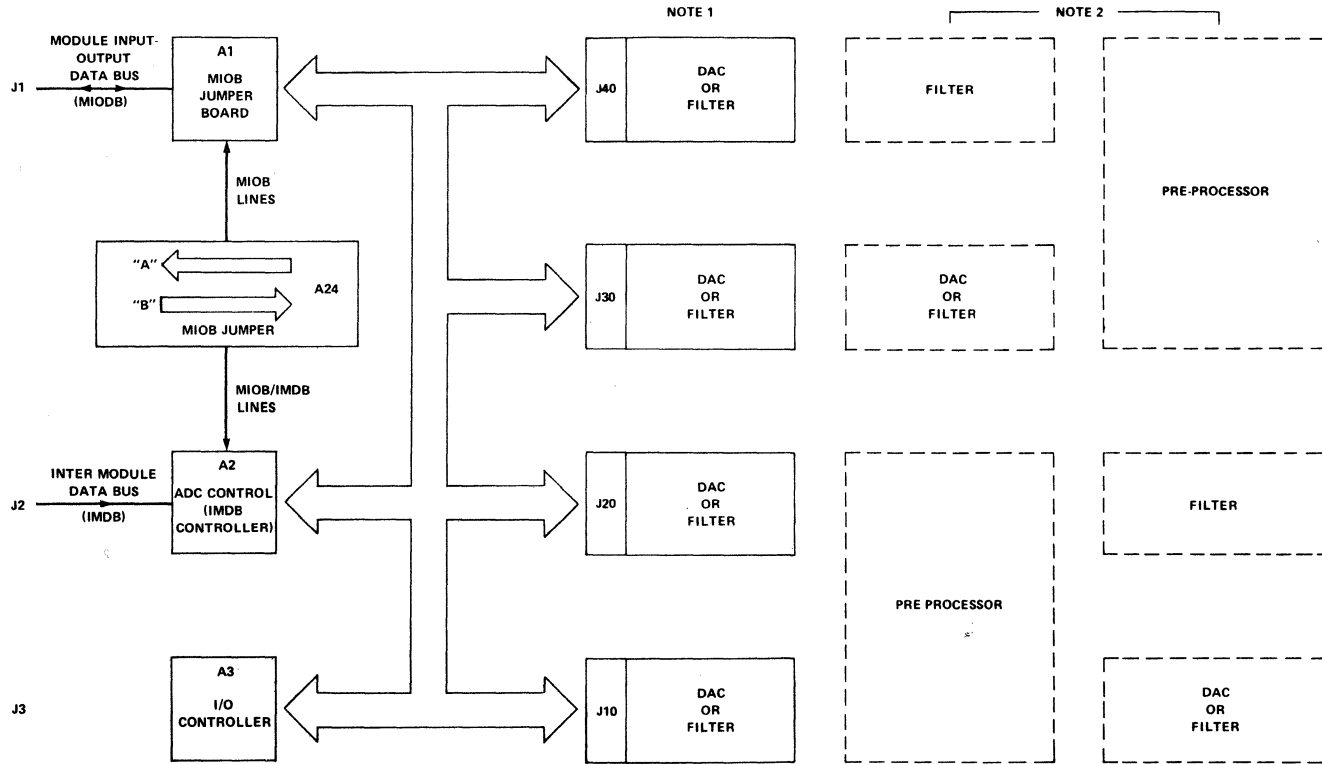
NOTE 1

NOTE 2

MODULE INPUT-
OUTPUT
DATA BUS

J1

(MIODB)

A1

MIOB
JUMPER
BOARD

MIOB
LINES

"A"

"B"   A24

MIOB JUMPER

MIOB/IMDB
LINES

INTER MODULE
DATA BUS

J2

(IMDB)

A2

ADC CONTROL
(IMDB
CONTROLLER)

A3

J3

I/O
CONTROLLER

J40   DAC
OR
FILTER

J30   DAC
OR
FILTER

J20   DAC
OR
FILTER

J10   DAC
OR
FILTER

FILTER

DAC
OR
FILTER

PRE PROCESSOR

PRE-PROCESSOR

FILTER

DAC
OR
FILTER

NOTE:

1— MIOB JUMPER IN "A" POSITION

a— DAC OR FILTER CAN BE IN
ANY SLOT.

2— MIOB JUMPER IN "B" POSITION

a— DAC TO BE IN SLOTS J10 OR
J30 ONLY.

b— FILTER CAN BE IN ANY SLOT.

c— PRE-PROCESSOR CAN BE IN
EITHER HALF OF MAINFRAME
BY REMOVING DIVIDERS
BETWEEN J10 & J20 OR
J30 & J40.

OPERATIONAL DEMONSTRATION

To operate the DAC, load in the system (if not alrady running) as
follows:

1. Set Processor's S-Reg = 101701 or if using 7906 Disc Drive = 111700

2. Press PRESET, IBL/TEST, and RUN

3. Press RUN to load in System

4. Press RUN to start up System

Load the following keyboard program before the checkout is begun.

```
RPLAC   0   ENTER
LABEL   0   ENTER
CLEAR   1   ENTER
LABEL   1   ENTER
ANALG IN   0   SPACE   1   ENTER
F   ENTER
POWER SPECT   ENTER
COUNT   1   SPACE   16   ENTER
LOAD   1   ENTER
LOG MAG   ENTER
DSPLAY   ENTER
LABEL   20   ENTER
PRINT   0   SPACE   26   ENTER
PRINT   0   SPACE   127   ENTER
PRINT   0   SPACE   225   ENTER
DSPLAY   ENTER
END   ENTER
TERM   ENTER
```

After entry, the resident keyboard program can be checked by pressing
"LIST ENTER" and comparing the results with the following:

```
 1   L        0
 5   CL       1
 9   L        1
13   RA       0        1
18   F
21   SP
24   #        1        16        0
30   X<       1
34   TL
37   D
40   L       20
44   W        0        26
49   W        0       127
54   W        0       225
59   D
62   .
```

OUTPUT FREQUENCY RESPONSE TEST

This test verifies that the frequency response for each filter range
meets the overall DAC specifications for flatness. Note that the test
spectrum for the DAC amplifier/filter flatness response has been com-
pensated for the inherent (sin X)/X rolloff due to the sample and hold
nature of DAC-generated signals. This test also checks that the filter
is attenuating the stopband properly by checking one point on the
transition slope. A 3-tone signal is created to check the output
filter at 2 frequencies in the passband and one in the transition band
rolloff (see keyboard program below).

SETUP   (Use "-" in the ENTRY(numeric) key group, not the DATA
         OPERATIONS(arithmetic) group).

Press keys:

     RESTART
     BLOCK SIZE 512 ENTER
     CLEAR ENTER
     KEYOBARD 0 SPACE 26 SPACE 26 ENTER
     KEYBOARD -4 SPACE 4 ENTER
     5022 SPACE 0 ENTER
     KEYBOARD 0 SPACE 127 SPACE 127 ENTER
     KEYBOARD -4 SPACE 4 ENTER
     5545 SPACE 0 ENTER
     KEYBOARD 0 SPACE 225 SPACE 225 ENTER
     KEYBOARD -4 SPACE 4 ENTER
     7030 SPACE 0 ENTER
     F ENTER
     STORE 2 ENTER

Set controls:

5466B   SAMPLE MODE to kHz/uSEC
         MULTIPLIER to 25/50/20
         INPUT SELECTOR & DISPLAY to A
         OVERLOAD VOLTAGE A to 8
         TRIGGER SOURCE to FREE RUN
         INPUT CHANNEL A to DC

5460A   DISPLAY TYPE to CONT,FUNCTION to DISPLAY
         All other controls to up or center position

5475A   STEP/RUN to RUN
         REPEAT/SINGLE to SINGLE
         Connect the DAC output to the ADC INPUT CHANNEL A.

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MEASUREMENT

Press keys:

    RESTART
    ANALG OUT   2   ENTER
    JUMP   0   ENTER

    Note: A power spectrum of output is measured.

    JUMP   20   ENTER

    The terminal will print:

        J 20
        SF   0   14   39
        (26)   (-615)   0
        SF   0   14   39
        (127)   (-614)   0
        SF   0   14   39
        (225)   -3757   0

    ANALOG OUT   ENTER

TEST RESULT

On the printout as shown above, channel 26 and 127 are within 0.2 dB
(20 counts) of each other. (To find the difference, subtract the
numbers circled above which should be within 20 counts.) Nominal value
is -600. The printout of channel 225 should be at least -32 dB
(-3200) down.

This ends the Option 620 Operation/Demonstration.

MODEL HP 54440A LOW-PASS FILTER

(Option 640)

INTRODUCTION

This section provides installation procedures and an operational
demonstration for the installer of Option 640, Model 54440A Filter.
The operation demonstration portion of this note demonstrates that the
filter is functioning properly; for verification of Filter specifica-
tions, refer to the HP 54440A Module Manual. If the Plug-In Mainframe
Module is an add-on option with the Filter, see Option 600/601 instal-
lation in this note before proceeding.

INSTALLATION

Check that the switch settings on the A8 Encoder card (in back right-
hand corner) are set for the desired address of the Filter. Normal
numbering sequence begins with 1 for the first Filter and proceeds
upward to 15. (Address 15 is reserved for the DAC, Option 620, if
installed.) See Figure below for setting the Address switches.

The Filter Address is the number used to address a specific filter
when entering commands from the Keyboard. Place the appropriate ad-
dress sticker on the Filter front panel to match the address you set
the A8 card switch.

Address Switch Setting

↑ TOP OF BOARD

1 TO PROCESSOR

0 TO PROCESSOR

1   2   4   8
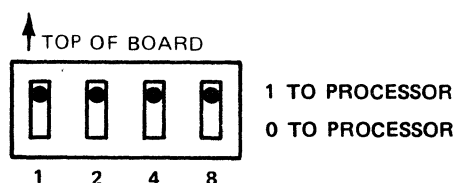
Example: Switch above with switches 1 and 4 set to 1 will
         have Filter address of 5.

OPERATIONAL DEMONSTRATION

To operate the Filter, load in the System (if not already running) as follows:

1. Set processor S-Reg = 101701

2. Press PRESET, IBL/TEST, and RUN

3. Press RUN to load in system

4. Press RUN to start up system

5. The system should come up running the display

The test procedure is dependent upon the folloiwng keyboard program. Press keys:

```
     REPLACE   ENTER
     LABEL   20   ENTER
     BLOCK SIZE   512   ENTER
     CLEAR   2   ENTER
     CLEAR   3   ENTER
     CLEAR   4   ENTER
     CLEAR   5   ENTER
     LABEL   21   ENTER
     ANALG IN   0   SPACE   2   ENTER
     HANN   ENTER
     HANN  1  ENTER
      ← 0   SPACE   256   ENTER
      ← 1   SPACE   256   ENTER
     F   0   SPACE   1   ENTER
      ∫ 0   SPACE   2   SPACE   254   ENTER
      ∫ 1   SPACE   2   SPACE   254   ENTER
     INTER CHGN 1 ENTER
     CLEAR   0   SPACE   0   SPACE   250   ENTER
     POWER SPECT   0   SPACE   2   SPACE   2   ENTER
     COUNT   21   SPACE   8   ENTER
     TRANS FCN   0   SPACE   2   SPACE   2   ENTER
     LOG MAG   ENTER
     PRINT   0   SPACE   252   ENTER
     DSPLY   0   ENTER
     JUMP   20   ENTER
     END   ENTER
     TERM   ENTER
```

To check the resident keyboard program, press "LIST ENTER" and compare the result with those shown below.

1	L	20		
5	BS	512		
9	CL	2		
13	CL	3		
17	CL	4		
21	CL	5		
25	L	21		
29	RA	0	2	
34	H1			
37	H1	1		
41	-	0	256	
46	-	1	256	
51	F	0	1	
56	$	0	2	254
62	$	1	2	254
68	X	1		
71	CL	0	0	250
77	SP	0	2	2
83	#	21	8	0
89	CH	0	2	2
95	TL			
98	W	0	252	
103	D	0		
107	J	20		
111	.			

These tests check the in-band gain and flatness of the Filter. The throughput gain of the output amplifier is checked for a gain accuracy of +/-0.04 dB before each filter channel is checked for specified 0.2 dB flatness and gain.

NOTE

The ADC is assumed to be in calibration and is used as the standard by which the Filter is tested. Verify the ADC accuracy be inputing the same signal into both ADC inputs, pressing JUMP 20 ENTER.

SETUP

Set controls and connect test equipment as follows:

5466B   Sample Mode to kHz us
         MULTIPLIER to 100/10/5
         INPUT SELECTOR to AB
         OVERLOAD VOLTAGE A & B to 2 (DC)

Connect the output of an oscillator to the Filter input and to channel B of the ADC. Connect the Filter output to channel A of the ADC. Set the oscillator frequency to 1 kHz +/-50 Hz and the amplitude to 1V P-P.
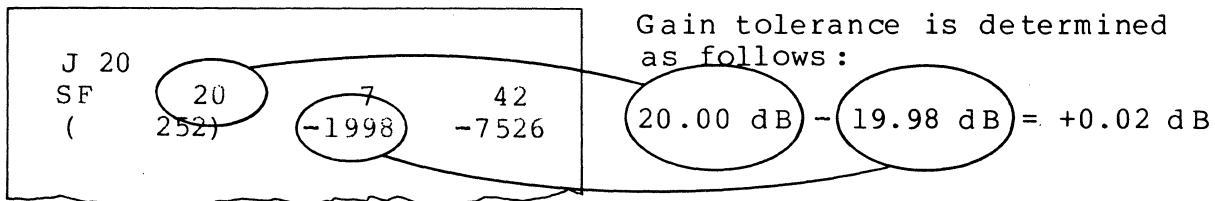

TEST

Press keys:

     USER PROG 100 SPACE 99 SPACE n* ENTER
     JUMP 20 ENTER

 *n = filter select code

RESULT

The printout on the System Terminal will indicate a gain of 0 +/- 0.05 dB. See sample printout below.

The following test checks the gain and flatness of each filter range at two frequencies: 0.1 times the cutoff and at the filter cutoff frequency, Fc. There are three filter boards with two to four filter ranges each.

The switch settings and frequency ranges are specified in the test table below.

SETUP

Connect the oscillator as specified for the previous test and set frequency to the first value shown in the Test Table.

TEST

Press keys:

```
USER PROG  100  SPACE  0  SPACE  n  ENTER
JUMP  20  ENTER
```

RESULT

With the filter range and the oscillator set to the first frequency specified in the test table, the printout will be 0 +/-0.1 dB, i.e., +/-10 counts.

TEST REPEAT

Perform the sequence above for frequencies denoted in the test table. This can be done by changing the oscillator frequency and the ADC multiplier switch followed by pressing the CONTINUE key on the Keyboards.

Test Table

Test Number	Oscillator Frequency	ADC Multiplier	Filter Range	Freq Code	GAIN pot Adjust
=======	==========	==========	========	======	========
1	5 Hz	5K/.2/.1	50 Hz	33	A4
2*	50 Hz	5K/.2/.1	50 Hz	33	**
3	125 Hz	200/5/2.5	1.25 kHz	38	A2
4*	1.25 kHz	200/5/2.5	1.25 kHz	38	**
5	2.5 kHz	50/100/10	25 kHz	43	A3
6*	25 kHz	50/100/10	25 kHz	43	**

*For even numbered tests the oscillator must be set no higher than the filter cutoff. Use a counter or other means to verify exact frequency or set oscillator lower than Fc to assure errors in oscillator calibration do not cause a test at a frequency higher than Fc.

**If a test is close to meeting a spec (e.g., .11 dB instead of .1 dB spec) repeat the test two additional times to see if the condition is persistent.

MODEL HP 7210A DIGITAL PLOTTER

(Option 157)

INTRODUCTION

This section provides installation procedures and an operational dem-
onstration of Option 157, Model HP 7210A Digital Plotter. The opera-
tion demonstration part of this section will check that the inter-
facing and Plotter are working correctly. Should a problem occur see
the Service Manual for the Plotter and the System Service Manual for
loading the Plotter diagnostic.

INSTALLATION

   1. As Add-On to the System

      Check that the jumpers on the interface card are as in the 7210A
      Jumper Table shown below. Install the interface card in the Proc-
      essor as listed in the configuration notice and continue on to
      the following paragraph.

   2. If Purchased With System

      Connect the interface cable (17210-60020) between the I/O card
      and the HP 7210A Plotter. Connect the power cord and turn on the
      HP 7210A. Insert paper in the Plotter as per the HP 7210A Opera-
      tor's Manual.

HP 7210A I/O CARD JUMPER TABLE

```
 _____
|                                                  |
|   W1 to A           W5 through W8 Installed       |
|   W2 to A           W9 to B                       |
|   W3 to B           W10 to A                      |
|   W4 to B           W11 to A                      |
|                     W12 through W13 Removed       |
|                                                  |
|_____|
```


OPERATIONAL DEMONSTRATION

The following Keyboard commands demonstrate the capabilities of the
graphics software and the operation of the HP 7210A Plotter and inter-
facing. These same commands can be used to check the graphic Terminal
in graphics mode.

This demonstration will plot a signal which will be put into the Processor as follows:

1. Enter commands: Description:

BLOCK SIZE 512 ENTER   Set block size to
                                                512 points.

CLEAR ENTER   Clear data block 0.

KEYBOARD 0 SPACE 6 SPACE 7 ENTER   Begin keyboard data se-
                                                quence. Data entered in
                                                block 0 at points 6 & 7.

KEYBOARD 0 SPACE 0 SPACE 11 ENTER   Data is time domain
                                                with a scale factor of 0
                                                (power of ten) and a
                                                maximum frequency of 50
                                                Hz (code 11).

1 ENTER   Data value of 1

F ENTER   Fourier transform data
                                                to the frequency domain.

2. On the 5460A Display, set the switches as follows:

   Mode to REAL/MAGNITUDE
   SCALE to 12 o´clock
   All other switches to CENTER

                              NOTE

     Before you continue be sure you have inserted paper
     and set up the vertical and horizonal scale on the
     Plotter.

3. Enter commands: Description:

USER PROG 5821 SPACE n* ENTER   Configure plot device.

* Note: n = 10   if plotter is HP 7210A
        n = 6   if checking graphics Terminal

USER PROG PLOT ENTER   Automatically plot the
                                                displayed data.

The last command will copy the display and annotate the plot. The
plot will be similar to Figure 1.

4. Set the 5460A Display Mode switch to COMPLEX. Insert new paper and ready the Plotter.

5. Enter commands: Description:

USER PROG   PLOT   ENTER   Automatically plot the displayed data.

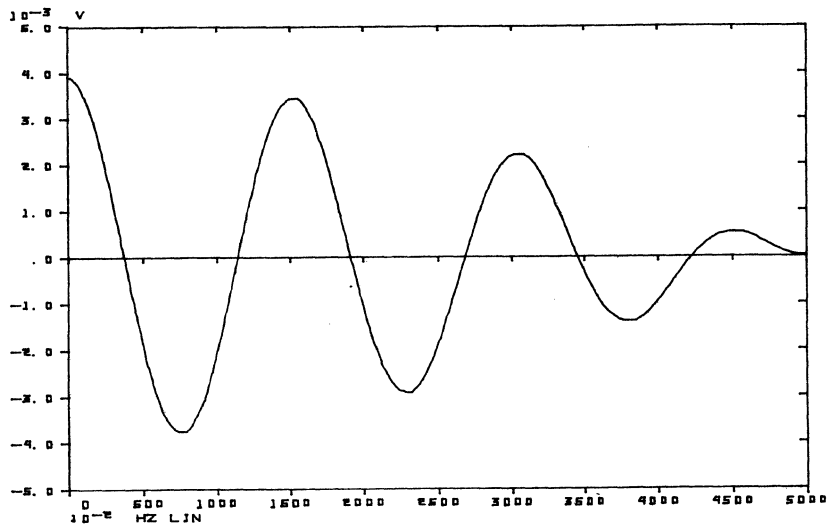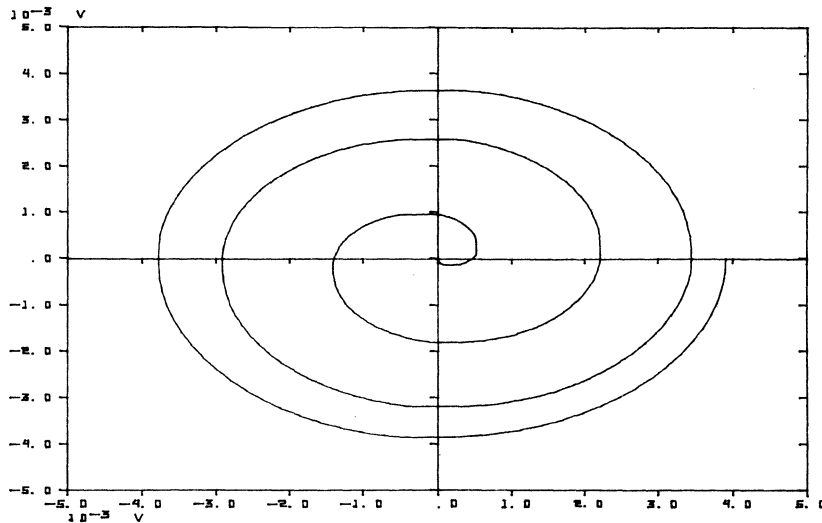The complex display should now be drawn as in Figure 2 below.

FIGURE 1.

FIGURE 2.

NOTE: This plot does not appear as symmetrical as the CRT display since plotter calibration in complex mode is 8 x 10 rather than 10 x 10 cm as the CRT.

This completes the operational demonstration of the HP 7210A Plotter.

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HP-IB DIGITAL PLOTTERS

INTRODUCTION

This section provides installation procedures and an operation demonstration of Digital Plotters operated through the 59310B HP-IB Interface. The operation demonstration part of this section will Check that the interfacing and Plotter are working correctly. Should a problem occur see the appropriate Service Manual for the Plotter and the System Service Manual for loading the Interface diagnostic.
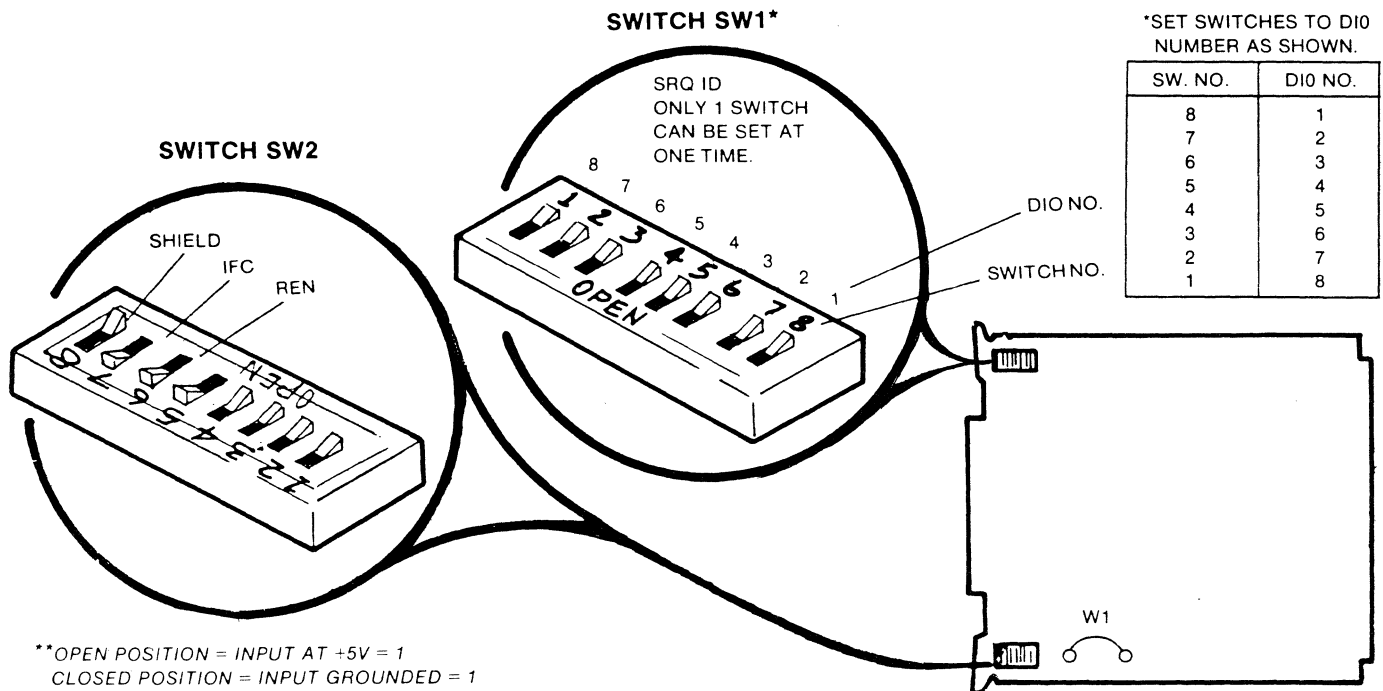
INSTALLATION

1. As Add-On to the System

    Check that the jumpers on the interface card are as in the 59310B Switch Figure shown below. Install the interface card in the Processor in the appropriate I/O slot (normally select code 22 octal) and continue on to the following paragraph.

2. If Purchased With System

    Connect the appropriate interface cable between the I/O card and the HP Plotter. Connect the power cord and turn on the Plotter. Insert paper in the Plotter as per the appropriate Operator's Manual. Set the plotting device HP-IB address to 5 octal.

Strapping of SW1, SW2 and W1 on HP-IB Interface PCA

SWITCH SW1*

SRQ ID
ONLY 1 SWITCH
CAN BE SET AT
ONE TIME.

SWITCH SW2

SHIELD
IFC
REN

DIO NO.

SWITCH NO.

*SET SWITCHES TO DIO NUMBER AS SHOWN.

SW. NO.	DIO NO.
8	1
7	2
6	3
5	4
4	5
3	6
2	7
1	8

W1

**OPEN POSITION = INPUT AT +5V = 1
CLOSED POSITION = INPUT GROUNDED = 1

OPERATIONAL DEMONSTRATION

The following Keyboard commands demonstrate the capabilities of the graphics software and the operation of the HP Digital Plotter and interfacing.

This demonstration will plot a signal which will be put into the Processor as follows:

1. Enter commands: Description:

BLOCK SIZE 512 ENTER   Set block size to
                                                          512 points.

CLEAR ENTER   Clear data block 0.

KEYBOARD 0 SPACE 6 SPACE 7 ENTER   Begin keyboard data se-
                                                          quence. Data entered in
                                                          block 0 at points 6 & 7.

KEYBOARD 0 SPACE 0 SPACE 11 ENTER   Data is time domain
                                                          with a scale factor of 0
                                                          (power of ten) and a
                                                          maximum frequency of 50
                                                          Hz (code 11).

1 ENTER   Data value of 1

F ENTER   Fourier transform data
                                                          to the frequency domain.

2. On the 5460A Display, set the switches as follows:

    Mode to REAL/MAGNITUDE
    SCALE to 12 o'clock
    All other switches to CENTER

3. Enter Commands: Description:

    USER PROG "PLOT" 35 ENTER   Automatically plot the
                                                          displayed data.

This command will copy the display and annotate the plot. The plot will be similar to Figure 1. If a multicolor plotter is used, data will be plotted using pen #1 and axes and labels will be plotted using pen #2.

4. Set the 5460A Display Mode switch to COMPLEX. Insert new paper and ready the Plotter.

5. Enter commands: Description:

    USER PROG 5881 SPACE 3 SPACE 4   Set up alternate pen colors.
    USER PROG PLOT ENTER   Automatically plot the
                                                          displayed data.

The complex display should now be drawn as in Figure 2 below. If a
multicolor plotter is used, data will be plotted using pen #3, and
axes and labels will be plotted using pen #4.
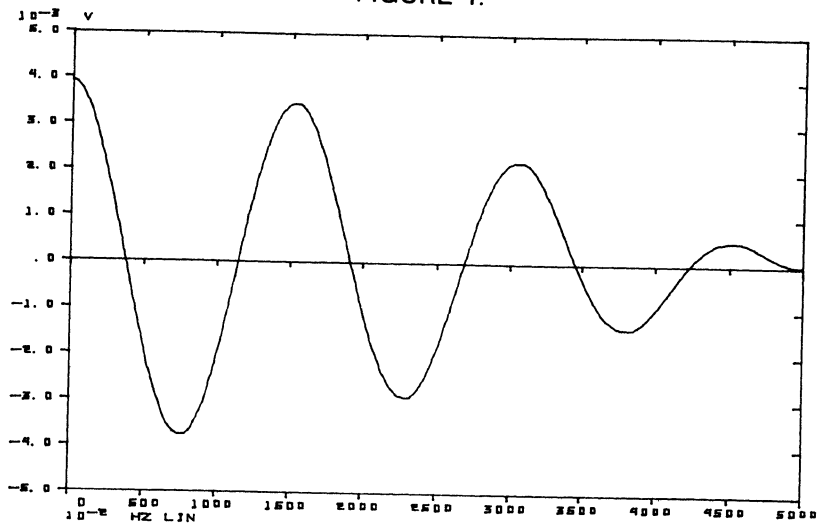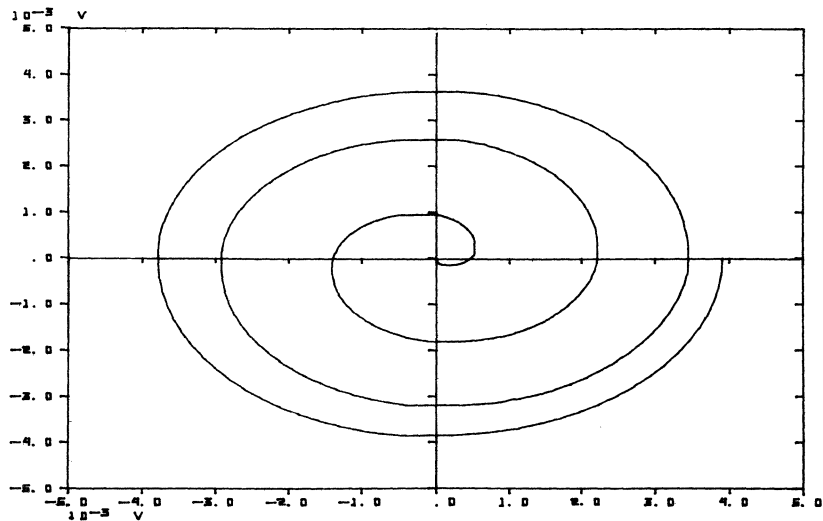
FIGURE 1.

FIGURE 2.

NOTE: This plot does not appear as symmetrical as the CRT display
since plotter calibration in complex mode is 8 x 10 rather than
10 x 10 cm as the CRT.

This completes the operational demonstration of the HP-IB Plotter.

MODEL HP 7970 MAGNETIC TAPE

(Options 261-265)

INTRODUCTION

This section provides installation procedures and an operational dem-
onstration for the installer of Option 261 or Option 265. The opera-
tional demonstration part of this section will check that the Mag Tape
is working correctly.

NOTE

As an add-on it will be the customers responsibility
to generate an operating system software disc to oper-
ate the Mag Tape. If the customer has not already done
so at the time of installation, the portion of this
note after electrical connection cannot be run.

INSTALLATION

Rack the magnetic tape in available space in the cabinet. Plug the I/O
cards in the following select codes:

  1. For software rev. codes 1836A and later, use select codes 23 and 24.

  2. For software rev. codes prior to 1836A, use select codes 24 and 25.

  3. Or use the select codes to which the customer has configured his
     software.

The disc should be set up as sub-unit 0 on the front. Connect the inter-
face cable between the magnetic tape and the interface cards. Install
power cable and power up unit.

Set up the ADC as follows:

    Sample Mode to kHz/us
    Multiplier to 10/20/50
    Input Selector to A
    Overload A to CHECK
    Trigger to Free Run

Press the following keys on the Keyboard in the following sequence:

                                              Action or Results:

  BLOCK SIZE 2048 ENTER   2048 light should
                                              light.

  MASS STORE 32 ENTER   Position Mag Tape to
                                              Throughput record 0.

  MASS STORE 22 SPACE 1 SPACE 10 ENTER   Write 10 records to Mag
                                              Tape.

  MASS STORE 32 ENTER   Position Mag Tape to
                                              Throughput record 0.

  CLEAR ENTER   Clear out block 0 in
                                              the Processor.

  MASS STORE 12 ENTER   Read record 0 back from
                                              the Mag Tape and
                                              display it.

OBSERVE: .... The check pulse originally stored on
                             the Mag Tape will now be on CRT. To
                             check the other records stored on the
                             tape repeat 9 times the CLEAR ENTER and
                             MASS STORE 12 ENTER commands. The Mag
                             Tape should move each time a record is
                             read in the Processor.

This concludes the operation demonstration for the Mag Tape.

MODEL HP 9866A TERMINAL LINE PRINTER

(Option 110)

INTRODUCTION

This section provides installation procedures and an operational dem-
onstration for the installer of the HP 9866A.

INSTALLATION

The thermal printer interfaces to the 5451C system through I/O card
05451-60025 and interconnecting cable 05451-60031. The system software
is configured for installation in the I/O channel specified in the
System Configuration Notice.

To install the thermal printer, insert all I/O cards into the slots
specified in the System Configuration Notice. For operation with the
thermal printer, verify that I/O card 05451-60025 jumper strapping is
as follows:

```
|------------------------------------------------------|
|                                                      |
|   W1 to A                      W9 to A               |
|   W2 to B                      W10 to A              |
|   W3 to A                      W11 to A              |
|   W4 to B                      W12 removed           |
|   W5 thru W8 removed           W13 removed           |
|                                                      |
|------------------------------------------------------|
```

Connect the 05451-60025 I/O card using the 05451-60031 cable supplied.
Install a roll of paper in the termal printer and turn on power. Press
the PAPER switch to advance paper. The hardware is now ready to
operate.

OPERATIONAL DEMONSTRATION

After proper installation, proper operation of the thermal printer can be verified using the following procedure.

1. Set the 5451C system controls as follows:

   5466B   SAMPLE MODE to kHz/us
            EXT/INT to INT
            MULTIPLIER to 25/50/20
            INPUT SELECTOR to A
            OVERLOAD VOLTAGE A to CHECK
            TRIGGERING to INTERNAL (A)
            SLOPE to POS

   5475A   REPEAT/SINGLE to REPEAT

2. On the system keyboard press:

        BLOCK SIZE   128   ENTER

   The 128 BLOCK SIZE lamp on the keyboard should light.

3. On the keyboard press:

        ANALG IN   ENTER

   Adjust TRIGGERING on the ADC for a single pulse display on the 5460A.

4. On the keyboard set REPEAT/SINGLE switch to SINGLE and press:

        PRINT   ENTER

5. On the Computer set "S" register bit 6 to on (lighted) and on the keyboard press:

        PRINT   ENTER

6. Compare the listing on the system terminal with the thermal printer listing. They should be the same.

This completes the operational demonstration for the 9866A. If a problem exists check the 9866A Service Manual.

MODEL HP 54470A FOURIER PRE-PROCESSOR

(Option 670)

INTRODUCTION

This section provides installation procedures and an operational
demonstration for the installer of Option 670, Model 54470A PRE-
PROCESSOR. If the Plug-In Mainframe Module is also an add-on option
with the 54470A, then see the Option 600/601 installation in this note
before proceeding.

INSTALLATION

1. Verify the I/O card strappings as in the table below:

I/O CARD STRAPPING

o I/O Card Strapping -- MIOB

W1 = C	W4 = B	W10 = Pin D of W1
W2 = B	W5 thru W8 = in	W11 = A
W3 = B	W9 = A	W12 = installed
		W13 = out

o I/O Card Strapping IMDB (ADC I/O P/N 05451-60025)

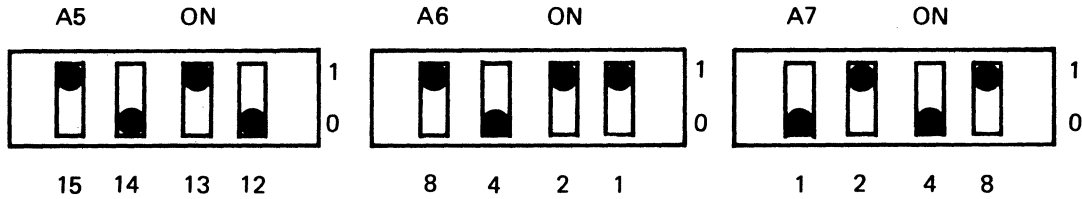|		
W1 = C	W4 = B	W10 = A
W2 = B	W5 thru W8 = out	W11 = A
W3 = B	W9 = A	W12 = out
		W14 = out

NOTE
If ADC I/O card P/N 05451-60068, set W1 = 5451C.

2. Verify the switch setting on the A5, A6, and A7 cards in the
   table on the following page.

3. Connect the MIOB cable (05451-60051) from the I/O card to J1 on
   the rear of the mainframe.

4. Connect the IMDB link cable (54470-60013) from the I/O card (ADC)
   to J2 on the rear of the mainframe and to J12 (ADC INTERFACE) on
   the rear panel of the 5475A (see Cable Diagram on next page).

5. Install the 54470A in the left (or right) half of the 5440B
   mainframe. (NOTE: The 54470A will not operate in the older
   5440A Mainframe.) Remove the quarter-width module divider panel.

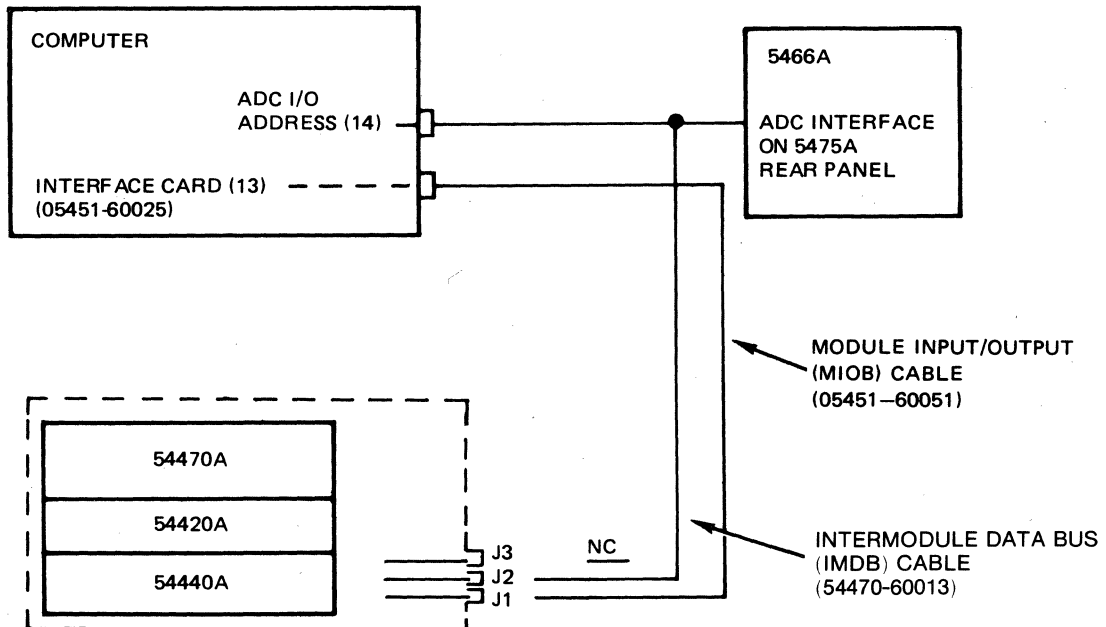6. Install the MIOB JUMPER in the mainframe to the "B" position
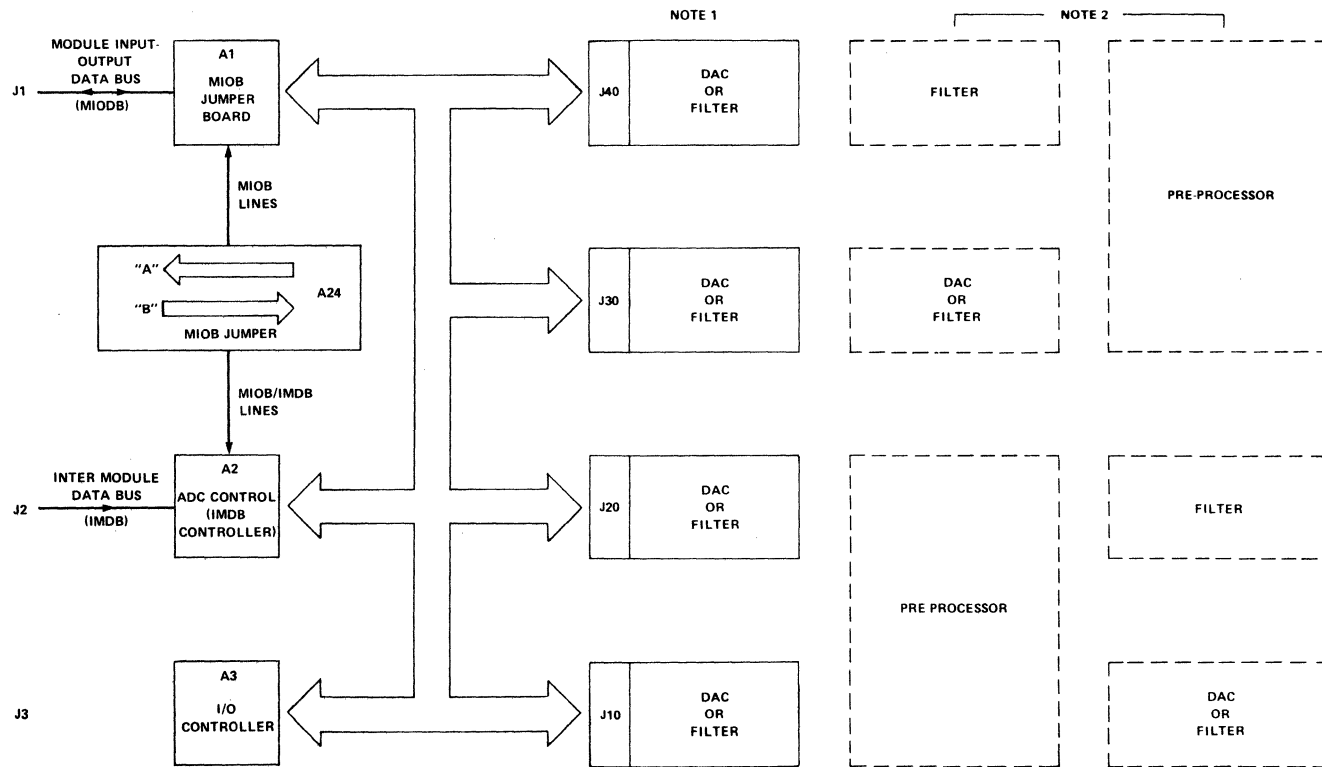   (B arrow forward).

Switch Settings

The 54470 FPP address switches on the A5, A6, and A7 cards are normally set for addresses as shown below.

A5   ON   A6   ON   A7   ON

| | | | |1 | | | | |1 | | | | |1
| | | | |0 | | | | |0 | | | | |0

15 14 13 12   8   4   2   1   1   2   4   8

NOTE: If switches are not set to the proper address, the computer will halt.

Cabling Diagram

COMPUTER

ADC I/O
ADDRESS (14)

INTERFACE CARD (13)
(05451-60025)

5466A

ADC INTERFACE
ON 5475A
REAR PANEL

MODULE INPUT/OUTPUT
(MIOB) CABLE
(05451—60051)

54470A

54420A

54440A

J3
J2
J1

NC

INTERMODULE DATA BUS
(IMDB) CABLE
(54470-60013)

NOTE 1

NOTE 2

MODULE INPUT-
OUTPUT
DATA BUS

J1

(MIODB)

A1

MIOB
JUMPER
BOARD

J40

DAC
OR
FILTER

FILTER

PRE-PROCESSOR

MIOB
LINES

"A"

"B"

A24

MIOB JUMPER

J30

DAC
OR
FILTER

DAC
OR
FILTER

MIOB/IMDB
LINES

INTER MODULE
DATA BUS

J2

(IMDB)

A2

ADC CONTROL
(IMDB
CONTROLLER)

J20

DAC
OR
FILTER

FILTER

PRE PROCESSOR

A3

J3

I/O
CONTROLLER

J10

DAC
OR
FILTER

DAC
OR
FILTER

NOTE:

1— MIOB JUMPER IN "A" POSITION

    a— DAC OR FILTER CAN BE IN
       ANY SLOT.

2— MIOB JUMPER IN "B" POSITION

    a— DAC TO BE IN SLOTS J10 OR
       J30 ONLY.

    b— FILTER CAN BE IN ANY SLOT.

    c— PRE-PROCESSOR CAN BE IN
       EITHER HALF OF MAINFRAME
       BY REMOVING DIVIDERS
       BETWEEN J10 & J20 OR
       J30 & J40.

OPERATIONAL DEMONSTRATION

Equipment Required

o Sinewave Generator

    Output frequency: 300 Hz +/- 2 Hz
    Output level: between 1-2V peak

o Cable (BNC to BNC) to connect sinewave generator to 5466B

Equipment Setup

o General Setup

   1. Connect the sineware generator OUTPUT to the 5466B CHANNEL A
      INPUT.

   2. Set the sinewave generator frequency controls for an output
      frequency of 300 Hz

o 5466B Setup

   1. SAMPLE MODE to kHz/us

   2. TRIGGER SOURCE to FREE RUN

   3. MULTIPLIER to 500/2/1 (where Fmax is 1kHz)

   4. INPUT SELECTOR to A

   5. CHANNEL "A" OVERLOAD VOLTAGE to 2

o 5460A Setup

   1. DISPLAY TYPE to CONT

   2. FUNCTION to DISPLAY

   3. All other controls to UP or center position

Procedure

The Test Procedure is dependent upon the following keyboard programs. Press the following keys:

```
REPLACE  0  ENTER
LABEL  0  ENTER
BLOCK SIZE  512   ENTER
ANALOG IN   ENTER
F   ENTER
POLAR  ENTER
DSPLY  0  SPACE  4  ENTER
JUMP  0  ENTER
LABEL  1  ENTER
USER PROG  40  SPACE  0  ENTER
USER PROG  45  SPACE  1  SPACE  1  ENTER
LOG MAG  1  ENTER
DSPLY  1  ENTER
USER PROG  40  SPACE  300  SPACE  25  ENTER
USER PROG  45  SPACE  .1  SPACE  1  ENTER
LOG MAG  1  ENTER
DSPLY  1  ENTER
JUMP  1  ENTER
END  ENTER
TERM ENTER
```

To check the resident Keyboard program, press LIST ENTER and compare the results with those below.

```
 1   L        0
 5   BS     512
 9   RA
12   F
15   TP
18   D        0        4
23   J        0
27   L        1
31   Y       40        0
36   Y       45        1        1
42   TL       1
46   D        1
50   Y       40      300       25
56   Y       45        1        1
62   TL       1
66   D        1
70   J        1
74   .
```
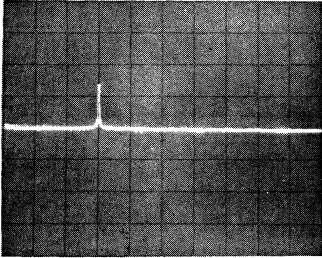
The keyboard program just entered will be used to set up the oscillator output frequency and amplitude in addition to verifying the 54470A operation.

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Press the following keys on the Keyboard in the following sequence:

Action or Results

JUMP 0 ENTER

The CRT will "flash" the Log Magnitude of the oscillator output. Adjust the oscillator amplitude until the "pulse" on the CRT is 1-1/2 cm high. Then adjust the oscillator frequency until the signal is positioned to the 3rd cm from the left of the CRT. The CRT should look as shown at the left.

RESTART

This reinitializes the keyboard stops the measurements.

JUMP 1
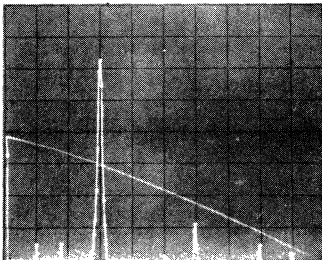
This command will set up the system to make a Baseband measurement with the following information displayed on the Terminal and CRT.
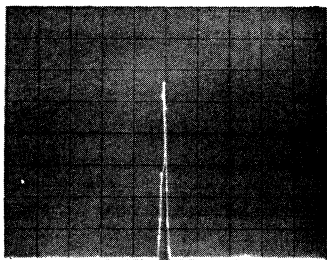

Observe:

BASEBAND   HZ/DIV: 100.00
DF   0003.906 250:   BLOCKS LEFT   56*
ZOOM POWER: 1

*NOTE — BLOCKS LEFT VARY WITH
         MEMORY AVAILABLE.

Press:

CONTINUE   The keyboard program now makes a ZOOM
                                      measurement with the following infor-
                                      mation displayed on the on the Termi-
                                      nal and CRT.

Observe:

CNTR FREQ:	0299.9878	HZ/DIV	3.125
DF*	0000.12207039	BLOCKS LEFT:	55*
ZOOM POWER:	32		

*NOTE – BLOCK LEFT VARY
WITH MEMORY AVAILABLE.

The displayed results may vary because of distortion of the oscillator.
If the signal is not centered on the CRT it is because the oscillator
is not set exactly to 300 Hz.

This ends the operational demonstration of the 54470A Pre-Processor.

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