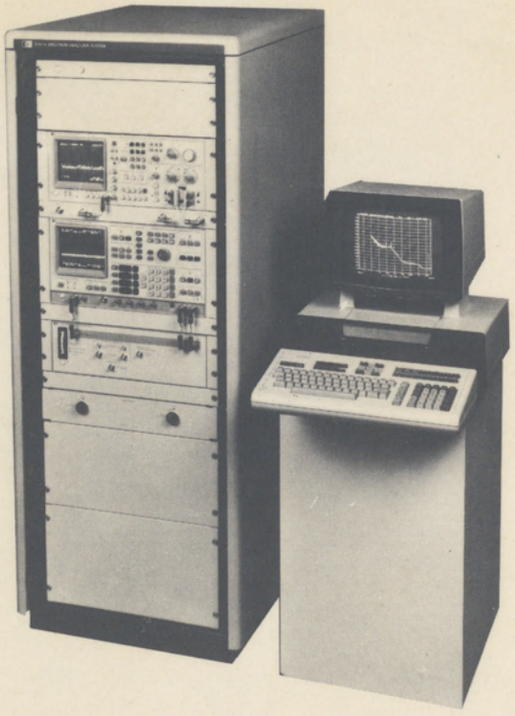
SYSTEM REFERENCE MANUAL

SPECTRUM ANALYZER SYSTEM

3047A

VOLUME II



Software Modification
Utility Software Description
Performance Tests
Special Operating Considerations

HEWLETT PACKARD

HEWLETT PACKARD

SYSTEM
REFERENCE MANUAL

MODEL 3047A
SPECTRUM ANALYZER SYSTEM

WARNING

To help minimize the possibility of electrical fire or shock hazards, do not expose this instrument to rain or excessive moisture

VOLUME II

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HEWLETT PACKARD

CERTIFICATION

Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility, and to the calibration facilities of other International Standards Organization members.

WARRANTY

This Hewlett-Packard system product is warranted against defects in materials and workmanship for a period of 90 days from date of installation [,except that in the case of certain components listed in Section I of this manual, the warranty shall be for the specified period]. During the warranty period, HP will, at its option, either repair or replace products which prove to be defective.

Warranty service of this product will be performed at Buyer's facility at no charge within HP service travel areas. Outside HP service travel areas, warranty service will be performed at Buyer's facility only upon HP's prior agreement and Buyer shall pay HP's round trip travel expenses. In all other cases, products must be returned to a service facility designated by HP.

For products returned to HP for warranty service, Buyer shall prepay shipping charges to HP and HP shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to HP from another country.

HP software and firmware products which are designated by HP for use with a hardware product, when properly installed on that hardware product, are warranted not to fail to execute their programming instructions due to defects in materials and workmanship. If HP receives notice of such defects during the warranty period, HP shall repair or replace software media and firmware which do not execute their programming instructions due to such defects. HP does not warrant that the operation of the software, firmware or hardware shall be uninterrupted or error free.

LIMITATION OF WARRANTY

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.

NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. HP SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

EXCLUSIVE REMEDIES

THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES. HP SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

ASSISTANCE

Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

12/4/81

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HEWLETT PACKARD

SAFETY SUMMARY

The following general safety precautions must be observed during all phases of operation, service, and repair of this system. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the system. Hewlett-Packard Company assumes no liability for the customer's failure to comply with these requirements. This is a Safety Class 1 system.

GROUND THE INSTRUMENT

To minimize shock hazard, the system chassis and/or cabinet must be connected to an electrical ground. The power cable must either be plugged into an approved three-contact electrical outlet or if permanently wired, the grounding wire (green) must be connected to a reliable electrical (safety) ground.

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE

Do not operate this system in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

KEEP AWAY FROM LIVE CIRCUITS

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified service trained maintenance personnel. Do not replace components with power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power and discharge circuits before touching them.

DO NOT SERVICE OR ADJUST ALONE

Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT

Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the instrument. Return the instrument to a Hewlett-Packard Sales and Service Office for service and repair to ensure that safety features are maintained.

DANGEROUS PROCEDURE WARNINGS

Warnings, such as the example below, precede potentially dangerous procedures throughout this manual. Instructions contained in the warnings must be followed.

WARNING

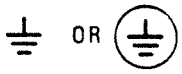
Dangerous voltages, capable of causing death, are present in this instrument. Use extreme caution when handling, testing, and adjusting.

SAFETY SYMBOLS

General Definitions of Safety Symbols Used On Equipment or In Manuals.

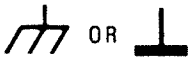
Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect against damage to the instrument.

Indicates dangerous voltage (terminals fed from the interior by voltage exceeding 1000 volts must be so marked).



Protective conductor terminal. For protection against electrical shock in case of a fault. Used with field wiring terminals to indicate the terminal which must be connected to ground before operating equipment.

Low-noise or noiseless, clean ground (earth) terminal. Used for a signal common, as well as providing protection against electrical shock in case of a fault. A terminal marked with this symbol must be connected to ground in the manner described in the installation (operating) manual, and before operating the equipment.



Frame or chassis terminal. A connection to the frame (chassis) of the equipment which normally includes all exposed metal structures.

Alternating current (power line).

Direct current (power line).

Alternating or direct current (power line).

DANGER

The DANGER sign denotes a hazard. It calls attention to an operating procedure, practice, condition or the like, which could result in injury or death to personnel even during normal operation.

WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, condition or the like, which, if not correctly performed or adhered to, could result in injury or death to personnel.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, condition or the like, which,if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product.

NOTE:

The NOTE sign denotes important information. It calls attention to procedure, practice, condition or the like, which is essential to highlight.

SECTION 5
SOFTWARE MODIFICATION

SECTION 5
SOFTWARE MODIFICATION

NOTE

The warranty on the -hp- 3047A programs does not cover modified programs. To protect the warranty, it is recommended that modified programs not be stored on the -hp- 3047A system software data cartridges supplied with the system.

5-1. ELIMINATING KEYBOARD ENTRY OF TEST CONFIGURATION CONSTANTS

In cases where data requested by a program is constant or the same test configuration is used repeatedly, it may be desirable to modify the programs to eliminate manual entry of the constant values for ease of program operation. As a guide for program modification a general example is given for the elimination of responses to prompts concerning the real time clock. In changing the program for a particular application, it is the responsibility of the user to determine the changes necessary for the proper operation of the program. The user should be aware that changes in a program routine may affect other routines with unexpected results. The user should not attempt modification to assembly language routines or routines that write into the -hp- 3582A RAM.

Information entered from the keyboard is acquired by the program through the use of the INPUT or LINPUT statements. These statements, when executed, issue a prompt (either a text message or a ? if a text message is not included as part of the command statement) then waits for the keyboard entry. The keyboard entry response to the INPUT statement is assigned to a variable designated in the INPUT statement. For the Setupclock routine (Figure 5-1), the statement

INPUT "IS THE REAL TIME CLOCK OPERATIONAL? (Y/N)",Ans$

prompts with the statement IS THE REAL TIME CLOCK OPERATIONAL? (Y/N) and waits for the keyboard entry that is assigned to the variable Ans$. (Depressing the computer CONTinue key without entering data causes a default entry and the variable retains the data most recently assigned.)

```
        .
        .
        .
    Clock = 6
        .
        .
        .
Not9845: !
        .
        .
        .
    CALL Setupclock
    IF Clock = 0 then Noclock
        Ans$ = "Y"
        INPUT "DO YOU WANT TO DISPLAY THE CLOCK? (Y/N)",
        Ans$
        IF UPC$ (Ans$[1,1]) < > "Y" THEN GOTO Noclock
            ON INT #CLOCK,9 CALL Irq
            CONTROL MASK Clock;128
            OUTPUT Clock;"U2H,U2 = 02,U2P 5000 /U2G"
            CALL Irq
Noclock: !
        .
        .
        .
Setupclock: !
SUB Setupclock
        .
        .
        .
    IF Clock = 0 THEN Clockreturn
    Ans$ = "Y"
    INPUT "IS THE REAL TIME CLOCK OPERATIONAL? (Y/N)",Ans$
    IF UPC$(Ans$[1,1]) < > "Y" THEN Clock = 0
    IF UPC$(Ans$[1,1]) < > "Y" THEN GOTO Clockreturn
        .
        .
        .
Clockreturn: !
        .
        .
        .
SUBEND
```

Figure 5-1. Direct Spectrum Analysis Clock Control Program Segment

Before attempting to change this INPUT statement it is necessary to consider other program statements for the Setupclock routine from the Direct Spectrum Analysis program. In this program segment, there are two input statements relating to the real time clock. Due to the CALL Setupclock statement, the first input statement encountered is

INPUT "IS THE REAL TIME CLOCK OPERATIONAL? (Y/N)",Ans$.

In eliminating this statement consider the following IF statements. The IF statements following the INPUT statement logically evaluates the first character assigned to the variable Ans$. If this character is not equal to "Y" the statement following the key word THEN is executed. Thus, if the entered response does not indicate that a real time clock is installed, the Clock variable is assigned the value of zero and the program execution continues starting at the Clockreturn statement. The variable Clock is assigned the value of 6 (the clock select code) previously in the program. Immediately preceding the INPUT statement is a statement assigning "Y" to the variable Ans$ so a positive response to the input statement or pressing the computer CONTinue key causes the following IF statements not to execute and program execution continues through the subroutine. When the SUBEND statement is reached, program execution continues with the statement following the CALL Setupclock statement.

The statement encountered following CALL Setupclock is another IF statement that evaluates the variable Clock. If the variable clock is equal to zero, program execution continues at the Noclock statement and the execution of the clock display routines is skipped. If clock is non-zero, the program will come to the next input statement for the clock:

```
INPUT "DO YOU WANT TO DISPLAY THE CLOCK? (Y/N)", Ans$
```

Interpretation of this input statement and the following IF statement is similar to the previous input statement. If it is not desired to display the clock, the following lines of code for displaying the clock are skipped. If the clock is to be displayed, program does not branch at the IF statement and program execution continues with the clock display sequence.

Modification of the program depends on the desired operation of the program. If it is desired that the clock be displayed, it is only necessary to deactivate or eliminate the input statements. The variables evaluated by these IF statements are defined for a positive result in each routine and the INPUT statement causes a program pause and provides an opportunity to change the variable. Without the INPUT statement, there is no pause and no change to the variable. An exclamation point placed at the start of the statements will deactivate the statements. The program interprets the characters following an exclamation point to be a remark and the INPUT statement is not executed. Thus, to display the clock without operator intervention, edit the program statements to start with an exclamation point:

```
! INPUT "DO YOU WANT TO DISPLAY THE CLOCK? (Y/N)", Ans$
! INPUT "IS THE REAL TIME CLOCK OPERATIONAL? (Y/N)",Ans$.
```

If displaying the time on the computer is not desired, it is necessary to deactivate the INPUT statement with the prompt for displaying the clock and change assigned value of the variable. One way to do this is

```
Ans$ = "N" ! INPUT "DO YOU WANT TO DISPLAY THE CLOCK? (Y/N)", Ans$
```

Changing the assigned value may also be done in the following manner:

```
Ans$ = "N"
! INPUT "DO YOU WANT TO DISPLAY THE CLOCK? (Y/N)", Ans$.
```

Both are correct but the former has the advantage of only changing one line of code and also retains the original value assigned to the variable. In this case, retaining the original value of the variable is trivial, however, in the case of a numeric variable, it may be desirable to retain the original value of the variable as a reference. In assigning a value to variable, ensure the format used is consistent with the format defining the default value of the variable.

As stated previously, an understanding of how the routine is used in the program is necessary to avoid unexpected results. As an example, the Setupplotters routine in the program relies on the pause caused by Setupclock INPUT statement to display an advisory message that an external plotter is not in the system. Without the pause, the message is flashed on the computer display too fast to be read. A PAUSE statement added after the

```
PRINT "ASSUME THE EXTERNAL PLOTTER IS NOT IN THE SYSTEM"
```

statement in the Setpplotters routine will provide the necessary pause to allow the message to be read.

More information on the the comment delimiter (exclamation point), remark, PAUSE, INPUT, LINPUT, and IF statements may be obtained from the System 45 Operating and Programming Manual.

5-2. AIDS IN PROGRAM MODIFICATION

Determining the line number of an input statement to be modified is a relatively simple task. Run the program and when the prompt to be eliminated appears, press the computer STEP key. Program execution will halt, and the next line to be executed is displayed. The INPUT statement to be deactivated may be found by entering the computer edit mode to edit the displayed line. When in the computer edit mode the program listing may be scanned through the use of the computer DISPLAY arrow keys to find the INPUT statement and determine the method used to deactivate the statement.

If problems arise in another part of the program due to program modification, there are several aids that may be used in tracing the problem. Flow of program control may be dynamically determined by activating the computer TRACE mode and printing the line numbers generated by trace on the thermal printer or observing the numbers as they are printed on the computer display. The block diagrams in this manual also illustrate the flow of program control and list the routine labels used in the program. If it is desired to examine a routine, either enter the command LIST or EDIT followed by the routine label listed in the illustrations. When referencing a routine with list or edit, the routine name format is lower-case letters except for the first letter which is upper case. A program or program segment may also be listed to a printer for examination. A listing is the most convenient way to scan the program, however, the analysis programs are quite long and considerable time and paper is required to obtain a complete listing. An external printer is preferred for a complete program listing rather than the thermal printer due to the length of the listings.

NOTE

When a noise analysis program is run, the special function keys (computer keys labeled K0 through K15) are redefined and the editing functions of the keys are not available. To edit or list a program after the program is run, it is necessary to type the commands EDIT or LIST into the computer.

After a program is modified, it is necessary to STORE or SAVE the program on a data cartrige if it is desired to keep the modified program. Additional information on the TRACE, EDIT, LIST, SAVE, STORE, and STEP commands and computer modes is found in the System 45 Operating and Programming manual.

5-3. SAVING THE PROGRAMS

After a program is modified, it is necessary to store the modified program in mass storage. The commands required for saving a program to mass storage are STORE, SAVE, STORE BIN, RE-STORE, and RE-SAVE. The STORE command creates a program file and stores the program and any binary routines in computer memory in the file. The SAVE command creates a data file and stores the program and subprograms in computer memory into the file. The direct spectrum, AM/PM noise analysis, and phase noise analysis programs require binary routines that are stored with the programs for proper operation. If a program is saved as a data file, the STORE BIN command will store the binary routines in a separate file. RE-STORE and RE-SAVE are the same as STORE and SAVE except the program is written into an existing file. Programs in data files are retreived from mass storage with the GET statement and programs stored in program files are retrieved with the LOAD command. Binary routines are retrieved from mass storage with the LOAD BIN command. It is also possible to load the binary routines into the computer memory by loading a noise analysis program file into the computer then overwriting the program in memory by GETting a data file program. The binary routines may then be stored with the program using the STORE command.

Additional information on the SAVE, STORE, RE-SAVE, RE-STORE, GET, LOAD, STORE BIN, and LOAD BIN commands is found in the System 45 Operating and Programming manual. If a new tape is to be used in storing the programs, it may be necessary to format the tape. For information on formatting the tape, refer to the INITIALIZE statement in the Mass Storage ROM manual or the System 45 Operating and Programming manual.

5-4. PROCEDURES FOR MODIFICATION OF THE PHASE NOISE ANALYSIS PROGRAM

Modifications to the Phase Noise Analysis program are slightly more complex than modifications to the other programs because the LIBRY file is linked to the end of the phase noise analysis program. Linking LIBRY alters the length of the phase noise analysis program and prohibits storage of the phase noise program on a data cartridge with only the store command. Each program segment (LIBRY and phase noise analysis) is stored separately.

Before the phase noise analysis program is run, it is necessary to determine the last line number of the phase noise analysis program (before LIBRY is linked). The program may then be run and modified. If the LIBRY routines are modified, they are saved to mass storage with the SAVE "LIBRY", line # command where line # is the line number following the last line number of the phase noise analysis program obtained before the program was run. The RE-SAVE statement may be substituted if it is desired to write over the existing file in mass storage. After saving LIBRY (if necessary), delete the LIBRY routines from the computer memory with the DEL line #, ending line # command where line # is the line number following the last line number of the phase noise analysis program obtained before the program was run and ending line # is the last line of the LIBRY routines. The phase noise program is then stored with the STORE "PHASE" command. The RE-STORE statement may be substituted for STORE if it is desired to write over the existing file in mass storage.

Additional information on the SAVE, STORE, RE-SAVE, RE-STORE, and DELete commands is found in the System 45 Operating and Programming manual. If a new tape is to be used in storing the programs, it may be necessary to format the tape. For information on formatting the tape, refer to the INITIALIZE statement in the Mass Storage ROM manual or the System 45 Operating and Programming manual.

5-5. RESTORING SWITCH

Switch is deactivated in the program to prevent inadvertent operation. Switch is reactivated by deleting the comment delimiter (!) from the special function key definition in the program. This definition is located near the beginning of the program. For the direct spectrum program, the definition precedes the program label Loop; for the AM/PM and phase noise analysis program, the definition follows the program label Noclock. To activate switch, load the program to be modified and enter the command EDIT followed by the label Loop (for direct analysis) or Noclock (for AM/PM or phase noise analysis). Use the DISPLAY arrow keys on the computer to scan the program for ! ON KEY #23-C9835*4,10 CALL Switch and to position the cursor on the ! preceding the word ON. Press the computer EDIT/SYSTEM FUNCTION DEL CHR key, press the store key, and press the STOP key to delete the !, store the line, and exit the edit mode. Access to the switch function is now available when the program is run.

After a program is modified, it is necessary to STORE the program on a data cartridge if it is desired to keep the modified program. Additional information on the EDIT and STORE commands is found in the System 45 Operating and Programming manual.

SECTION 6
UTILITY SOFTWARE DESCRIPTION

SECTION 6
UTILITY SOFTWARE DESCRIPTION

6-1. AUTOST PROGRAM

The AUTOST program causes a noise measurement or system test program to load and run when power is initially applied to the computer and the computer autostart key is in the down position. Depending on the tape cartridge in tape drive T15, AUTOST is coded to load the DIRECT, AM/PM, PHASE, or 3047CK programs.

6-2. CKSUM PROGRAM

The program CKSUM returns a number that corresponds to the numeric value of the information stored on a data cartridge. If the catalog of two cartridges are the same and the checksum values are the same, then the data cartridges can be considered duplicates. If the checksum values are not the same, the data cartridges are not duplicates due to modifications to a file or copy errors. If problems arise during system operation and assistance is requested from your systems engineer, the systems engineer may request the checksum value to determine the software version.

Operation of the program is straightforward, load "CKSUM" then depress the run key. When the computer displays "PUT TAPE TO BE CHECKSUMMED IN T15, THEN PRESS CONTINUE", insert the tape cartridge to be checksummed in tape drive T15 and press the CONTinue key. The program processes the tape in tape drive T15 and, after a brief time, the checksum value is returned. After the checksum value is obtained, insert another tape to be checksummed in tape drive T15 and press the CONTinue key to obtain another value, or press the computer STOP key to end program execution.

6-3. DECOMM DATA FILE

The DECOMM data file is a utility program used in support of the -hp- 3047A software. In developing this software, additonal lines of code were added to explain program routine operation and generate information for troubleshooting the system and program operation. DECOMM deactivates the troubleshooting routines (program statements flagged "! DEL") in a program by adding a comment delimiter (!) to the start of the statement or deletes the comment statements or troubleshooting routines from the program.

DECOMM requires that the program to be processed be SAVEd as a data file. For tape operation, the AM/PM and phase noise analysis programs must be split and each portion SAVEd on a tape cartridge due to program length. The following steps describe the operating procedures for the program.

a. Load DECOMM.

b. Insert the tape with the data file to be processed in tape drive T15.

c. Insert an initialized data cartridge into tape drive T14.

d. Depress the computer RUN key.

e. In response to "ENTER INPUT FILE NAME" enter the data file name for processing and press CONT.

f. Enter the number corresponding to the desired operation when the menu is displayed and press CONT.

g. In response to "ENTER # OF RECORD PER FILE", enter the number corresponding to the data file REC/FILE entry on the computer display.

h. In response to "ENTER # OF BYTES PER RECORD", enter the number coresponding to the data file BYTES/REC entry on the computer display.

i. When the new file name is requested, enter the new file name followed by ":T14" to select tape drive T14 and press CONT.

Program operation then proceeds without further operator interaction. The decommented program on the data cartridge in tape drive T14 must be loaded into the computer for operation when it is desired to run the program. The program data file is loaded into the computer with the GET command. If a program was split, it is necessary to merge the separate files in the computer memory using the GET command. The direct spectrum analysis, AM/PM noise analysis, and phase noise analysis programs require binary programs for operation. The SAVE command does not store these binary in the program data file and these routines must be restored.

The STORE BIN command will store the binary routines in a separate file. Binary routines are retrieved from mass storage with the LOAD BIN command. It is also possible to load the binary routines into the computer memory by loading a noise analysis program file into the computer then overwriting the program in memory by GETting a data file program. The binary routines and program may then be stored in a program file with the STORE command.

Additional information on the SAVE, STORE, GET, LOAD, STORE BIN, and LOAD BIN commands is found in the System 45 Operating and Programming manual. If a new tape is to be used in storing the programs, it may be necessary to format the tape. For information on formatting the tape, refer to the INITIALIZE statement in the Mass Storage ROM manual or the System 45 Operating and Programming manual.

6-4. KEYS FILE

The KEYS file is used by various programs to clear the computer special function key definitions in the computer memory. The special function keys are redefined by the program for use during program execution.

6-5. LIBRY DATA FILE

The LIBRY file contains subroutines common to other programs included on the -hp- 3047A system tape cartridges. With the exception of the phase noise analysis, the necessary LIBRY routines required for program operation are incorporated into the programs requiring these routines. The length of the phase noise analysis core program prohibits the storage of the phase noise program with the LIBRY routines on a single data cartridge. The phase noise analysis program links LIBRY during operation to obtain the subroutines required for operation. Details of LIBRY routines are included in the block diagrams and descriptions of the programs requiring the LIBRY routines.

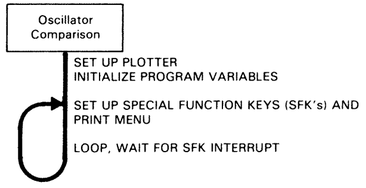
6-6. XREF PROGRAM

The XREF program generates a cross reference of a program's variables and labels. XREF operation requires that an assembly language ROM option be installed in the computer and the program that is to have a cross reference listing produced be stored on a tape cartridge as a data file.

6-7. OSC PROGRAM

The oscillator comparison program consists of a small main program and a number of specialized subroutines and subprograms. The major functions of the program are accessed by pressing the special function keys (SFK's) on the computer. Special function keys are defined in the main program according to the main menu. Information on subroutine content and flow of program control is illustrated in the oscillator comparison block diagrams. Descriptions of the principle subroutines used in the oscillator comparison program are listed with the illustrations. The routines are organized by special function key definition numeric order. The routine names listed refer to the labels used in the program. Comments imbedded in the oscillator comparison program are also an aid in understanding program operation. Operation of the program is described in the -hp- 3047A operation manual.

MAIN PROGRAM: The main program initializes the system hardware and software. The program determines if an external plotter is in the system and defines the special function keys. The main program calls the routine Initprog to set the initial values of the plot parameters (graph type, X-Y axis dimensions, title, etc.) and the necessary variables and strings used in the program. Some of the SFK's are redefined during the operation of some subroutines.

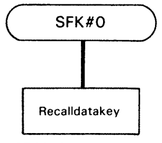


MENU-OSCILLATOR COMPARISON
K0 ... INPUT A SINGLE DATA FILE
K1 ... PERFORM A 2 OSCILLATOR COMPARISON
K2 ... PERFORM A 3 OSCILLATOR COMPARISON

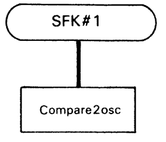
K5 ... WRITE MEASUREMENT DATA TO MASS STORAGE

K7 ... PLOT DATA/GENERATE NEW GRATICULE
K8 ... POSITION CRT MARKER ON GRAPH
K9 ... DRAW SLOPE LINES ON GRAPH

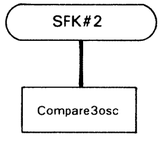
K13 ... DUMP GRAPHICS (DO A TOP OF FORM FIRST IF NOT AT TOP OF PAGE
K14 ... DISPLAY GRAPHICS
K15 ... DISPLAY MENU
<SHIFT> K15 ... PRINT MENU ON THERMAL PRINTER



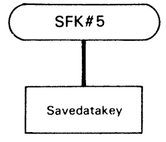
RETRIEVE STORED DATA FROM MASS STORAGE AND DELETE SPURS FROM DATA



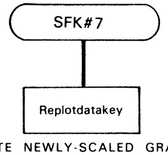
COMPARE 2 DATA FILES IN MEMORY AND PRODUCE A RESULT FILE



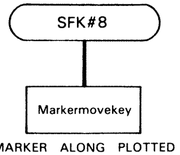
COMPARE 3 DATA FILES IN MEMORY AND PRODUCE 3 RESULT FILES



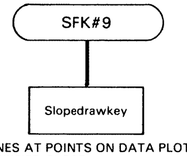
STORE MEASUREMENT DATA IN MASS STORAGE



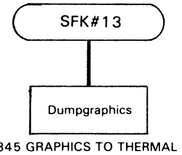
GENERATE NEWLY-SCALED GRATICULE AND/OR PLOT MEASUREMENT DATA ON EXISTING GRATICULE



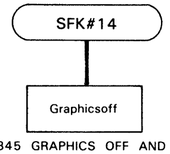
MOVE MARKER ALONG PLOTTED DATA, READING FREQUENCY AND AMPLITUDE AT EACH POINT



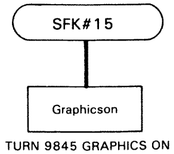
DRAW LINES AT POINTS ON DATA PLOT WITH USER SPECIFIED SLOPE



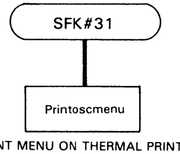
DUMP 9845 GRAPHICS TO THERMAL PRINTER



TURN 9845 GRAPHICS OFF AND DISPLAY MENU



TURN 9845 GRAPHICS ON



PRINT MENU ON THERMAL PRINTER

Figure 6-1. Index To Oscillator Comparison Program Special Function Key Routines

RECALLDATAKEY (SFK #0): The Recalldatakey routine loads data from mass storage. Recalldatakey uses Choosefile to determine the type of file to be read (i.e. A vs. B or B vs. A). Recalldatakey calls Recalldata to request information on which mass storage device to use and the name of the file to access. Data recalled from mass storage overwrites data in the computer memory and the data is lost unless previously stored in mass storage. Recalling a file overwrites only those segments contained in the file. Recalldatakey calls Deletespurs to delete spurs from the data file.

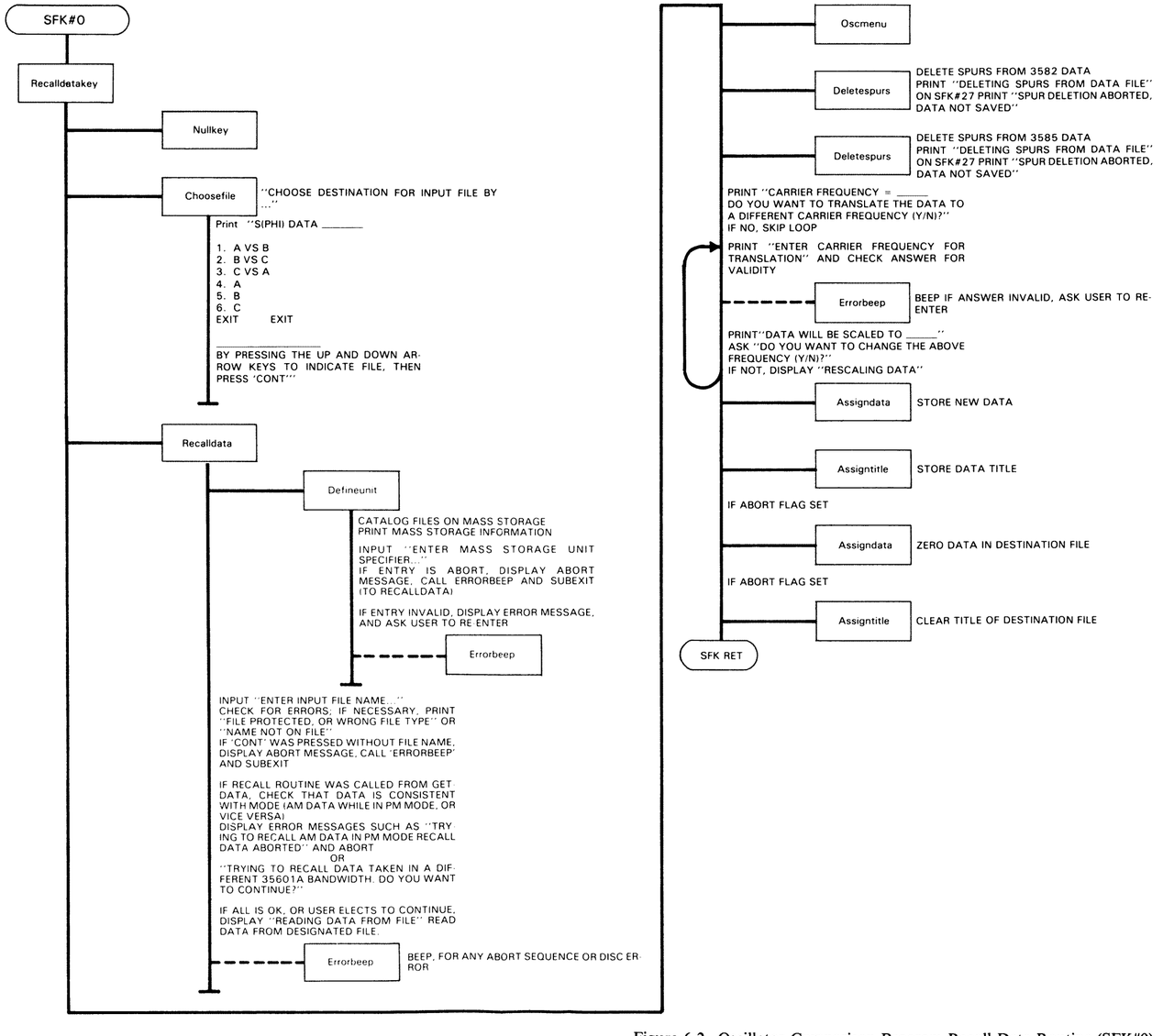


Figure 6-2. Oscillator Comparison Program Recall Data Routine (SFK#0)

COMPARE2OSC (SFK #1): Compare2osc uses the results of a comparison between two oscillators, when one of the oscillators is known, to compute the noise of the unknown oscillator. The Choosefile routine is called to determine which file is used for the known oscillator and which file is used for the comparison oscillator. The option is provided to change the title or carrier frequency of the new data file.

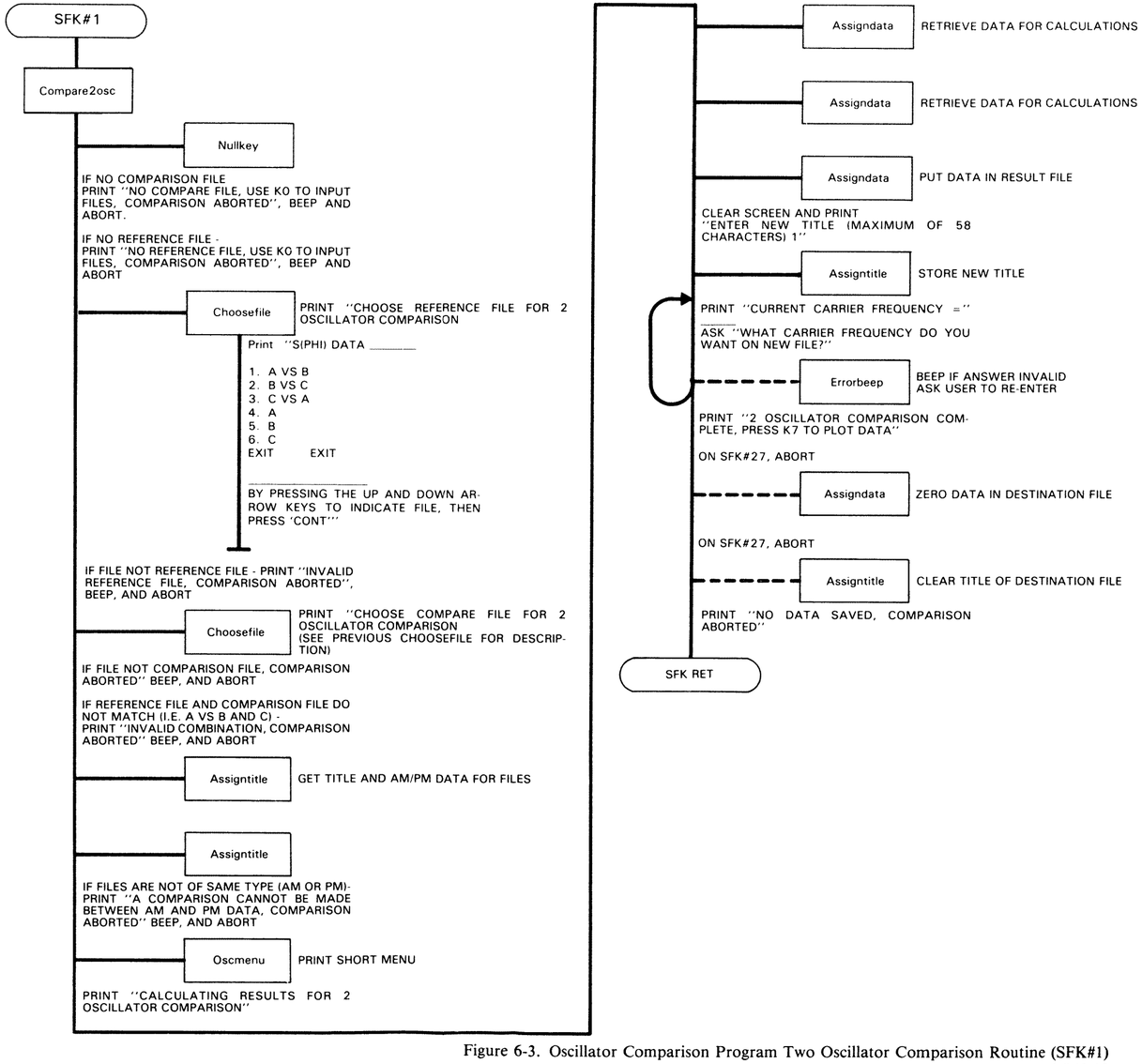


Figure 6-3. Oscillator Comparison Program Two Oscillator Comparison Routine (SFK#1)

COMPARE3OSC (SFK #2): Compare3osc uses the results of 3 pair-wise measurements among three oscillators to compute the actual noise of each individual oscillator. The title or carrier frequency of each data file may be changed after the noise of each oscillator is computed. Choosefile is called to select the file for the changing of the title or carrier frequency.

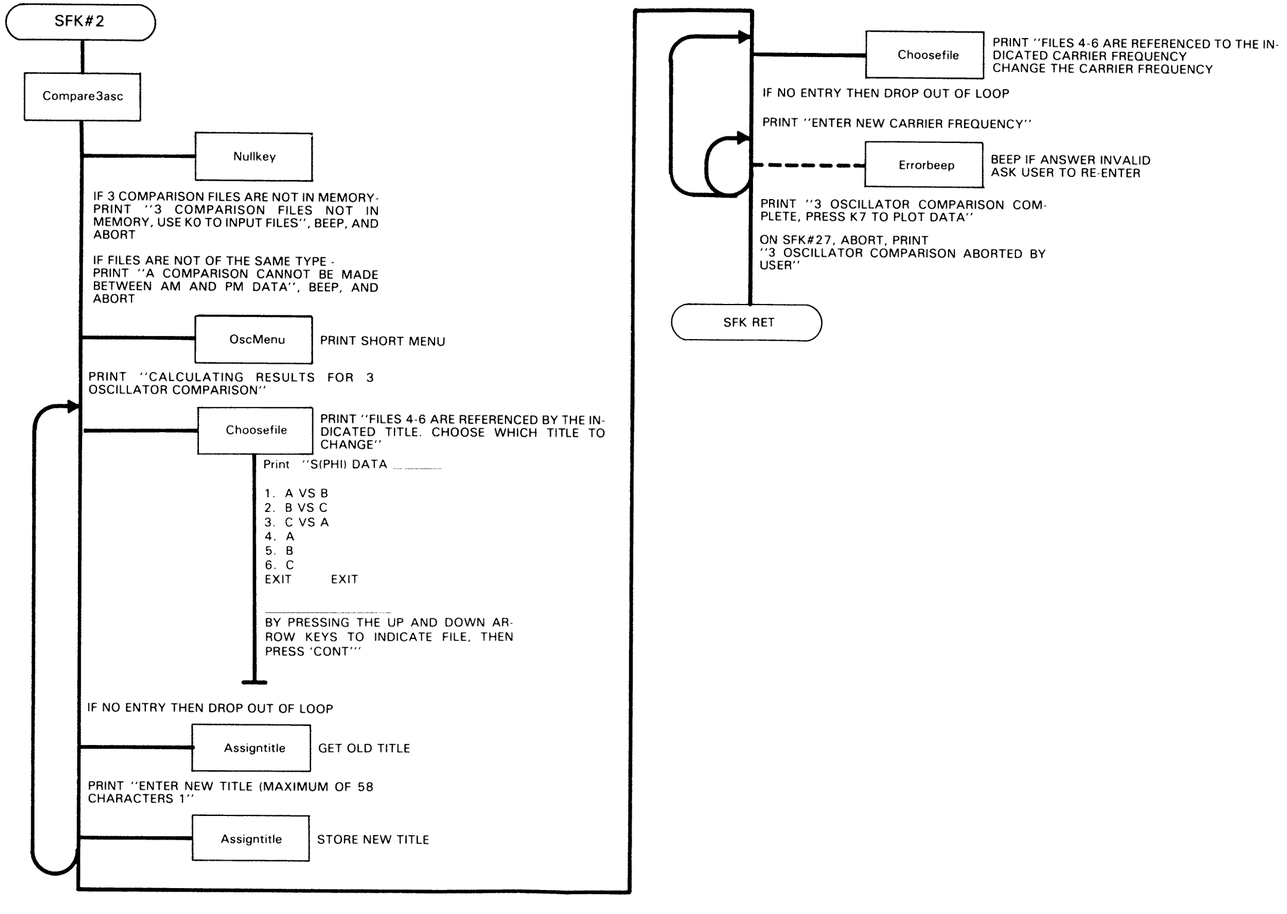


Figure 6-4. Oscillator Comparison Program Three Oscillator Comparison Routine

SAVEDATAKEY (SFK #5): The Savedatakey routine stores the computer data array in a mass storage file. Choosefile is called to select the file to be saved. Major functions of Savedatakey are performed by the Savedata routine. Savedata requests which mass storage device to use and the name of the storage file. Savedata checks that old files are not inadvertantly overwitten.

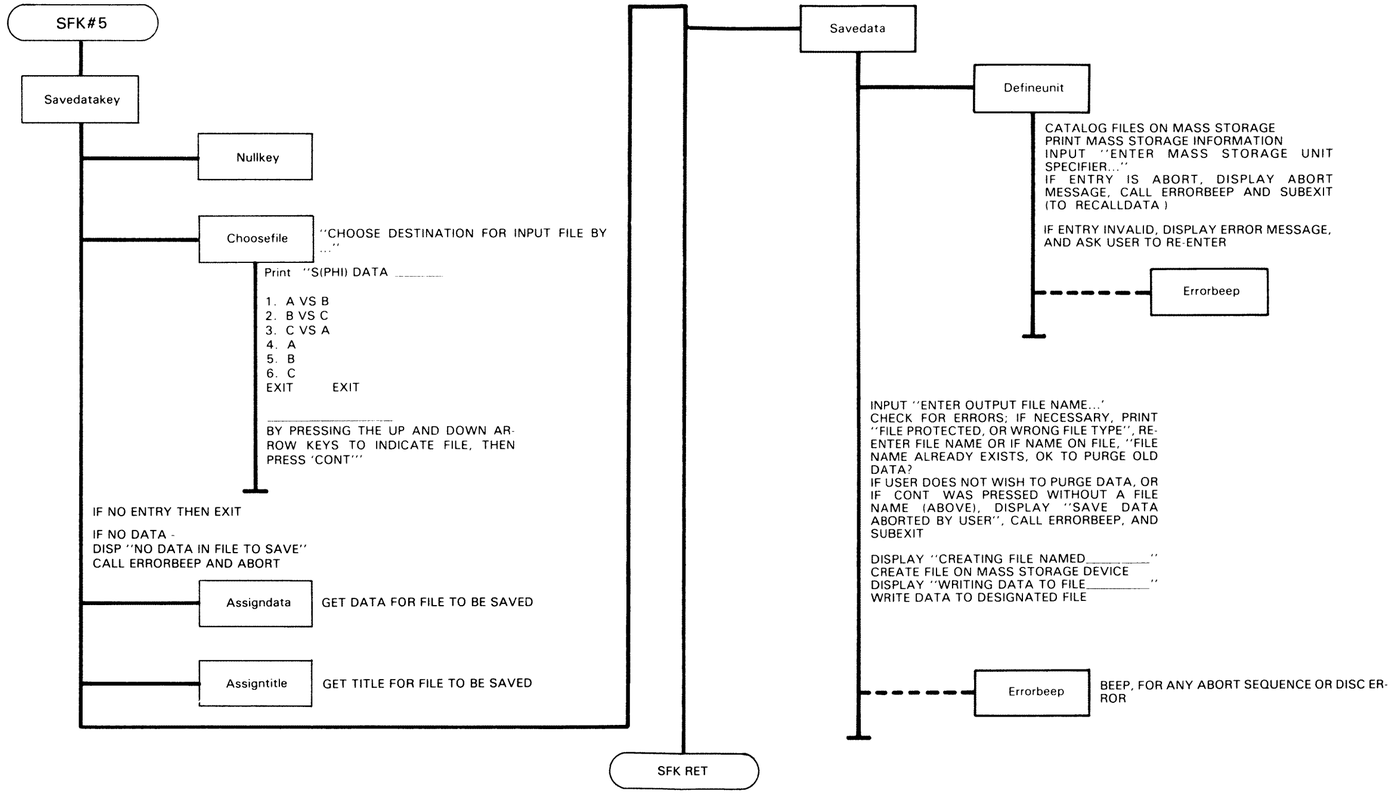


Figure 6-5. Oscillator Comparison Program Save Data Routine (SFK#5)

REPLOTDATAKEY (SFK #7): The Replotdatakey routine draws a new labeled graph or plots the measurement data on the existing graticule. Redoplot is called to redraw the graph. Redoplot displays the current plot parameters and requests changes to the parameters. Redoplot calls Initplot to generate the graticule. Redoplot requests the data plot frequency limits then calls Getfreqparms to determine which segments must contain data. Getfreqparms checks that data exists for at least one of the necessary segments. Each segment is plotted by the Plotsegment routine. Replotdatakey does not erase data previously plotted on the graph so it is possible to plot multiple sets of data on the same graph for comparison.

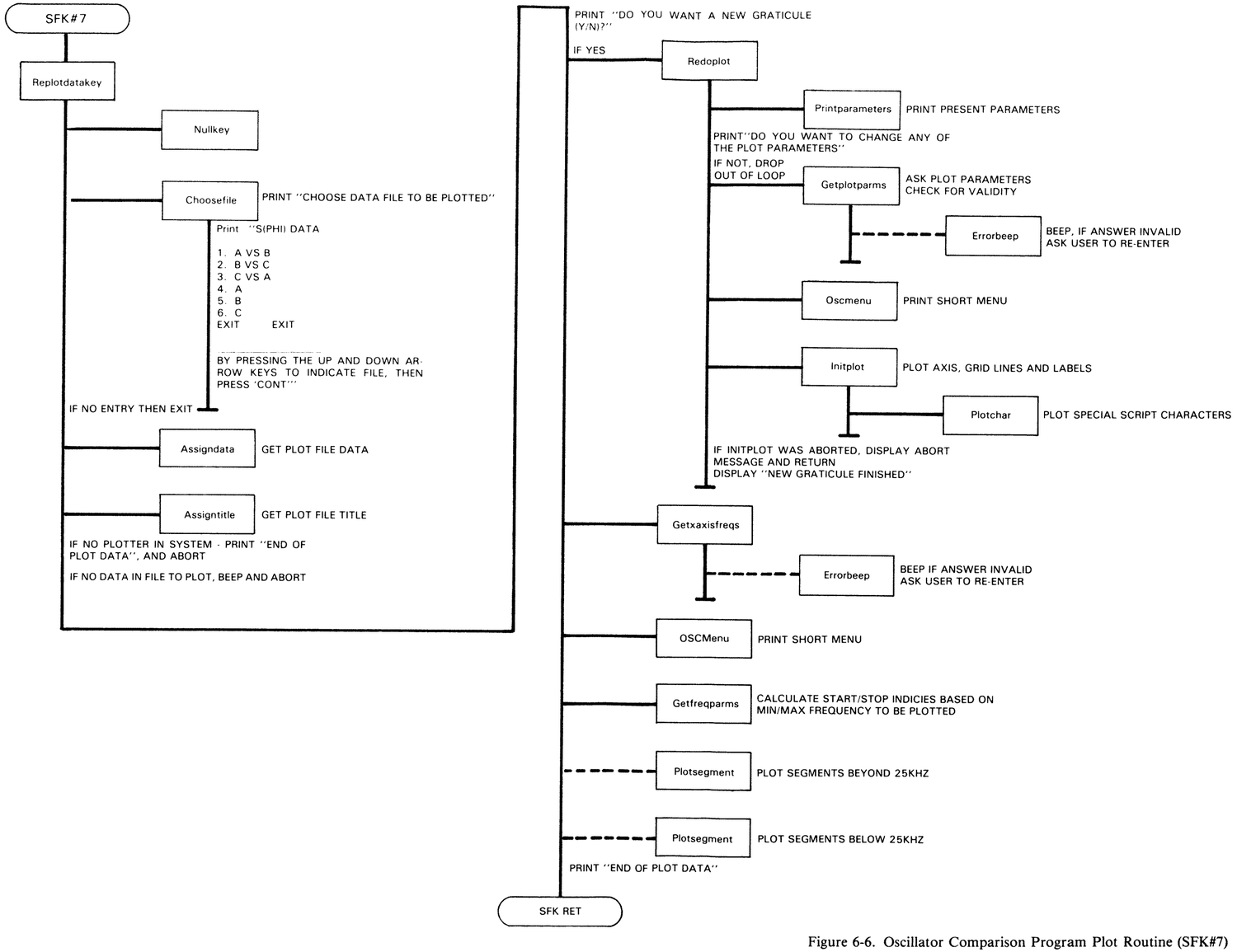


Figure 6-6. Oscillator Comparison Program Plot Routine (SFK#7)

MARKERMOVEKEY (SFK #8): The Markermovekey routine moves a cross-hair marker left or right along the plotted data and reads the amplitude and frequency to the greatest possible resolution. The main functions of Markermovekey are provided by the Markermove routine. Markermove calls Getfreqparms to determine which segments are within the boundaries of the graticule, then checks if measurement data exists within those boundaries. Use of the arrow keys to move the marker along the data plot is described by a menu. The amplitude and frequency are displayed on the computer screen. Markermove is exited by depressing <SHIFT> SFK #11. A limited set of SFK's are active during this routine.

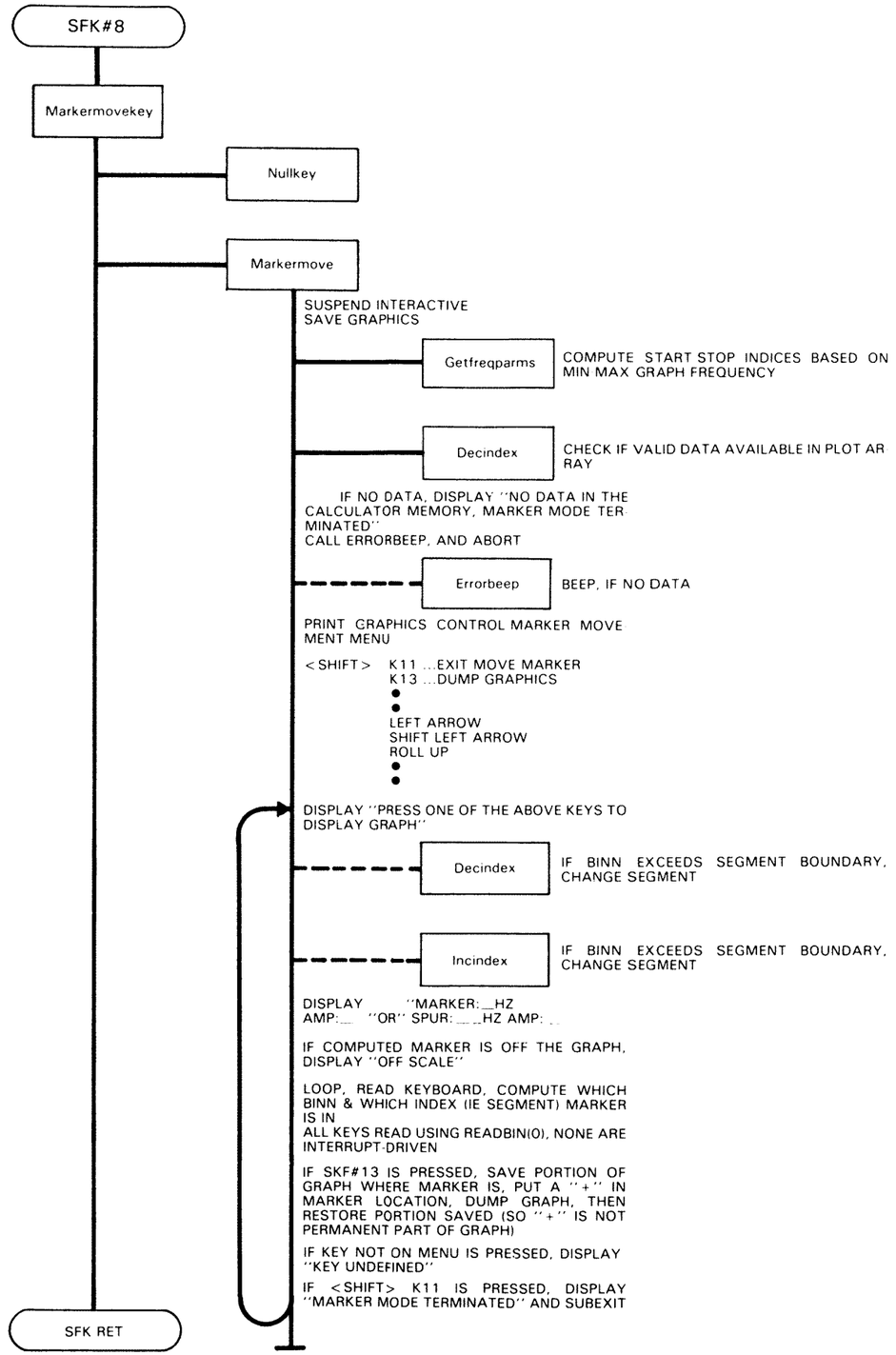


Figure 6-7. Oscillator Comparison Program Marker Movement Routine (SFK#8)

SLOPEDRAWKEY (SFK #9): The routine Slopedrawkey draws a line on the graph with a user specified slope. The main functions of this routine are provided by the Slopedraw routine which redefines the SFK's for line drawing. SFK #0 permits line creation by the Enterline routine. This routine erases the most recently drawn line (unless saved) by redrawing it with a negative pen, displays the current X-Y coordinates and slope, and requests new values for the coordinates and slope. The end points of the line are calculated and the Dodraw routine draws the line. SFK #1 invokes the Saveline routine. If the program is requested to save the line as a permanent part of the graph, the line is drawn on the plotter and a computer flag is set to prevent the Enterline routine and exit sequence from erasing the line. Depressing <SHIFT> SFK #11 causes a branch back to the calling routine. On exit, Dodraw erases the most recent line if it was not saved. The points of intersection between the plot and slope line are also erased with the slope line.

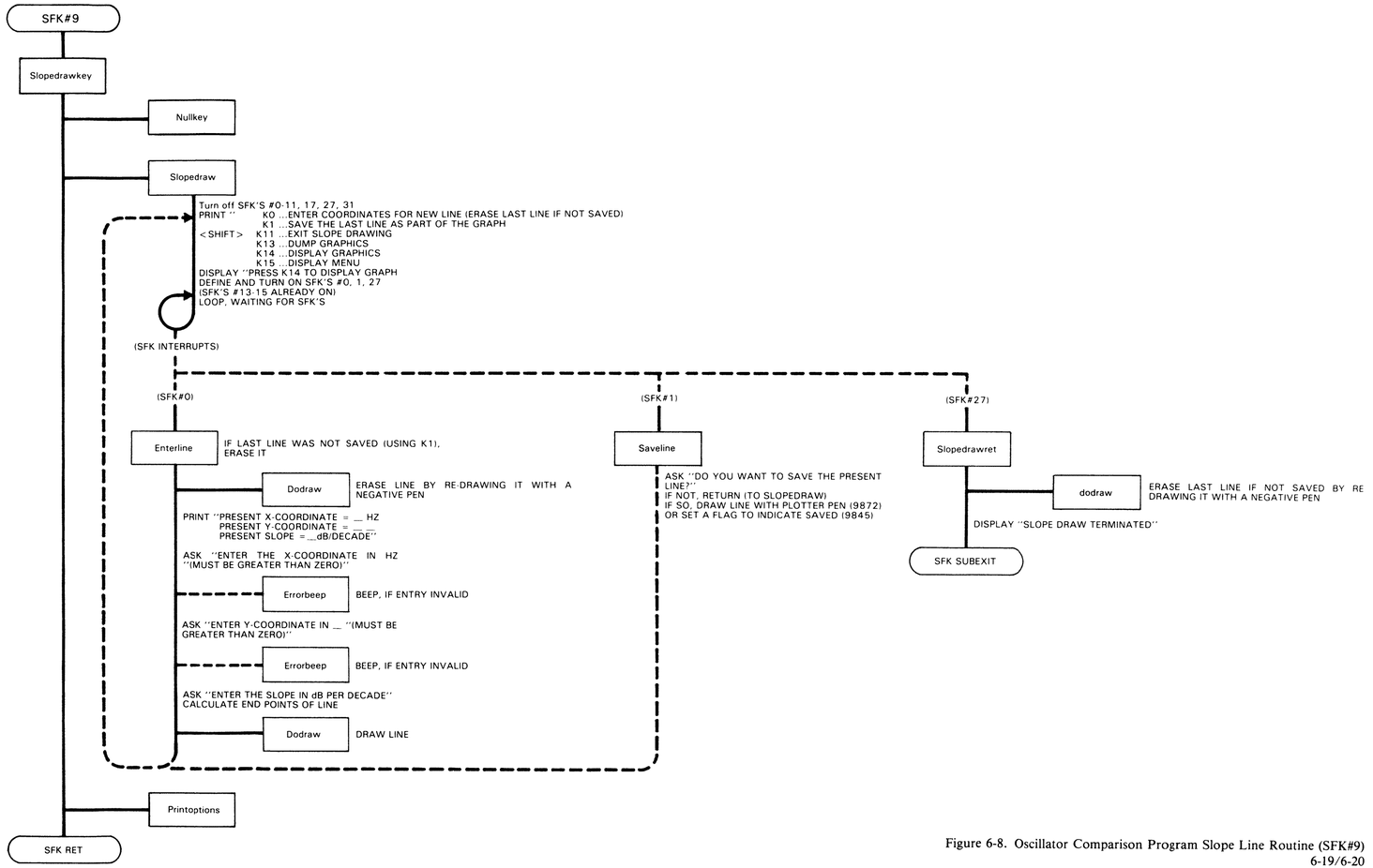


Figure 6-8. Oscillator Comparison Program Slope Line Routine (SFK#9)

DUMPGRAPHICS (SFK #13): The Dumpgraphics routine prints the computer graphics memory contents on the thermal printer. Dumpgraphics does not execute a top of form command prior to printing because significant amounts of unperforated paper are wasted when used in the computer.

GRAPHICSON (SFK #14): The Graphicson routine enables the computer to display the graphics memory on the computer display.

GRAPHICSOFF (SFK #15): The Graphicsoff routine disables the computer graphics display and displays the current menu.

PRINTOSCMENU (SFK #31 OR <SHIFT> SFK #15): Printoscmenu prints a copy of the menu on the thermal printer.

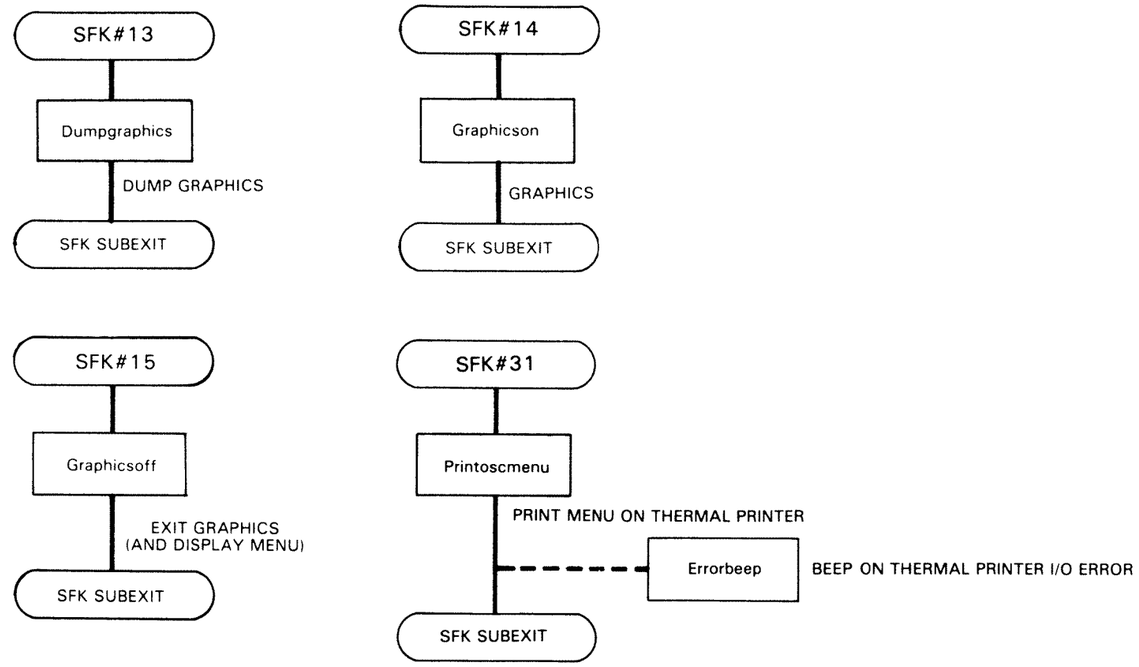


Figure 6-9. Oscillator Comparison Program Print Menu and Graphics Control Routines (SFK#13-15, 31)

6-8. 3047CK PROGRAM

The 3047CK program provides a system diagnostic and functional test of the -hp- 3047A Spectrum Analyzer System without requiring additional test equipment. The functional test portion of the program verifies that the system is operational and requires little operator interaction. The diagnostic test is a more complete test than the functional test. The diagnostic test assists in identifying a faulty component of a non-functional system. Computer prompts guide the operator in making the necessary circuit configuration changes required during test operation. Program operation is detailed in the -hp- 3047A Spectrum Analyzer System Operating Manual. Information on subroutine content and flow of program contol is available from the 3047CK block diagrams contained in this section. Descriptions of the major subroutines listed in the 3047CK block diagrams are included with the illustrations. Comments imbedded in the 3047CK program are also an aid in understanding program operation. The routine names listed refer to labels used in the program.

MAIN PROGRAM: The main program displays the menu offering the choice for the functional or diagnostic test and prompts for entry the desired function. The main program calls the various routines used during the test. The routines called are Iocardcheck, Checkclock, Checkhandshake, Check35601light, I82dccheck, Check82cal, Check85cal, Check85trkgen, Initial601test, Check20khzbeat, Getvcxoslope, Chklowfreqloop, Chk601hifreq, and Gaintest. These routines are described by label in the following illustrations.

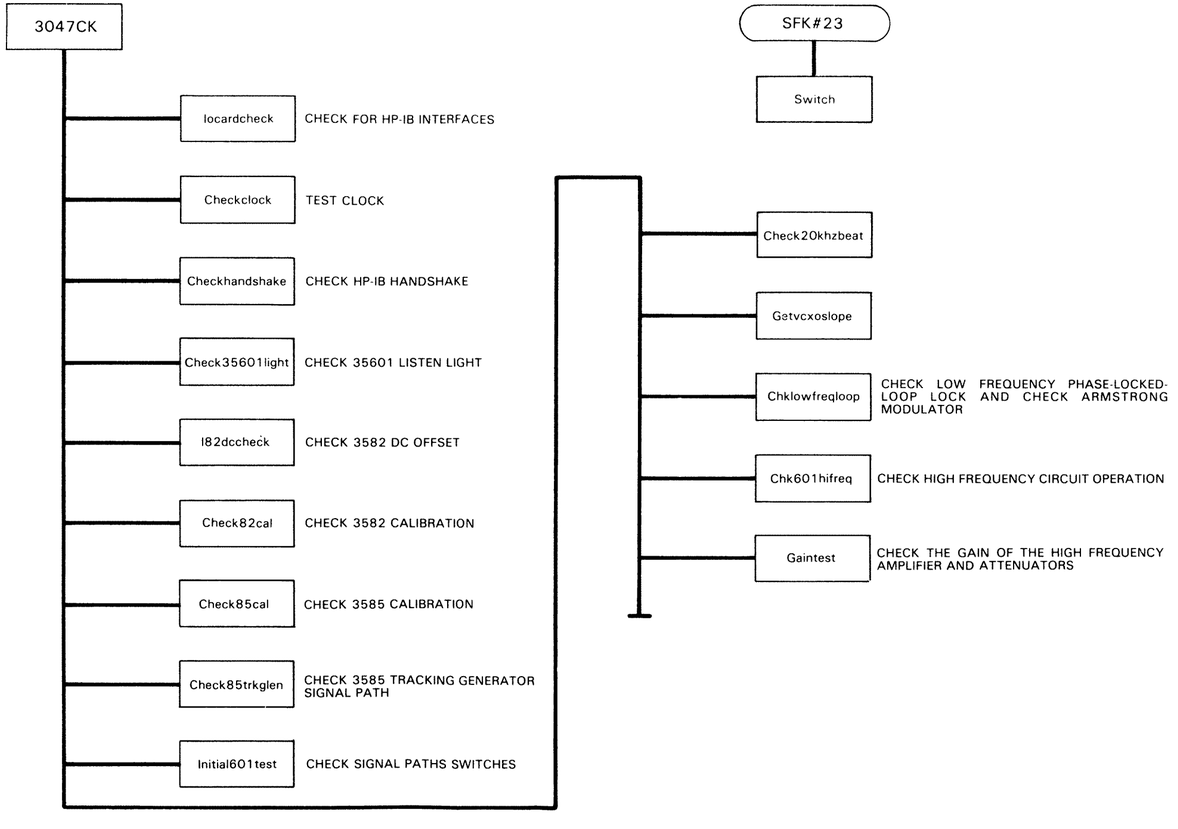


Figure 6-10. Index to 3047CK Program Routines

IOCARDCHECK: The Iocardcheck routine checks that a HP-IB interface card is present for the -hp- 3582A, -hp- 3585A, and -hp- 35601A. The Checkcode routine is used to do the actual check.

CHECKCLOCK: The Checkclock routine tests the real time clock installed in the -hp- 3047A system.

CHECKHANDSHAKE: The Checkhandshake routine checks the HP-IB interface handshake on the -hp- 3582A and -hp- 3585A. The Handsub routine is used for the actual check.

CHECK35601LIGHT: The Check35601light routine checks the operation of the -hp- 35601A interface front panel LISTEN light.

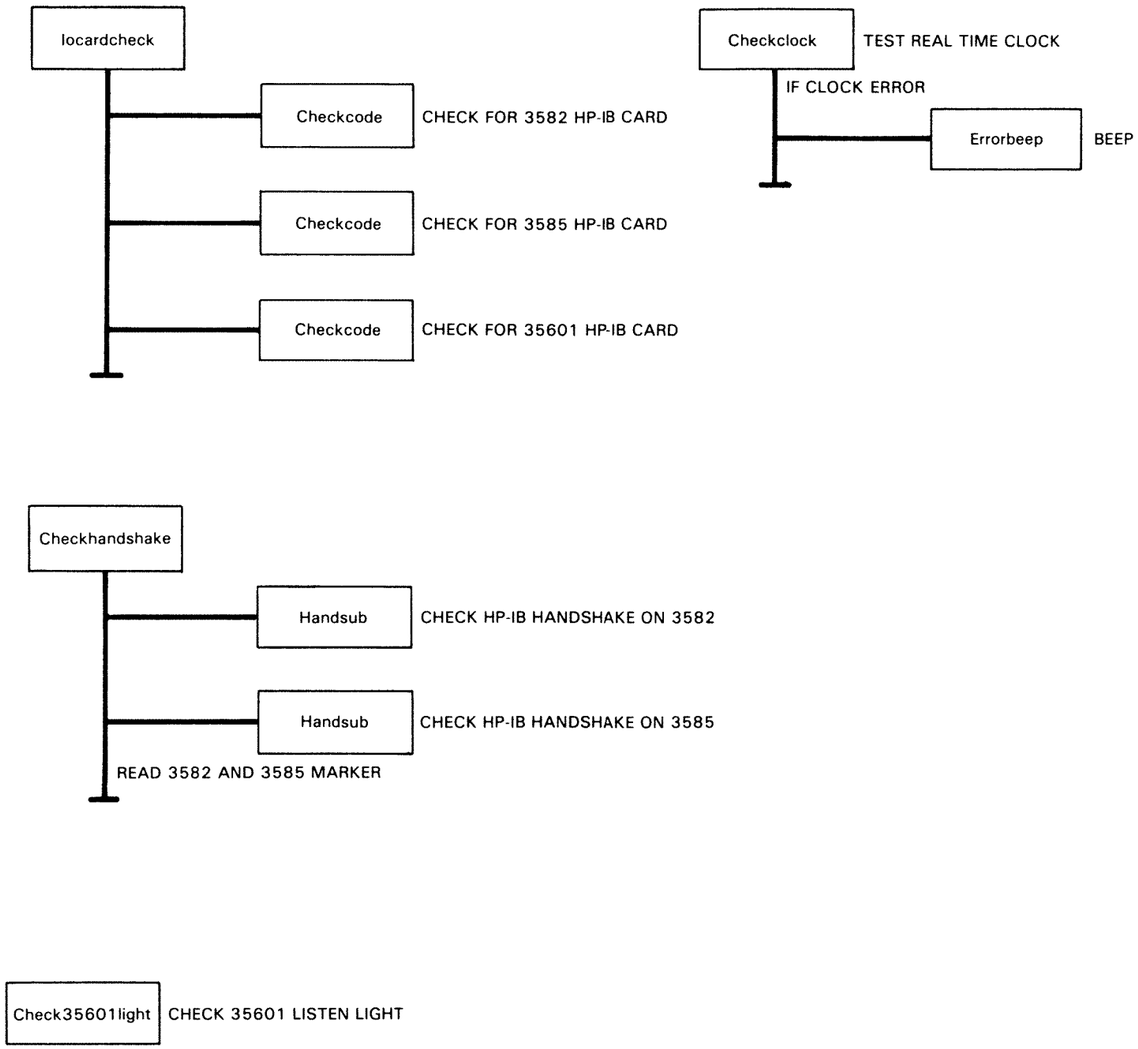


Figure 6-11. 3047CK HP-IB, Clock and 35601 Listen Light Check Routines

I82DCCHECK: The I82dccheck routine checks the DC offset on the -hp- 3582A spectrum analyzer. I82dccheck calls the Setupinterface routine to set up the -hp- 35601A circuits required for the test. The Toggle routine is used to toggle the out-of-lock and overload flip-flops.

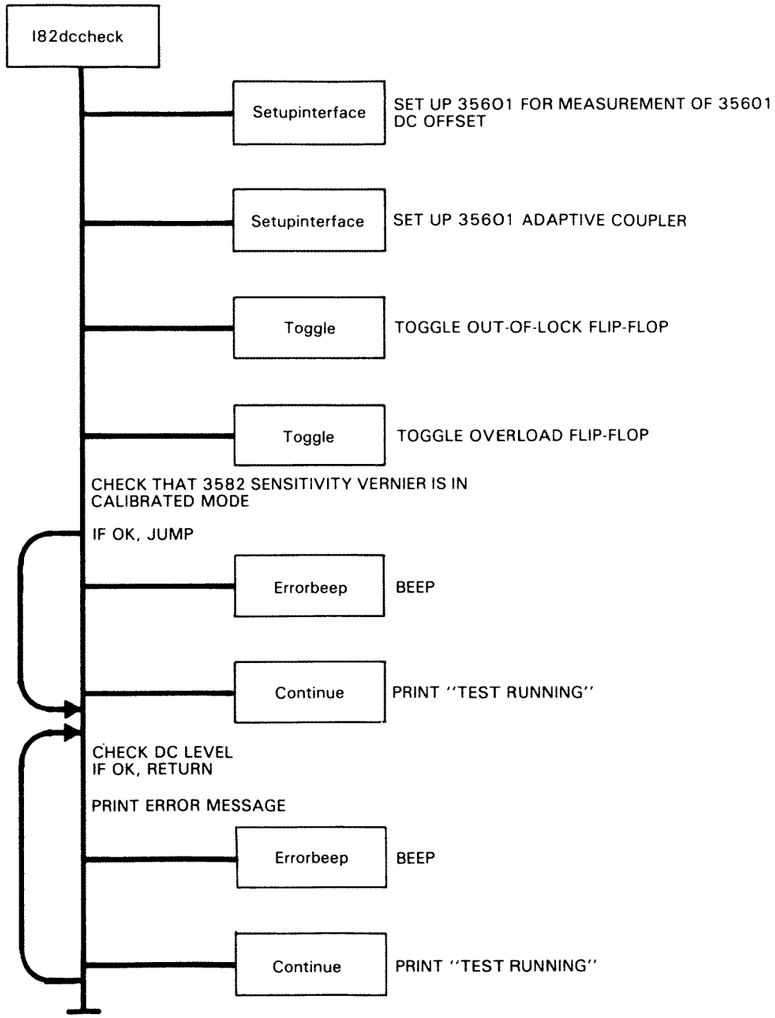


Figure 6-12. 3047CK I82dccheck

CHECK82CAL: The Check82cal checks that the -hp- 3582A calibration is valid. If the calibration is not valid, the Errorstop routine is used to print an appropriate error message.

CHECK85CAL: The Check85cal checks that the -hp- 3585A calibration is valid. If the calibration is not valid, the Errorstop routine is used to print an appropriate error message.

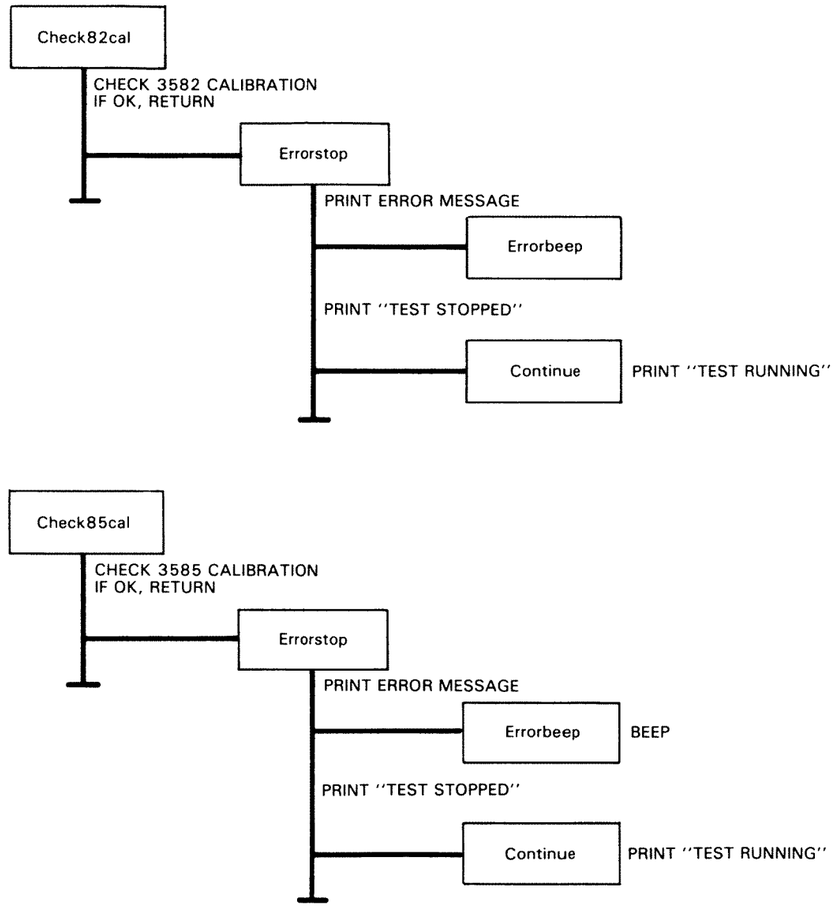


Figure 6-13. 3047CK Check Spectrum Analyzer Calibration Routines

CHECK85TRKGEN: The Check85trkgen routine checks that the -hp- 3585A tracking generator is connected to the -hp- 35601A and checks that the switches in the tracking generator path are functioning. Setupinterface is used to configure the -hp- 35601A for the test sequence.

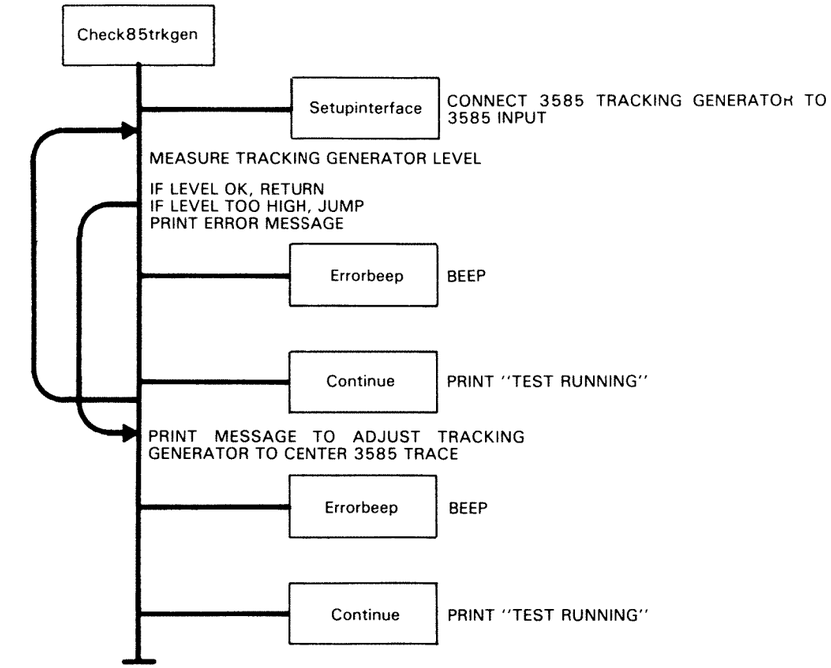


Figure 6-14. 3047CK Check Tracking Generator Signal Path Routine

INITIALIZE601TEST: The Initial601test routine tests various signal paths and switches in the -hp- 35601A interface. The -hp- 3585A tracking generator or the -hp- 3582A noise source is used as a signal source and a spectrum analyzer is used to measure the signal. Setupinterface is used to initially configure the -hp- 35601A and open and close the required switches in the signal path to verify switch operation. Amptest is used to check the circuit paths that may be connected to the -hp- 3585A input. Check82sweep is used to check the circuit paths that may be connected to the -hp- 3582A input. The Errorstop routine is used to print an appropriate error message if a fault in a measurement is encountered.

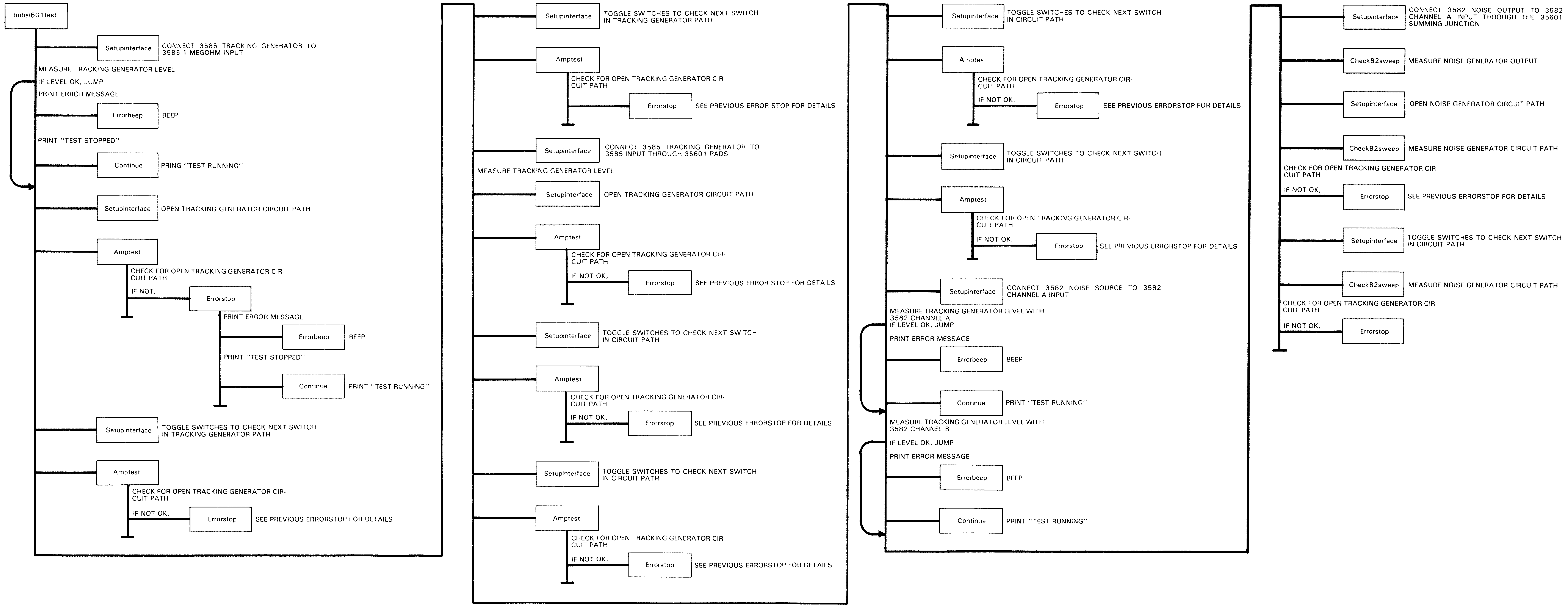


Figure 6-15. 3047CK Initial601Test Routine

CHECk20KHZBEAT: The Check20khzbeat routine checks the low frequency phase-locked-loop. Check20khzbeat calls Setupinterface to configure the -hp- 35601A and toggle the switches required to test circuit operation. Check82sweep is used to read the -hp- 3582A marker amplitude. The Errorstop routine is used to print an appropriate error message if a fault in a measurement is encountered. If a fault is sensed in the the 350 kHz phase-locked-loop, I601error is called to pass an error message to Errorstop.

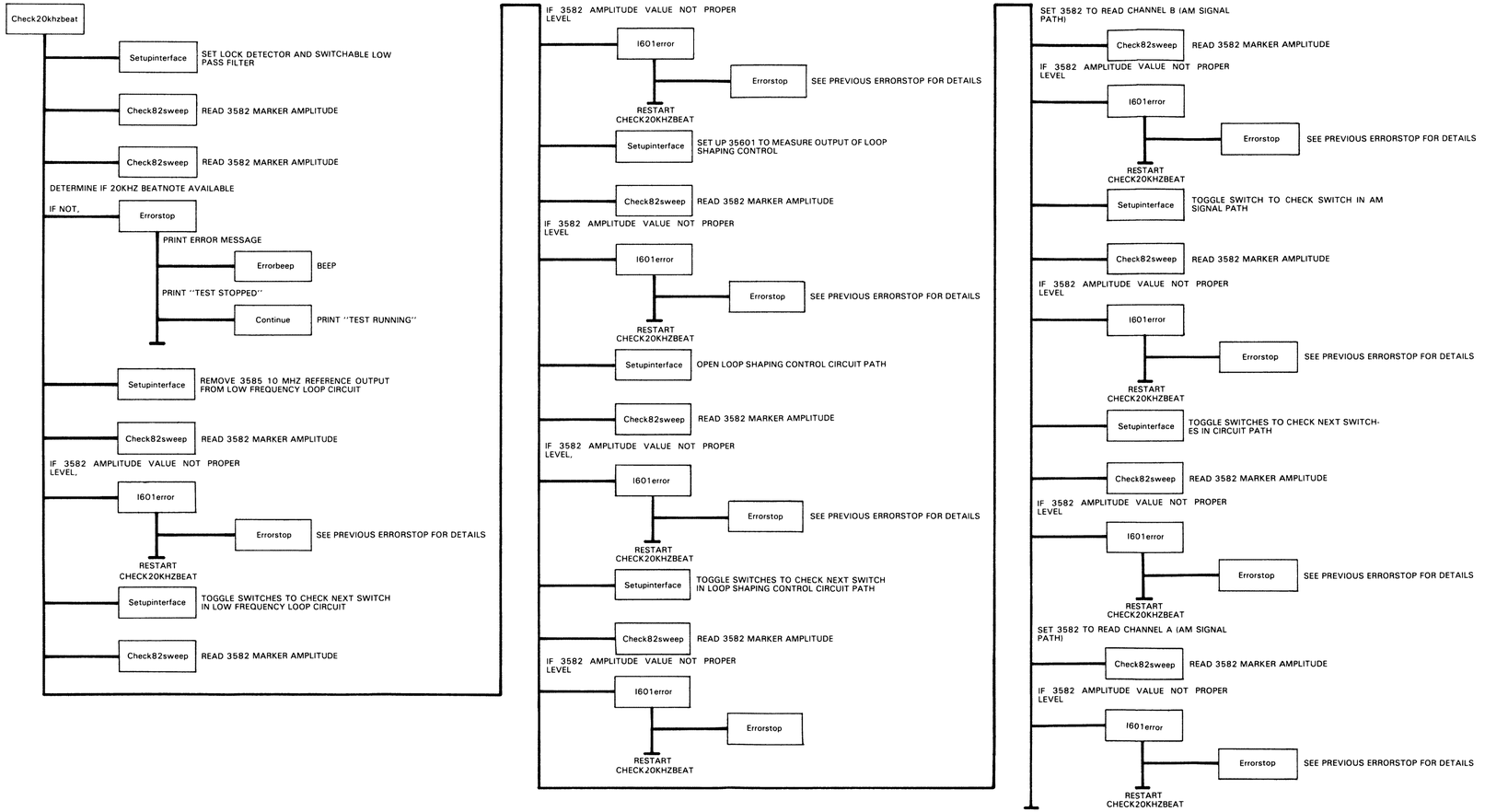


Figure 6-16. 3047CK Check 20 kHz Beatnote Routine

GETVCXOSLOPE: The Getvcxoslope routine measures the VCXO tuning slope of the low frequency phase-locked-loop. Setupinterface configures the -hp- 35601A for the measurement. Getdc is called to measure the DC voltage from the phase-locked-loop. Getdc calls Check82sweep to read the -hp- 3582A marker amplitude. If the calculated VCXO slope is not within prescribed limits, Errorstop is called to print an error message.

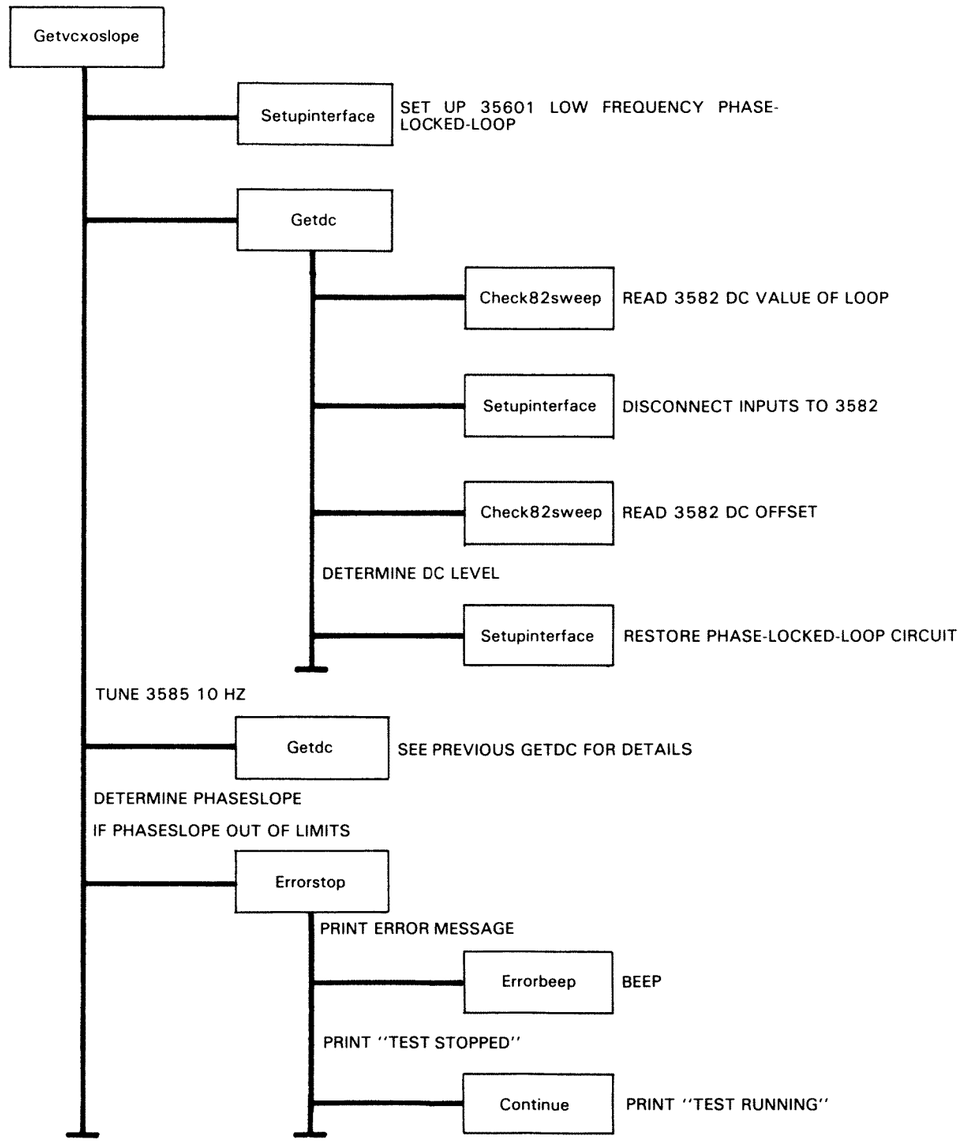


Figure 6-17. 3047CK Get VCXO Slope Routine

CHKLOWFREQLOOP: The Chklowfreqloop routine tests that the low frequency phase-locked-loop locks and the Armstrong modulator is operational. Setupinterface configures the -hp- 35601A for measurement. Phase-locked-loop values are measured with the Check82sweep and Getdc routines. The routine Avedone waits for the -hp- 3582A to finish the measurement average during the Amstrong modulator and switchable low pass filter checks.

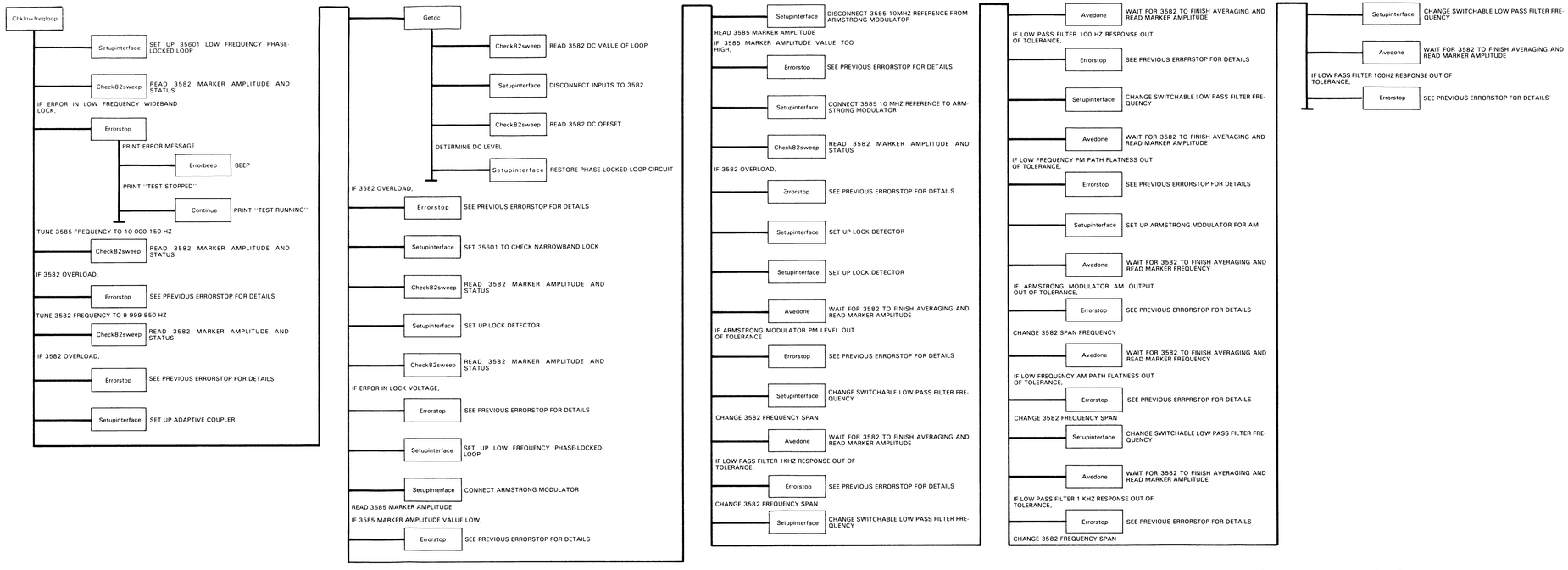
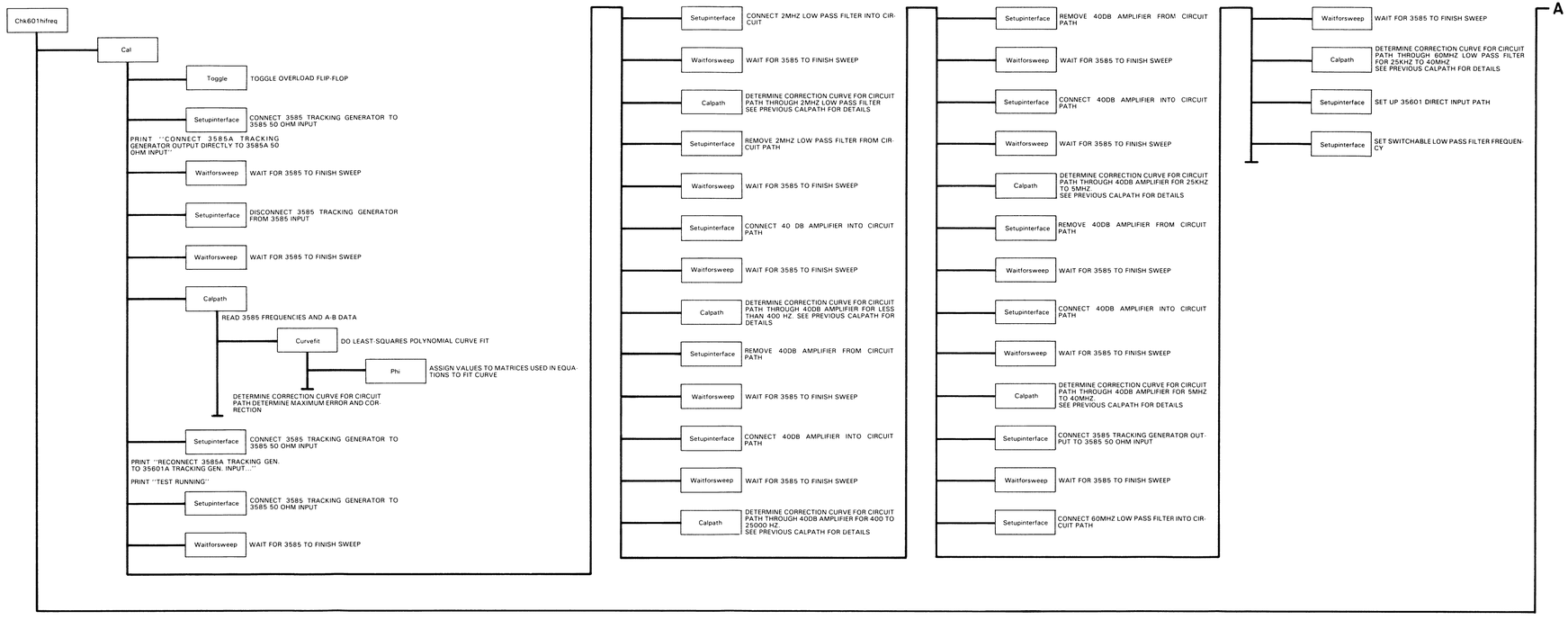


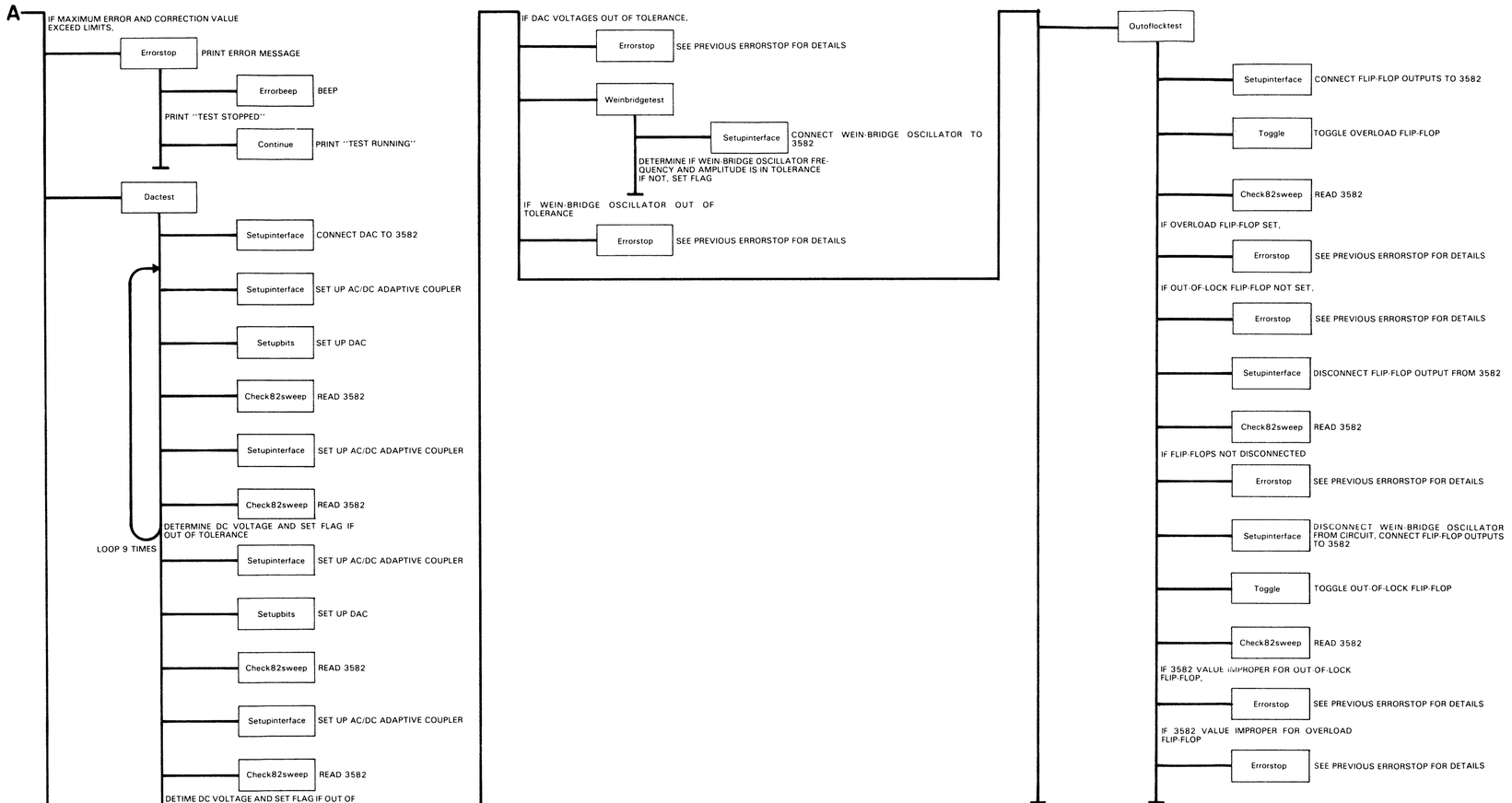
Figure 6-18. 3047CK Check Low Frequency Phase-Locked-Loop Routine

CHK601HIFREQ: The Chk601hifreq checks the high frequency circuit operation of the -hp- 35601A. Chk601hifreq calls the routines Cal, Dactest, Weinbridgetest, and Outoflocktest to check the circuits. Chk601hifreq uses the routine Cal to calibrate the high frequency circuits. Dactest is called to test the DC output of the D/A converter. Weinbridgetest is used to test the Wein-bridge oscillator is operational and produces the correct output level. The Outoflocktest routine tests the out-of-lock indicator. Setupinterface is used to configure the -hp- 35601A for the test. Toggle is used to toggle the overload and out-of-lock flip-flops. The Waitforsweep routine waits for the -hp- 3585A to finish a measurement sweep. The Cal routine uses the Calpath routine to generate a correction curve for a circuit path. Curvefit does a least-squares polynomial curve fit to determine the coeffecients of the correction curve. Setupbits is used to set the D/A converter. Check82sweep is used to read the -hp- 3582A. If a fault occurs during a test, Errorstop is used to print the appropriate error message.



p/o Figure 6-19. 3047CK Check 35601 High Frequency Circuit Operation Routine

CHK601HIFREQ: The Chk601hifreq checks the high frequency circuit operation of the -hp- 35601A. Chk601hifreq calls the routines Cal, Dactest, Weinbridgetest, and Outoflocktest to check the circuits. Chk601hifreq uses the routine Cal to calibrate the high frequency circuits. Dactest is called to test the DC output of the D/A converter. Weinbridgetest is used to test the Wein-bridge oscillator is operational and produces the correct output level. The Outoflocktest routine tests the out-of-lock indicator. Setupinterface is used to configure the -hp- 35601A for the test. Toggle is used to toggle the overload and out-of-lock flip-flops. The Waitforsweep routine waits for the -hp- 3585A to finish a measurement sweep. The Cal routine uses the Calpath routine to generate a correction curve for a circuit path. Curvefit does a least-squares polynomial curve fit to determine the coeffecients of the correction curve. Setupbits is used to set the D/A converter. Check82sweep is used to read the -hp- 3582A. If a fault occurs during a test, Errorstop is used to print the appropriate error message.



p/o Figure 6-19. 3047CK Check 35601 High Frequency Circuit Operation Routine

GAINTEST: The Gaintest routine tests the gains of the high frequency amplifiers and attenuators. Setupbits is used to set the ampliers, attenuators, and lag-lead network. Check82sweep is used to read the -hp- 3582A. If a fault occurs during a test, Errorstop is used to print the appropriate error message. Testlevel is used to read the -hp- 3585A. If a fault is detected in Testlevel, Testlevel passes an error message to Errorstop.

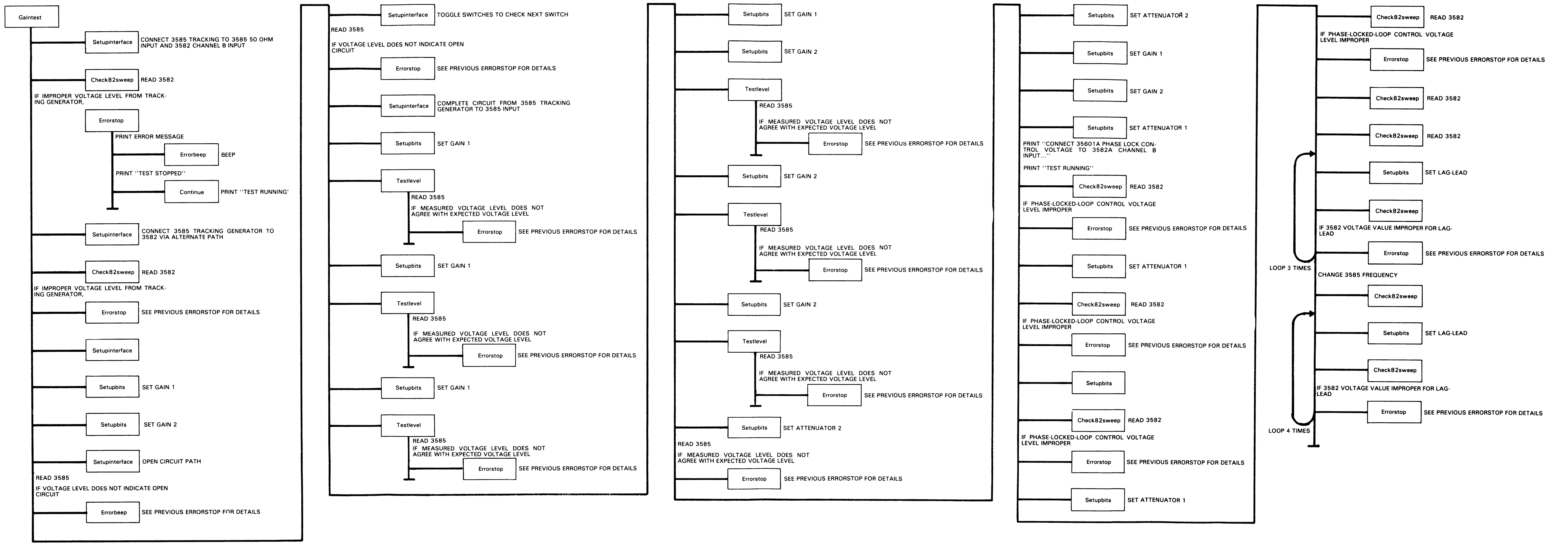


Figure 6-20. 3047CK Gain Test Routine

6-9. 601TST DATA FILE

The 601TST data file program is used in testing and trouble shooting the -hp- 35601A Spectrum Analyzer Interface. Program operation divided into high and low frequency circuit test portions. The high frequency portion of the program checks the components on the high frequency and phase-locked-loop control circuit boards. The low frequency portion of the program tests the components on the low frequency and HP-IB circuit boards. Selection of either test set is accomplished by depressing a special function key. The option of performing the entire high or low frequency circuit test or testing of a particular circuit is provided by the computer special function keys (SFK'S) as indicated by the displayed menu. A new menu is displayed whenever the alternate frequency test is selected.

Information on subroutine content and flow of program contol is illustrated in the 601TST block diagrams contained in this section. A description of the principle subroutines used in 601TST are listed with the illustrations. The routine names listed refer to labels used in the program. Description of the subroutines are listed in order defined by the special function keys and grouped into high and low frequency test sequences. Illustrations of the circuits tested are available in the -hp- 35601A Spectrum Analyzer Interface Operating and Service Manual. Written descriptions of circuits tested are included for each test routine and an -hp- 35601A schematic is included in Figure 6-21 for reference. Comments imbedded in the 601TST program are also an aid in understanding program operation.

Program operation is detailed in the -hp- 35601A Spectrum Analyzer Interface Operating and Service Manual. 601TST requires external test equipment for program operation. Test equipment required for program operation is listed in the -hp- 35601A Spectrum Analyzer Interface Operating and Service Manual.

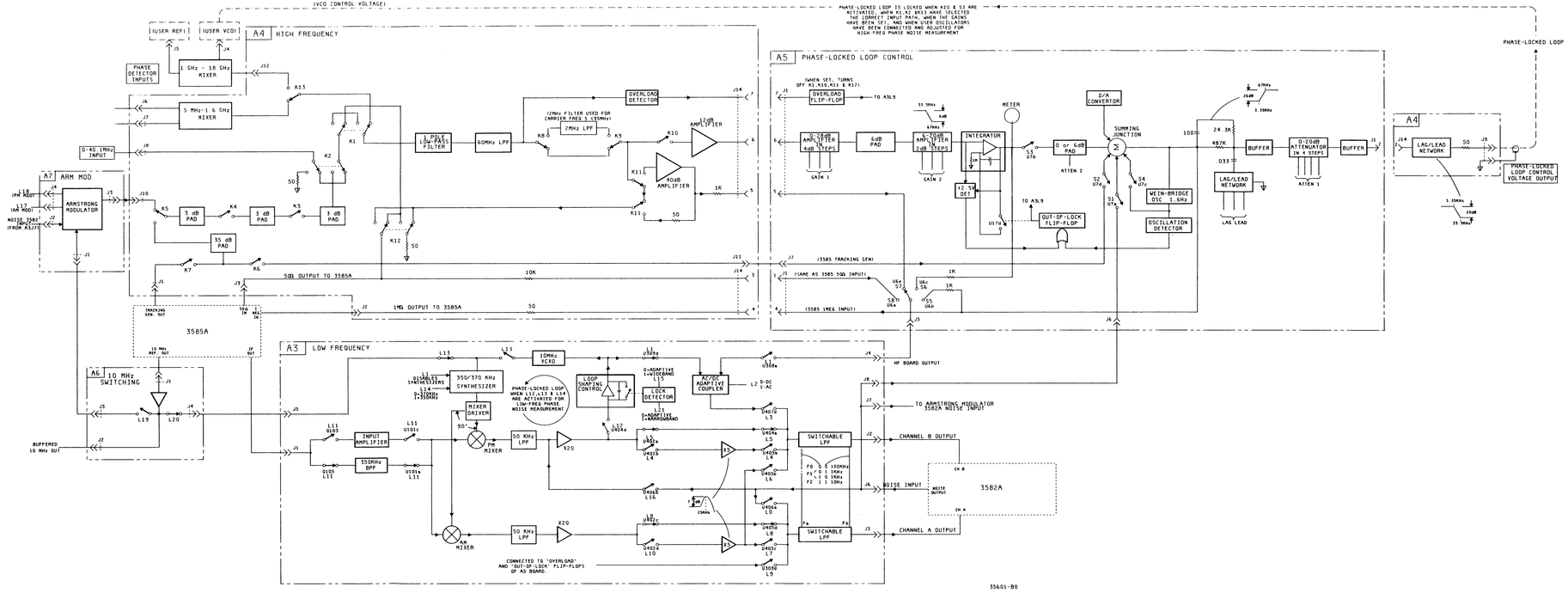
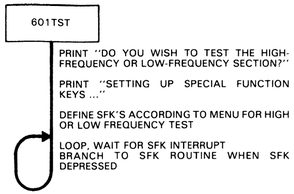


Figure 6-21. -hp- 35601 Spectrum Analyzer Interface Schematic

MAIN PROGRAM: The main program determines if an electronic tool (ET) is part of the system and whether the high or low frequency tests are to be performed. After obtaining the information on which test set to access, the main program defines the special function keys for the test sequences and displays a menu indicating the function of each special function key. After displaying the menu, the main program waits for a special function key to be depressed.



HIGH FREQUENCY MENU

YOU MAY SELECT FROM THE FOLLOWING MENU ... THE TESTS SHOULD BE PERFORMED SEQUENTIALLY IF YOU ARE SETTING UP THE HIGH-FREQUENCY SECTION FOR THE FIRST TIME

TERMINATE THE 3585 (50-OHM) CONNECTOR ON THE 35601A FOR ALL HIGH-FREQUENCY TESTS

SFK #0 : PERFORM TESTS AUTOMATICALLY (SEQUENTIALLY) . . . . . .
SFK #1 : Test Bypass Path . . . . . TEST #1
SFK #2 : Test 2MHz Low-pass Filter . . . . . TEST #2
SFK #3 : Test/Align x100 Amplifier . . . . . TEST #3
SFK #4 : Test Pads in Tracking Generator Input Path . . . . . TEST #4
SFK #5 : Test/Adjust Adaptive Coupler . . . . . TEST #5
SFK #6 : Test D/A Converter . . . . . TEST #6
SFK #7 : Test Output Attenuator . . . . . TEST #7
SFK #8 : Test Wein-bridge Oscillator . . . . . TEST #8
SFK #9 : Test 3582 Noise Source Input to Summing Jct . . . . . TEST #9
SFK #10: Test Tracking Generator Input to Summing Jct . . . . . TEST #10
SFK #11: Test Output Path to 3582-3585 . . . . . TEST #11
SFK #12: Test Programmable Gains . . . . . TEST #12
SFK #13: Test 1.5 GHz Mixer DC Offset (requires hookup) . . . . . TEST #13
SFK #15: RE-START TEST PROGRAM . . . YOU MAY CHOOSE TO TEST EITHER SECTION
<SHIFT> SFK#11: Manual Switch Routine . . . . . SWITCH

HIGH FREQUENCY MENU SFK INTERRUPT

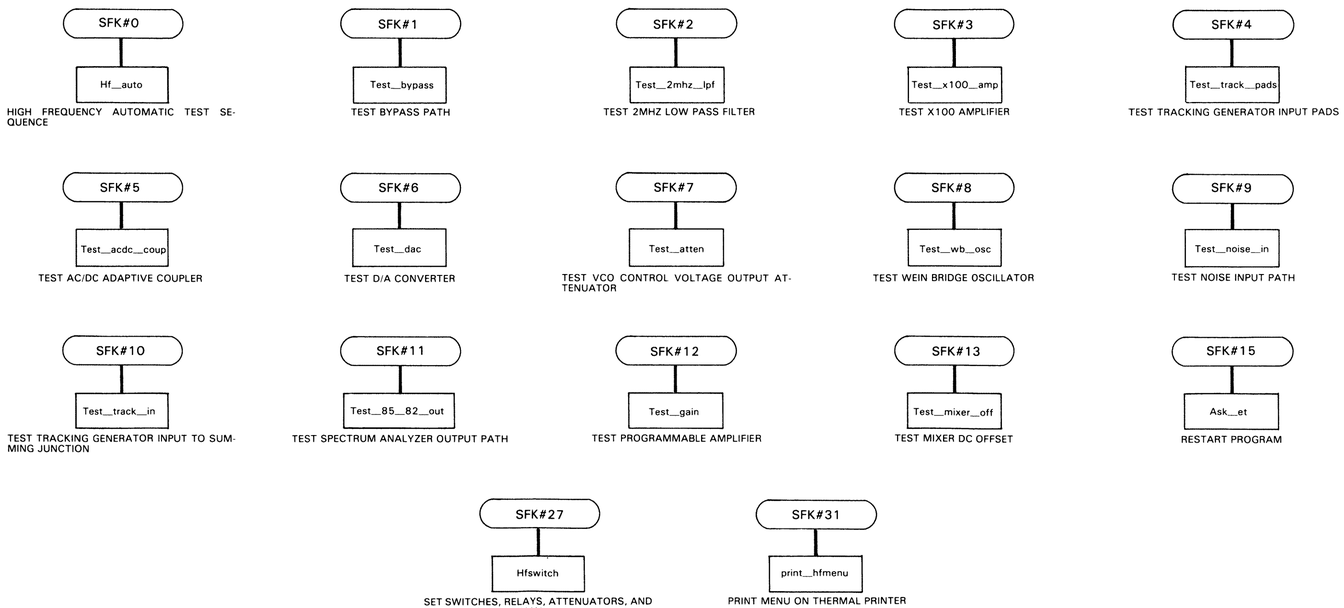


Figure 6-22. Index to 601TST High Frequency Special Function Key Routines

HF__AUTO (SFK #0): The Hf__auto routine automatically sequences through the available high frequency test routines. Hf__auto calls the Test__bypass, Test__2mhz__lpf, Test__x100__amp, Test__track__pads, Test__acdc__coup, Test__dac, Test__atten, Test__wb__osc, Test__noise__in, Test__track__in, Test__85__82__out, Test__gain, and Test__mixer__off routines. These routines are detailed in the following illustrations. Hf__auto returns control to the main menu after completion of these routines.

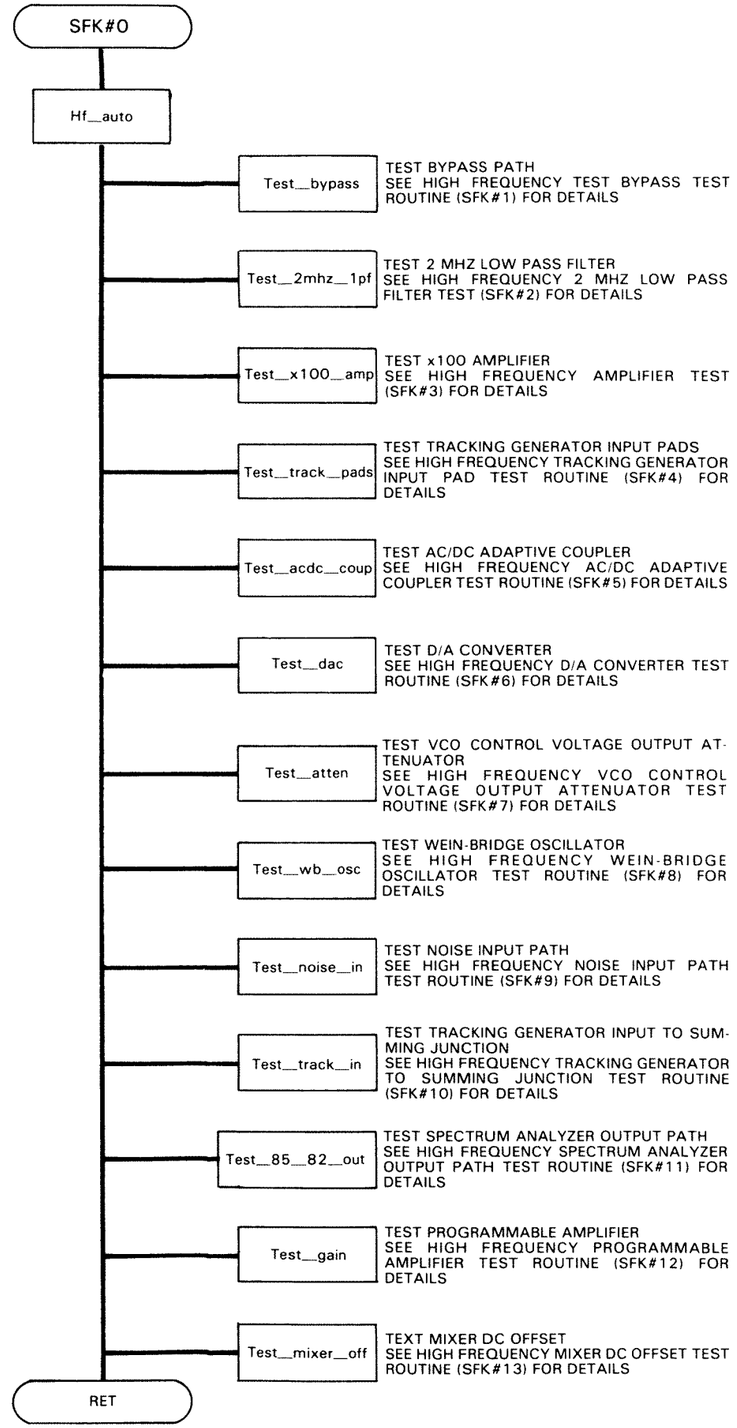


Figure 6-23. High Frequency Automatic Test Routine (SFK#0)

TEST__BYPASS (SFK #1): The Test__bypass routine checks the continuity of the direct input signal path to the -hp- 3585A 50Ω output port. Setup__interface is used to configure the -hp- 35601A. The Toggle routine is used to toggle the flip-flops contained in the -hp- 35601A.

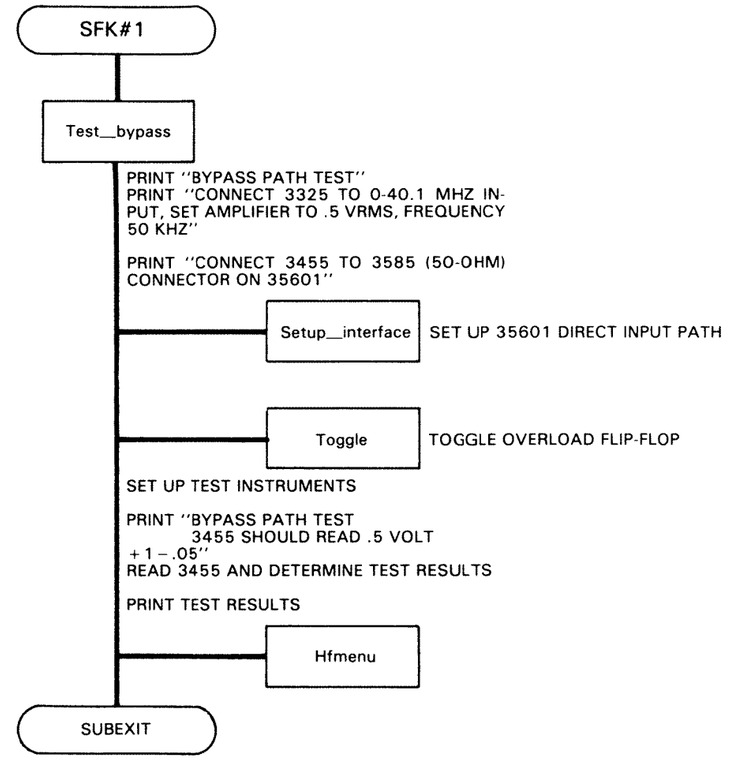


Figure 6-24. High Frequency Bypass Test Routine (SFK#1)

TEST__2MHZ__LPF (SFK #2): The Test__2mhz__lpf routine checks the circuit to the -hp- 3585A 50Ω output port through and around the 2 MHz low pass filter. The circuit checked includes the elements for the one pole low pass filter and the 60 MHz low pass filter. Setup__interface is used to configure the -hp- 35601A. The Toggle routine is used to toggle the flip-flops contained in the -hp- 35601A.

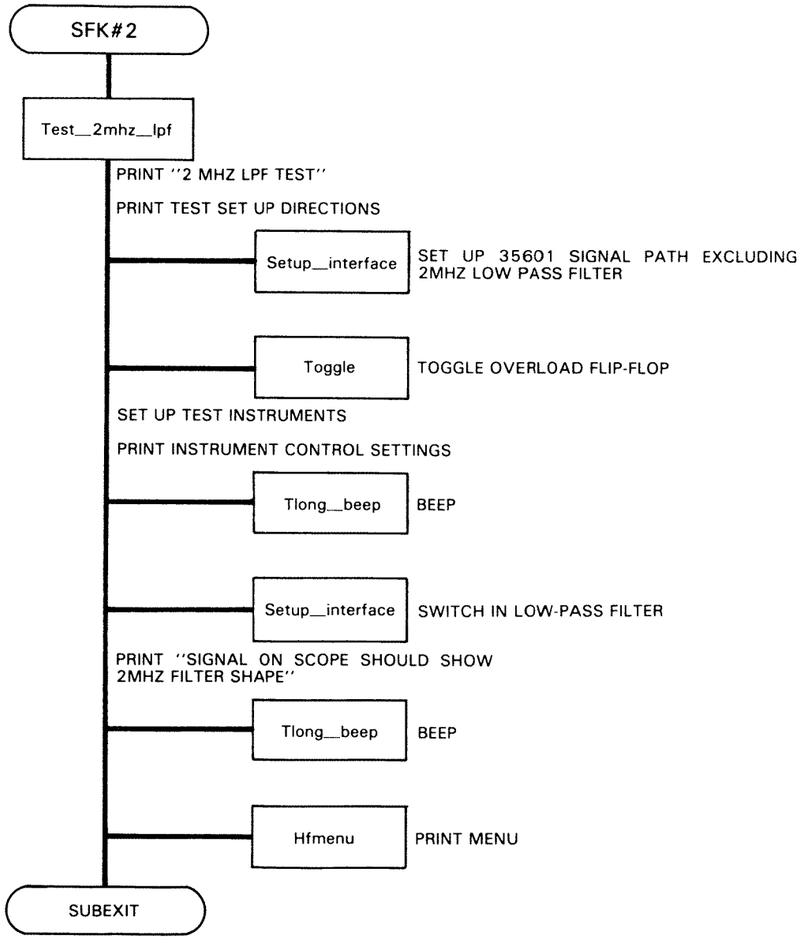


Figure 6-25. High Frequency 2MHz Low Pass Filter Test Routine (SFK#2)

TEST__X100__AMP (SFK #3): The Test__x100__amp routine checks the circuit to the -hp- 3585A 50Ω output port through the x100 (40 dB) amplifier. The circuit path tested includes the elements for the one pole low pass filter and the 60 MHz low pass filter. Setup__interface is used to configure the -hp- 35601A. The Toggle routine is used to toggle the flip-flops contained in the -hp- 35601A.

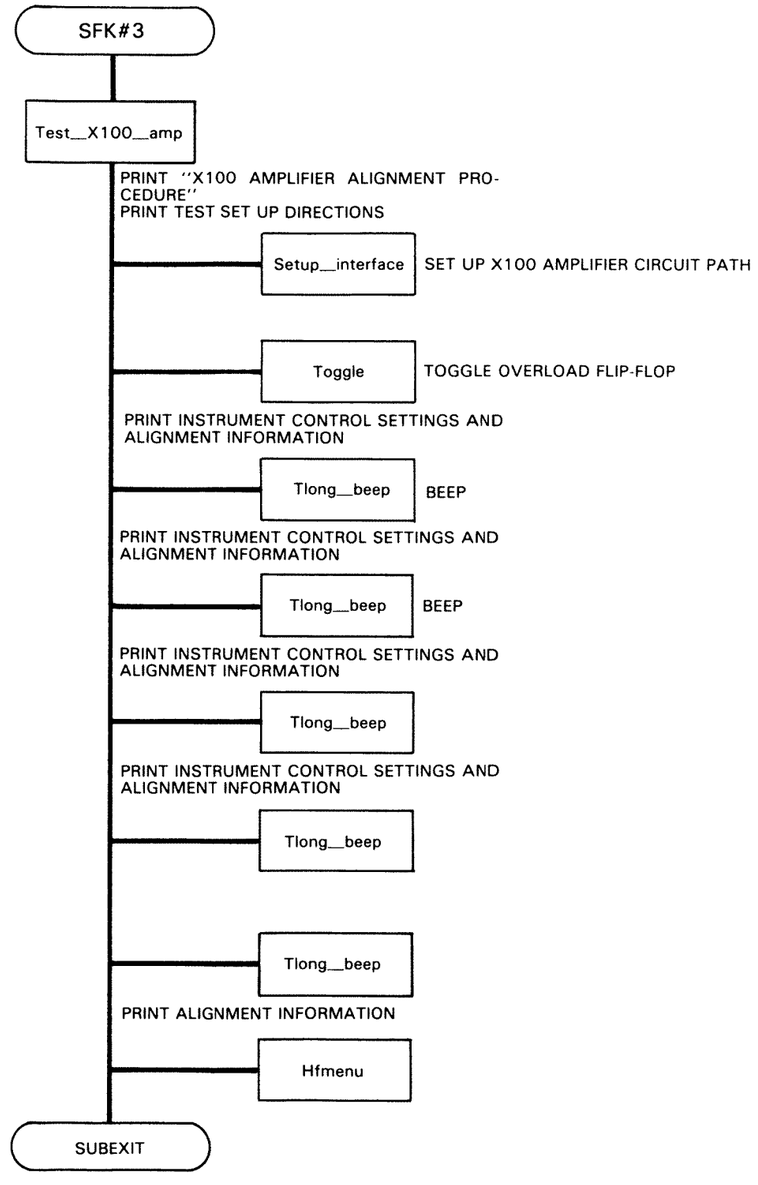


Figure 6-26. High Frequency Amplifier Test Routine (SFK#3)

TEST__TRACK__PADS (SFK #4): The Test__track__pads routine checks the circuit from the -hp- 3585A tracking generator port to the -hp- 3585A 50Ω output port through the -hp- 35601A tracking generator attenuators (pads). The circuit includes the elements for the one pole low pass filter and 60 MHz low pass filter. Setup__interface is used to configure the -hp- 35601A. The Toggle routine is used to toggle the flip-flops contained in the -hp- 35601A.

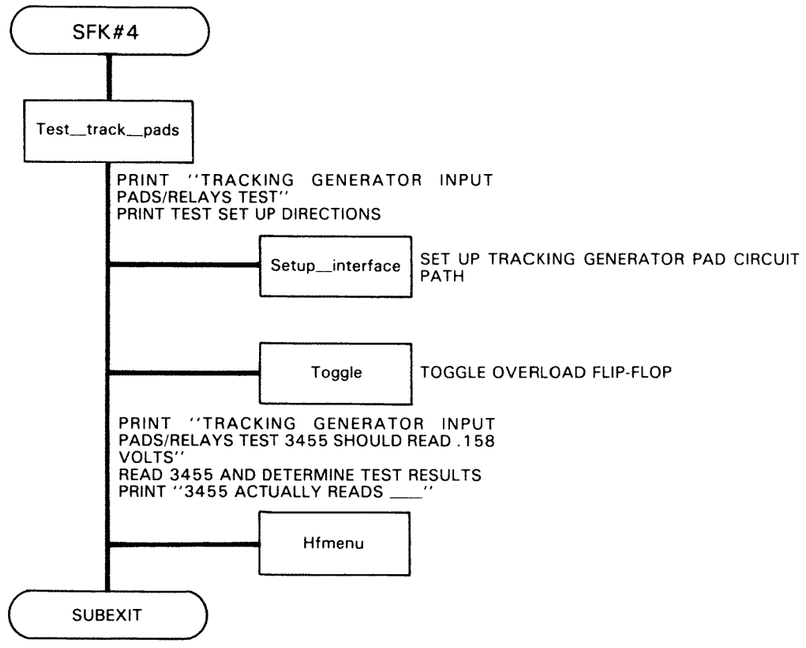


Figure 6-27. High Frequency Tracking Generator Input Pad Test Routine (SFK#4)

TEST__ACDC__COUPLER (SFK #5): The Test__acdc__coupler routine checks the circuit from 0-40.1 MHz input to the -hp- 3582A channel B output port. The circuit path tested includes the AC/DC adaptive coupler and, for channel B, the switchable low pass filter. Setup__interface is used to configure the -hp- 35601A.

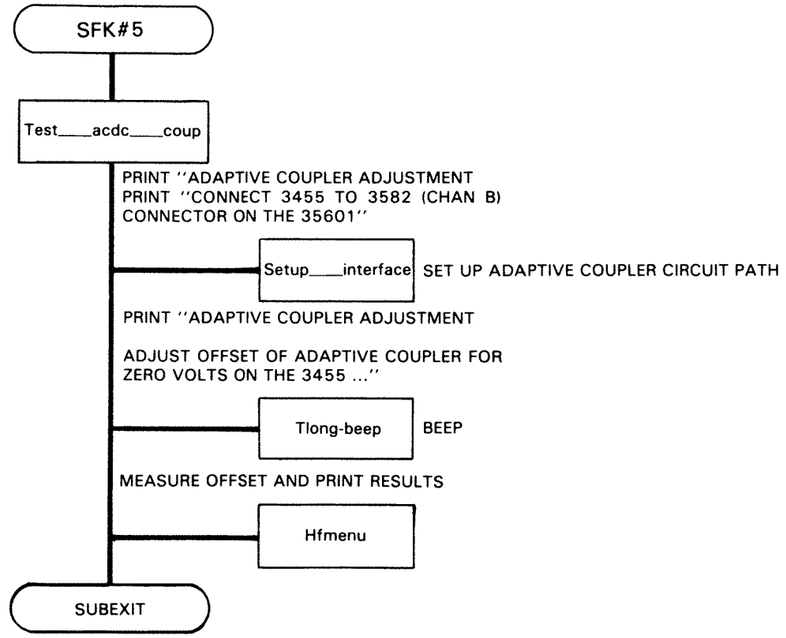


Figure 6-28. High Frequency AC/DC Adaptive Coupler Test Routine (SFK#5)

TEST__DAC (SFK #6): The Test__dac routine checks the circuit from the D/A converter through the summing junction to the 1 MΩ output port for the -hp- 3585A. During the test the D/A converter is stepped and the output is measured. Setup__interface is used to configure the -hp- 35601A and set the D/A converter.

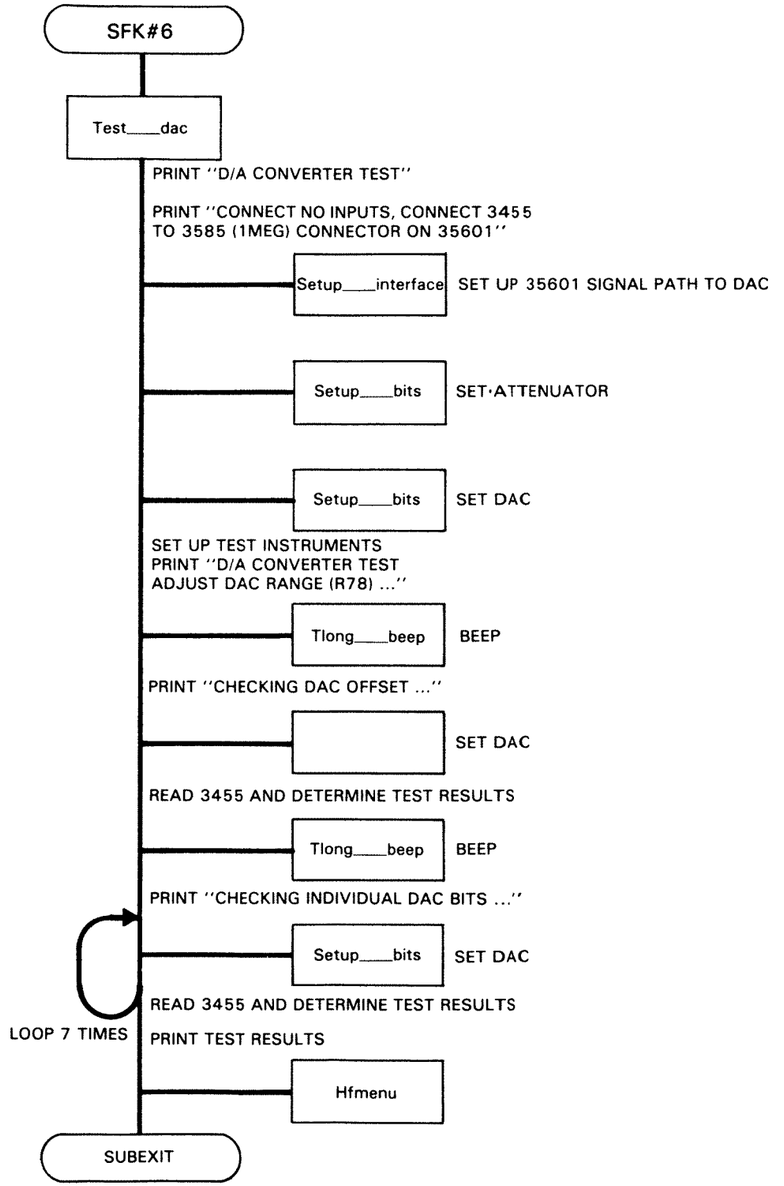


Figure 6-29. High Frequency D/A Converter Test Routine (SFK#6)

TEST__ATTEN (SFK #7): The Test__atten routine checks the output attenuator in the circuit from the D/A convertor to the phase-locked-loop control voltage output port. Two buffers are included in the circuit tested. During the test the D/A converter is used a reference voltage and the output port is monitored as the attenuator is stepped through its ranges. Setup__interface is used to configure the -hp- 35601A. Setup__bits is used to set the D/A converter and attenuator.

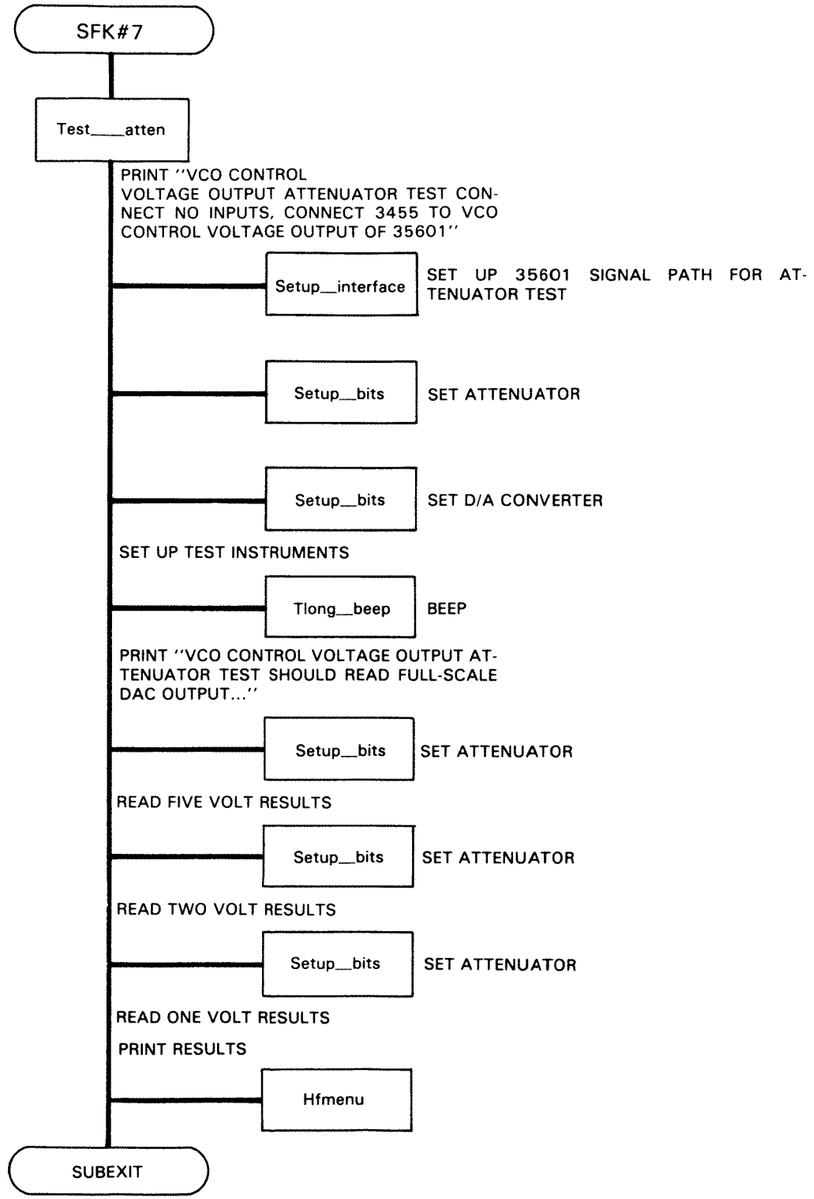


Figure 6-30. High Frequency VCO Control Voltage Output Attenuator Test Routine (SFK#7)

TEST__WB__OSC (SFK #8): The Test__wb__osc routine checks Wein-bridge oscillator. The elements included in the circuit from the Wein-bridge oscillator to the phase-locked-loop control voltage output port include the summing junction, buffers, output attenuator, and lag-lead network. During the test, the output of the oscillator is monitored with an external voltmeter. Setup__interface is used to configure the -hp- 35601A. Setup__bits is used to set the D/A converter and attenuator.

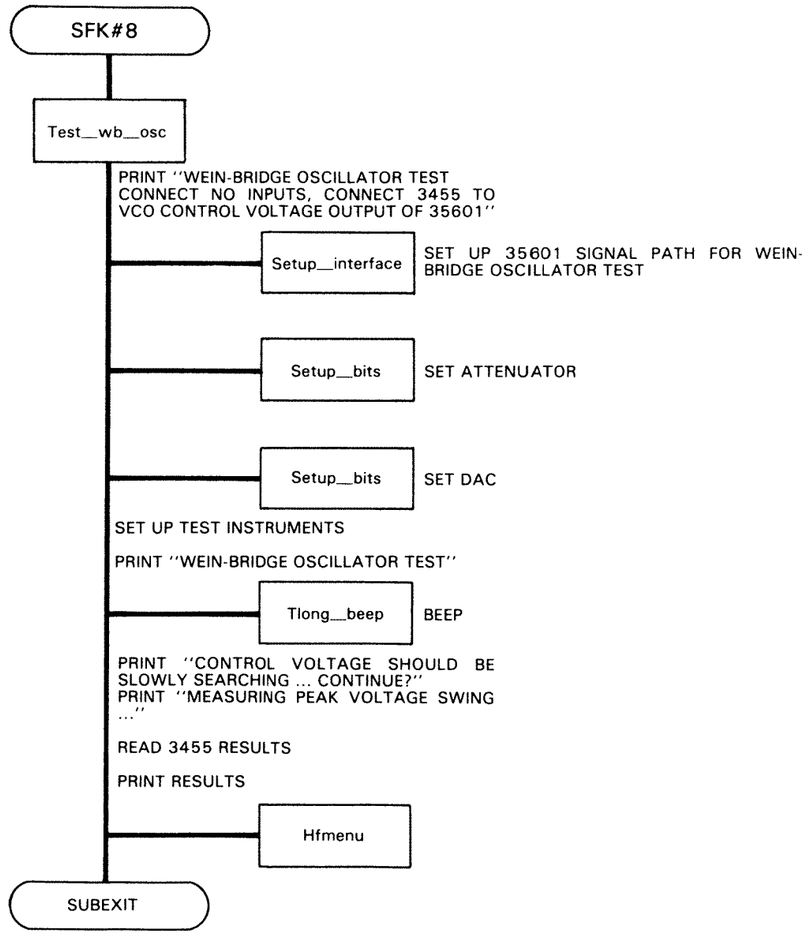


Figure 6-31. High Frequency Wein-Bridge Oscillator Test Routine (SFK#8)

TEST__NOISE__IN (SFK #9): The Test__noise__in routine checks the circuit from the -hp- 3582A noise input port through the summing junction to the -hp- 3585A 1 MΩ output port. A signal is applied to the noise port and measured at the -hp- 3585A input port. Setup__interface is used to configure the -hp- 35601A. Setup__bits is used to reset the D/A converter and attenuator.

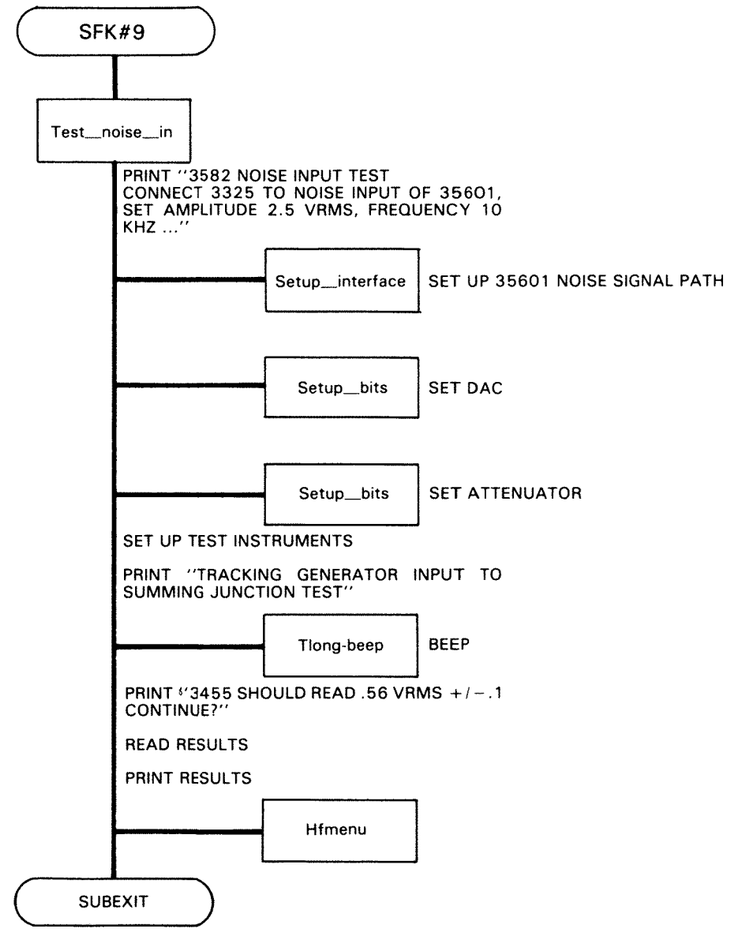


Figure 6-32. High Frequency Noise Path Test Routine (SFk#9)

TEST__TRACK__IN (SFK #10): The Test__track__in routine checks the circuit from the -hp- 3585A tracking generator input port through the summing junction to the -hp- 3585A 1 MΩ output port. A signal is applied to the tracking generator port and measured at the -hp- 3585A output port. Setup__interface is used to configure the -hp- 35601A. Setup__bits is used to reset the D/A converter and attenuator.

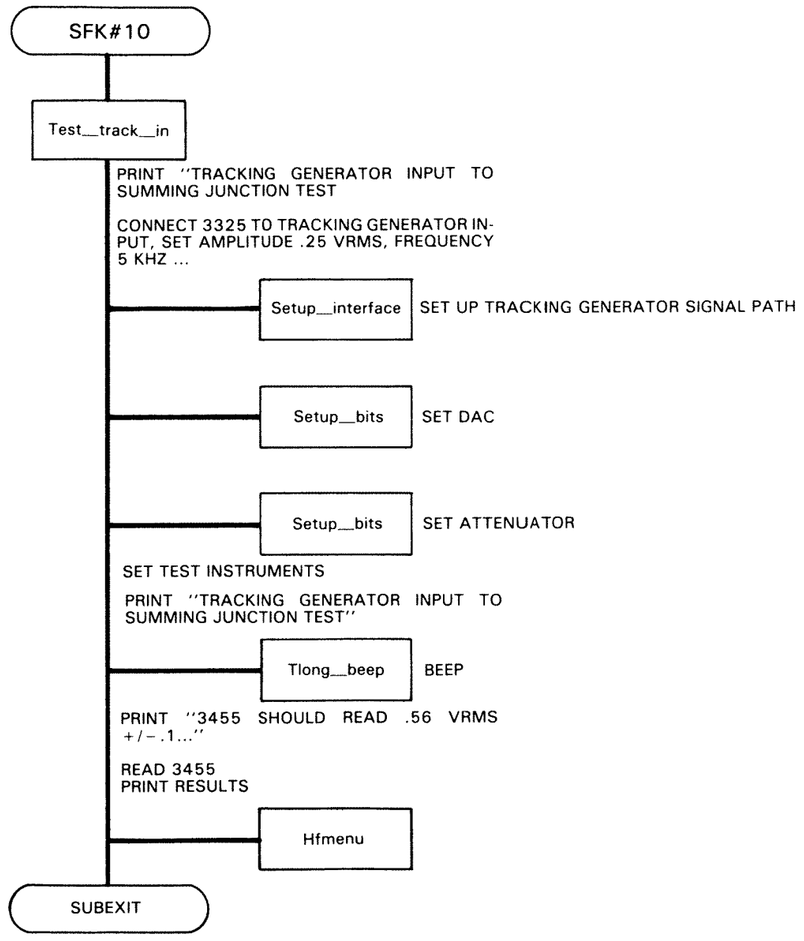


Figure 6-33. High Frequency Tracking Generator To Summing Junction Test Routine (SFK#10)

TEST__85__82__OUT (SFK #11): The Test__85__82__out routine checks the circuit from the D/A converter to the -hp- 3585A 1 MΩ output port and from the D/A converter to the -hp- 3582A channel B output port. Each of these circuits include the summing junction. The circuit to the -hp- 3582A channel B output port includes the AC/DC adaptive coupler and switchable low pass filter. The output of the D/A convertor is monitored at the spectrum analyzer output ports with a voltmeter. Setup__interface is used to configure the -hp- 35601A. Setup__bits is used to set the D/A converter.

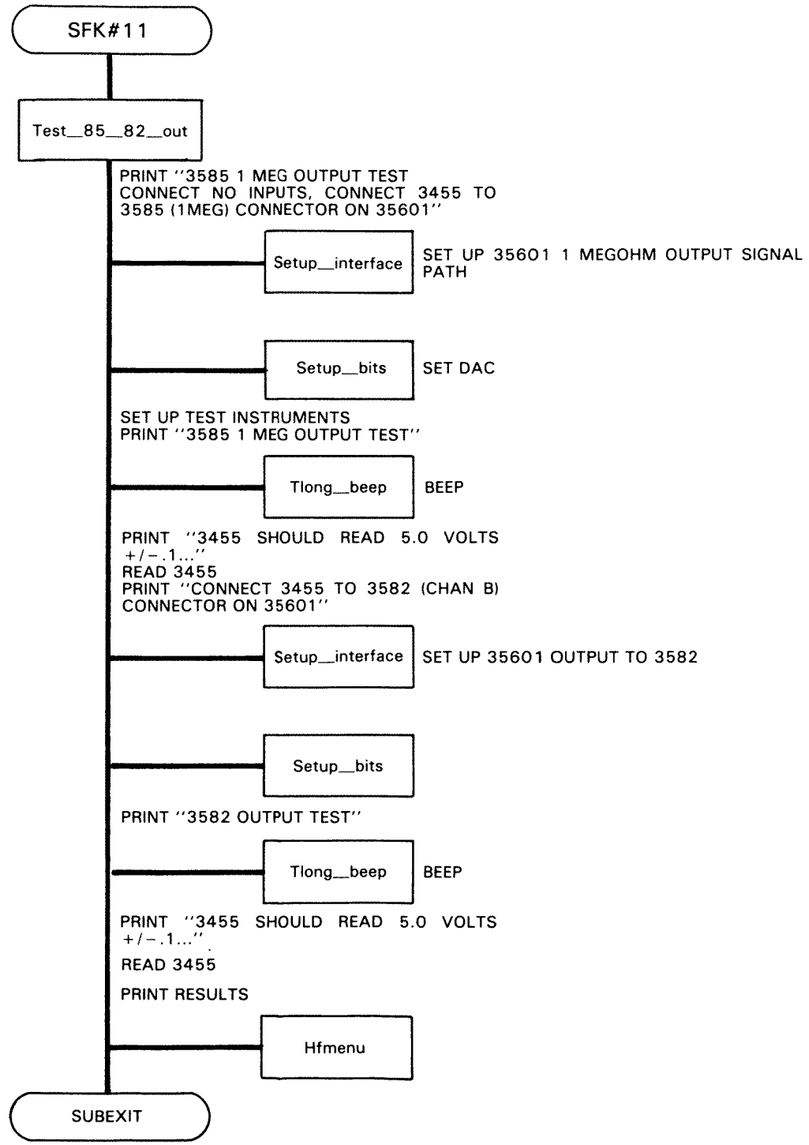


Figure 6-34. High Frequency Spectrum Analyzer Output Path Test Routine (SFK#11)

TEST__GAIN (SFK #12): The Test__gain routine checks the circuit from the 0-40.1 MHz input to the -hp- 3585A 1 MΩ output port. The circuit includes the 60 Mhz low pass filter, one pole low pass filter, and the circuit elements from the 12 dB amplifier through the summing junction. During the test, a signal is injected into the input port and measured at -hp- 3585A output port. The amplifiers and attenuators are stepped and the output response to the input is monitored. Setup__interface is used to configure the -hp- 35601A. Setup__bits is used to set the D/A converter, attenuator, and amplifier levels. The Toggle routine is used to toggle the flip-flops contained in the -hp- 35601A. The routine Chk__ol__ool checks for overloads and sets overload flags if an overload is sensed. The interface unit is reconfigured during the check for overloads so Chk__ol__ool calls the Save__switch and Restore__switch routines to save and restore the interface unit switch configuration so the interface unit can be tested.

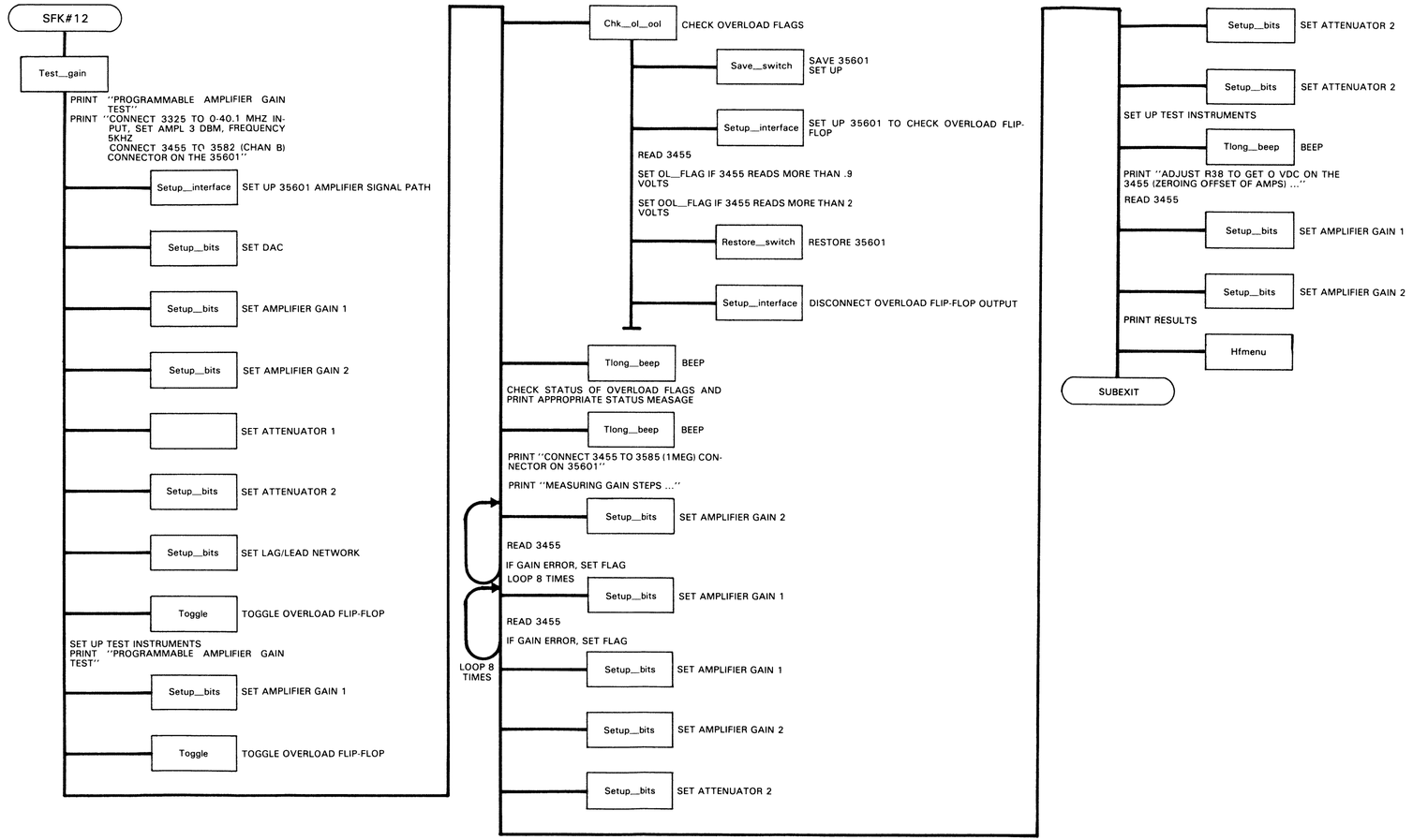


Figure 6-35. High Frequency Programmable Amplifier Test Routine (SFK#12)

TEST__MIXER__OFF (SFK #13): The Test__mixer__off routine checks the 5 MHz-1.6 GHz mixer DC offset. The circuit used in the test includes 5 MHz - 1.6 GHz mixer, one pole low pass filter, and 60 MHz low pass filter. The signal output is checked at the -hp- 3585A 50 Ω output port. Setup__interface is used to configure the -hp- 35601A.

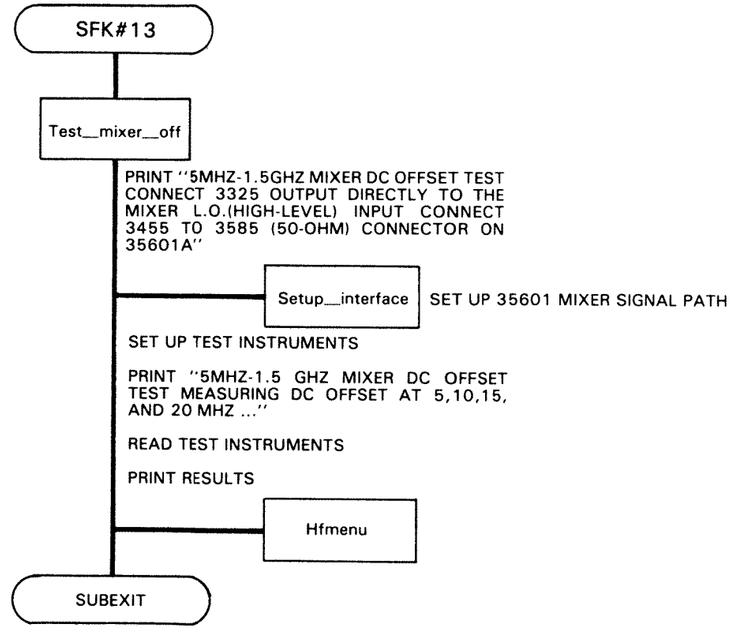


Figure 6-36. High Frequency Mixer DC Offset Test Routine (SFK#13)

HFSWITCH (SFK #27 or <SHIFT> SFK #11): The Hfswitch routine is used to call the switch routine. Switch provides control of the programmable switches, relays, gains, offsets, filters, and attenuators within the -hp- 35601 Spectrum Analyzer Interface. For operation of switch refer to the -hp- 35601A operating and service manual.

PRINT_HFMENU (SFK #31 OR <SHIFT> SFK #15): The Print_hfmenu prints a copy of the high frequency test section on the computer thermal printer.

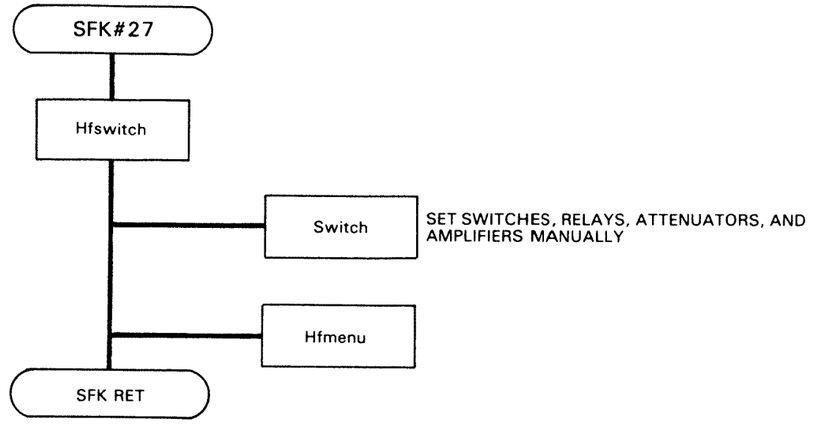
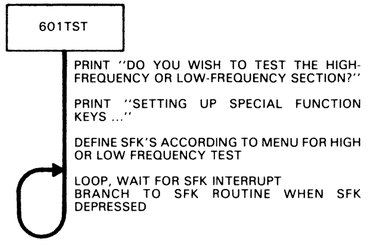


Figure 6-37. High Frequency Switch Routines and Print Menu (SFK#27, 31)

The preceding illustrations detail the subroutines accessed from the high frequency menu. The following illustrations detail the subroutines accessed from the low frequency menu.

MAIN PROGRAM: The main program determines if an electronic tool (ET) is part of the system and whether the high or low frequency tests are to be performed. After obtaining the information on which test set to access, the main program defines the special function keys for the test sequences and displays a menu indicating the function of each special function key. After displaying the menu, the main program waits for a special function key to be depressed.



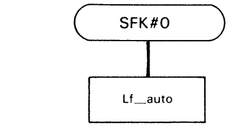
LOW FREQUENCY MENU

YOU MAY SELECT FROM THE FOLLOWING MENU . . . THE TESTS SHOULD BE PERFORMED SEQUENTIALLY IF YOU ARE SETTING UP THE LOW-FREQUENCY SECTION FOR THE FIRST TIME

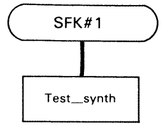
REFER TO THE BLOCK DIAGRAMS TO DETERMINE THE SIGNAL PATH USED IN EACH TEST

SFK #0 : PERFORM TESTS AUTOMAICALLY (SEQUENTIALLY) . . . . . .
SFK #1 : Test 350/370 KHz Synthesizer . . . . . TEST #1
SFK #2 : Test/Adjust VCx0 . . . . . TEST #2
SFK #3 : Test/Adjust 350 KHz Band-pass Filters . . . . . TEST #3
SFK #4 : Test x20, x5, and Peaking Amps . . . . . TEST #4
SFK #5 : Test Switchable Filters . . . . . TEST #5
SFK #6 : Test HPIB Board with Signature Analyzer . . . . . TEST #6
SFK #15: RE-START TEST PROGRAM . . . YOU MAY CHOOSE TO TEST EITHER SECTION
<SHIFT>SFK #11: Manual Switch Routine . . . . . .SWITCH

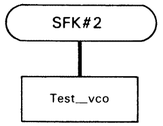
LOW FREQUENCY MENU SFK INTERRUPT



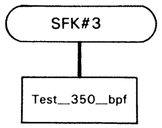
LOW FREQUENCY AUTOMATIC TEST SEQUENCE



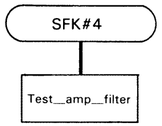
TEST FREQUENCY SYNTHESIZER



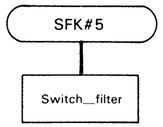
TEST VCO



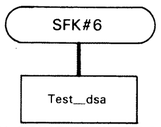
TEST 350 HZ BAND PASS FILTER



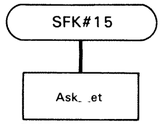
TEST LOW FREQUENCY AMPLIFIERS



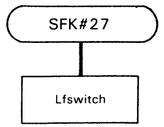
TEST SWITCHABLE FILTER



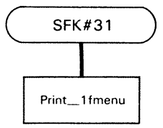
DIGITAL SIGNATURE ANALYSIS TEST



RESTART PROGRAM



SET SWITCHES, RELAYS, ATTENUATORS, AND AMPLIFIERS MANUALLY



PRINT MENU ON THERMAL PRINTER

Figure 6-38. Index to 601TST Low Frequency Special Function Key Routines
6-87/6-88

LF__AUTO (SFK #0): The Lf__auto routine automatically sequences through the available low frequency test routines. Lf__auto calls the following routines: Test__synth, Test__vco, Test__350__bpf, Test__amp__filter, and Switch__filter. These routines are detailed in the illustrations. Lf__auto returns control to the main program after completion of all the test routines.

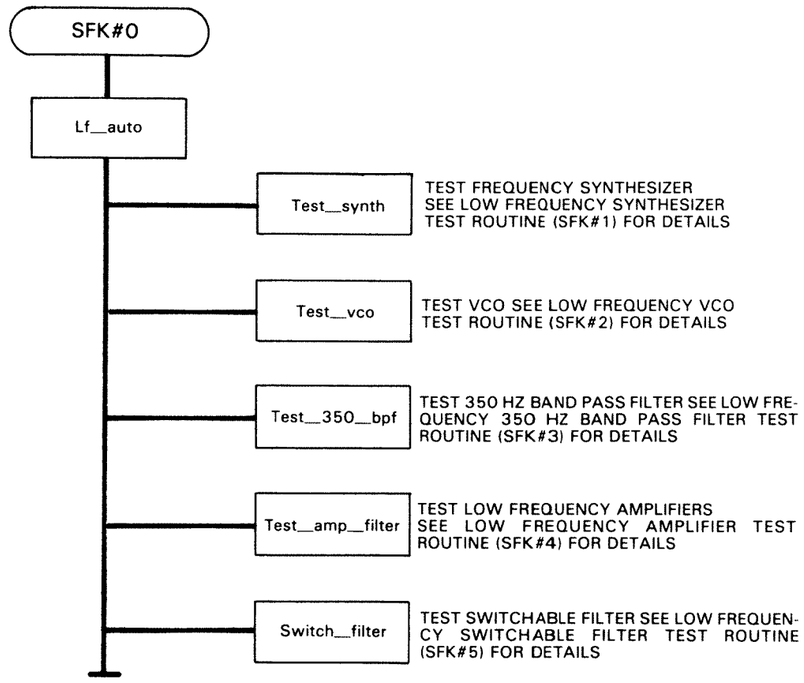


Figure 6-39. Low Frequency Automatic Test Routine (SFK#0)

TEST_SYNTH (SFK #1): The Test_synth routine checks the -hp- 35601A internal 350/370 kHz synthesizer. The -hp- 3585A 10 MHz reference input port and the IF input port are used for the signal input ports. The -hp- 3582A channel B output port is used as the signal output port to the counter. The components in the test circuit include the 350/370 kHz synthesizer, mixer driver, 350 kHz bandbass filter, PM mixer, 50 kHz low pass filter, x20 amplifier, and switchable low pass filter. Setup_interface is used to configure the -hp- 35601A circuit.

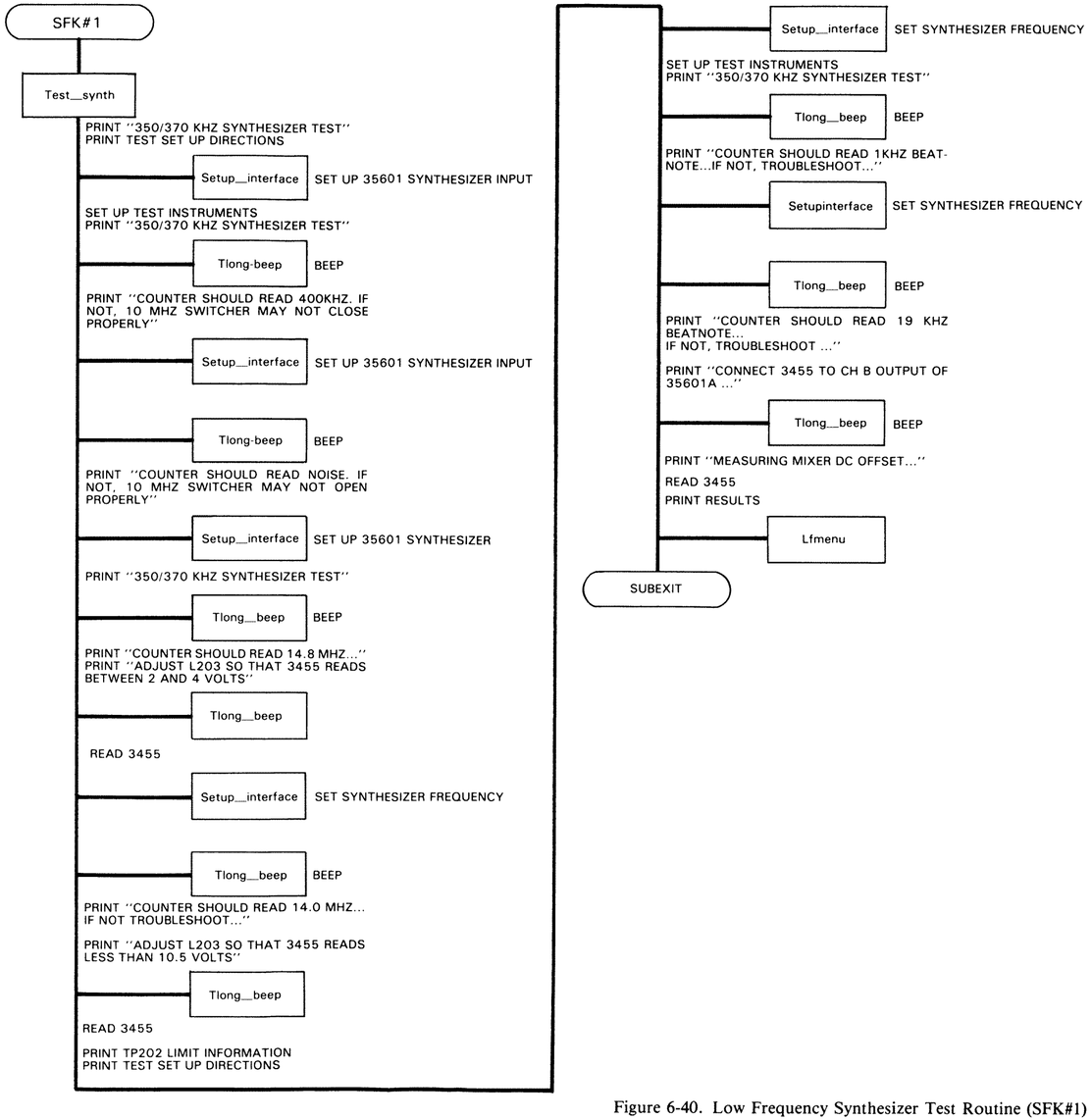


Figure 6-40. Low Frequency Synthesizer Test Routine (SFK#1)

TEST__VCO (SFK #2): The Test__vco routine tests the -hp- 35601A voltage controlled crystal oscillator, loop shaping control circuit, and lock detector. The circuit involved in the test includes the input amplifier, elements in the PM phase-locked-loop, AC/DC adaptive coupler, and switchable low pass filter. The test signal is injected into the -hp- 3585A IF input port and monitored at the -hp- 3582A channel B output port with a counter. Setup__interface is used to configure the -hp- 35601A circuit and set the synthesizer frequency.

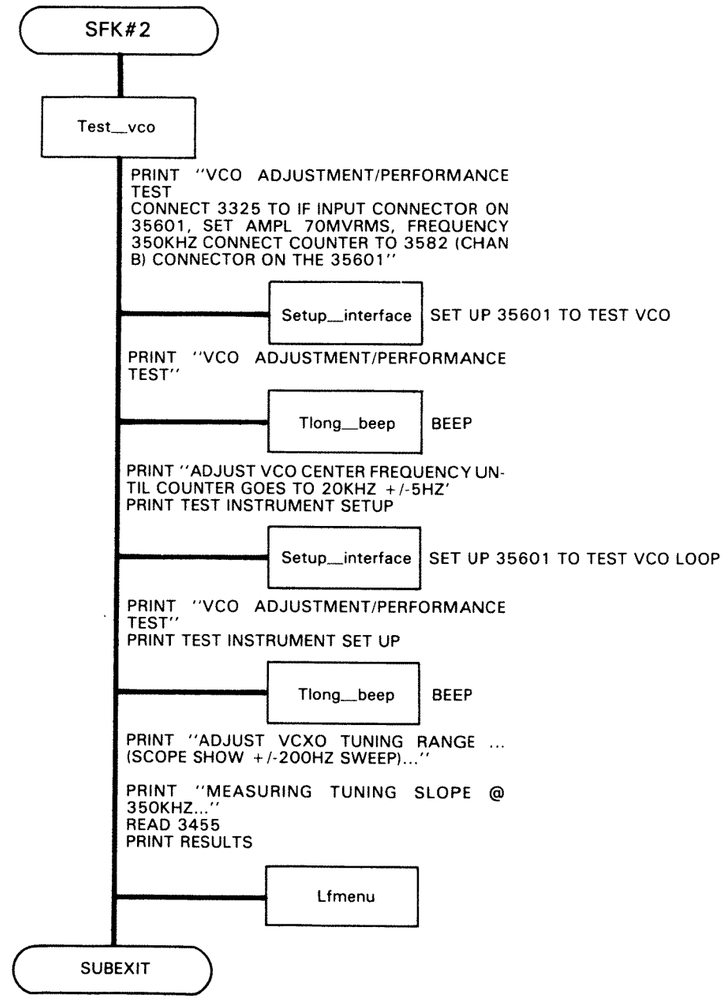


Figure 6-41. Low Frequency VCO Test Routine (SFK#2)

TEST_350_BPF (SFK #3): The Test_350_bpf tests the -hp- 35601A 350 Khz band pass filter. The -hp- 3585A 10 MHz reference input port and the IF input port are used for the signal input ports. The -hp- 3582A channel B output port is used as the signal output port for measurements. The components in the test circuit include the 350/370 kHz synthesizer, mixer driver, 350 kHz bandpass filter, PM mixer, 50 kHz low pass filter, x20 amplifier, and switchable low pass filter. Setup_interface is used to configure the -hp- 35601A circuit. The routine Peak is used to measure filter peaking. Peak uses the routine Step_freq to step the oscillator and read the voltmeter.

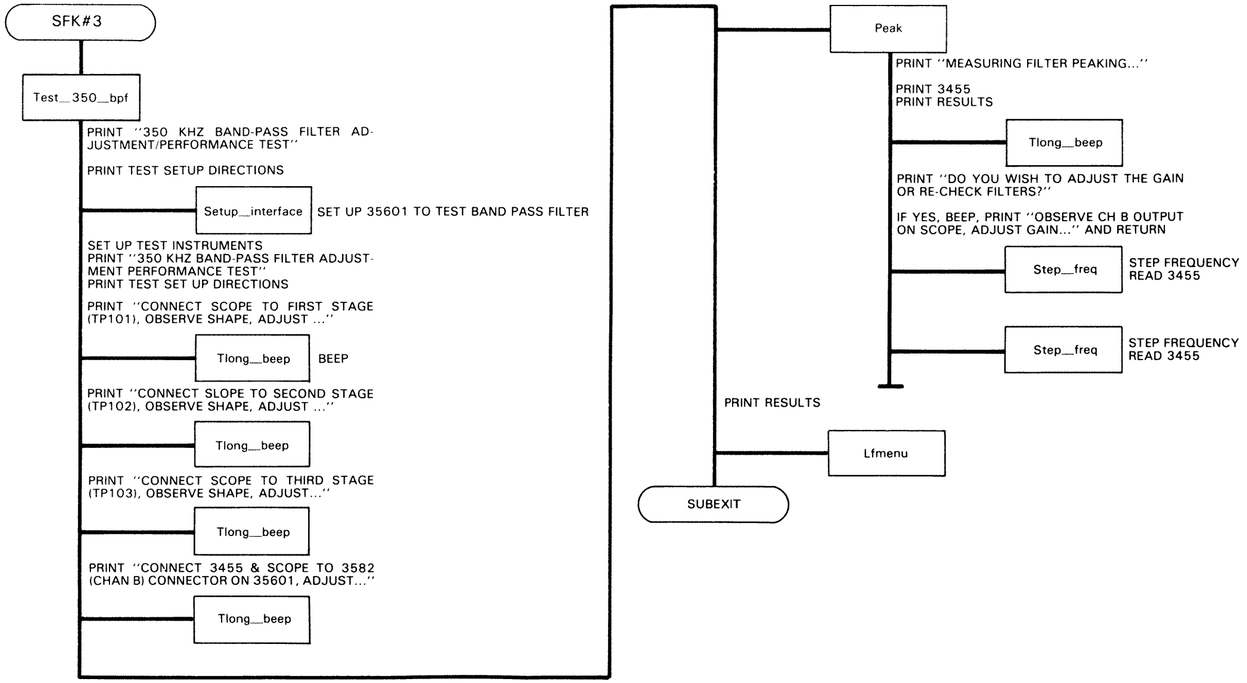


Figure 6-42. Low Frequency 350 Hz Band Pass Filter Test Routine (SFK#3)

TEST_AMP_FILTER (SFK #4): The Test_amp_filter tests the x5 and x20 amplifiers in the circuit between the AM and PM mixer outputs and the -hp- 3582A channel A and B output ports. The -hp- 3585A 10 MHz reference input port and the IF input port are used for the signal input ports. The -hp- 3582A channel A and B output ports are used for the signal measurement ports. The components in the test circuit include the 350/370 kHz synthesizer, mixer drivers, input amplifier, AM mixer, PM mixer, 50 kHz low pass filters, x20 amplifiers, x5 amplifiers, and switchable low pass filters. Setup_interface is used to configure the -hp- 35601A circuit.

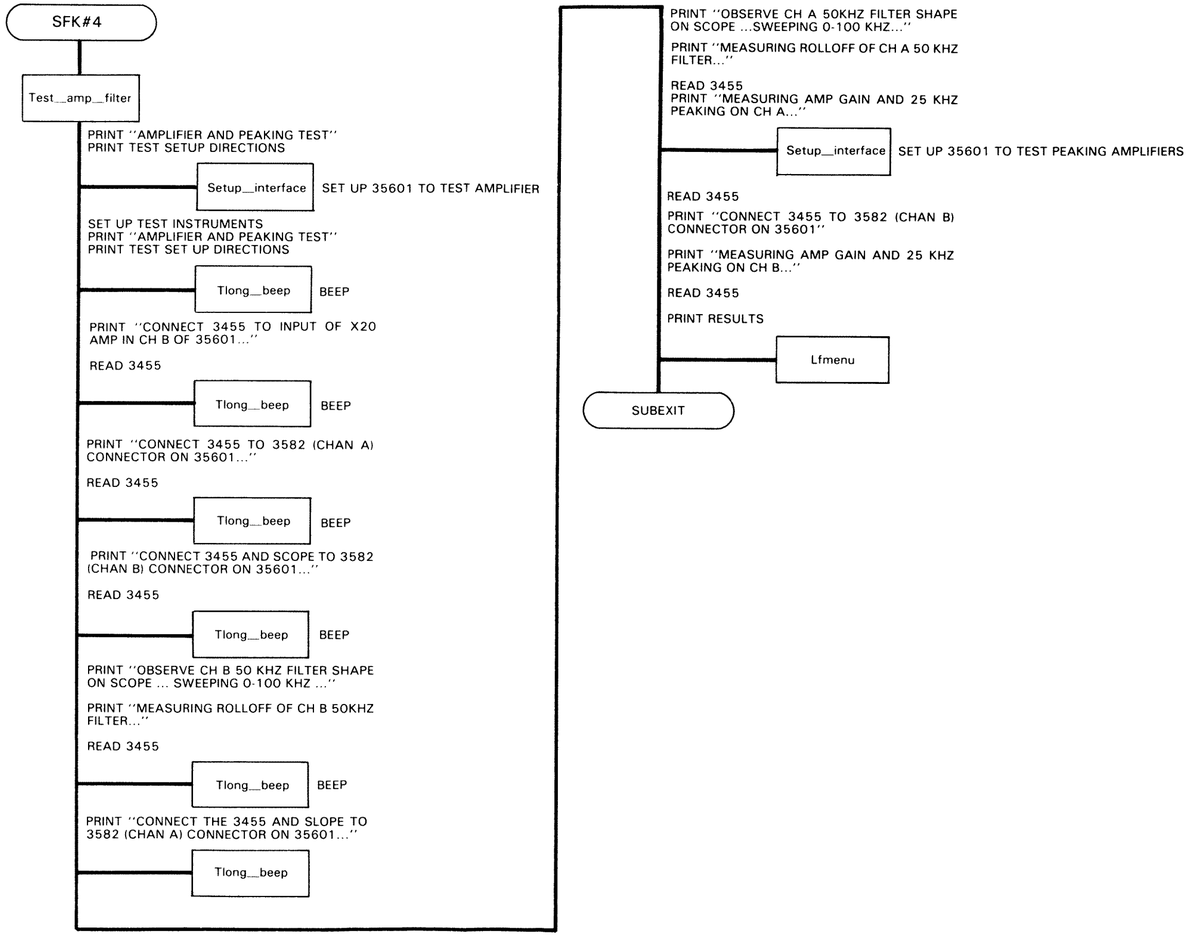


Figure 6-43. Low Frequency Amplifier Test Routine (SFK#4)

SWITCH__FILTER (SFK #5): The Switch__filter routine tests the switchable low pass filters. Signals are injected into the 0-40.1 Mhz input and monitored at the -hp- 3582A channel B output port and into the -hp- 3582A noise input port and monitored at the -hp- 3582A channel A output port. The elements in the circuits include the switchable low pass filter and AC/DC adaptive coupler (for the -hp- 3482A channel B circuit). Setup__interface is used to configure the -hp- 35601A circuit and set the switchable low pass filters.

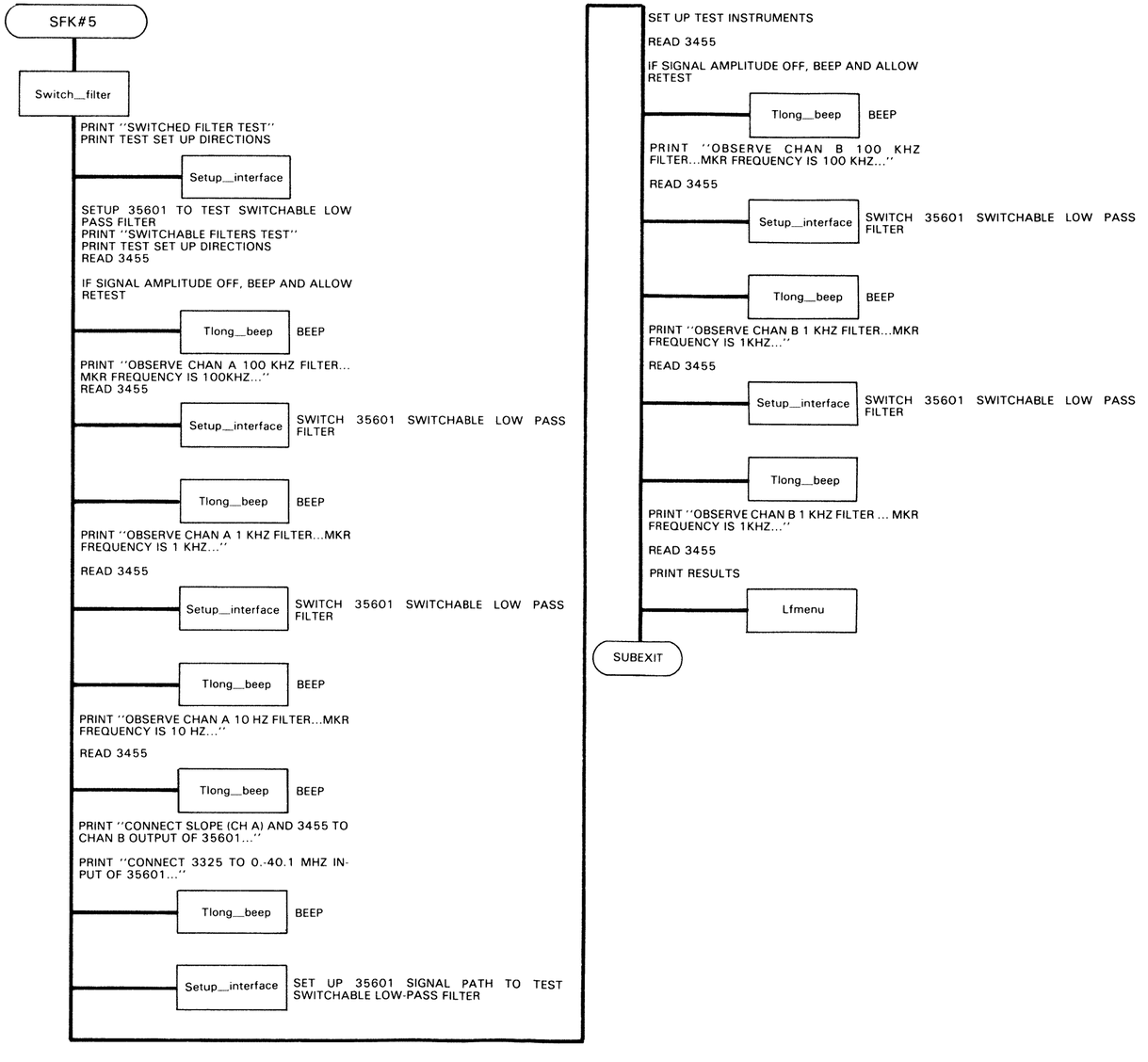
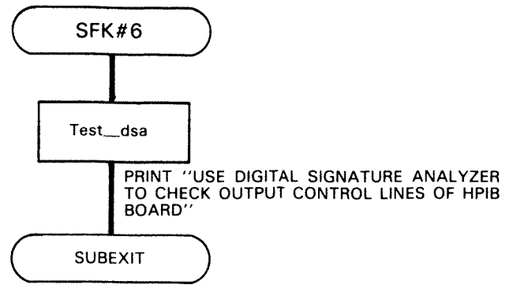


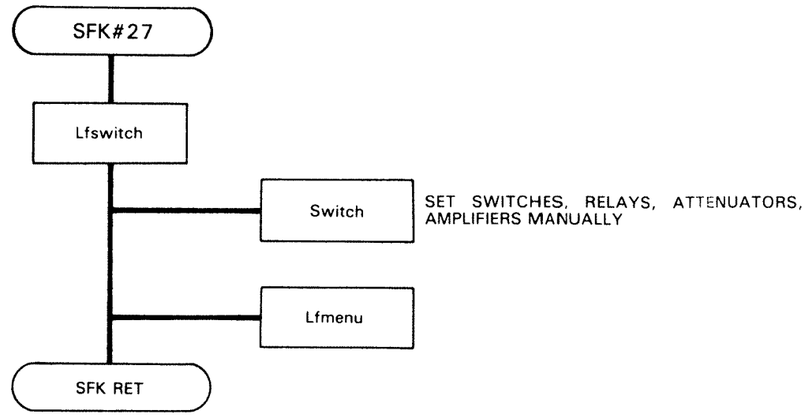
Figure 6-44. Low Frequency Switchable Filter Test Routine (SFK#5)

TEST__DSA (SFK #6): The Test__dsa routine checks the operation of the HP-IB interface board using digital signature analysis. Predictable signatures are generated at various points in the circuit if the circuit is working properly.

LFSWITCH (SFK #27 or <SHIFT> SFK #11): The Lfswitch routine is used to call the switch routine. Switch provides control of the programmable switches, relays, gains, offsets, filters, and attenuators within the -hp- 35601 Spectrum Analyzer Interface. For operation of switch refer to the -hp- 35601A operating and service manual.

PRINT__LFMENU (SFK #31 OR <SHIFT> SFK #15): The Print__lfmenu prints a copy of the low frequency test options on the computer thermal printer.





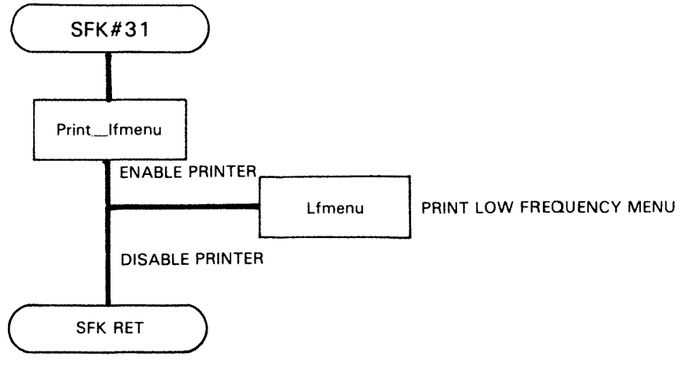


Figure 6-45. Low Frequency Digital Signature Analysis, Switch, and Print Menu Routines (SFK#6, 27, 31)

SECTION 7
SYSTEM PERFORMANCE TESTING

SECTION 7
SYSTEM PERFORMANCE TESTING

7-1. INTRODUCTION

This section contains the procedures for the performance tests which verify that the -hp- 3047A Spectrum Analyzer System will meet its published specifications. A complete Performance Test will take about 5 1/2 hours. If complete performance testing is not required, Operation Verification procedures may be found in the System Operators Manual and the System Installation Manual. The verification test requires much less time to perform, but it does not verify performance to published specifications.

7-2. CALIBRATION CYCLE

The -hp- 3047A Spectrum Analyzer System requires verification of its specified performance every 12 months. The Performance Test procedures found in this manual section should be used when verifying performance specifications. The Operation Verification procedures can be used as part of installation, incoming inspection, or after a repair has been made to one of the component instruments. All instrument in the system should have their fan filter screens cleaned monthly to ensure proper system and instrument cooling.

7-3. PERFORMANCE TEST RECORD

A Performance Test Record card is provided at the end of this section for your convenience to record the performance of the -hp- 3047A during performance testing. This card can be removed from the manual and used as a permanent record of the incoming inspection or of a routine performance testing. The Performance Test Record card may be reproduced without the written permission of Hewlett-Packard.

7-4. RECOMMENDED TEST EQUIPMENT

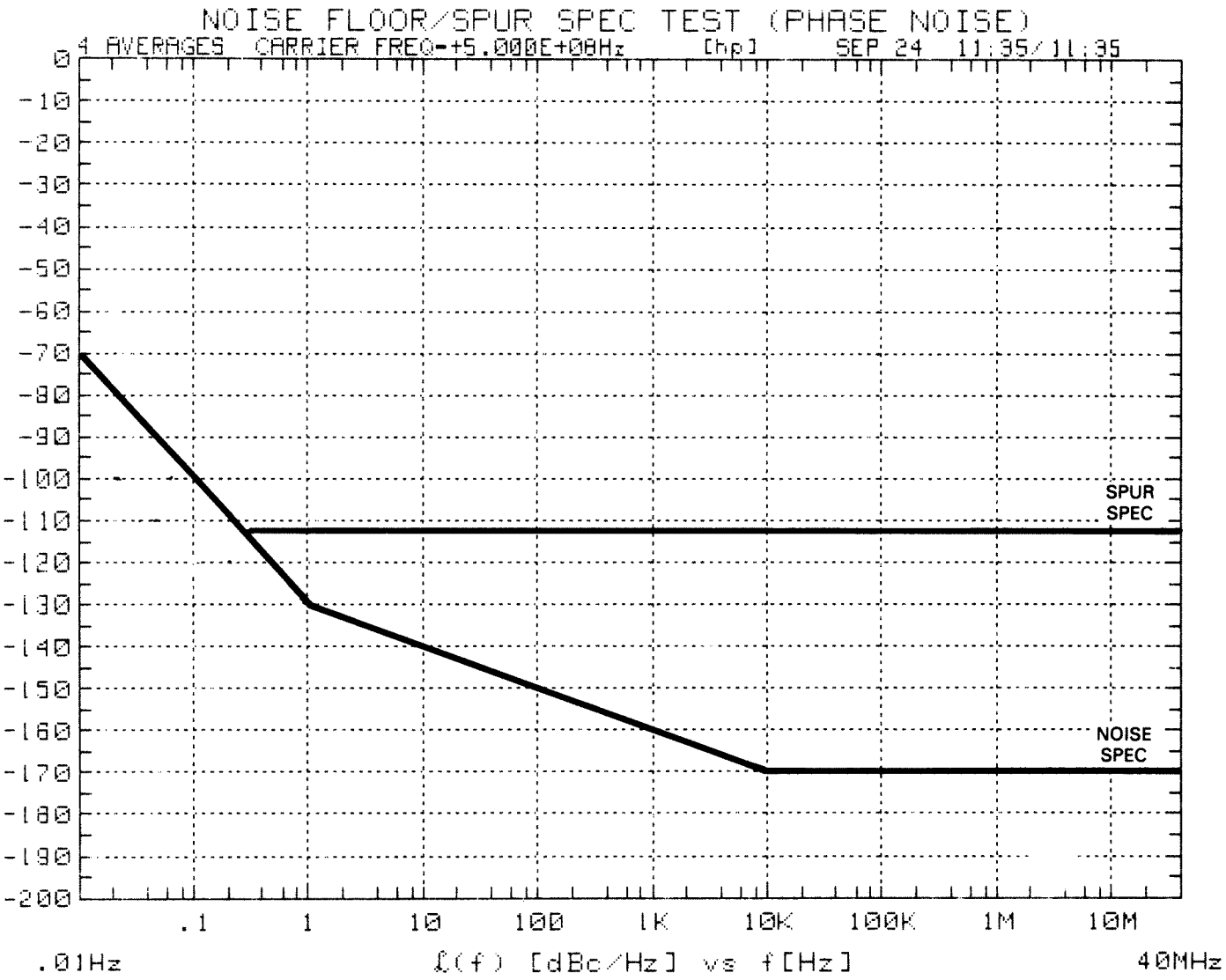
The equipment that is recommend for testing the -hp- 3047A Spectrum Analyzer System is listed in Table 7-1. If the recommended model is not available, use a substitute that meets the "Required Characteristics" given in the table.

Table 7-1. Recommended Test Equipment

Instrument	Required Characteristics	Recommended Model
Function Generator	Frequency Range: .1 Hz to 30 kHz Level Flatness: < ± 3%	-hp- 3312A
Signal Generator	Low broadband and close-in noise (see -hp- 8460 specs) Output Power: ≥ +19 dBm FM-dc port for PLL Control Voltage Input Tuneable output frequency to 500 MHz	-hp- 8640B
Function Generator/ Frequency Synthsizer	(See -hp- 3325A specs and performance features).	-hp- 3325A
Synthesized Signal Generator (2 ea)	Freq: ≥ 1.3 GHz, tuneable Amplitude: ≥ 10 dBm	-hp- 8660A (-hp- 86602B)
Quadrature Test Fixture		-hp- part number 03047-84401
50 Ω Termination		-hp- 11048
10 dB Fixed Attenuator	± .6 dB	-hp- 8493A

Table 7-2. Performance Tests Index

Noise Floor/Spur Test:



PHASE NOISE ANALYSIS
NOISE FLOOR AND SPUR SPECIFICATIONS FOR 0.6 VOLTS/RADIAN PHASE SLOPE

ATTACH COPY OF PHASE/NOISE ANALYSIS NOISE FLOOR AND SPUR TEST HERE

SECTION 8
SPECIAL OPERATING CONSIDERATIONS

SECTION 8
SPECIAL OPERATING CONSIDERATIONS

Guidelines for configuring the -hp- 3047A system to maximize system accuracy and extending measurement capabilities are provided in the following paragraphs. Some of these procedures, while enchanging a measurement, have a potential for degrading the system specifications due to improper design of external circuits or selecting a signal path that can not be adequately calibrated by the software.

8-1. REDUCING THE NOISE FLOOR IN THE AM/PM AND DIRECT SPECTRUM MEASUREMENT PROGRAMS

GENERAL DESCRIPTION: If the maximum input signal level is less than -35 dBm, the noise floor in the AM/PM noise and direct spectrum measurement programs may be reduced by approximately 20 dB by adding an -hp- 35601A internal low noise amplifier into the signal path. Adding this amplifier increases the signal to noise ratio.

HARDWARE REQUIRED: This procedure requires activation of the switch routine and no external hardware. Refer to the program modification section of this manual for activation of the switch routine.

MEASUREMENT SETUP: Load and run either the direct spectrum or the AM/PM noise measurement program. When the main menu is displayed enter the switch routine by depressing SHIFT K7. Enter the command strings K1, K12, and K11 to switch the low noise amplifier into the circuit (Figure 8-1). Exit switch by depressing SHIFT K11. Connect the signal to be analyzed to the -hp- 35601A front panel SIGNAL INPUT connector and proceed with the measurement as in a normal direct spectrum or AM/PM noise measurement. After the measurement is complete, the spectrum analyzer interface may be returned to the original state by returning to switch and entering the command strings -K1,-K12, and -K11.

INTERPRETING RESULTS: Because the low noise amplifier is not calibrated by the direct spectrum or AM/PM noise analysis software, the absolute amplitude accuracy for this measurement is unknown. The displayed signal amplitude will be approximately 35 to 40 dB greater than the actual signal amplitude. Relative amplitude measurements are accurate in this system configuration, thus this system configuation can be used for relative measurements and pulling low level signals out of the noise floor.

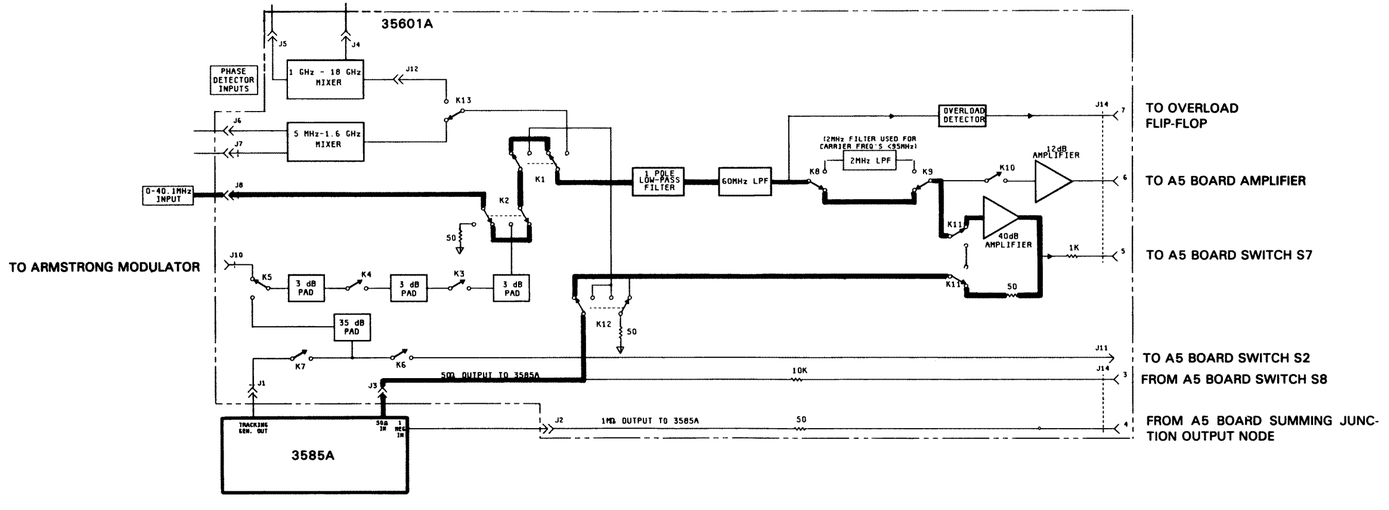


Figure 8-1. Signal Path for Reducing System Noise Floor in AM/PM and Direct Spectrum Measurements

8-2. MEASUREMENTS ABOVE 40.1 MHz IN THE DIRECT SPECTRUM AND AM/PM NOISE MEASUREMENT PROGRAMS

GENERAL DESCRIPTION: The upper frequency limit of the direct spectrum and AM/PM noise measurement programs may be extended above 40.1 MHz by utilizing an external frequency source and an -hp- 35601A internal mixer. The frequency source is used as a local oscillator input into the mixer to frequency shift high frequency test signals down to a frequency within the program 40.1 MHz limit. These signals are then analyzed in the normal program procedure.

HARDWARE REQUIRED: This procedure requires activation of the switch routine and a frequency source. The frequency source must have either a square wave or a sine wave output with low even order harmonic distortion (at least 30 dB below the fundamental frequency). The frequency source output level must be between +15 and +23 dBm, unless the test signal is greater than +15 dBm, in which case the range is from -10 to +23 dBm. To prevent the frequency source from influencing the test results, the frequency source noise should be less than that of the test signal. This is may be accomplished by setting the external frequency signal at a much lower frequency than the test signal. Refer to the program modification section of this manual for activation of the switch routine.

MEASUREMENT SETUP: Load and run either the direct spectrum or the AM/PM noise measurement program. When the main menu is displayed, enter the switch routine by depressing SHIFT K7. Enter the command string K12 to switch the internal mixer into the circuit, and enter -K13 to use the 5 MHz to 1.6 GHz mixer, or enter K13 to use the 1.2 GHz to 18 GHz mixer (Figure 8-2). Exit switch by depressing SHIFT K11. Connect the high level source to the L port of the appropriate mixer, and connect the lower level test signal to the R port of the same mixer. The test is then completed as a normal AM/PM noise or direct spectrum measurement. When the measurement is completed, the system may be returned to the normal measurement state by entering the switch routine and entering the command strings -K13, and -K12. If the internal mixer output is less than -35 dBm the internal amplifier may be used as described in the section on reducing the noise floor during direct spectrum and AM/PM noise measurements.

INTERPRETING RESULTS: In this mode of operation, absolute frequency and amplitude measurements do not yield valid results because the software neither calibrates nor compensates for the additional circuits. Relative amplitude and frequency measurements are not affected by the additional circuits.

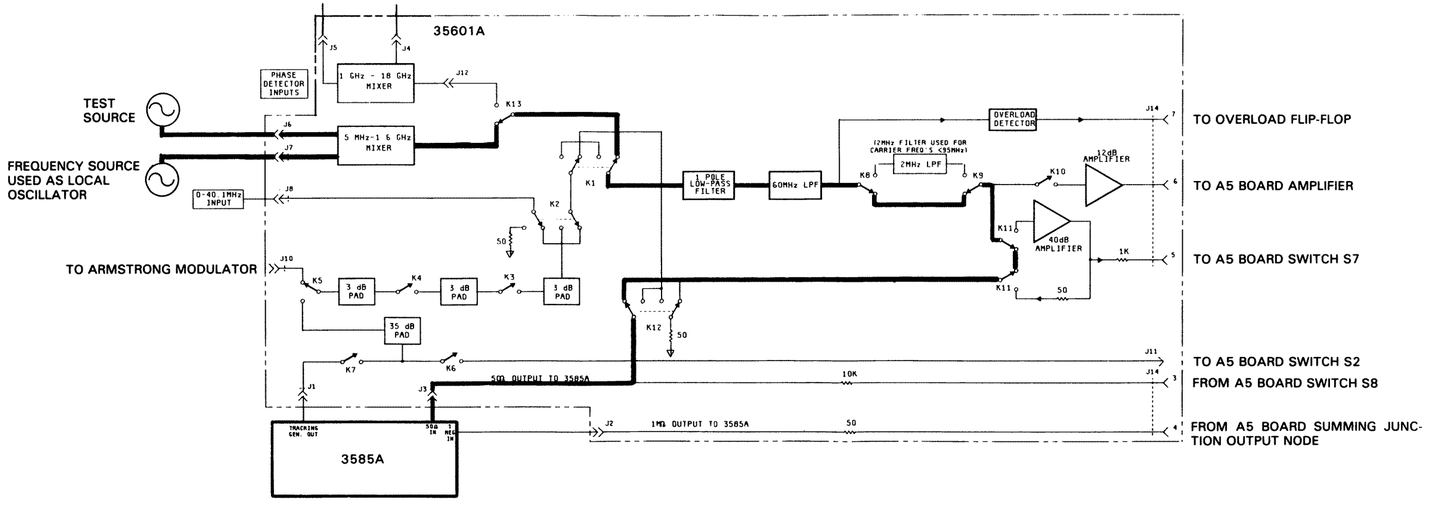


Figure 8-2. Signal Path for Extending the Frequency Range of Direct Spectrum and AM/PM Noise Measurements

8-3. EXTENDING THE FREQUENCY RANGE OF THE PHASE NOISE ANALYSIS MEASUREMENT PROGRAM BELOW 5 MHz OR ABOVE 18 GHz

GENERAL DESCRIPTION: Signals less than 5 MHz in frequency may be analyzed by the phase noise analysis program with the addition of an external mixer and low pass filter. The mixer is used as a low frequency phase detector, while the low pass filter attenuates unwanted mixer products. When measuring signals above 18 GHz, only the external mixer is required.

HARDWARE REQUIRED: This procedure requires an external mixer and a low pass filter. The mixer should be a double balanced low noise mixer capable of being used as a phase detector. The mixer must have a flat frequency response over the tuning range of the oscillator under test, and a DC offset of less than one half of the peak signal out of the mixer when used as a phase detector. Requirements for the low pass filter are listed in Figure 8-3. In addition to these requirements, the low pass filter should properly terminate the mixer output impedance. The filter must be must be designed to terminate in a 50Ω load. It is more important to achieve a flat passband response than to increase stopband rejection. It is recommended to use the scaled element values from either the 60 MHz low pass filter or the 2 MHz low pass filter in the -hp- 35601A Spectrum Analyzer Interface. These filters are 6th order Butterworth filters.

MEASUREMENT SETUP: Load and run the phase noise analysis program. When the main menu is displayed, setup the hardware as shown in Figure 8-4. When the program asks if the parameters are to be changed, enter yes. For measurements on frequencies below 5 MHz, enter 5 MHz as the phase detector input frequency, the actual signal frequency as the carrier frequency, and external as the mixer type. For measurements on frequencies above 18 GHz, enter the phase detector frequency as 18 GHz, the carrier frequency as the actual test signal frequency and external as the mixer type. The measurements are then completed as usual.

INTERPRETING RESULTS: In this mode of operation the software calibrates the external hardware, thus absolute amplitude accuracy is not significantly degraded. A noise floor measurement should be made on the system with the extra hardware installed before an actual measurement is made.

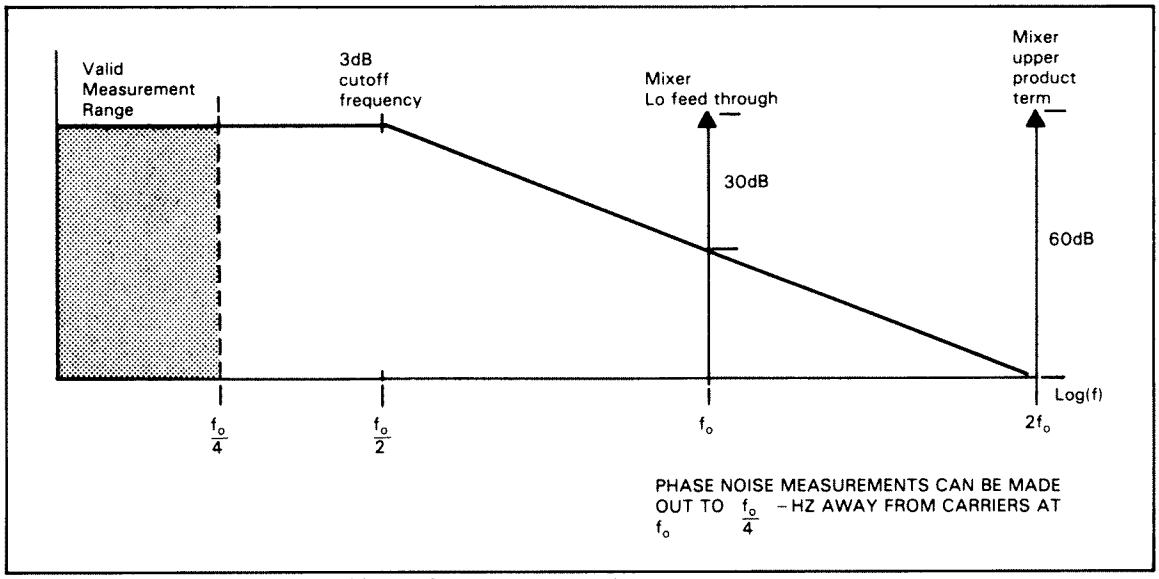


Figure 8-3. Low Pass Filter Requirements

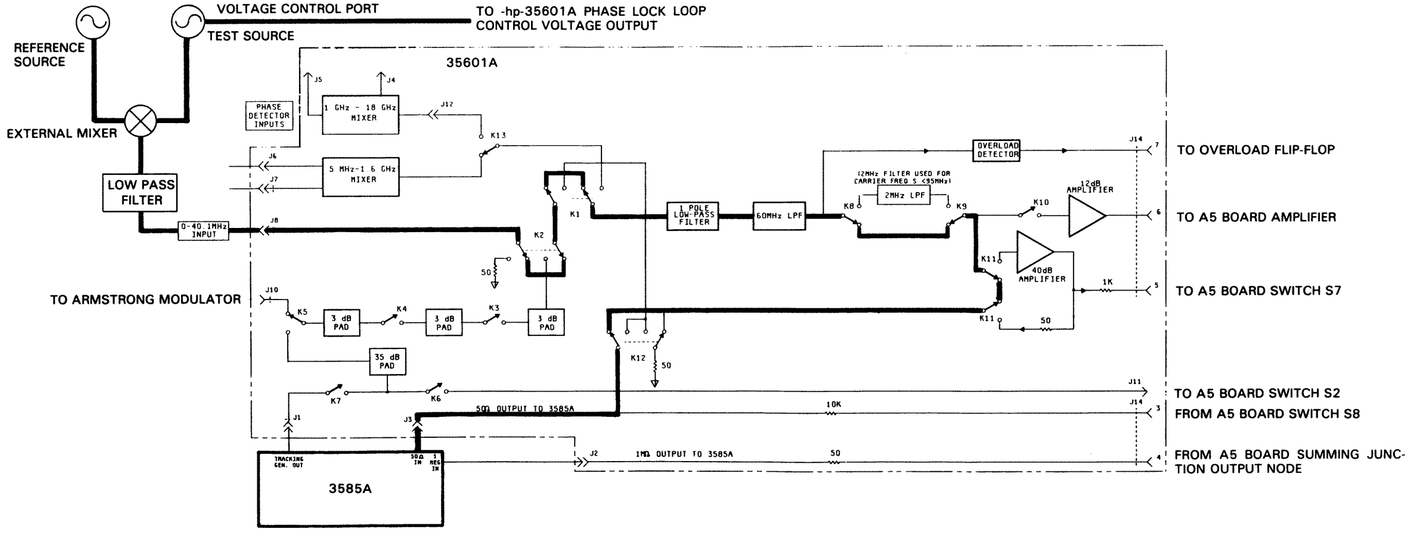


Figure 8-4. Hardware Setup and Signal Path for Extending Frequency Range of Phase Noise Analysis Measurements

8-4. MEASURING NON-VOLTAGE CONTROLLED SOURCES WITH THE PHASE NOISE ANALYSIS MEASUREMENT PROGRAM

GENERAL DESCRIPTION: Fixed frequency sources that will not maintain a quadrature phase relationship throughout the measurement may be measured with the phase noise analysis program with the addition of an external mixer and a low pass filter. The fixed frequency test source is mixed with a lower frequency source. The difference frequency output signal of the mixer is then phase locked to a low frequency tunable source. The phase noise of the lower frequency source needs to be below that of the oscillator under test. Since phase noise is generally better for low frequency oscillators, this requirement should be achievable.

HARDWARE REQUIRED: This procedure requires an external mixer and a low pass filter. The mixer should be a double balanced low noise mixer, with a flat frequency response over the frequency range of interest. The low pass filter requirements are listed in Figure 8-5. In addition to these requirements, the low pass filter should properly terminate the mixer output impedance. The low pass filter must be terminated in one of the mixer inputs of the -hp- 35601A. It is recomended to use the element values of either the 60 MHz or 2 MHz filter in the -hp- 35601A scaled to the desired cutoff frequency. These filters are 50Ω, 6th order Butterworth filters.

MEASUREMENT SETUP: Load and run the phase noise analysis program. When the main menu is displayed, setup the measurement hardware as illustrated in Figure 8-5. When the program asks if there are changes to any parameters, respond yes. Enter the frequency of source 3 for the phase detector input frequency and the frequency of source 1 for the carrier frequency. The measurements are then completed as usual.

INTERPRETING RESULTS: Because the software compensates for the external hardware in this mode, the results are interpreted as usual. A noise floor test should be made on the system with the external hardware installed before an actual measurement is made.

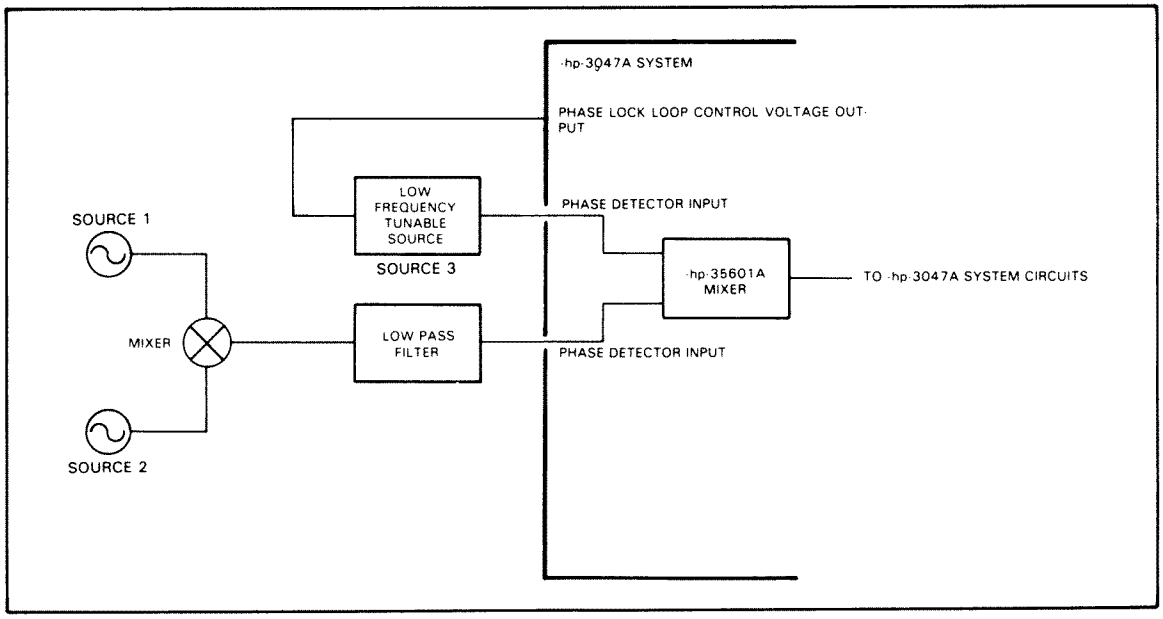


Figure 8-5. Low Pass Filter Requirements for Mixing Non-voltage Controlled Sources

8-5. USING EXTERNAL LAG-LEAD NETWORKS WITH THE PHASE NOISE ANALYSIS PROGRAM

GENERAL DESCRIPTION: When using the phase noise analysis program, an external lag-lead network may be added to the -hp- 35601A control port to reduce the control port noise. Any noise on the voltage control input of a voltage controlled oscillator directly frequency modulates the oscillator output. External lag-lead networks reduce the control port noise by reducing the impedance level thus reducing thermal noise, and by filtering the noise output. An external lag-lead should only be considered when measuring a very quiet oscillator with a very wide tuning range because a wide tuning range oscillator effectively amplifies any signal on the voltage control input to frequency fluctuations on the output.

HARDWARE REQUIRED: An external lag-lead network is shown in Figure 8-6. The pole and zero frequencies of an external lag-lead network must correspond exactly with the allowed internal pole and zero frequencies. A table of allowed pole and zero frequencies is in Figure 8-7. The control port output impedance is 50Ω over the entire frequency range regardless of loading. The input impedance of the oscillator control port must be considered when using an external lag-lead network.

MEASUREMENT SETUP: To enable the use of external lag-lead networks the phase noise analysis program must be modified. To modify the program load type in "EDIT Lagleadfound" and depress the EXECUTE key. The following program lines will appear.

```
Lagleadfound: !
! PRINT "INITIAL LAG LEAD CHOICE = ";Laglead ! DEL
! PRINT "NEEDED ZERO FREQ = ";zero ! DEL
! PRINT "ACTUAL ZERO FREQ = ;Zerofreq(laglead) ! DEL
! PRINTER IS 16 ! DEL
! PRINT ! DEL
```

Remove the leading exclamation marks from these lines following "Lagleadfound:", and place a exclamation mark in front of the line that reads "GOTO Noexternal !COMMENT FOR EXTERNAL LAG-LEAD". Once the program is modified, select the lag-lead desired. The lag-lead selected must corespond to one of the internal lag-lead networks. The default lag-lead chosen by the software is given in Figure 8-8 as a function of the source tuning range. The portion of the lag-lead to be implemented externally is then chosen. The entire lag-lead may implemented internally, in which case a loop band width other than the default value may be chosen. The pole frequency of the external lag-lead must correspond to the zero frequency of the internal lag-lead, and the zero frequency of the external lag-lead must correspond to the overall zero frequency. An example is given below.

EXAMPLE: Implement lag-lead number six using an external lag-lead network and lag-lead number five internally. Lag-lead six has a pole frequency of 9.95 Hz and a zero frequency of 5 kHz. Lag-lead five has a pole frequency of 9.95 Hz and a zero frequency 1.985 kHz. Therefore, the external lag-lead must have a pole frequency of 1.985 kHz and a zero frequency of 5 kHz.

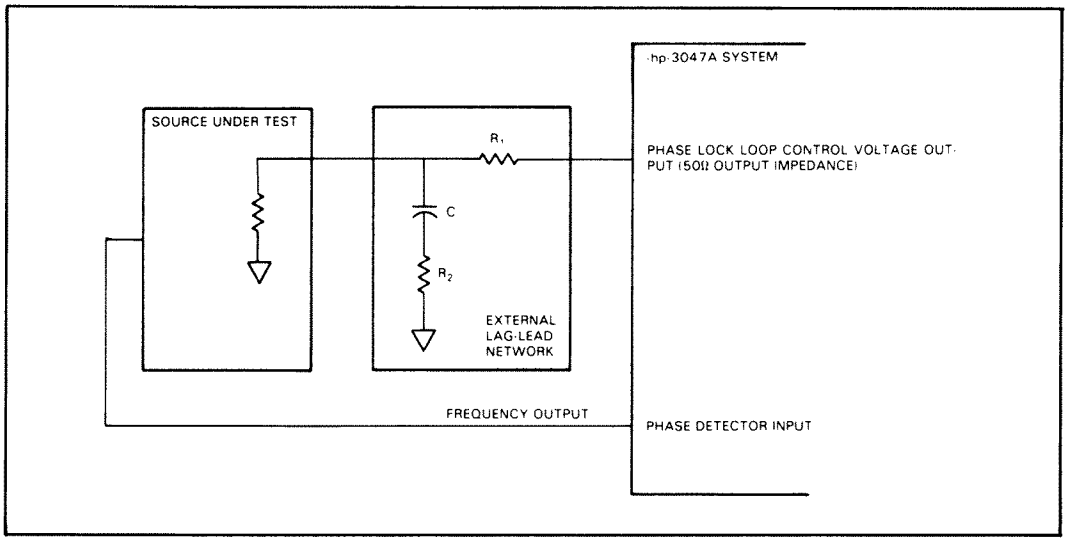
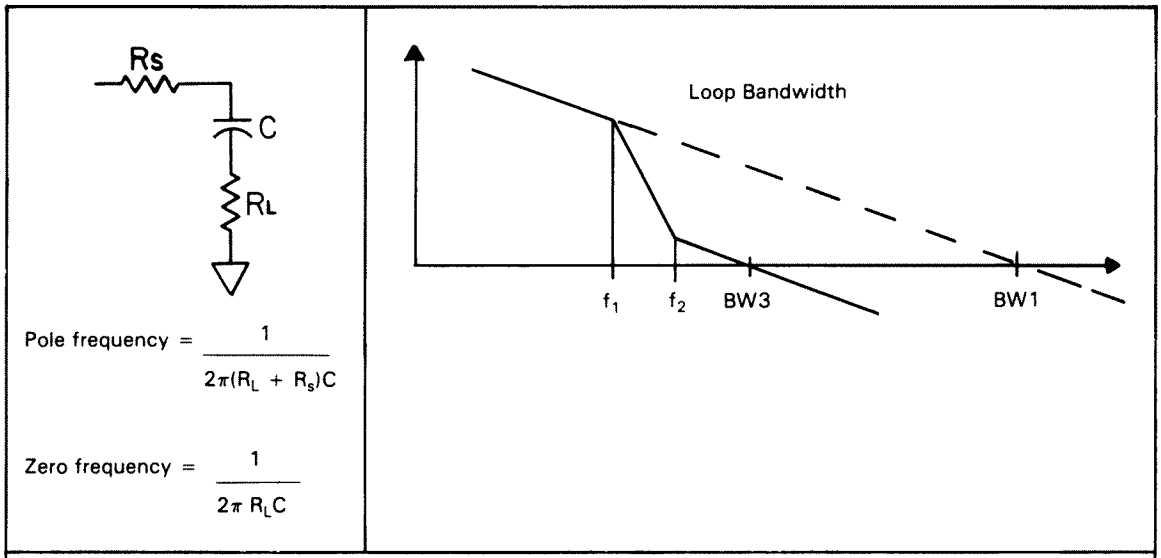


Figure 8-6. Lag-lead Network



$$\text{Pole frequency} = \frac{1}{2\pi(R_L + R_s)C}$$

$$\text{Zero frequency} = \frac{1}{2\pi R_L C}$$

Lag-Lead Number	Pole Frequency (f_1)	Zero Frequency (f_2)
0	9.95 Hz	4.82 Hz
1	40.1	8.01
2	115.9	9.17
3	306	9.68
4	784	9.95
5	1.985 KHz	9.95
6	5.00	9.95
7	12.58	9.99
8	31.6	9.99
9	79.4	9.99

Figure 8-7. Lag-lead Pole and Zero Locations

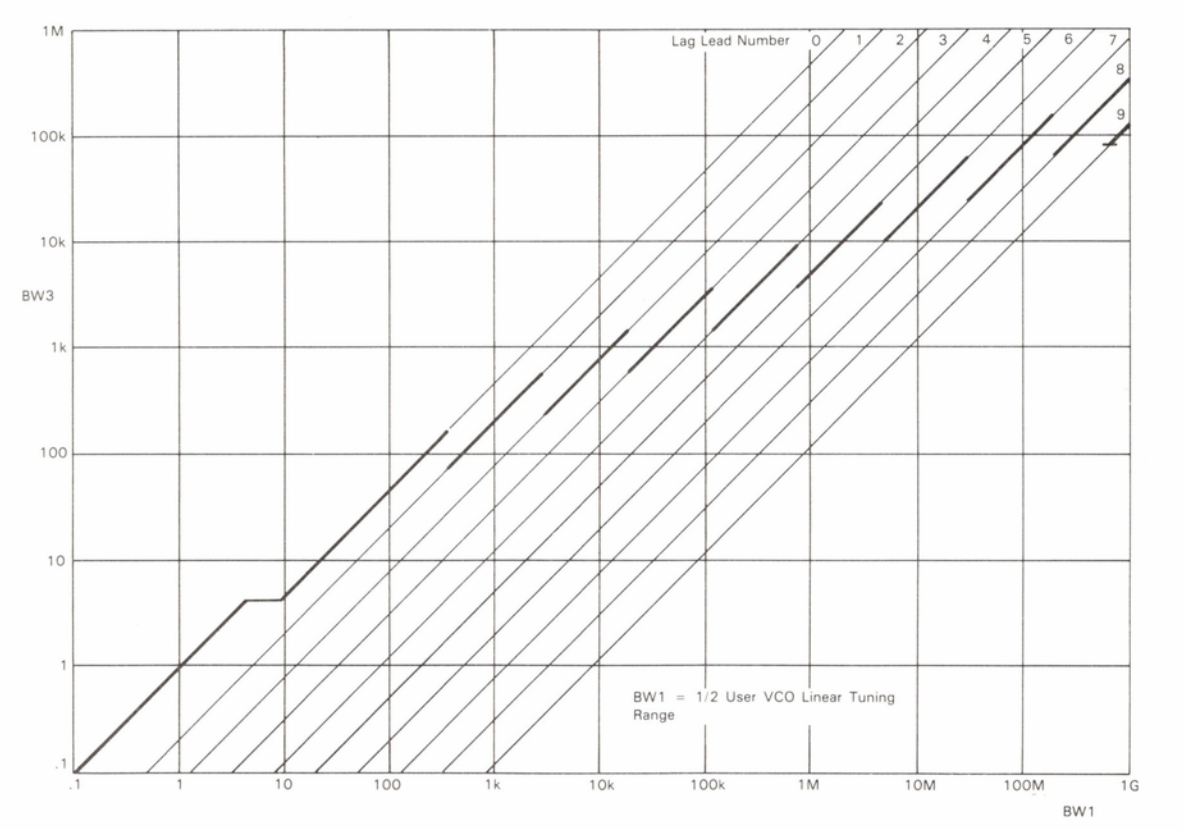


Figure 8-8. Lag-lead Number as a Function of Tuning Curve

8-6. DEGRADED ACCURACY

The accuracy of the -hp- 3047A system depends partially on its ability to measure the voltage tuning slope (Hz/V) of the oscillator under test, and the phase detector slope (V/rad). An error in the measurement of either of these parameters can degrade the accuracy of the -hp- 3047A system. A few factors that cause a degraded accuracy specification are discussed below.

INJECTION LOCKING: Injection locking is the most common cause of degraded accuracy. Injection locking degrades accuracy by causing an error in the measurement of the voltage tuning slope of the test source. Injection locking occurs when the signal of one source couples to a second source causing the second source to oscillate at the same frequency as the first source. Signals can be transmitted from one source to another by several paths, including the -hp- 35601A mixer, RF emission, capacitive coupling, or power line coupling. The most common cause of injection locking while using the -hp- 3047A system is coupling through the -hp- 35601A mixer. Adding an amplifier and an attenuator on the output of the source under test increases the isolation between sources to eliminate injection locking. Shielding and filters may be used to increase the source isolation through paths other than the -hp- 35601A mixer.

SECOND ORDER HARMONIC DISTORTION: Second order harmonic distortion on the mixer beatnote causes an error in the measurement of the phase detector slope (V/rad). Second order harmonic distortion on the beatnote is caused by either second order harmonic distortion on the input signal or by inadequate signal drive levels into the mixer. Low drive levels into the PHASE DETECTOR INPUT L port is more susceptible to second order harmonic distortion than the R port.

CLOSE IN VCO POLE: When the response of the loop is measured during system calibration, the measured values should ideally correspond with an equation formulated by the software. However, generally it is necessary to adjust the value of the open loop gain and the frequency of an assumed pole in order to make the equation fit the experimental data. The software assumes an extra pole is added to the system from the user supplied portion of the phase-locked-loop. Initially this pole is assumed to be well outside the loop band width. Significant adjustment to the pole frequency can be expected if peaking in the measured loop response is observed (i.e. the pole supplied by the user was closer to the loop band width than orginally assumed). Such adjustment may degrade the accuracy slightly (usually less than 1 dB) and if the accuracy is degraded, the degraded accuracy message is displayed.

8-7. WHEN TO USE A FREQUENCY DISCRIMINATOR

The -hp- 3047A system makes measurements with a phase-locked-loop or a frequency discriminator. In general, very noisy sources will not lock in the phase locked technique and a frequency discriminator must be used. Frequency discriminators cannot resolve the noise of very quiet sources, thus quiet sources require the phase-locked technique.

Phase noise measurement is accomplished by measuring the phase or frequency fluctuations of a source under test against a reference. The reference may be passive, as in the case of frequency measurements with a delay line or cavity discriminator; or active as in the case phase measurements with respect to a reference source. The main disadvantage of the passive reference system is that the passive reference itself must have and effective Q comparable to or qreater than the Q of the resonator of the source under test or the sensitivity will not be adequate to resolve close to the carrier noise. This requirement is difficult to meet for high stability sources over a wide range of carrier frequencies, but the technique is very useful for many UHF or microwave sources. Also, the high effective Q that enhances close in sensitivity, limits how far from the carrier noise can be measured. The advantage is that it is possible to measure over a wide range of carrier frquencies with fairly simple hardware, and without a second source.

The active reference system has traditionally been used for very high quality sorces at lower frequencies. The disadvantages of this system are, first, a source at least equal in quality to the source under test is required, and, secondly, since the phase of these sources is compared in a phase detector with a limited range of phase differences possible, the relative phase of the two sources must be closely held by a phase-locked-loop. The phase lock can be to either the reference or to the source under test. The phase-locked-loop will have a bandwidth dependendent upon the particular circuit constants.

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Tel: 2659
P

CANADA

Alberta

Hewlett-Packard (Canada) Ltd.
210, 7220 Fisher Street S.W.
CALGARY, Alberta T2H 2H8
Tel: (403) 253-2713
Telex: 610-821-6141
A,CM,CP,E*,MS,P*

Hewlett-Packard (Canada) Ltd.
11620A-168th Street
EDMONTON, Alberta T5M 3T9
Tel: (403) 452-3670
Telex: 610-831-2431
A,CM,CP,E,MS,P*

British Columbia

Hewlett-Packard (Canada) Ltd.
10691 Shellbridge Way
RICHMOND, British Columbia V6X 2W7
Tel: (604) 270-2277
Telex: 610-922-5059
A,CM,CP,E*,MS,P*

Manitoba

Hewlett-Packard (Canada) Ltd.
380-550 Century Street
Saint James
WINNIPEG, Manitoba R3H 0L8
Tel: (204) 786-6701
Telex: 610-671-3531
A,CM,CS,E,MS,P*

Nova Scotia

Hewlett-Packard (Canada) Ltd.
P.O. Box 931
900 Windmill Road
DARTMOUTH, Nova Scotia B2Y 3Z6
Tel: (902) 469-7820
Telex: 610-271-4482
CM,CP,E*,MS,P*

Ontario

Hewlett-Packard (Canada) Ltd.
552 Newbold Street
LONDON, Ontario N6E 2S5
Tel: (519) 686-9181
Telex: 610-352-1201
A,CM,CS,E*,MS,P*

Hewlett-Packard (Canada) Ltd.
6877 Goreway Drive
MISSISSAUGA, Ontario L4V 1M8
Tel: (416) 678-9430
Telex: 610-492-4246
A,CM,CP,E,MP,P

Hewlett-Packard (Canada) Ltd.
1020 Morrison Drive
OTTAWA, Ontario K2H 8K7
Tel: (613) 820-6483
Telex: 610-563-1636
A,CM,CP,E*,MS,P*

Quebec

Hewlett-Packard (Canada) Ltd.
275 Hymus Boulevard
POINTE-CLAIRE, Quebec H9R 1G7
Tel: (514) 697-4232
Telex: 610-422-3022
A,CM,CP,E,MP,P*

CHILE

Jorge Calcagni y Cia. Ltda.
Arturo Burhle 065
Casilla 16475
*Correo 9, **SANTIAGO***
Tel: 220222
Telex: JCALCAGNI
A,E,M,P

Olympia (Chile) Ltd.
Rodrico de Araya 1045
Casilla 256-V
***SANTIAGO** 21*
Tel: 25-50-44
Telex: 40-565
P

COLOMBIA

Instrumentacion
H. A. Langebaek & Kier S.A.
Carrera 7 No. 48-75
***BOGOTA** 2, DE*
Apartado Aereo 6287
***BOGOTA** 1 D.E.*
Tel: 269-8877
Telex: 44400
Cable: AARIS Bogota
A,E,M,P

Instrumentacion
H.A. Langebaek & Kier S.A.
Edif. Camacol, Local 105
Carrera 63 NO. 49-A-31
Apartado 54098
MEDELLIN
Tel: 304475
A,E,M,P

COSTA RICA

Cientifica Costarricense S.A.
Avenida 2, Calle 5
San Pedro de Montes de Oca
Apartado 10159
SAN JOSE
Tel: 24-38-20, 24-08-19
Telex: 2367 GALGUR CR
Cable: GALGUR
A,E,M,P

CYPRUS

Kryponics
19 Gregorios Xenopoulos Street
P.O. Box 1152
NICOSIA
Tel: 45628, 45629
Telex: 3018
E,M,P

CZECHOSLOVAKIA

Vyojova a Provozni Zakladna
Vyzkumnych Ustavu v Bechovicich
*CSSR-25097 **BECHOVICE U PRAHY***
Tel: 89-9341
Telex: 12133
P

Hewlett-Packard
Obchodni Zastupitelstvi v CSSR
Pisemny styk
Post. schranka 27
*CS 118 01 **PRAHA 011***
Tel: 66-296
Telex: 121353 1HC
A,C*,E*,M*,P*

DENMARK

Hewlett-Packard A/S
Datavej 52
DK-3460 **BIRKEROD**
Tel: (02) 81-66-40
Telex: 37409 hpas dk
A,CM,CP,E,MS,P

Hewlett-Packard A/S
Navervej 1
DK-8600 **SILKEBORG**
Tel: (06) 82-71-66
Telex: 37409 hpas dk
CM,CS,E

ECUADOR

CYEDE Cia. Ltda.
P.O. Box 6423 CCI
Avenida Eloy Alfaro 1749
QUITO
Tel: 450-975, 243-052
Telex: 2548 CYEDE ED
Cable: CYEDE-Quito
A,E,P

Hospitalar S.A.
Casilla 3590
Robles 625
QUITO
Tel: 545-250, 545-122
Cable: HOSPITALAR-Quito
M

EGYPT

Samitro
Sami Amin Trading Office
18 Abdel Aziz Gawish
ABDINE-CAIRO
Tel: 24-932
P

International Engineering Associates
24 Hussein Hegazi Street
Kasr-el-Aini
CAIRO
Tel: 23-829
Telex: 93830
E,M

SALES & SUPPORT OFFICES

Arranged alphabetically by country

EL SALVADOR
IPESA
Boulevard de los Heroes
Edificio Sarah 1148
SAN SALVADOR
Tel: 252787
A,C,E,M,P*

ETHIOPA
Abdella Abdulmalik
P.O. Box 2635
ADDIS ABABA
Tel: 11-93-40
A,E,M

FINLAND
Hewlett-Packard Oy
Revontulentie 7
SF-02100 **ESPOO** 10
Tel: (90) 455-0211
Telex: 121563 hewpa sf
A,CM,CP,E,MS,P

FRANCE
Hewlett-Packard France
Le Ligoures
Bureau de Vente de
Aix-en-Provence
Place Romee de Villeneuve
F-13090 **AIX-EN-PROVENCE**
Tel: (42) 59-41-02
Telex: 410770F
A,CM,CS,E,MS,P*

Hewlett-Packard France
Bureau de Vente de Lyon
Chemin des Mouilles
Boite Postale No. 162
F-69130 **ECULLY** Cedex
Tel: (78) 33-81-25
Telex: 310617F
A,CM,CP,E,MP

Hewlett-Packard France
Immeuble France Evry
Tour Lorraine
Boulevard de France
F-91035 **EVRY** Cedex
Tel: (60) 77-96-60
Telex: 692315F
CM,E

Hewlett-Packard France
Batiment Ampere
Rue de la Commune de Paris
Boite Postale 300
F-95153 **LE BLANC MESNIL**
Tel: (01) 865-44-52
Telex: 211032F
CM,CP,E,MS

Hewlett-Packard France
Avenue du President JF Kennedy
F-33700 **MERIGNAC**
Tel: (56) 34-00-84
Telex: 550105F
CM,CP,E,MS

Hewlett-Packard France
32 Rue Lothaire
F-57000 **METZ**
Tel: (87) 65-53-50
CM,CS

Hewlett-Packard France
Avenue des Tropiques
Zone d'activities de Courtaboeuf
Boite Postale 6
F-91401 **ORSAY** Cedex
Tel: (1) 907-78-25
Telex: 600048F
A,CM,CP,E,MP,P

Hewlett-Packard France
15 Boulevard De L'Amiral Bruix
F-75016 **PARIS**
Tel: (01) 502-12-20
Telex: 613663F
CM,CP,MS,P

Hewlett-Packard France
2 Allee de la Bourgonette
F-35100 **RENNES**
Tel: (99) 51-42-44
Telex: 740912F
CM,CS,E,MS,P*

Hewlett-Packard France
4 Rue Thomas Mann
F-67033 **STRASSBOURG** Cedex
Tel: (88) 28-56-46
Telex: 890141F
CM,CS,E,MS,P*

Hewlett-Packard France
20 Chemin de la Cepiere
31081 **TOULOUSE** Cedex
Tel: (61) 40-11-12
Telex: 531639F
A,CM,CS,E,P*

Hewlett-Packard France
Bureau de Vente de Lille
Immeuble Pericentre
Rue Van Gogh
F-59650 **VILLENEUVE D'ASQ**
Tel: (20) 91-41-25
Telex: 160124F
CM,CS,E,MS,P*

GERMAN FEDERAL REPUBLIC
Hewlett-Packard GmbH
Technisches Buro Berlin
Keithstrasse 2-4
D-1000 **BERLIN** 30
Tel: (030) 24-90-86
Telex: 018 3405 hpbln d
CM,CS,E,P

Hewlett-Packard GmbH
Technisches Buro Boblingen
Herrenberger Strasse 110
D-7030 **BOBLINGEN**
Tel: (07031) 667-1
Telex: 07265739 bbn
A,CM,CP,E,MP,P

Hewlett-Packard GmbH
Technisches Buro Dusseldorf
Emanuel-Leutze-Strasse 1
D-4000 **DUSSELDORF**
Tel: (0211) 5971-1
Telex: 085/86 533 hpdd d
A,CM,CP,E,MS,P

Hewlett-Packard GmbH
Vertriebszentrale Frankfurt
Berner Strasse 117
Postfach 560 140
D-6000 **FRANKFURT** 56
Tel: (0611) 50-04-1
Telex: (841) 04 13249 hpffm d
A,CM,CP,E,MP,P

Hewlett-Packard GmbH
Technisches Buro Hamburg
Kapstadtring 5
D-2000 **HAMBURG** 60
Tel: (040) 63804-1
Telex: 021 63 032 hphh d
A,CM,CP,E,MS,P

Hewlett-Packard GmbH
Technisches Buro Hannover
Am Grossmarkt 6
D-3000 **HANNOVER** 91
Tel: (0511) 46-60-01
Telex: 092 3259
A,CM,CS,E,MS,P

Hewlett-Packard GmbH
Technisches Buro Nurnberg
Neumeyerstrasse 90
D-8500 **NURNBERG**
Tel: (0911) 56-30-83
Telex: 0623 860
CM,CS,E,MS,P

Hewlett-Packard GmbH
Technisches Buro Munchen
Eschenstrasse 5
D-8021 **TAUFKIRCHEN**
Tel: (089) 6117-1
Telex: 0524985
A,CM,CP,E,MS,P

GREAT BRITAIN
Hewlett-Packard Ltd.
Trafalgar House
Navigation Road
ALTRINCHAM
Chesire WA14 1NU
Tel: (061) 928-6422
Telex: 668068
A,CM,CP,E*,MS

Hewlett-Packard Ltd.
Lorrilleaux Bolton Premises
Morely Road, Staplehill
BRISTOL BS16 4QT
Tel: (0272) 570743
CM,CS,MS

Hewlett-Packard Ltd.
14 Wesley Street
CASTLEFORD
Yorkshire WF10 1AE
Tel: (0977) 550016
Telex: 5557355
CM,CP

Hewlett-Packard Ltd.
9 Savoy Street
LONDON WC2R 0BA
Tel: 013797700
CM,CP

Hewlett-Packard Ltd.
Fourier House
257-263 High Street
LONDON COLNEY, St. Albans
Herts., AL21HA
Tel: (0727) 24400
Telex: 1-8952716
CM,CP,E,MS

Hewlett-Packard Ltd
Tradax House, St. Mary's Walk
MAIDENHEAD
Berkshire, SL6 1ST
Tel: (0628) 39151
CM,CP

Hewlett-Packard Ltd.
308/314 Kings Road
READING, Berkshire
Tel: 61022
Telex: 84-80-68
A,CM,E*,MS

Hewlett-Packard Ltd.
Quadrangle
106-118 Station Road
REDHILL, Surrey RH1 1PS
Tel: (0737) 68655
A,CM,CP,E,MS,P

Hewlett-Packard Ltd.
Westminster House
190 Stratford Road
SHIRLEY, SOLIHULL
West Midlands B90-3BJ
Tel: (021) 7458800
Telex: 339105
CM,CP,MS

Hewlett-Packard Ltd.
King Street Lane
WINNERSH, Wokingham
Berkshire RG11 5AR
Tel: (0734) 784774
Telex: HEWPIE WINNERSH 847178
A,CM,E,MP,P

GREECE
Kostas Karaynnis
8 Omirou Street
***ATHENS** 133*
Tel: 32-30-303, 32-37-371
Telex: 21 59 62 RKAR GR
E,M,P

"Plaiso"
G. Gerados
24 Stournara Street
ATHENS
Tel: 36-11-160
Telex: 21 9492
P

GUAM
Guam Medical Supply, Inc.
Jay Ese Bldg., Room 210
P.O. Box 8947
***TAMUNING** 96911*
Tel: 6464513
Cable: EARMED Guam
M,P

GUATEMALA
IPESA
Avenida Reforma 3-48
Zona 9
GUATEMALA CITY
Tel: 316627, 314786, 664715
Telex: 4192 Teltro Gu
A,C,E,M,P

HONG KONG
Hewlett-Packard Hong Kong, Ltd.
Room 105, Austin Center
1st Floor
21 Austin Avenue
TST P.O. Box 98524
KOWLOON, Hong Kong
Tel: 3-721143/8
Telex: 36678 HEWPA HX
Cable: PASIALTO Hong Kong
E,CP,P

Hewlett-Packard Hong Kong, Ltd.
11th Floor,Four Seas Building
212 Nathan Road
P.O. Box 795
KOWLOON, Hong Kong
Tel: 3697446
Telex: 36678 HEWPA HX
Cable: HEWPACK Hong Kong
E,CP,P

Schmidt & Co. (Hong Kong) Ltd.
Wing On Centre, 28th Floor
Connaught Road, C.
HONG KONG
Tel: 5-455644
Telex: 74766 SCHMX HX
A,M

ICELAND
Elding Trading Company Inc.
Hafnarnvoli-Tryggvagotu
P.O. Box 895
IS-REYKJAVIK
Tel: 1-58-20, 1-63-03
M

INDIA
Blue Star Ltd.
Bhavdeep
Stadium Road
***AHMEDABAD** 380 014*
Tel: 42932
Telex: 012-234
Cable: BLUEFROST
E

Blue Star Ltd.
11 Magarath Road
***BANGALORE** 560 025*
Tel: 55668
Telex: 0845-430
Cable: BLUESTAR
A,CM,C,E

Blue Star Ltd.
Band Box House
Prabhadevi
***BOMBAY** 400 025*
Tel: 45-73-01
Telex: 011-3751
Cable: BLUESTAR
A,M

Blue Star Ltd.
Sahas
414/2 Vir Savarkar Marg
Prabhadevi
***BOMBAY** 400 025*
Tel: 46 65 55
Telex: 011-4093
Cable: FROSTBLUE
A,CM,C,E,M

Blue Star Ltd.
7 Hare Street
***CALCUTTA** 700 001*
Tel: 12-01-31
Telex: 021-7655
Cable: BLUESTAR
A,M

Blue Star Ltd.
Meenakshi Mandiram
XXXXV/1379-2 Mahatma Gandhi
Road
***COCHIN** 682-016*
Tel: 32069
Telex: 085-514
Cable: BLUESTAR
*A**

Blue Star Ltd.
133 Kodambakkam High Road
***MADRAS** 600 034*
Tel: 82057
Telex: 041-379
Cable: BLUESTAR
A,M

Blue Star Ltd.
Bhandari House, 7th/8th Floors
91 Nehru Place
***NEW DELHI** 110 024*
Tel: 682547, 682970
Telex: 031-2463
Cable: BLUESTAR
A,CM,C,E,M

Blue Star Ltd.
1-1-117/1 Sarojini Devi Road
***SECUNDERABAD** 500 033*
Tel: 70126
Telex: 0155-459
Cable: BLUESTAR
A,E

Blue Star Ltd.
T.C. 7/603 Poornima
Maruthankuzhi
***TRIVANDRUM** 695 013*
Tel: 65799
Telex: 0884-259
Cable: BLUESTAR
E

SALES & SUPPORT OFFICES

Arranged alphabetically by country

INDONESIA

BERCA Indonesia P.T.
P.O.Box 496/Jkt.
JL. Abdul Muis 62
JAKARTA
Tel: 373009
Telex: 46748 BERSAL IA
Cable: BERSAL
A,E,M,P

BERCA Indonesia P.T.
J.L. Jimento 23
SURABAYA
Tel: 42027
Telex: 31146 BERSAL S.D.
Cable: BERCACON
A,E,M,P*

IRAQ

Hewlett-Packard Trading S.A.
Mansoor City 9B/3/7
BAGHDAD
Tel: 5514973
Telex: 2455 HEPAIRAQ 1k
CP

IRELAND

Hewlett-Packard Ltd.
Kestrel House
Clanwilliam Place
Lower Mount Street
DUBLIN 2, Eire
Tel: 680424, 680426
Telex: 30439
A,E,P*

Hewlett-Packard Ltd.
2C Avongberg Ind. Est.
Long Mile Road
DUBLIN 12, Eire
Tel: 514322, 514224
Telex: 30439
A*,CP,E,MS,P*

Cardiac Services Ltd.
Kilmore Road
Artane
***DUBLIN** 5, Eire*
Tel: (0J) 315820
M

ISRAEL

Electronics & Engineering Div.
Motorola Israel Ltd.
16 Kremenetski Street
P.O. Box 25016
TEL-AVIV
Tel: 338973
Telex: 33569
Cable: BASTEL Tel-Aviv
A,CM,C,E,M,P

ITALY

Hewlett-Packard Italiana S.p.A.
Via Martin Luther King, 38/III
I-40132 **BOLOGNA**
Tel: (051) 402394
Telex: 511630
CM,CS,E,MS

Hewlett-Packard Italiana S.p.A.
Via G. Di Vittorio 9
I-20063 **CERNUSCO SUL NAVLIGLIO**
Tel: (2) 903691
Telex: 334632
A,CM,CP,E,MP,P

Hewlett-Packard Italiana S.p.A.
Via Nuova san Rocco A
Capadimonte, 62A
I-80135 **NAPOLI**
Tel: (081) 7413544
A,CM,CS,E

Hewlett-Packard Italiana S.p.A.
Via Turazza 14
I-35100 **PADOVA**
Tel: (49) 664888
Telex: 430315
A,CM,CS,E,MS

Hewlett-Packard Italiana S.p.A.
Via G. Armellini 10
I-00143 **ROMA**
Tel: (06) 546961
Telex: 610514
A,CM,CS,E,MS,P*

Hewlett-Packard Italiana S.p.A.
Corso Giovanni Lanza 94
I-10133 **TORINO**
Tel: (011) 682245, 659308
Telex: 221079
CM,CS,E

JAPAN

Yokogawa-Hewlett-Packard Ltd.
Inoue Building
1348-3, Asahi-cho
ATSUGI, Kanagawa 243
Tel: (0462) 24-0451
CM,C*,E

Yokogawa-Hewlett-Packard Ltd.
Kumagaya Ashai Building
4 Tusukuba, 3-chome
KUMAGAYA, Saitama 360
Tel: (0485) 24-6563
CM,CS,E

Yokogawa-Hewlett-Packard Ltd.
Mito Mitsui Building
4-73, San-no-maru, 1-chome
MITO, Ibaragi 310
Tel: (0292) 25-7470
CM,CS,E

Yokogawa-Hewlett-Packard Ltd.
Sunitomo Seimei Bldg.
11-2 Shimo-sasajima-cho
Nakamura-ku
NAGOYA, Aichi 450
Tel: (052) 581-1850
CM,CS,E,MS

Yokogawa-Hewlett-Packard Ltd.
Chuo Bldg., 4TH FLOOR
54-20 Nishinakajima, 5-chome
Yodogawa-ku, Osaka-shi
OSAKA, 532
Tel: (06) 304-6021
Telex: 523-3624 YHPOSA
A,CM,CP,E,MP,P*

Yokogawa-Hewlett-Packard Ltd.
29-21 Takaido-Higashi 3-chome
Suginami-ku **TOKYO** 168
Tel: (03) 331-6111
Telex: 232-2024 YHPTOK
Cable: YUHPMARKET TOK23 724
A,CM,CP,E,MP,P*

Yokogawa-Hewlett-Packard Ltd.
Tanigawa Building
2-24-1 Tsuruya-cho
Kanagawa-ku
YOKOHAMA, Kanagawa 221
Tel: (045) 312-1252
Telex: 382-3204 YHP YOK
CM,CS,E

JORDAN

Mouasher Cousins Company
P.O. Box 1387
AMMAN
Tel: 21456, 24907, 39907
Telex: 21456 SABCO JO
E,M,P

KENYA

International Aeradio (E.A.) Ltd.
P.O. Box 95221
MOMBASA
M

ADCOM Ltd., Inc.
City House, Wabera Street
P.O. Box 30635
NAIROBI
Tel: 331955
Telex: 22639
A,E,M*

International Aeradio (E.A.) Ltd
P.O. Box 19012
Nairobi Airport
NAIROBI
Tel: 336055, 336056
Telex: 22201, 22301
M

KOREA

Samsung Electronics
C.P.O. 2775
SEOUL
Tel: 8334311, 8330002, 8330006
Telex: SAMSAN 27364
A,C,E,M,P

KUWAIT

Al-Khalidya Trading & Contracting
P.O. Box 830 Safat
KUWAIT
Tel: 42-4910, 41-1726
Telex: 2481 Areeg kt
A,E,M

Photo & Cine Equipment
P.O. Box 270 Safat
KUWAIT
Tel: 42-2846, 42-3801
Telex: 2247 Matin
P

LUXEMBOURG

Hewlett-Packard Belgium S.A./N.V.
Boulevard de la Woluwe 100
Woluwedal
B-1200 **BRUSSELS**
Belgium
Tel: 762/32/00
Telex: 23-494 paloben bru
A,CP,E,MP,P

MALAYSIA

Hewlett-Packard Sales (Malaysia)
Sdn. Bhd.
Suite 2.21/2.22
Bangunan Angkasa Raya
Jalan Ampang
KUALA LUMPUR
Tel: 483544
Telex: MA31011
A,CP,E,M,P*

Protel Engineering
P.O. Box 1917
Lot 319, Satok Road
*Kuching, **SARAWAK***
Tel: 53544
Telex: MA 70904 PROMAL
Cable: PROTELENG
A,E,M

MEXICO

Hewlett-Packard Mexicana, S.A. de C.V.
Av. Periferico Sur No. 6501
Tepepan, Xochimilco
MEXICO CITY 23, D.F.
Tel: (905) 676-4600
Telex: 017-74-507
A,CP,E,MS,P

Hewlett-Packard Mexicana, S.A. de C.V.
Rio Volga #600 Colonia del Valle
MONTERREY, N.L.
Tel: 78-42-93, 78-42-40, 78-42-41
Telex: 038-410
CS

MOROCCO

Dolbeau
81 rue Karatchi
CASABLANCA
Tel: 3041-82, 3068-38
Telex: 23051, 22822
E

Gerep
2 rue d'Agadir
Boite Postale 156
CASABLANCA
Tel: 272093, 272095
Telex: 23 739
P

MOZAMBIQUE

A.N. Goncalves Ltd.
162, 1° Apt. 14 Av. D. Luis
Caixa Postal 107
MAPUTO
Tel: 27091, 27114
Telex: 6-203 NEGON Mo
Cable: NEGON
A,E,M,P

NETHERLANDS

Hewlett-Packard Nederland B.V.
Van Heuven Goedhartlaan 121
NL1181KK **AMSTELVEEN**
Tel: (20) 47-20-21
Telex: 13 216
A,CM,CP,E,MP,P

Hewlett-Packard Nederland B.V.
Bongerd 2
NL2906 VK **CAPELLE** A/D Ijssel
Tel: (10) 51-64-44
Telex: 21261 hepac nl
A,CM,CP

NEW ZEALAND

Hewlett-Packard (N.Z.) Ltd.
169 Manukau Road
P.O. Box 26-189
Epsom, **AUCKLAND**
Tel: 68-7159
Cable: HEWPACK Auckland
CM,CS,E,P*

Northrop Instruments & Systems Ltd.
Eden House, 44 Khyber Pass Road
P.O. Box 9682
*Newmarket, **AUCKLAND***
Tel: 794-091
A,M

Northrop Instruments & Systems Ltd.
Terrace House, 4 Oxford Terrace
P.O. Box 8388
CHRISTCHURCH
Tel: 64-165
A,M

Hewlett-Packard (N.Z.) Ltd.
4-12 Cruickshank Street
P.O. Box 9443
Kilbirnie, **WELLINGTON** 3
Tel: 877-199
Cable: HEWPACK Wellington
CM,CP,E,P

Northrop Instruments & Systems Ltd.
Sturdee House
85-87 Ghuznee Street
P.O. Box 2406
WELLINGTON
Tel: 850-091
Telex: NZ 31296
A,M

NIGERIA

The Electronics Instrumentations Ltd.
N6B/770 Oyo Road
Oluseun House
P.M.B. 5402
IBADAN
Tel: 461577
Telex: 31231 TEIL NG
A,E,M,P

The Electronics Instrumentations Ltd.
144 Agege Motor Road, Mushin
P.O. Box 6645
*Mushin, **LAGOS***
A,E,M,P

NORTHERN IRELAND

Cardiac Services Company
95A Finaghy Road South
***BELFAST** BT 10 OBY*
Tel: (0232) 625-566
Telex: 747626
M

NORWAY

Hewlett-Packard Norge A/S
Nygaardsgaten 114
P.O. Box 4210
N-5013 Nygaardsgaten, **BERGEN**
Tel: (05) 21-97-33
Telex: 16621 hpnas n
CM,CS,E

Hewlett-Packard Norge A/S
Oestendalen 18
P.O. Box 34
N-1345 **OESTERAAS**
Tel: (02) 17-11-80
Telex: 16621 hpnas n
A*,CM,CP,E,MS,P

OMAN

Khimji Ramdas
P.O. Box 19
MUSCAT
Tel: 72-22-17, 72-22-25
Telex: 3289 BROKER MB MUSCAT
P

PAKISTAN

Mushko & Company Ltd.
10, Bazar Road
Sector G-6/4
ISLAMABAD
Tel: 28624
Cable: FEMUS Rawalpindi
A,E,M,P

Mushko & Company Ltd.
Oosman Chambers
Abdullah Haroon Road
***KARACHI** 0302*
Tel: 511027, 512927
Telex: 2894 MUSHKO PK
Cable: COOPERATOR Karachi
*A,E,M,P**

SALES & SUPPORT OFFICES

Arranged alphabetically by country

PANAMA

Electronico Balboa, S.A.
Apartado 4929
Panama 5
Calle Samuel Lewis
Edificio "Alfa" No. 2
CIUDAD DE PANAMA
Tel: 64-2700
Telex: 3480380
Cable: ELECTRON Panama
A,E,M,P

Foto Internacional, S.A.
P.O. Box 2068
Free Zone of Colon
COLON 3
Tel: 45-2333
Telex: 3485126
Cable: IMPORT COLON/Panama
P

PERU

Compania Electro Medica S.A.
Los Flamencos 145, San Isidro
Casilla 1030
LIMA 1
Tel: 41-4325
Telex: Pub. Booth 25424 SISIDRO
Cable: ELMED Lima
A,E,M,P

PHILIPPINES

The Online Advanced Systems Corporation
Rico House, Amorsolo Cor. Herrera Street
Legaspi Village, Makati
P.O. Box 1510
Metro ***MANILA***
Tel: 85-35-81, 85-34-91, 85-32-21
Telex: 3274 ONLINE
A,C,E,M

Electronic Specialists and Proponents Inc.
690-B Epifanio de los Santos Avenue
Cubao, ***QUEZON CITY***
P.O. Box 2649 Manila
Tel: 98-96-81, 98-96-82, 98-96-83
Telex: 742-40287
Cable: ESPINC MANILA
P

POLAND

Buro Informacjii Technicznej Hewlett-Packard
Ul Stawki 2, 6P
PL00-950 ***WARSZAWA***
Tel: 39-59-62, 39-67-43
Telex: 81 24 53
A,C,E*,M*,P**

PORTUGAL

Telectra-Empresa Tecnica de Equipmentos Electricos S.a.r.l.
Rua Rodrigo da Fonseca 103
P.O. Box 2531
P-LISBON 1
Tel: (19) 68-60-72
Telex: 12598
A,C,E,P

Mundinter
Intercambio Mundial de Comercio S.a.r.l
P.O. Box 2761
Avenida Antonio Augusto de Aguiar 138
P-LISBON
Tel: (19) 53-21-31, 53-21-37
Telex: 16691 munter p
M

PUERTO RICO

Hewlett-Packard Puerto Rico
Calle 272
#203 Urb. Country Club
RIO PIEDRAS, Puerto Rico 00924
Tel: (809) 762-7255
Telex: 345 0514
A,CP

QATAR

Business Communications Quatar
P.O. Box 3656
DOHA
Tel: 5851
Telex: 4454
P

Nasser Trading & Contracting
P.O. Box 1563
DOHA
Tel: 22170
Telex: 4439 NASSER
M

RHODESIA

Field Technical Sales
45 Kelvin Road North
P.O. Box 3548
SALISBURY
Tel: 705231
Telex: RH 4122
A,E,M,P

ROMANIA

Hewlett-Packard Reprezentanta
Boulevard Nicolae Balcescu 16
BUCURESTI
Tel: 130725
Telex: 10440
C,E**

SAUDI ARABIA

Modern Electronic Establishment
P.O. Box 193
AL-KHOBAR
Tel: 44-678, 44-813
Telex: 670136
Cable: ELECTA AL-KHOBAR
C,E,M,P

Modern Electronic Establishment
P.O. Box 1228, Baghdadiah Street
JEDDAH
Tel: 27-798
Telex: 401035
Cable: ELECTA JEDDAH
C,E,M,P

Modern Electronic Establishment
P.O. Box 2728
RIYADH
Tel: 62-596, 66-232
Telex: 202049
C,E,M,P

SCOTLAND

Hewlett-Packard Ltd.
Royal Bank Buildings
Swan Street
BRECHIN, Angus, Scotland
Tel: 3101, 3102
CM,CS

Hewlett-Packard Ltd.
SOUTH QUEENSFERRY
West Lothian, EH30 9TG
GB-Scotland
Tel: (031) 3311000
Telex: 72682
CM,CP,E,MS

SINGAPORE

Hewlett-Packard Singapore (Pte.) Ltd.
6th Floor, Inchcape House
450-452 Alexandra Road
SINGAPORE 0511
P. O. Box 58 Alexandra Post Office
Singapore 9115
Tel: 631788
Telex: HPSGSO RS 32409
Cable: HEWPACK, Singapore
A,CP,E,MS,P

SOUTH AFRICA

Hewlett-Packard South Africa (Pty.) Ltd.
Pine Park Center
Forest Drive, Pinelands
CAPE PROVINCE, 7405
P.O. Box 120
Howard Place
CAPE PROVINCE 7450
Tel: 53-7955, 53-7956, 53-7957, 53-7958, 53-7959
Telex: 57-0006
A,CM,CS,E,MS,P

Hewlett-Packard South Africa (Pty.) Ltd.
P.O. Box 37066
Overport
DURBAN 4067
Tel: 28-4178, 28-4179, 28-4110
CM,CS

Hewlett-Packard South Africa (Pty.) Ltd.
Hewlett-Packard Centre
Daphne Street
Private Bag Wendywood
SANDTON 2144
Tel: 802-5111
Telex: 84782
Cable: HEWPACK Johannesburg
A,CM,CP,E,MS,P

SPAIN

Hewlett-Packard Espanola S.A.
c/Entenza 312
E-**BARCELONA** 29
Tel: (3) 322-24-51, 321-73-54
Telex: 52603 hpbe e
A,CM,CP,E,MS,P

Hewlett-Packard Espanola S.A.
c/San Vicente s/n
Edificio Albia II, 7°B
E-**BILBAO** 1
Tel: 423-82-06, 423-83-06
A,CM,E,MS

Hewlett-Packard Espanola S.A.
Calle Jerez 3
E-**MADRID** 16
Tel: (1) 458-2600
Telex: 23515 hpe
A,CM,E,MP,P

Hewlett-Packard Espanola S.A.
Colonia Mirasierra
Edificio Juban
c/o Costa Brava 13
E-**MADRID** 34
Tel: (1) 734-8061, 734-1162
CM,CP

Hewlett-Packard Espanola S.A.
Av Ramon y Cajal 1
Edificio Sevilla 1, Planta 9
E-**SEVILLA** 5
Tel: (954) 64-44-54, 64-44-58
A,CM,CS,MS,P

Hewlett-Packard Espanola S.A.
C/Ramon Gordillo 1 (Entlo.)
E-**VALENCIA** 10
Tel: (96) 361-1354
CM,CS,P

SRI LANKA

Metropolitan Agencies Ltd.
209/9 Union Place
COLOMBO 2
Tel: 35947
Telex: 1377METROLTD CE
Cable: METROLTD
A,E,M,P

SUDAN

Radison Trade
P.O. Box 921
KHARTOUM
Tel: 44048
Telex: 375
A,E,M

SURINAM

Surtel Radio Holland N.V.
Grote Hofstr. 3-5
P.O. Box 155
PARAMARIBO
Tel: 72118, 77880
Cable: Surtel
E,M

SWEDEN

Hewlett-Packard Sverige AB
Enighetsvagen 3
S-16120 **BROMMA**
Tel: (08) 730-0550
Telex: (854) 10721 MESSAGES
Cable: MEASUREMENTS
A,CM,CP,E,MS,P

Hewlett-Packard Sverige AB
Sunnanvagen 14K
S-22226 **LUND**
Tel: (46) 13-69-79
CM,CS

Hewlett-Packard Sverige AB
Vastra Vintergatan 9
S-70344 **OREBRO**
Tel: (019) 14-07-20
CM,CS

Hewlett-Packard Sverige AB
Frotallisgatan 30
S-42132 **VASTRA-FROLUNDA**
Tel: (031) 49-09-50
Telex: 85410721
CM,CS,E,P

SWITZERLAND

Hewlett-Packard (Schweiz) AG
Clarastrasse 12
CH-4058 **BASEL**
Tel: (061) 33-59-20
A,CM

Hewlett-Packard (Schweiz) AG
Bahnhoherweg 44
3018 **BERN**
Tel: (031) 56-24-22
CM

Hewlett-Packard (Schweiz) AG
47 Avenue Blanc
CH-1202 **GENEVA**
Tel: (022) 32-30-05, 32-48-00
CM,CP

Hewlett-Packard (Schweiz) AG
29 Chemin Chateau Bloc
CH-1219 **LE LIGNON**-Geneva
Tel: (022) 96-03-22
Telex: 27333 hpag ch
Cable: HEWPACKAG Geneva
A,CM,E,MS,P

Hewlett-Packard (Schweiz) AG
Zurcherstrasse 20
P.O. Box 307
CH-8952 **SCHLIEREN**-Zurich
Tel: (01) 730-5240, 730-1821
Telex: 53933 hpag ch
Cable: HPAG CH
A,CM,CP,E,MS,P

SYRIA

General Electronic Inc.
Nuri Basha-Ahnaf Ebn Kays Street
P.O. Box 5781
DAMASCUS
Tel: 33-24-87
Telex: 11215 ITIKAL
Cable: ELECTROBOR DAMASCUS
E

Sawah & Co.
Place Azme
Boite Postale 2308
DAMASCUS
Tel: 16-367, 19-697, 14-268
Telex: 11304 SATACO SY
Cable: SAWAH, DAMASCUS
M

Suleiman Hilal El Mlawi
P.O. Box 2528
Mamoun Bitar Street, 56-58
DAMASCUS
Tel: 11-46-63
Telex: 11270
Cable: HILAL DAMASCUS
M

TAIWAN

Hewlett-Packard Far East Ltd.
Kaohsiung Branch
68-2, Chung Cheng 3rd Road
Shin Shin, Chu
KAOHSIUNG
Tel: 241-2318, 261-3253
CS,E,MS,P

Hewlett-Packard Far East Ltd.
Taiwan Branch
Bank Tower, 5th Floor
205 Tun Hwa North Road
TAIPEI
Tel. 751-0404
Cable:HEWPACK Taipei
A*,CP,E,MS,P

San Kwang Instruments Co., Ltd.
20 Yung Sui Road
TAIPEI
Tel: 361-5446, 361-5447, 361-5448, 361-5449
Telex: 22894 SANKWANG
Cable: SANKWANG Taipei
A

TANZANIA

International Aeradio (E.A.) Ltd.
P.O. Box 861
DAR ES SALAAM
Tel: 21251
Telex: 41030
M

THAILAND

UNIMESA Co. Ltd.
Elcom Research Building
2538 Sukhumvit Ave.
Bangchak, ***BANGKOK***
Tel: 393-2387, 393-0338
Telex: TH81160, 82938, 81038
Cable: UNIMESA Bangkok
A,E,M

Bangkok Business Equipment Ltd.
5/5-6 Dejo Road
BANGKOK
Tel: 234-8670, 234-8671, 234-8672, 234-8673
Cable: BUSIQUIPT Bangkok
P

TRINIDAD & TOBAGO

CARTEL
Caribbean Telecoms Ltd.
P.O. Box 732
50/A Jerningham Avenue
PORT-OF-SPAIN
Tel: 62 4214, 62 4213
A,E,M,P

TUNISIA
Tunisie Electronique
31 Avenue de la Liberte
TUNIS
Tel: 280-144
E,P

Corema
1 ter. Av. de Carthage
TUNIS
Tel: 253-821
Telex: 12319 CABAM TN
M

TURKEY
Teknim Company Ltd.
Riza Sah Pehlievi
Caddesi No. 7
Kavaklidere, ***ANKARA***
Tel: 275800
Telex: 42155
E

UNITED ARAB EMIRATES
Emitac Ltd.
P.O. Box 2711
ABU DHABI
Tel: 331370, 331371
E,M,P

Emitac Ltd.
P.O. Box 1641
SHARJAH
Tel: 354121, 354123
Telex: 68136
E,M,P

UNITED KINGDOM
see: GREAT BRITAIN
NORTHERN IRELAND
SCOTLAND

UNITED STATES OF AMERICA

Alabama
Hewlett-Packard Co.
700 Century Park South
Suite 128
BIRMINGHAM, AL 35226
Tel: (205) 822-6802
CM,CS,MP

Hewlett-Packard Co.
P.O. Box 4207
8290 Whitesburg Drive, S.E.
HUNTSVILLE, AL 35802
Tel: (205) 881-4591
CM,CP,E,M*

Alaska
Hewlett-Packard Co.
1577 "C" Street, Suite 252
ANCHORAGE, AK 99510
Tel: (206) 454-3971
CM,CS**

Arizona
Hewlett-Packard Co.
2336 East Magnolia Street
PHOENIX, AZ 85034
Tel: (602) 273-8000
A,CM,CP,E,MS

Hewlett-Packard Co.
2424 East Aragon Road
TUCSON, AZ 85706
Tel: (602) 889-4661
CM,CS,E,MS**

Arkansas
Hewlett-Packard Co.
P.O. Box 5646
Brady Station
LITTLE ROCK, AR 72215
Tel: (501) 376-1844
CM,MS

California
Hewlett-Packard Co.
7621 Canoga Avenue
CANOGA PARK, CA 91304
Tel: (213) 702-8300
A,CM,CP,E,P

Hewlett-Packard Co.
1579 W. Shaw Avenue
FRESNO, CA 93771
Tel: (209) 224-0582
CM,MS

Hewlett-Packard Co.
1430 East Orangethorpe
FULLERTON, CA 92631
Tel: (714) 870-1000
CM,CP,E,MP

Hewlett-Packard Co.
5400 W. Rosecrans Boulevard
LOS ANGELES, CA 90260
Tel: (213) 970-7500
CM,CP,MP

Hewlett-Packard Co.
3939 Lankersham Blvd.
NORTH HOLLYWOOD, CA 91604
Tel: (213) 877-1282
regional headquarters

Hewlett-Packard Co.
3200 Hillview Avenue
PALO ALTO, CA 94304
Tel: (415) 857-8000
CM,CP,E

Hewlett-Packard Co.
646 W. North Market Boulevard
SACRAMENTO, CA 95834
Tel: (916) 929-7222
A*,CM,CS,E,MS

Hewlett-Packard Co.
9606 Aero Drive
P.O. Box 23333
SAN DIEGO, CA 92123
Tel: (714) 279-3200
CM,CP,E,MP

Hewlett-Packard Co.
363 Brookhollow Drive
SANTA ANA, CA 92705
Tel: (714) 641-0977
A,CM,C*,E

Hewlett-Packard Co.
3003 Scott Boulevard
SANTA CLARA, CA 95050
Tel: (408) 988-7000
A,CM,CP,E,MP

Hewlett-Packard Co.
454 Carlton Court
SO. SAN FRANCISCO, CA 94080
Tel: (415) 877-0772
CM,CP

Colorado
Hewlett-Packard Co.
5600 DTC Parkway
ENGLEWOOD, CO 80110
Tel: (303) 771-3455
A,CM,CP,E,MS

Connecticut
Hewlett-Packard Co.
47 Barnes Industrial Road South
P.O. Box 5007
WALLINGFORD, CT 06492
Tel: (203) 265-7801
A,CM,CP,E,MS

Florida
Hewlett-Packard Co.
P.O. Box 24210
2727 N.W. 62nd Street
FORT LAUDERDALE, FL 33309
Tel: (305) 973-2600
CM,CP,E,MP

Hewlett-Packard Co.
4080 Woodcock Drive, #132
Brownett Building
JACKSONVILLE, FL 32207
Tel: (904) 398-0663
CM,C*,E*,MS**

Hewlett-Packard Co.
P.O. Box 13910
6177 Lake Ellenor Drive
ORLANDO, FL 32809
Tel: (305) 859-2900
A,CM,CP,E,MS

Hewlett-Packard Co.
P.O. Box 12826
Suite 5, Building 1
Office Park North
PENSACOLA, FL 32575
Tel: (904) 476-8422
A,CM,MS

Hewlett-Packard Co.
110 South Hoover, Suite 120
TAMPA, FL 33609
Tel: (813) 872-0900
A*,CM,CS,E*,M*

Georgia
Hewlett-Packard Co.
P.O. Box 105005
450 Interstate N. Parkway
ATLANTA, GA 30339
Tel: (404) 955-1500
Telex: 810-766-4890
A,CM,CP,E,MP

Hewlett-Packard Co.
Executive Park Suite 306
P.O. Box 816
AUGUSTA, GA 30903
Tel: (404) 736-0592
CM,MS

Hewlett-Packard Co.
P.O. Box 2103
1172 N. Davis Drive
WARNER ROBINS, GA 31098
Tel: (912) 922-0449
CM,E

Hawaii
Hewlett-Packard Co.
2875 South King Street
HONOLULU, HI 96826
Tel: (808) 955-4455
A,CM,CS,E,MS

Idaho
Hewlett-Packard Co.
11311 Chinden Boulevard
BOISE, ID 83707
Tel: (208) 376-6000
CM,CS,M*

Illinois
Hewlett-Packard Co.
211 Prospect Road
BLOOMINGTON, IL 61701
Tel: (309) 663-0383
CM,CS,MS**

Hewlett-Packard Co.
1100 31st Street
DOWNERS GROVE, IL 60515
Tel: (312) 960-5760
CM,CP

Hewlett-Packard Co.
5201 Tollview Drive
ROLLING MEADOWS, IL 60008
Tel: (312) 255-9800
A,CM,CP,E,MP

Indiana
Hewlett-Packard Co.
P.O. Box 50807
7301 No. Shadeland Avenue
INDIANAPOLIS, IN 46250
Tel: (317) 842-1000
A,CM,CS,E,MS

Iowa
Hewlett-Packard Co.
5815 S.W. 5th Street
DES MOINES, IA 50315
Tel: (515) 243-5876
CM,MS**

Hewlett-Packard Co.
2415 Heinz Road
IOWA CITY, IA 52240
Tel: (319) 351-1020
CM,CS,E*,MS

Kansas
Hewlett-Packard Co.
514 South Westview
DERBY, KA 67037
Tel: (316) 265-5200
CM,CS

Kentucky
Hewlett-Packard Co.
10170 Linn Station Rd., Suite 525
Atkinson Square
LOUISVILLE, KY 40223
Tel: (502) 426-0100
A,CM,CS,MS

Louisiana
Hewlett-Packard Co.
P.O. Box 1449
3229 Williams Boulevard
KENNER, LA 70062
Tel: (504) 443-6201
A,CM,CS,E,MS

Maryland
Hewlett-Packard Co.
7121 Standard Drive
HANOVER, MD 21076
Tel: (301) 796-7700
A,CM,CP,E,MS

Hewlett-Packard Co.
2 Choke Cherry Road
ROCKVILLE, MD 20850
Tel: (301) 948-6370
A,CM,CP,E,MP

Massachusetts
Hewlett-Packard Co.
32 Hartwell Avenue
LEXINGTON, MA 02173
Tel: (617) 861-8960
A,CM,CP,E,MP

Michigan
Hewlett-Packard Co.
23855 Research Drive
FARMINGTON HILLS, MI 48024
Tel: (313) 476-6400
A,CM,CP,E,MP

Hewlett-Packard Co.
4326 Cascade Road S.E.
GRAND RAPIDS, MI 49506
Tel: (616) 957-1970
CM,CS,MS

Minnesota
Hewlett-Packard Co.
2025 W. Larpenteur Ave.
ST. PAUL, MN 55113
Tel: (612) 644-1100
A,CM,CP,E,MP

Mississippi
Hewlett-Packard Co.
322 N. Mart Plaza
JACKSON, MS 39206
Tel: (601) 982-9363
CM,MS

Missouri
Hewlett-Packard Co.
11131 Colorado
KANSAS CITY, MO 64137
Tel: (816) 763-8000
Telex: 910-771-2087
A,CM,CS,E,MS

Hewlett-Packard Co.
1024 Executive Parkway
ST. LOUIS, MO 63141
Tel: (314) 878-0200
A,CM,CP,E,MP

Nebraska
Hewlett-Packard
Suite 101
7101 Mercy Road
OMAHA, NE 68106
Tel: (402) 392-0948
CM,MS

Nevada
Hewlett-Packard Co.
Suite D-130
5030 Paradise Blvd.
LAS VEGAS, NV 89119
Tel: (702) 736-6610
CM,MS**

New Jersey
Hewlett-Packard Co.
W120 Century Road
PARAMUS, NJ 07652
Tel: (201) 265-5000
A,CM,CP,E,MP

Hewlett-Packard Co.
60 New England West
PISCATAWAY, NJ 08854
Tel: (201) 981-1199
A,CM,CP,E

New Mexico
Hewlett-Packard Co.
P.O. Box 11634
Station E
11300 Lomas Blvd.,N.E.
ALBUQUERQUE, NM 87192
Tel: (505) 292-1330
Telex: 910-989-1185
CM,CP,E,MS

Hewlett-Packard Co.
156 Wyatt Drive
LAS CRUCES, NM 88001
Tel: (505) 526-2484
Telex: 910-9983-0550
CM,C*,E,M*

New York
Hewlett-Packard Co.
6 Automation Lane
Computer Park
ALBANY, NY 12205
Tel: (518) 458-1550
Telex: 710-444-4691
A,CM,CS,E,MS

Hewlett-Packard Co.
650 Perinton Hill Office Park
FAIRPORT, NY 14450
Tel: (716) 223-9950
Telex: 510-253-0092
CM,CP,E,MS

Hewlett-Packard Co.
No. 1 Pennsylvania Plaza
55th Floor
34th Street & 8th Avenue
NEW YORK, NY 10001
Tel: (212) 971-0800
CM,CP,E*,M*

Hewlett-Packard Co.
5858 East Molloy Road
SYRACUSE NY 13211
Tel: (315) 455-2486
A,CM,CS,E,MS

Hewlett-Packard Co.
3 Crossways Park West
WOODBURY, NY 11797
Tel: (516) 921-0300
Telex: 510-221-2183
A,CM,CP,E,MS

6

SALES & SUPPORT OFFICES

Arranged alphabetically by country

North Carolina
Hewlett-Packard Co.
5605 Roanne Way
GREENSBORO, NC 27409
Tel: (919) 852-1800
A,CM,CP,E,MS

Ohio
Hewlett-Packard Co.
9920 Carver Road
CINCINNATI, OH 45242
Tel: (513) 891-9870
CM,CP,MS

Hewlett-Packard Co.
16500 Sprague Road
CLEVELAND, OH 44130
Tel: (216) 243-7300
Telex: 810-423-9430
A,CM,CP,E,MS

Hewlett-Packard Co.
962 Crupper Ave.
COLUMBUS, OH 43229
Tel: (614) 432-1041
CM,CP,E*

Hewlett-Packard Co.
330 Progress Rd.
DAYTON, OH 45449
Tel: (513) 859-8202
A,CM,CP,E*,MS

Oklahoma
Hewlett-Packard Co.
P.O. Box 32008
6301 N. Meridan Avenue
OKLAHOMA CITY, OK 73122
Tel: (405) 721-0200
A*,CM,CP,E*,MS

Hewlett-Packard Co.
Suite 121
9920 E. 42nd Street
TULSA, OK 74145
Tel: (918) 665-3300
A**,CM,CS,M*

Oregon
Hewlett-Packard Co.
9255 Pioneer Court
WILSONVILLE, OR 97070
Tel: (503) 682-8000
A,CM,CP,E*,MS

Pennsylvania
Hewlett-Packard Co.
Crystal Brook Professional Building
Route 35
EATONTOWN, PA 07724
Tel: (201) 542-1384
A*,CM,C*,E*,P*

Hewlett-Packard Co.
1021 8th Avenue
King of Prussia Industrial Park
KING OF PRUSSIA, PA 19406
Tel: (215) 265-7000
Telex: 510-660-2670
A,CM,CP,E,MP

Hewlett-Packard Co.
111 Zeta Drive
PITTSBURGH, PA 15238
Tel: (412) 782-0400
A,CM,CP,E,MP

South Carolina
Hewlett-Packard Co.
P.O. Box 6442
6941-1 N. Trenholm Road
COLUMBIA, SC 29260
Tel: (803) 782-6493
CM,CS,E,MS

Tennessee
Hewlett-Packard Co.
8906 Kingston Pike
KNOXVILLE, TN 37919
Tel: (615) 691-2371
A*,CM,MS

Hewlett-Packard Co.
3070 Directors Row
Directors Square
MEMPHIS, TN 38131
Tel: (901) 346-8370
A,CM,CS,MS

Hewlett-Packard Co.
Suite 103
478 Craighead Street
NASHVILLE, TN 37204
Tel: (615) 383-9130
CM,MS**

Texas
Hewlett-Packard Co.
Suite 310W
7800 Shoalcreek Blvd.
AUSTIN, TX 78757
Tel: (512) 459-3143
CM,E

Hewlett-Packard Co.
Suite C110
4171 North Mesa
EL PASO, TX 79902
Tel: (915) 533-3555
CM,CS,E*,MS**

Hewlett-Packard Co.
5020 Mark IV Parkway
FORT WORTH, TX 76106
Tel: (817) 625-6361
CM,C*

Hewlett-Packard Co.
10535 Harwin Street
HOUSTON, TX 77036
Tel: (713) 776-6400
A,CM,CP,E,MP

Hewlett-Packard Co.
P.O. Box 1270
930 E. Campbell Rd.
RICHARDSON, TX 75081
Tel: (214) 231-6101
A,CM,CP,E,MP

Hewlett-Packard Co.
205 Billy Mitchell Road
SAN ANTONIO, TX 78226
Tel: (512) 434-8241
CM,CS,E,MS

Utah
Hewlett-Packard Co.
3550 W. 2100 South Street
SALT LAKE CITY, UT 84119
Tel: (801) 974-1700
A,CM,CP,E,MS

Virginia
Hewlett-Packard Co.
P.O. Box 9669
2914 Hungary Spring Road
RICHMOND, VA 23228
Tel: (804) 285-3431
A,CM,CP,E,MS

Hewlett-Packard Co.
3110 Peters Creek Road, N.W.
ROANOKE, VA 24015
Tel: (703) 922-7000
CM,CS,E**

Hewlett-Packard Co.
5700 Thurston Avenue
VIRGINIA BEACH, VA 23455
Tel: (804) 460-2471
CM,CS,MS

Washington
Hewlett-Packard Co.
Bellefield Office Park
1203 114th Ave. S.E
BELLEVUE, WA 98004
Tel: (206) 454-3971
A,CM,CP,E,MP

Hewlett-Packard Co.
Suite A-1
708 North Argonne Road
SPOKANE, WA 99206
Tel: (509) 535-0864
CM,CS

West Virginia
Hewlett-Packard Co.
4604 MacCorkle Ave., S.E.
CHARLESTON, WV 25304
Tel: (304) 925-0492
A,CM,MS

Wisconsin
Hewlett-Packard Co.
150 S. Sunny Slope Road
BROOKFIELD, WI 53005
Tel: (414) 784-8800
A,CM,CS,E*,MP

URUGUAY

Pablo Ferrando S.A.C. e.I.
Avenida Italia 2877
Casilla de Correo 370
MONTEVIDEO
Tel: 40-3102
Telex: 901 Public Booth Para Pablo Ferrando 919520
Cable: RADIUM Montevideo
A,E,M

Guillermo Kraft del Uruguay S.A.
Avda. Libertador Brig. Gral.
Lavalleja 2083
MONTEVIDEO
Tel: 23 45 88, 23 48 08, 20 88 30
P

VENEZUELA

Hewlett-Packard de Venezuela C.A.
P. O. Box 50933
3a Transversal Los Ruices Norte
Edificio Segre 2Y3
CARACAS 1071
Tel: 239-4133
Telex: 25146 HEWPACK
Cable: HEWPACK Caracas
A,CP,E,MS,P

YUGOSLAVIA

Iskra Commerce, n. sol. o.
Zastopstvo Hewlett-Packard
Obilicev Venac 26
YU 11000 ***BEOGRAD***
Tel: 636955
Telex: 11530
C,E*,M*,P**

Iskra Commerce, n. sol. o.
Zastopstvo Hewlett-Packard
Miklosiceva 38/VII
YU-61000 ***LJUBLJANA***
Tel: 321674, 315870
Telex: 31300
C,E*,M*,P**

ZAMBIA

R.J. Tilbury (Zambia) Ltd.
P.O. Box 2792
LUSAKA
Tel: 81243
A,E,M,P

FOR COUNTRIES AND AREAS NOT LISTED:

CANADA

Ontario
Hewlett-Packard (Canada) Ltd.
6877 Goreway Drive
MISSISSAUGA, Ontario L4V IM8
Tel: (416) 678-9430
Telex: 610-492-4246

EASTERN USA

New Jersey
Hewlett-Packard Co.
W120 Century Road
PARAMUS, NJ 07652
Tel: (201) 265-5000

MIDWESTERN USA

Illinois
Hewlett-Packard Co.
5201 Tollview Drive
ROLLING MEADOWS, IL 60008
Tel: (312) 255-9800

SOUTHERN USA

Georgia
Hewlett-Packard Co.
P.O. Box 105005
450 Interstate N. Parkway
ATLANTA, GA 30339
Tel: (404) 955-1500
Telex: 810-766-4890

WESTERN USA

California
Hewlett-Packard Co.
3939 Lankersham Blvd.
NORTH HOLLYWOOD, CA 91604
Tel: (213) 877-1282

EAST EUROPEAN AREAS

AUSTRIA

Hewlett-Packard Ges.m.b.h.
Wehlistrasse 29
P.O. Box 7
A-1205 **VIENNA**, Austria
Tel: (222) 35-16-20
Telex: 135823/135066

EUROPEAN AREAS

SWITZERLAND

Hewlett-Packard S.A.
7 Rue du Bois-du-Lan
CH-1217 **MEYRIN** 2, Switzerland
Tel: (022) 98-96-51
Telex: 27835 hpse
Cable: HEWPACKSA Geneve

MEDITERRANEAN AND MIDDLE EAST AREAS

GREECE

Hewlett-Packard S.A.
Mediterranean & Middle East
Operations
35 Kolokatroni St.
Platia Kefallariou
GR-Kifissia, **ATHENS**, Greece
Tel: 808-0359, 808-0429
Telex: 21-6588
Cable: HEWPACKSA Athens

OTHER AREAS

Hewlett-Packard Co.
ICON Headquarters
3495 Deer Creek Road
PALO ALTO, CA 94304
U.S.A.
Tel: (415) 857-2824
TWX: 910-373-1267
Telex: 034-8300; 034-8493
Cable: HEWPACK