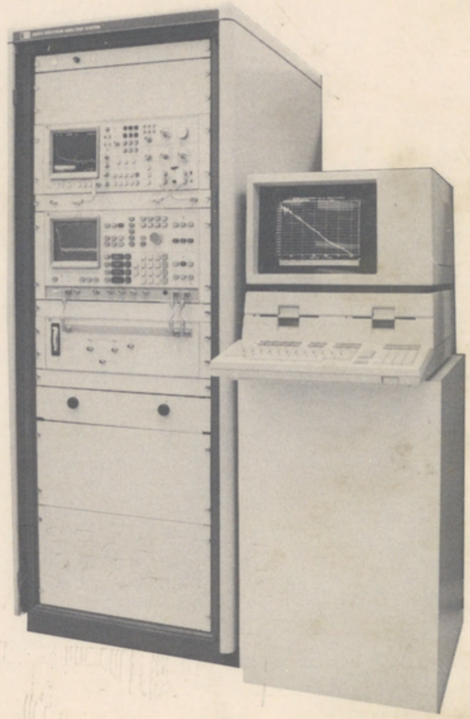
SYSTEM REFERENCE MANUAL

SPECTRUM ANALYZER SYSTEM

3047A

ED PERDUE
CSL

OPTION 036



VOLUME II

Software Modification
Utility Software Description
Performance Tests
Special Operating Considerations

HEWLETT PACKARD

HEWLETT PACKARD

SYSTEM REFERENCE MANUAL

MODEL 3047A SPECTRUM ANALYZER SYSTEM

OPTION 036

WARNING

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

VOLUME II

Manual Part No. 03047-90013

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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.
ϟ	Indicates dangerous voltage (terminals fed from the interior by voltage exceeding 1000 volts must be so marked).
⏚ OR (⏚)	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.
⏛ OR ⊥	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 discs 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 "DO YOU WANT TO USE THE CLOCK (Y/N)?",A$

prompts with the statement DO YOU WANT TO USE THE CLOCK (Y/N)? and waits for the keyboard entry that is assigned to the variable A$. (Depressing the computer continue key without entering data causes a default entry and the variable retains the data most recently assigned.)

```
        .
        .
        .
        .
Not9836: !
        .
        .
        .
   Setupclock
        .
        .
        .
Setupclock: !
SUB Setupclock
        .
        .
        .
   Clock = 1
   A$[1] = "Y"
   INPUT "DO YOU WANT TO USE CLOCK (Y/N)?", A$
   IF FNUpc$(A$[1,1]) = "N" THEN
                     Clock = 0
                     SUBEXIT

   END IF
   Ask again: INPUT "DAY, MONTH,YEAR (e.g. 24, 19, 1982)", Day, Month, Year
        .
        .
        .
SUBEND
```

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

It is necessary to consider operation of the Direct Spectrum Analysis Setupclock routine prior to modification of this INPUT statement. Initially program control is transferred to the Setupclock routine from the main program by the Setupclock CALL statement. Setupclock initializes the program variables CLOCK and A$ prior to executing the INPUT statement which is to be eliminated. The IF statement following the INPUT statement logically evaluates the first character assigned to the variable A$. If this character is equal to "N" the statements following the key word THEN are executed. Thus, if the entered response indicates that a real time clock is not to be used the Clock variable is assigned the value of zero and due to the SUBEXIT program execution continues following at the Setupclock CALL statement. Immediately preceding the INPUT statement is a statement assigning "Y" to the variable A$ 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 with the label Askagain. When the SUBEND statement is reached, program execution continues with the statement following the Setupclock CALL statement.

Modification of the program depends on the desired operation of the program. If it is desired that the clock be used, it is only necessary to deactivate or eliminate the input statement. The variable evaluated by the IF statements is defined for a negative result and the INPUT statement causes a program pause and provides an opportunity to change the variable from the positive default value. Without the INPUT statement, there is no pause and no change to the variable. An exclamation point placed at the start of the statement will deactivate the statement. The program interprets the characters following an exclamation point to be a remark and the INPUT statement is not executed. Thus, to eliminate this statement , edit the program statement to start with an exclamation point:

```
! INPUT "DO YOU WANT TO USE THE CLOCK (Y/N)?", A$
```

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

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

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

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

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.

More information on the the comment delimiter (exclamation point), remark, PAUSE, INPUT, LINPUT, and IF statements may be obtained from the BASIC Language Reference 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 cursor wheel or 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 (TRACE ALL, TRACE OFF) and 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 lowercase 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.

After a program is modified, it is necessary to STORE or SAVE the program on a disc 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 BASIC Language Reference 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 an ASCII file and stores the program and subprograms in computer memory into the file. If a program is saved as an ASCII 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 ASCII 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.

Additional information on the SAVE, STORE, RE-SAVE, RE-STORE, GET, LOAD, STORE BIN, and LOAD BIN commands is found in the BASIC Operating Manual or the BASIC Language Reference manual. If a new disc is to be used in storing the programs, it may be necessary to format the disc. For information on formatting the disc, refer to the INITIALIZE statement in the BASIC Operating 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 LIBRARY file is appended to the end of the phase noise analysis program. Appending LIBRARY alters the length of the phase noise analysis program and prohibits storage of the phase noise program on a disc with the store command. Each program segment (LIBRARY and phase noise analysis) is loaded, edited, then stored separately.

Additional information on the STORE, command is found in the BASIC Operating manual. If a new disc is to be used in storing the programs, it may be necessary to format the disc. For information on formatting the disc, refer to the INITIALIZE statement in the BASIC Operating 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 continue. To activate switch, load the program to be modified and enter the command EDIT followed by the label Loop (for direct analysis) or continue (for AM/PM or phase noise analysis). Use the cursor wheel or arrow keys on the computer to scan the program for ! ON KEY 18, 9 CALL Switch and to position the cursor on the ! preceding the word ON. Press the computer EDITING DEL CHR key, press the ENTER key, and press the PAUSE 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 disc if it is desired to keep the modified program. Additional information on the EDIT and STORE commands is found in the BASIC Operating manual or BASIC Language Reference manual.

SECTION 6
UTILITY SOFTWARE DESCRIPTION

SECTION 6
UTILITY SOFTWARE DESCRIPTION

6-1. AUTOST PROGRAM

The AUTOST program programs are coded to load and run selected -hp- 3047A programs. Computers with ROM BASIC will run this program automatically (thus run a measurement program automatically) if a disc with the AUTOST and related measurement programs is in the right disc drive when power is intially applied to the computer. The AUTOST programs are coded to load and run the following programs: DIRECT, AM_AND_PM, PHASE, or 3047ACHECK.

6-2. CHECKSUM PROGRAM

The CHECKSUM program verifies that a copy of the -hp- 3047A software is a replica of the master software. During operation, the program computes a number that corresponds to the numeric value of the data stored on a disc and compares this number to the value determined at the factory. The program then informs the operator whether or not the comparison succeeded. A successful comparison indicates that the disc is a replica of the master disc. An unsuccessful comparison only indicates that the disc checksummed is not a replica of the master disc. The comparison can fail due to: files added to or purged from the disc, copy errors, modifications to programs, or the master disc checksum value was not transfered to the disc being checksummed. 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 "CHECKSUM" then depress the run key. When the computer displays "INSERT DISC TO BE CHECKSUMMED IN THE RIGHT DISC DRIVE, PRESS CONTINUE", insert the disc to be checksummed in the right disc drive and press the continue key. The program processes the disc data and, after a brief time, the checksum value is returned.

6-3. LIBRARY PROGRAM

The LIBRARY program contains subroutines common to other programs included on the -hp-3047A system discs. With the exception of the phase noise analysis, the necessary LIBRARY 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 LIBRARY routines on a single disc. The phase noise analysis program loads LIBRARY during operation to obtain the subroutines required for operation. Details of LIBRARY routines are included in the block diagrams and descriptions of the programs requiring the LIBRARY routines.

6-4. OSCILLATOR 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.

Oscillator Comparison Operation

The Oscillator Comparison Program computes the noise of up to three individual oscillators from data files consisting of pair wise comparisons of the oscillators generated by the noise measurement software. To run the program, insert the LIBRARY AND OSCILLATOR disc in the right disc drive, then enter the computer command LOAD "OSCILLATOR", 1 and press the EXECUTE key on the computer keyboard. Shortly the following menu will be displayed:

MAIN MENU — OSCILLATOR COMPARISON

K0...INPUT A SINGLE DATA FILE
K1...PERFORM A 2 OSCILLATOR COMPARISON
K2...PERFORM A 3 OSCILLATOR COMPARISON
K3...PLOT DATA / GENERATE NEW GRATICULE

K5...WRITE MEASUREMENT DATA TO MASS STORAGE

K7...DISPLAY ALPHA
K8...DISPLAY GRAPHICS
(SHIFT) K0...DRAW SLOPE LINES ON GRAPH
(SHIFT) K2...POSITION CRT MARKER ON GRAPH

The program pauses at this point and waits for the selection of a special function key. It is important to note that data files must be read from mass storage with special function key K0 prior to selection of the remaining special function keys.

K0...INPUT A SINGLE DATA FILE

Pressing this special function key initiates the routine to recall data files from mass storage. During operation the routine requests information on the type of data file to recall (Oscillator A, B, C, A vs C, B vs C, or C vs A), which disc drive to use (:INTERNAL, 4, 0, is the right disc drive and :INTERNAL, 4, 1 is the left disc drive), and the name of the data file to recall. After the data file is read, spurs are deleted from the file and an opportunity is provided to translate the carrier frequency of the file.

K1...PERFORM A 2 OSCILLATOR COMPARISON

The two oscillator comparison routine produces a resultant file for a single oscillator from a comparison file of two oscillators and a reference file of a single oscillator. Prior to pressing this key it is necessary to input an oscillator reference file (a data file of a single oscillator, i.e. Oscillator file A, B, or C) and a comparison file (data file of Oscillator A vs B, B vs C, or C vs A). When K1 is pressed, the program requests that the reference and comparison files be identified and then checks that the files are both AM or PM data files. If the file types are compatible, the program will then calculate a resultant file for the unknown oscillator. For example, performing a 2 oscillator comparison with a comparison file of oscillator A vs B and a reference file of oscillator B produces a resultant file for oscillator A.

K2...PERFORM A 3 OSCILLATOR COMPARISON

The three oscillator comparison routine produces three single oscillator resultant files from three dual oscillator comparison files. Prior to pressing this key it is necessary to input three dual oscillator comparison files (Oscillator A vs B, B vs C, and C vs A) with special function key K0. When special function key K2 is pressed, the routine checks that three files are available and that they are all AM or PM data files. If the file types are compatible the routine calculates resultant files for each oscillator (Oscillator A, B, and C).

K3...PLOT DATA / GENERATE NEW GRATICULE

Pressing this key initiates the routine to generate a new graticule and plot the data files. The data file to be plotted is selected from a menu displayed each time this key is pressed. After the data file is selected, an opportunity is presented to generate a new graticule. If data is presently on the graph and a new graticule is not desired, the data file to be plotted is plotted in addition to the data presently plotted on the graph. Requesting a new graticule erases the current display and provides the opportunity to change the current graph parameters.

K5...WRITE MEASUREMENT DATA TO MASS STORAGE

Pressing the key initiates the routine to save a data file to mass storage. During operation the routine requests information on which data file to save, which disc drive to use (:INTERNAL, 4, 0, is the right disc drive and :INTERNAL, 4, 1 is the left disc drive), and the name of the data file that is to appear in the disc catalog.

K7...DISPLAY ALPHA

Pressing this special function key turns off the graphics display and enables the computer text display. This key has the same effect as pressing the computer ALPHA key twice.

K8...DISPLAY GRAPHICS

Pressing this special function key disables the computer text display and enables the computer graphics display. This key has the same effect as pressing the computer GRAPHICS key twice.

(SHIFT) K0...DRAW SLOPE LINES ON GRAPH

Pressing this special function key enters the slope lines routine which allows slope lines to be drawn on the current graph. The slope lines are positioned on the graph by pressing SFK K0. When special function key K0 is pressed, the routine requests information concerning the X and Y coordinates and the slope of the line. Once all line data is entered, the line will appear displayed on the measurement data graph. When the line is positioned where desired, the line is saved by pressing special function key K1. During entry of the line coordinates, the graph may be viewed by pressing the computer GRAPHICS key; and pressing the ALPHA key returns the slope line entry display.

(SHIFT) K2...POSITION CRT MARKER ON GRAPH

Pressing this special function key enters the marker mode which allows a marker to be positioned on the current graph. Upon entering the marker mode, the marker mode menu is displayed. To display the data, press the right or left arrow cursor control keys, or rotate the cursor wheel. The marker is positioned on the display by using the cursor wheel and right and left arrow cursor keys on the computer keyboard. The cursor wheel rapidly moves the marker right or left, and the right and left arrow cursor control keys single steps the marker.

In addition to the cursor controls, special function keys K6 through K9 are used in the Marker Mode. Special function key K6, which is only active when the Oscillator program is initialized with an external printer, dumps the graphics display to an external HP-GL printer. Special function keys K7 and K8 toggle the display between the alpha and graphics displays. Special function key K9 terminates the marker function and returns control to the main menu of the Oscillator program.

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.

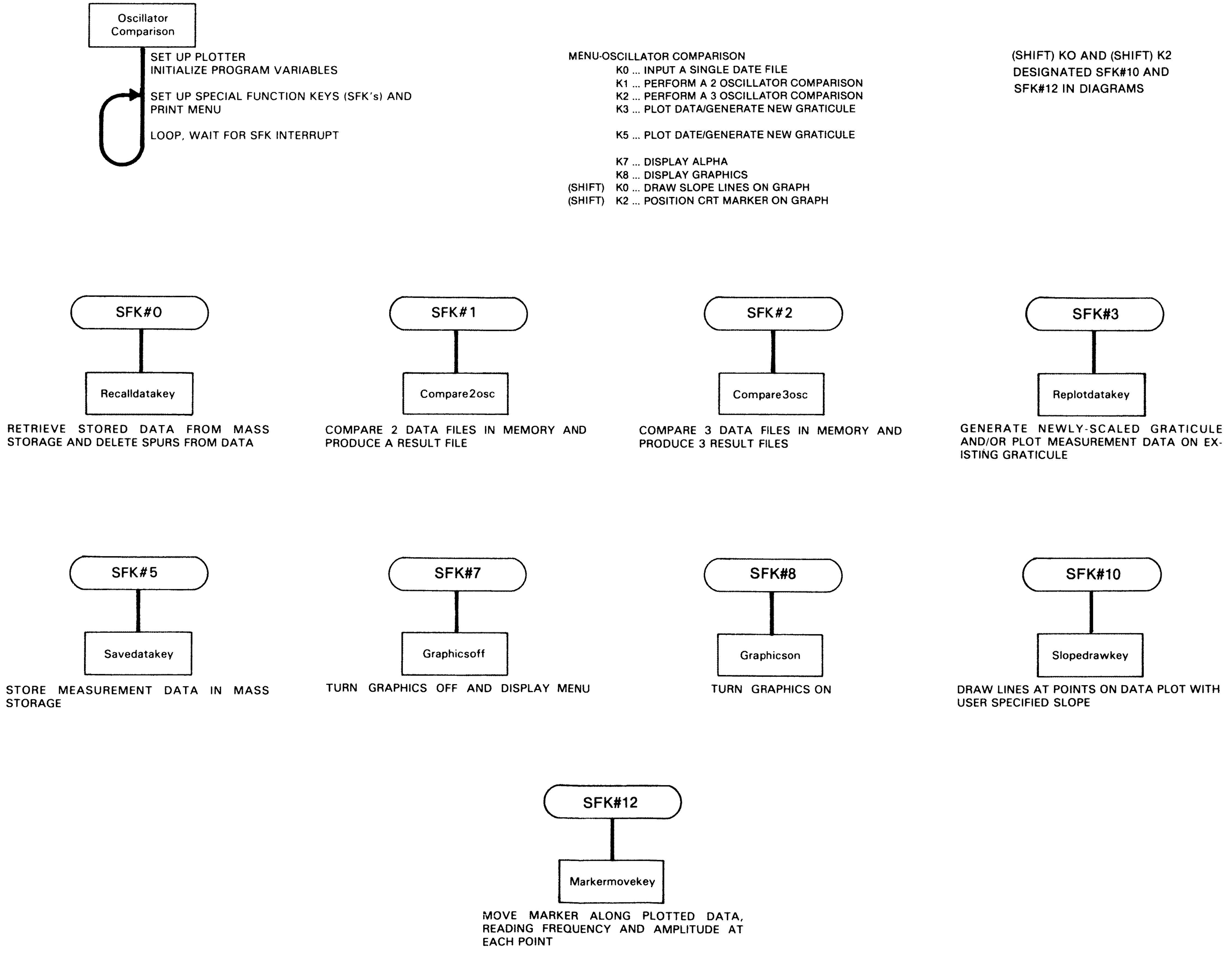


Figure 6-1. Index To Oscillator Comparison Program Special Function Key Routines

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.

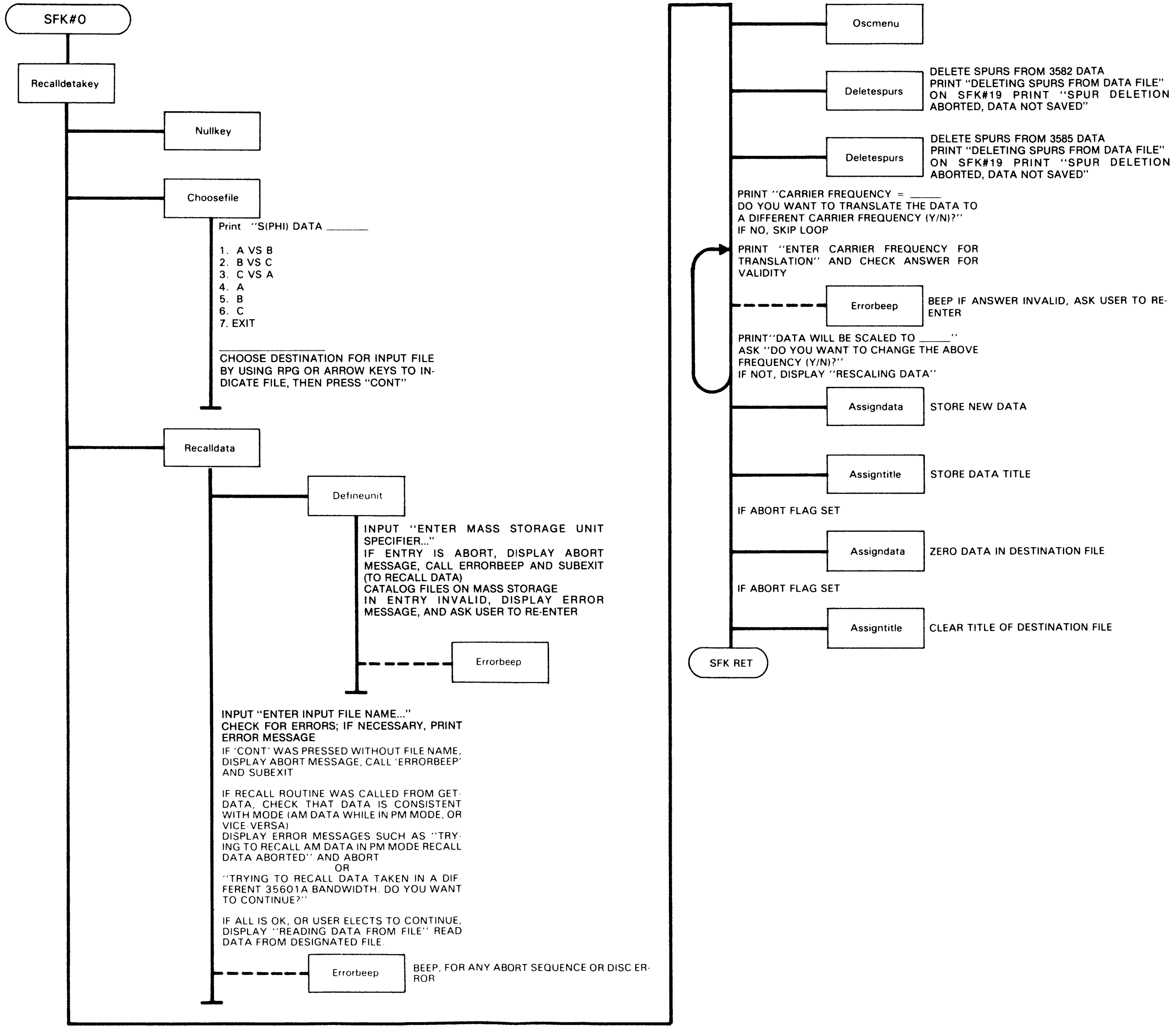


Figure 6-2. Oscillator Comparison Program Recall Data Routine (SFK#0)

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.

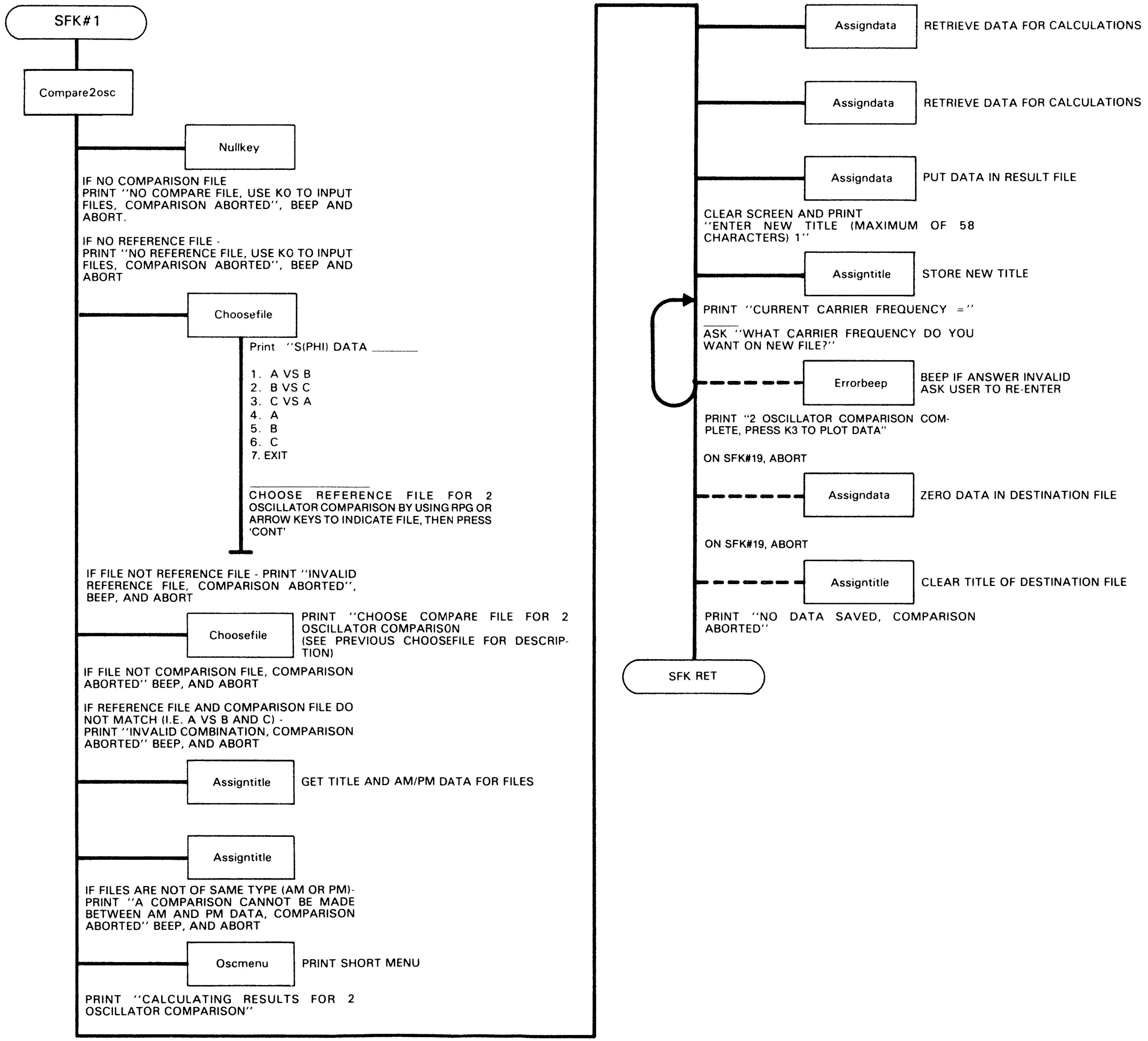


Figure 6-3. Oscillator Comparison Program Two Oscillator Comparison Routine (SFK#1)

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.

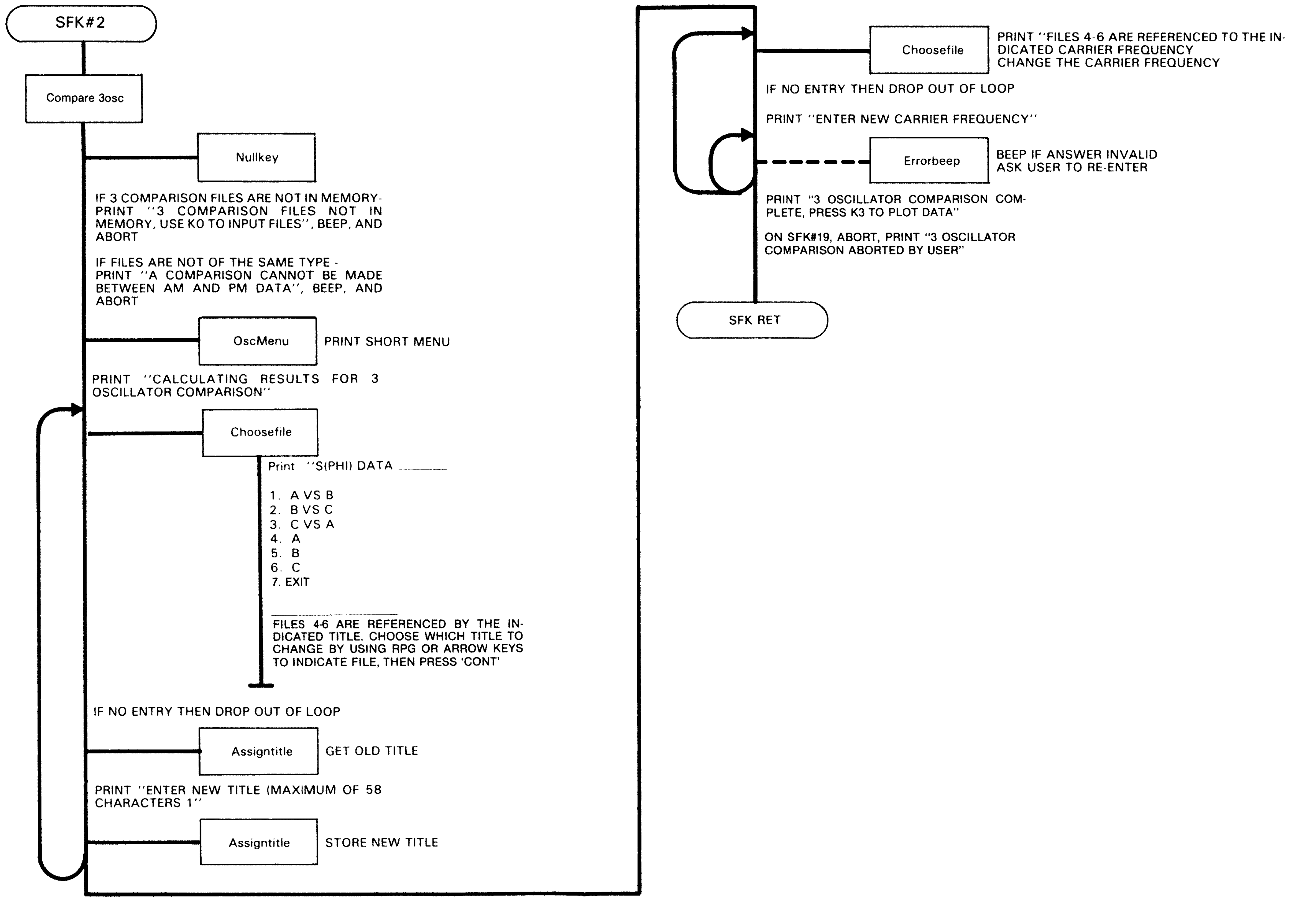


Figure 6-4. Oscillator Comparison Program Three Oscillator Comparison Routine (SFK#2)

REPLOTDATAKEY (SFK #3): 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.

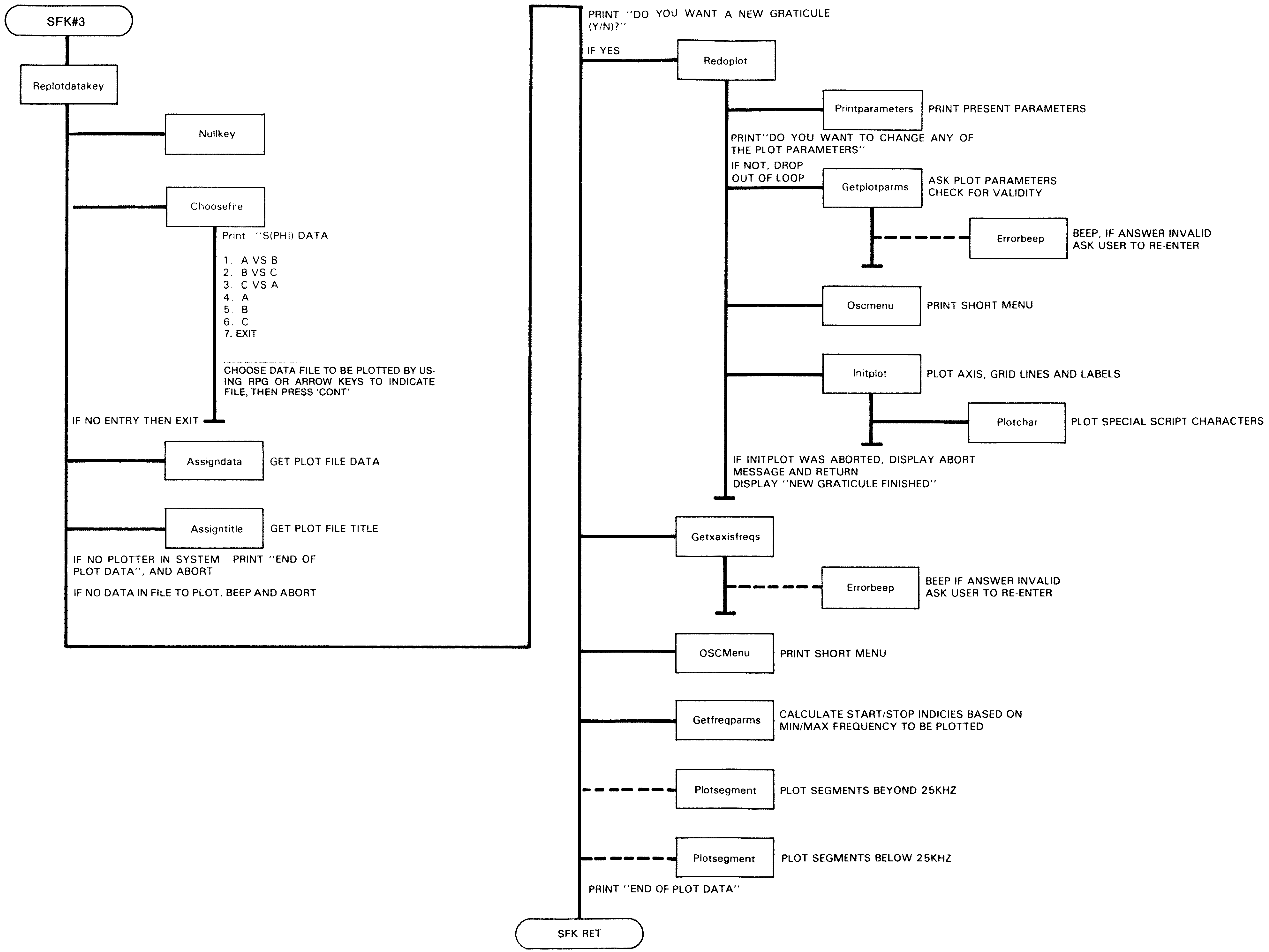


Figure 6-5. Oscillator Comparison Program Plot Routine (SFK#3)

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.

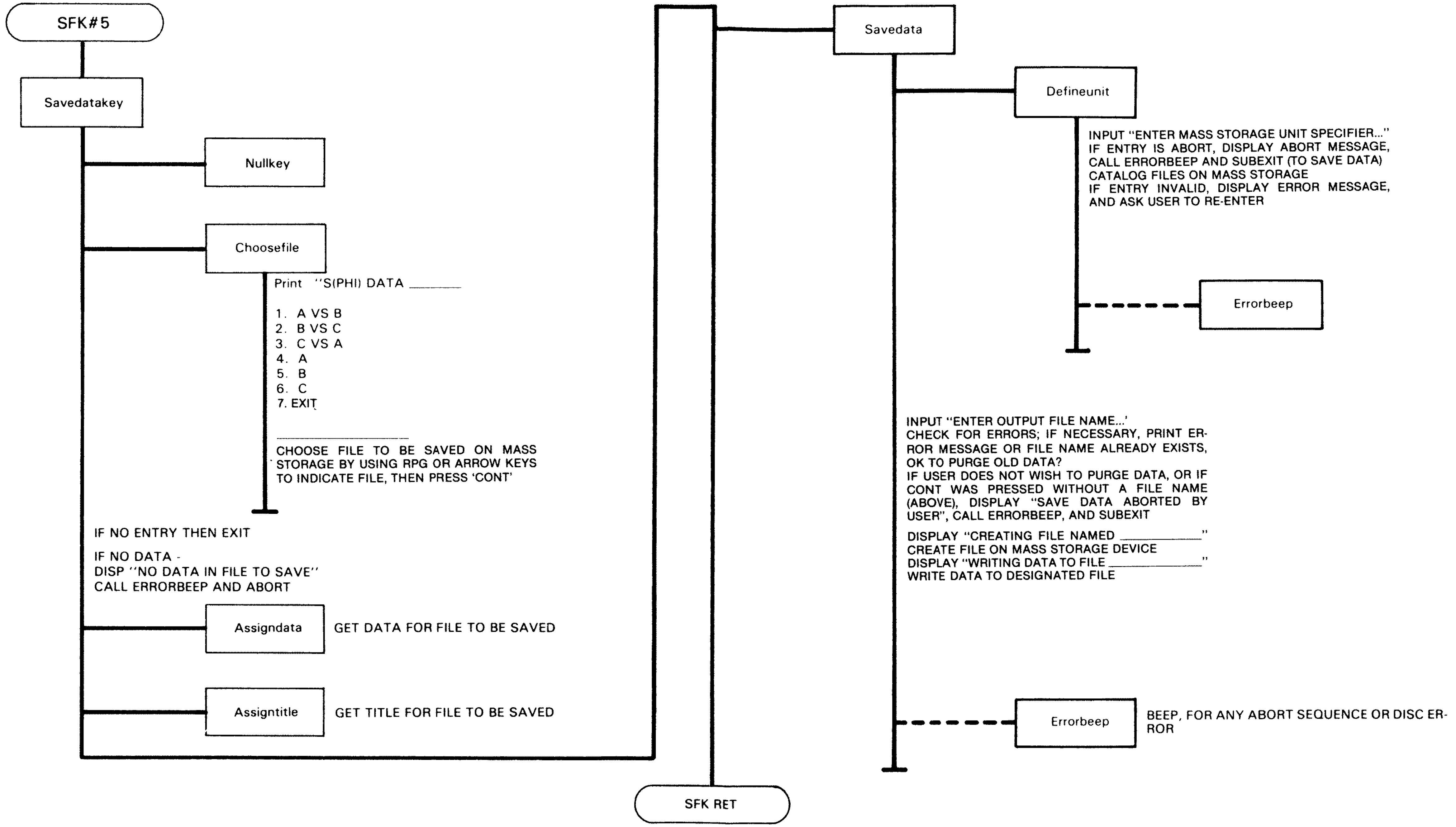


Figure 6-6. Oscillator Comparison Program Save Data Routine (SFK#5)

GRAPHICSOFF (SFK #7): The Graphicsoff routine disables the computer graphics display and displays the current menu.

GRAPHICSON (SFK #8): The Graphicson routine enables the computer to display the graphics memory on the computer display.

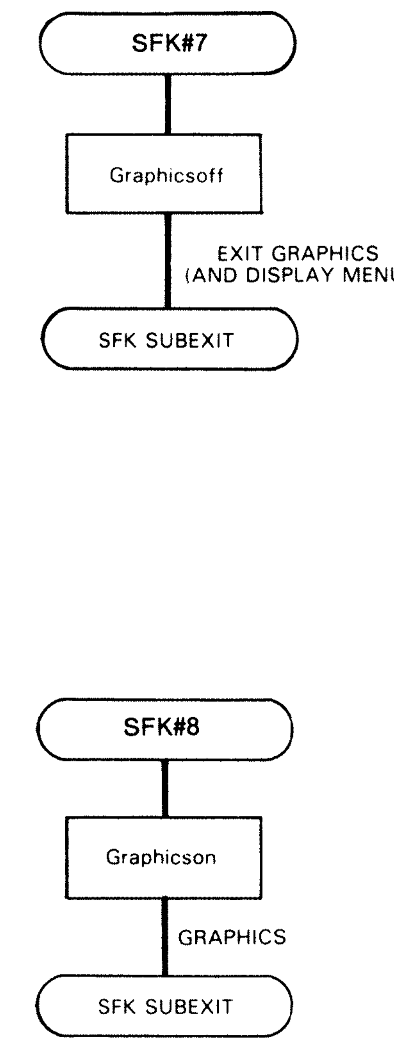


Figure 6-7. Oscillator Comparison Program Graphics Control Routines(SFK #7, 8)

SLOPEDRAWKEY (SFK #10 or (SHIFT) SFK #0): 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 SFK #9 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.

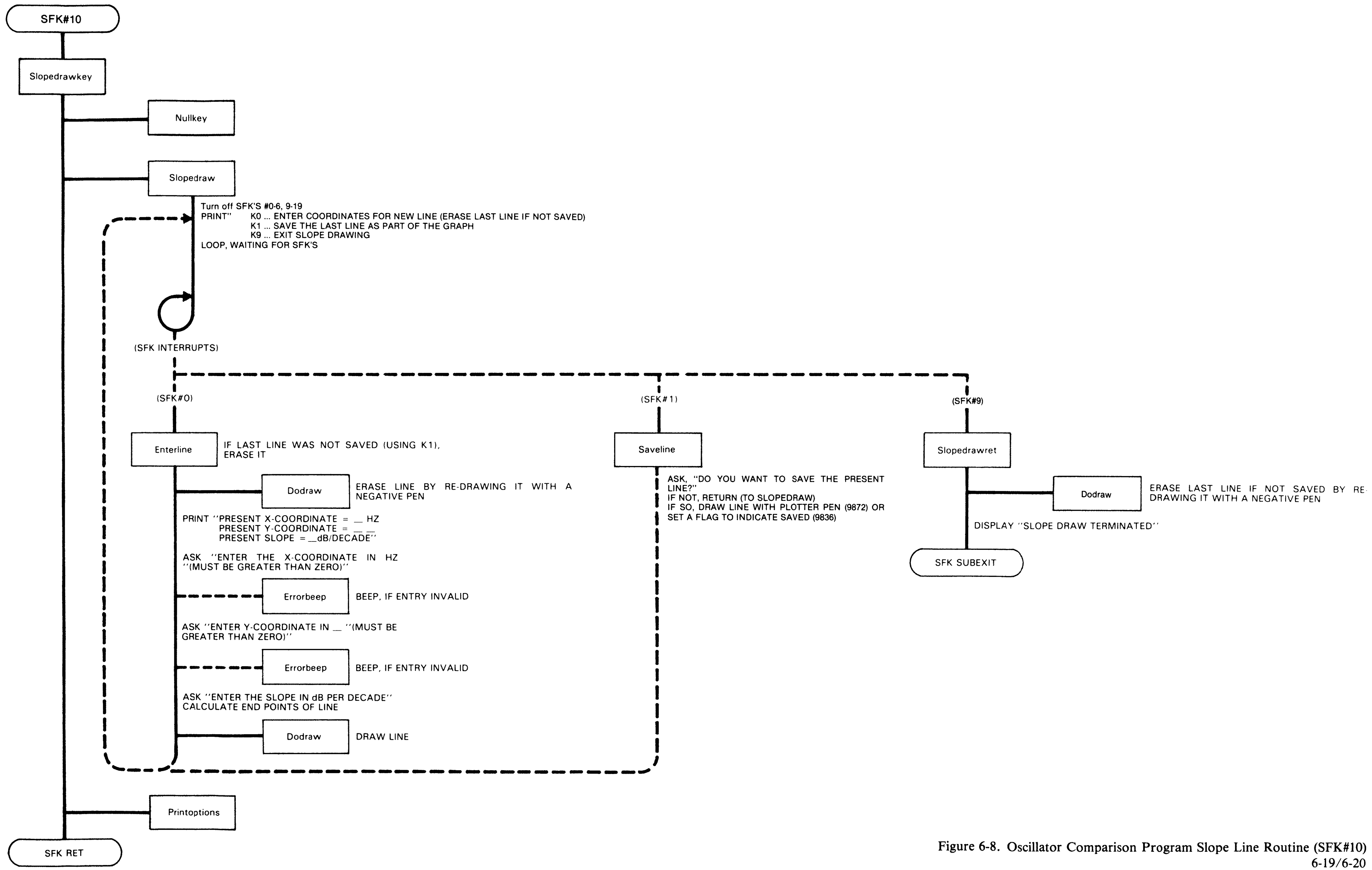


Figure 6-8. Oscillator Comparison Program Slope Line Routine (SFK#10)

MARKERMOVEKEY (SFK #12 or (SHIFT) SFK #2): 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 SFK #9. A limited set of SFK's are active during this routine.

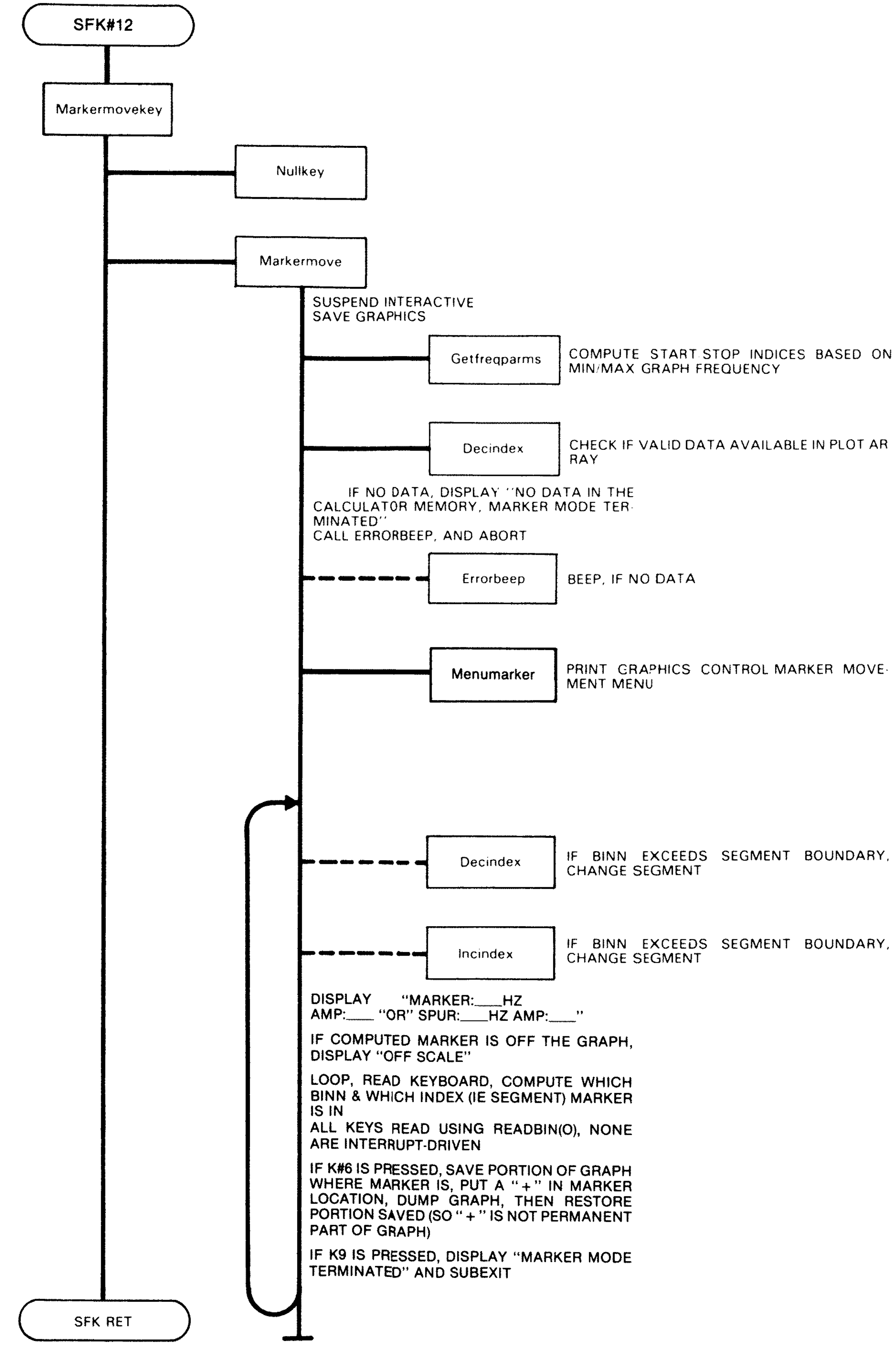


Figure 6-9. Oscillator Comparison Program Marker Movement Routine (SFK#12)

6-5. 3047ACHECK PROGRAM

The 3047ACHECK 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 3047ACHECK block diagrams contained in this section. Descriptions of the major subroutines listed in the 3047ACHECK block diagrams are included with the illustrations. Comments imbedded in the 3047ACHECK 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.

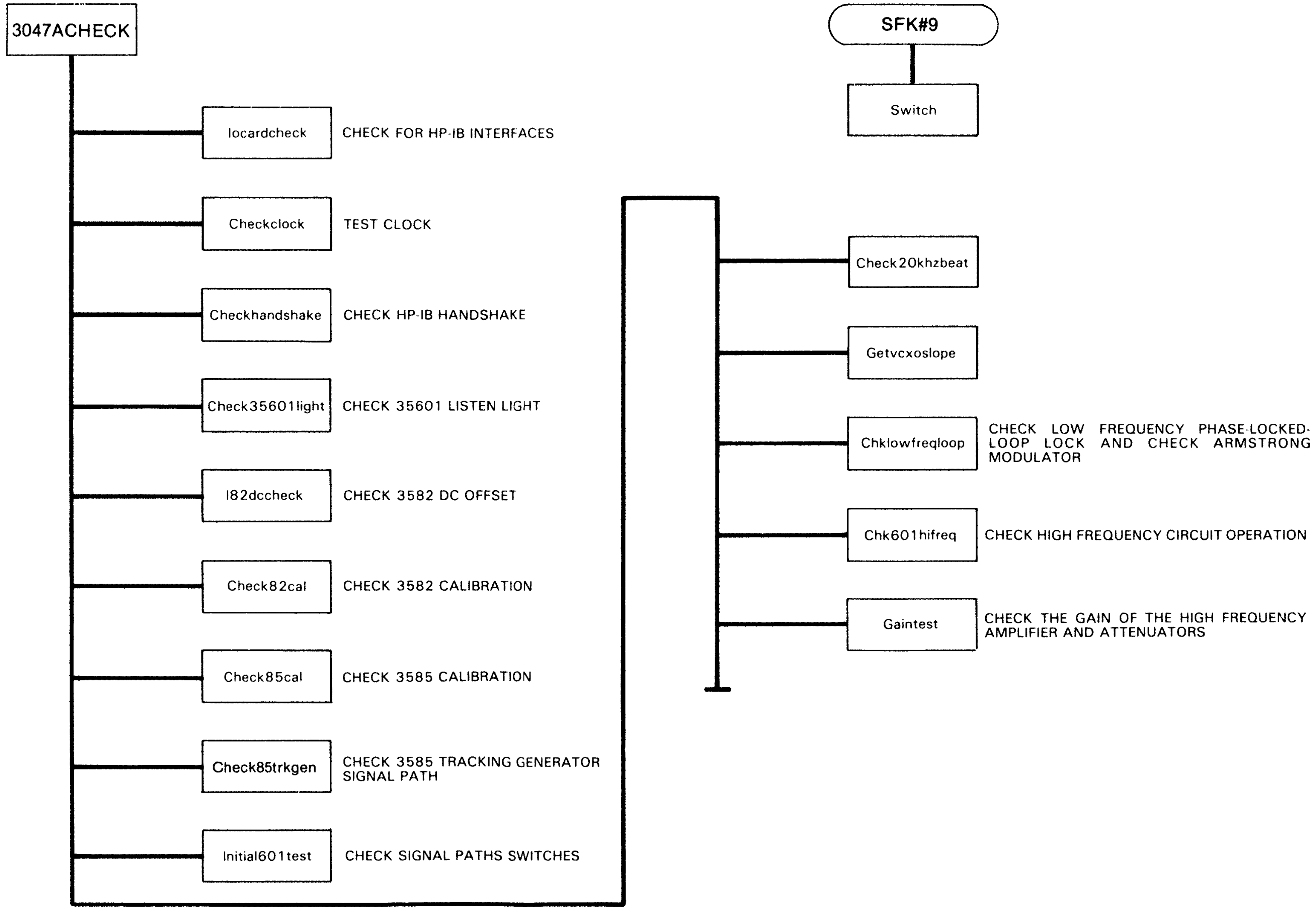


Figure 6-10. Index to 3047ACHECK Program Routines

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.

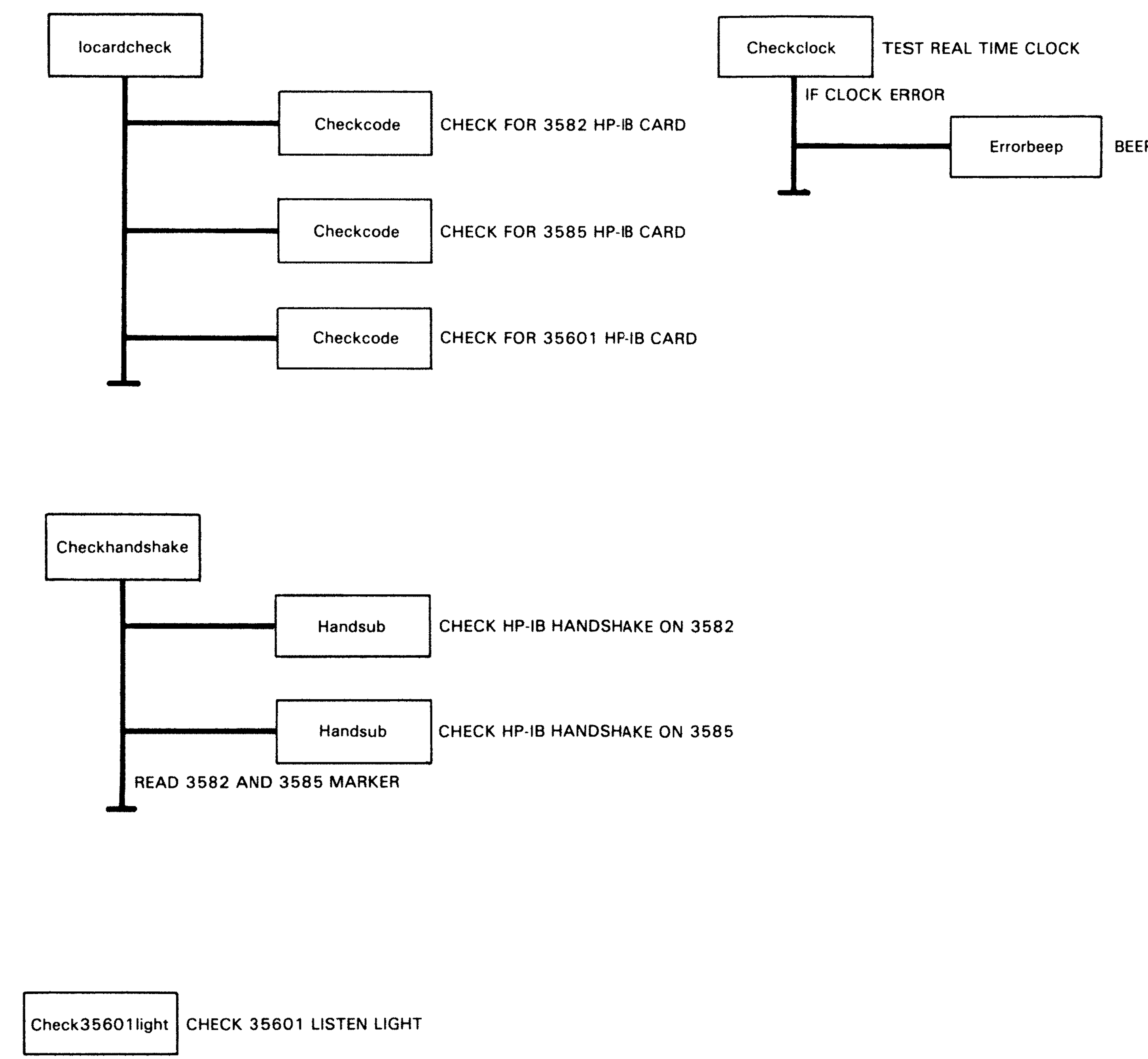


Figure 6-11. 3047ACHECK HP-IB, Clock and 35601 Listen Light Check Routines

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.

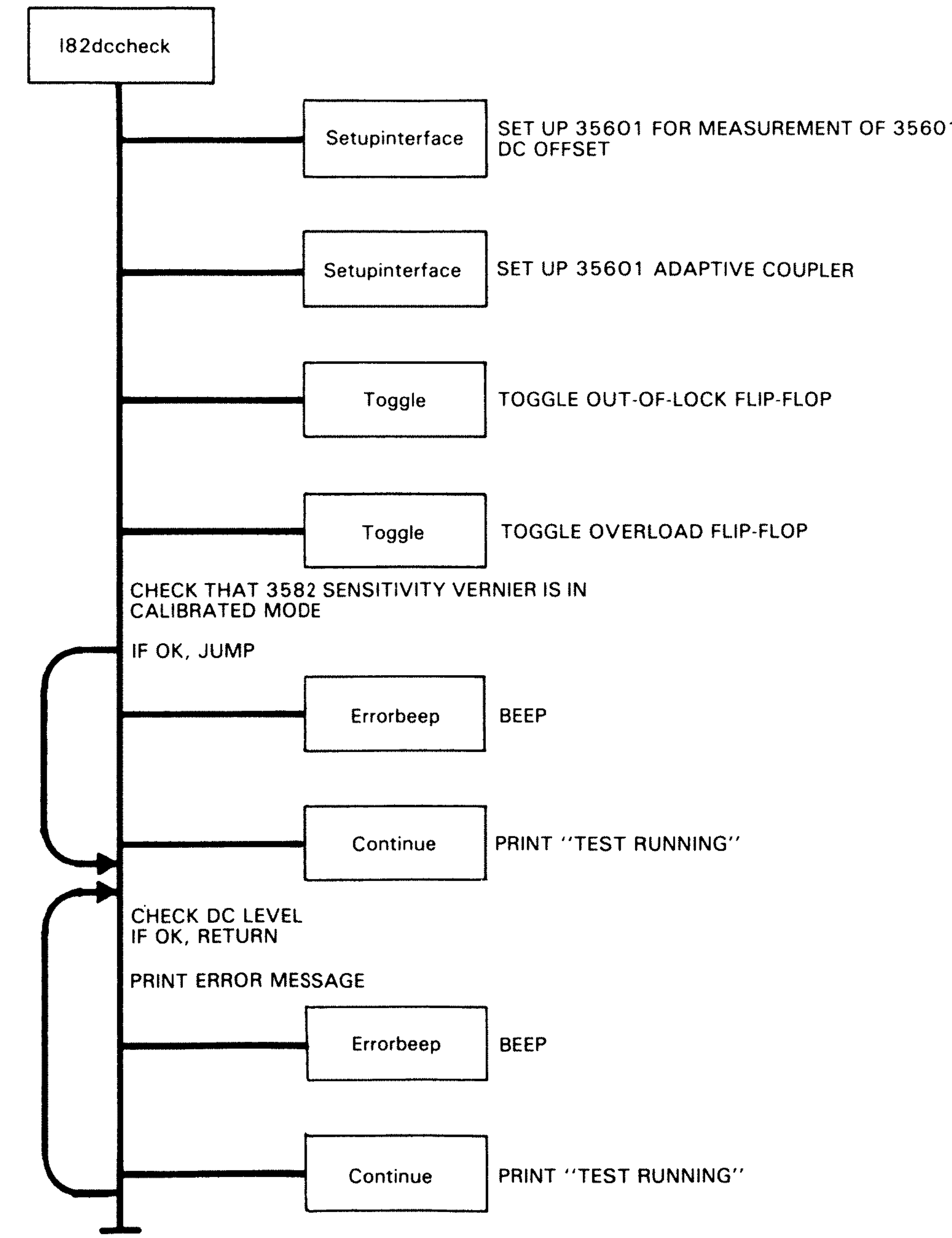


Figure 6-12. 3047ACHECK I82dccheck

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.

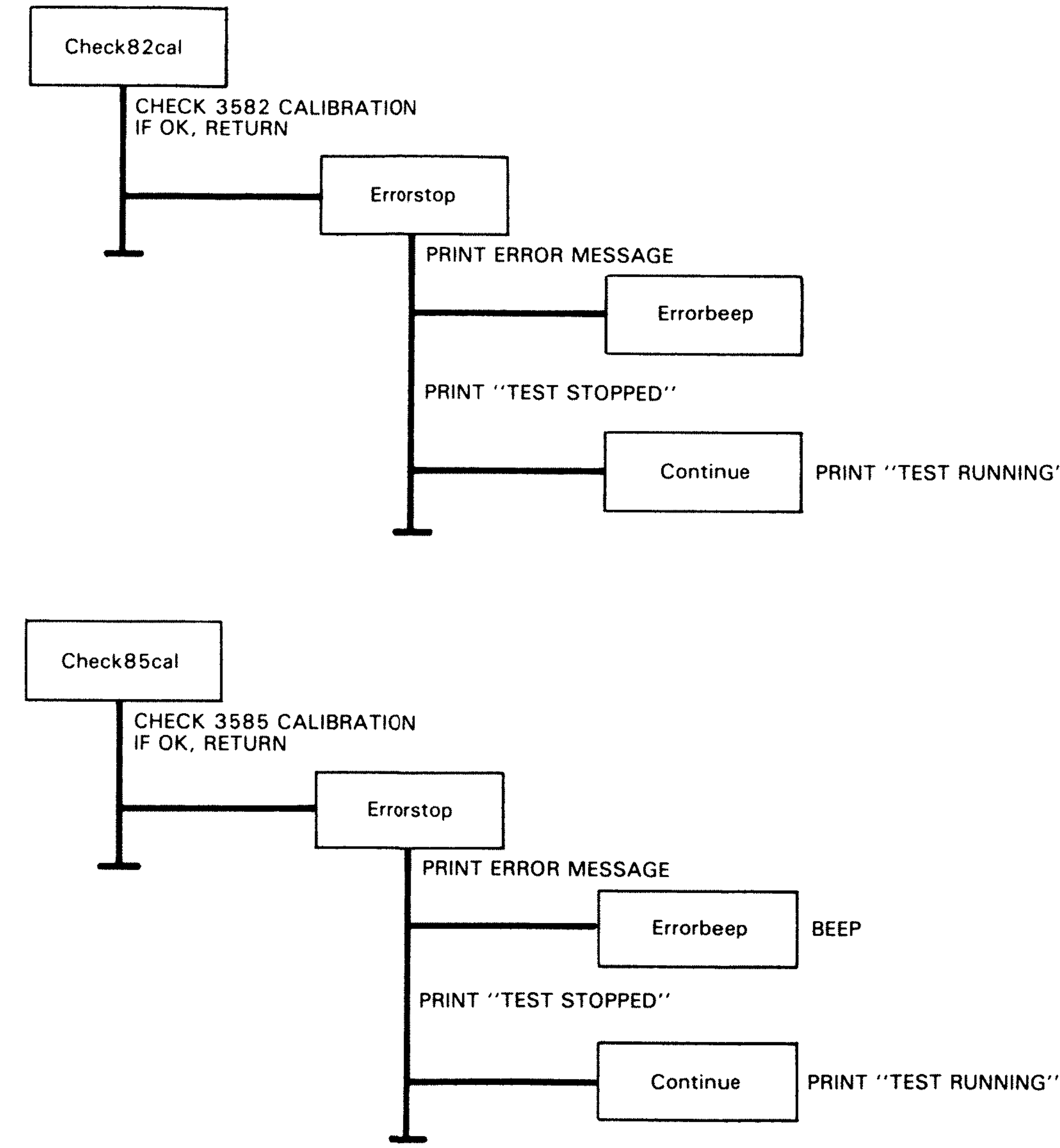


Figure 6-13. 3047ACHECK Check Spectrum Analyzer Calibration Routines

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.

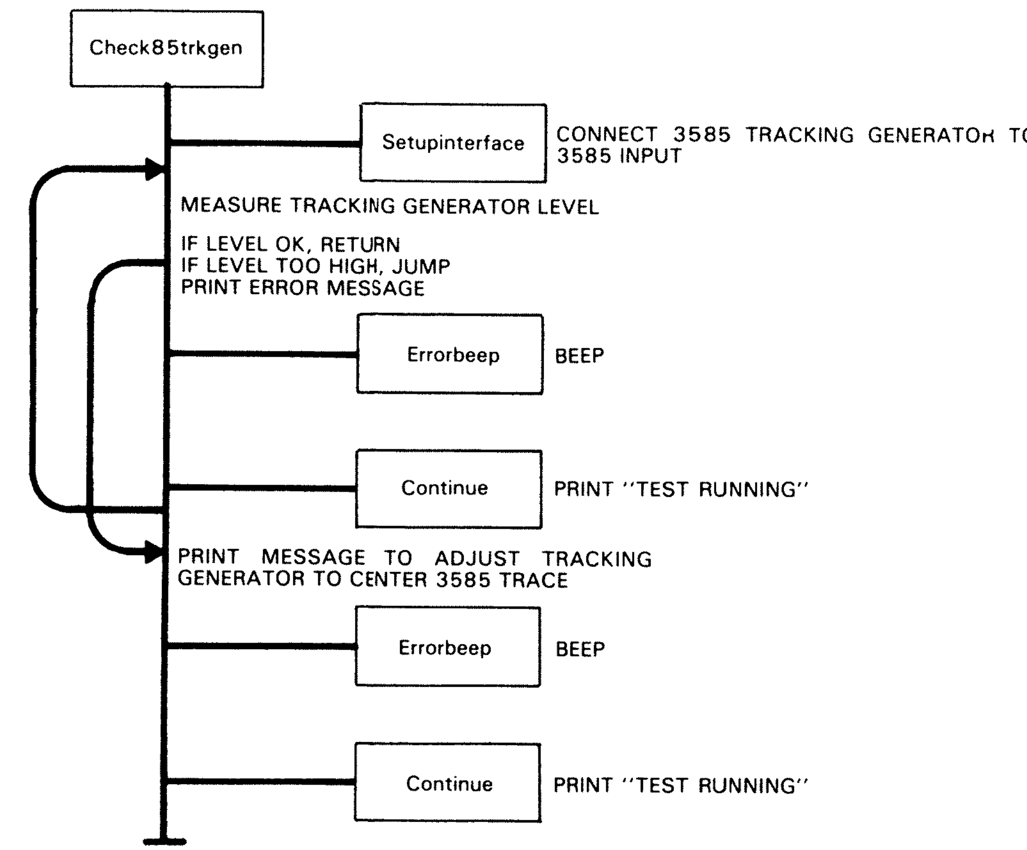


Figure 6-14. 3047ACHECK Check Tracking Generator Signal Path Routine

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.

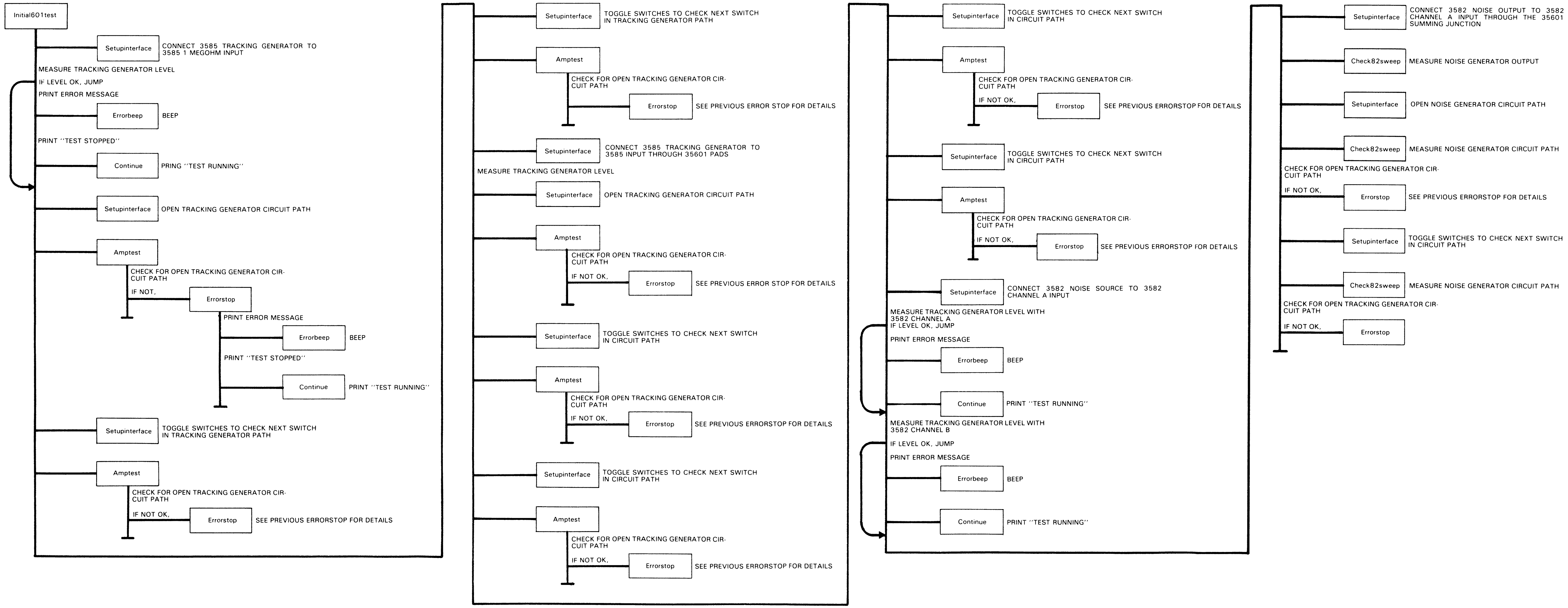


Figure 6-15. 3047ACHECK Initial601Test Routine

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, 1601error is called to pass an error message to Errorstop.

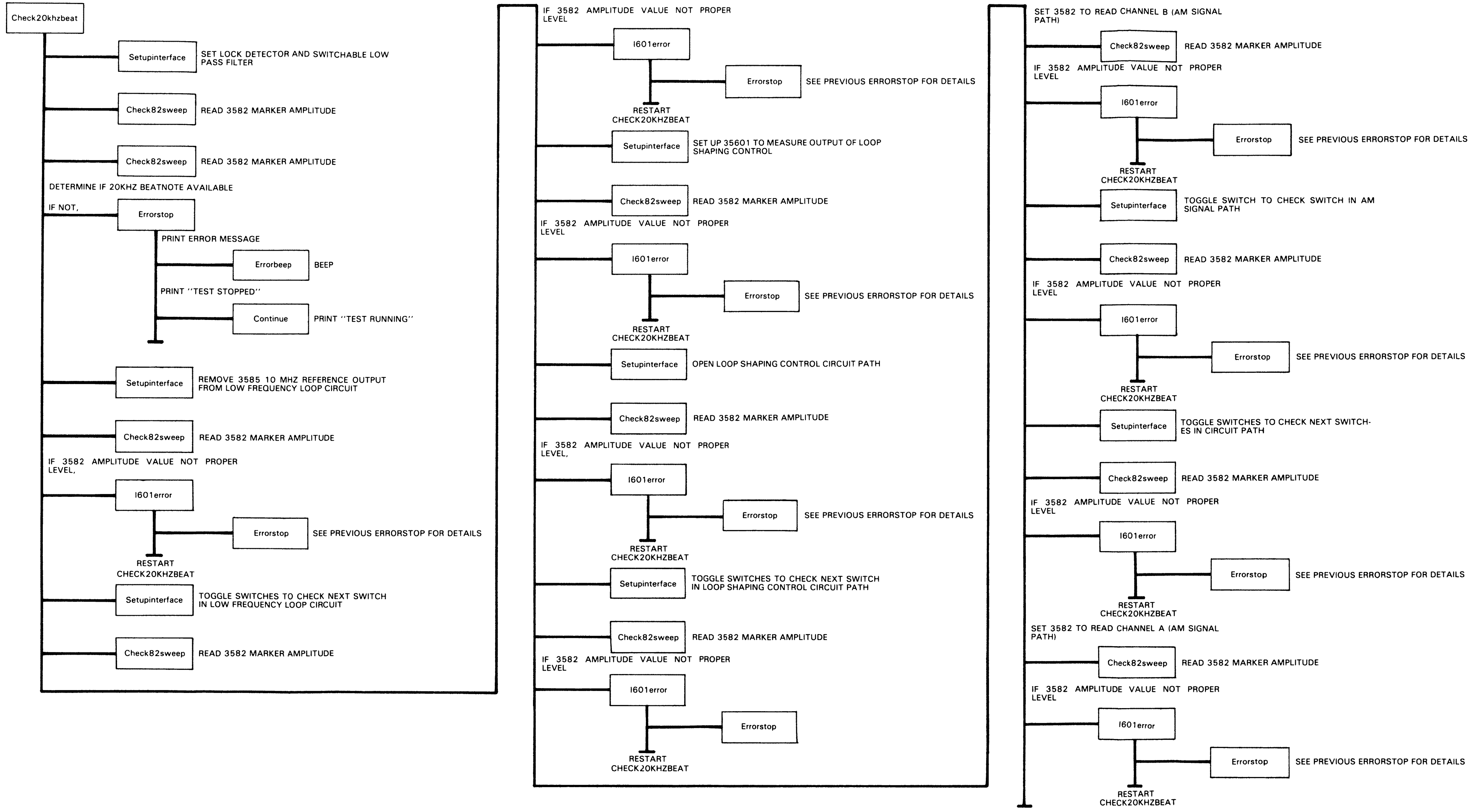


Figure 6-16. 3047ACHECK Check 20 kHz Beatnote Routine

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.

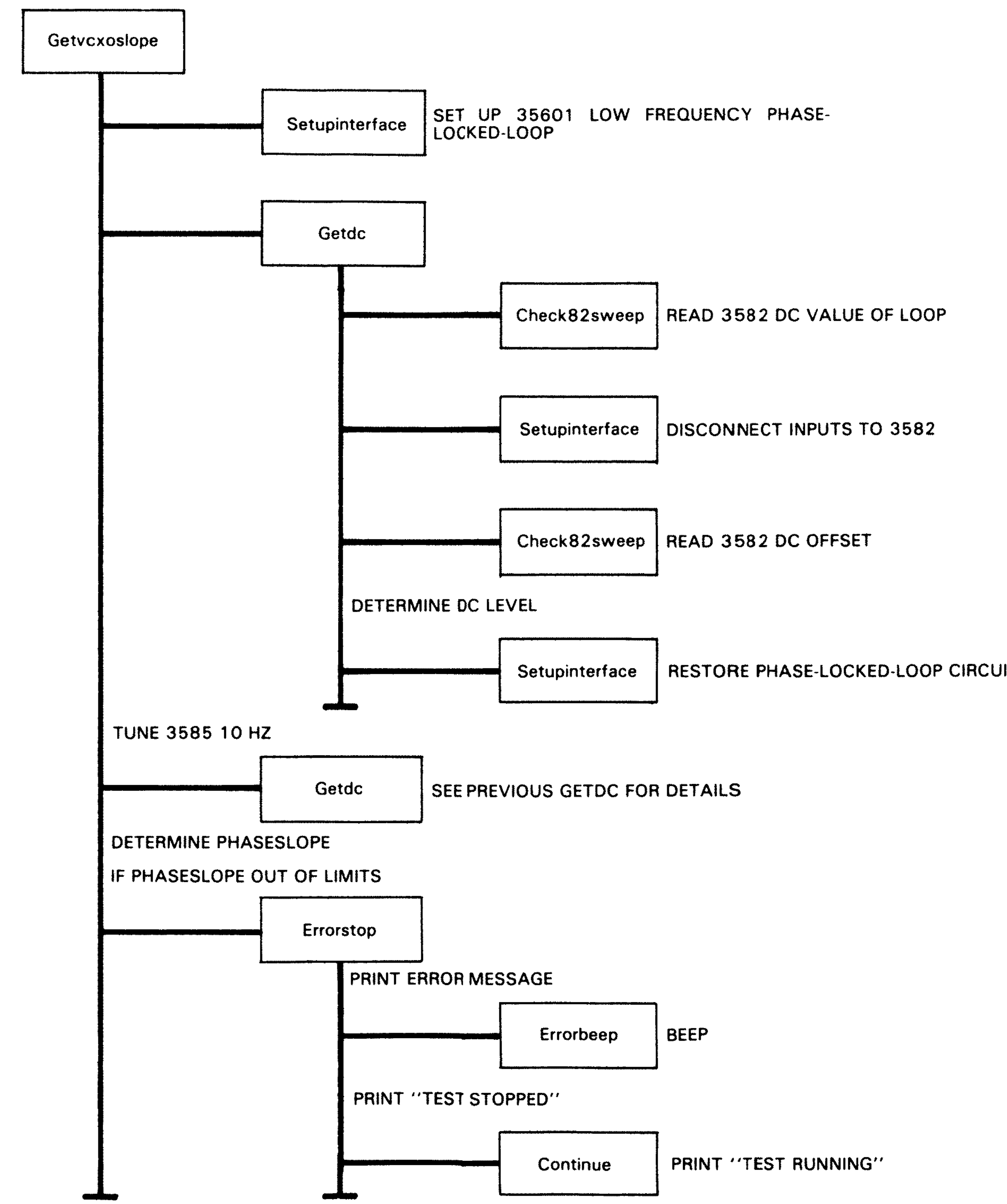


Figure 6-17. 3047ACHECK Get VCXO Slope Routine

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.

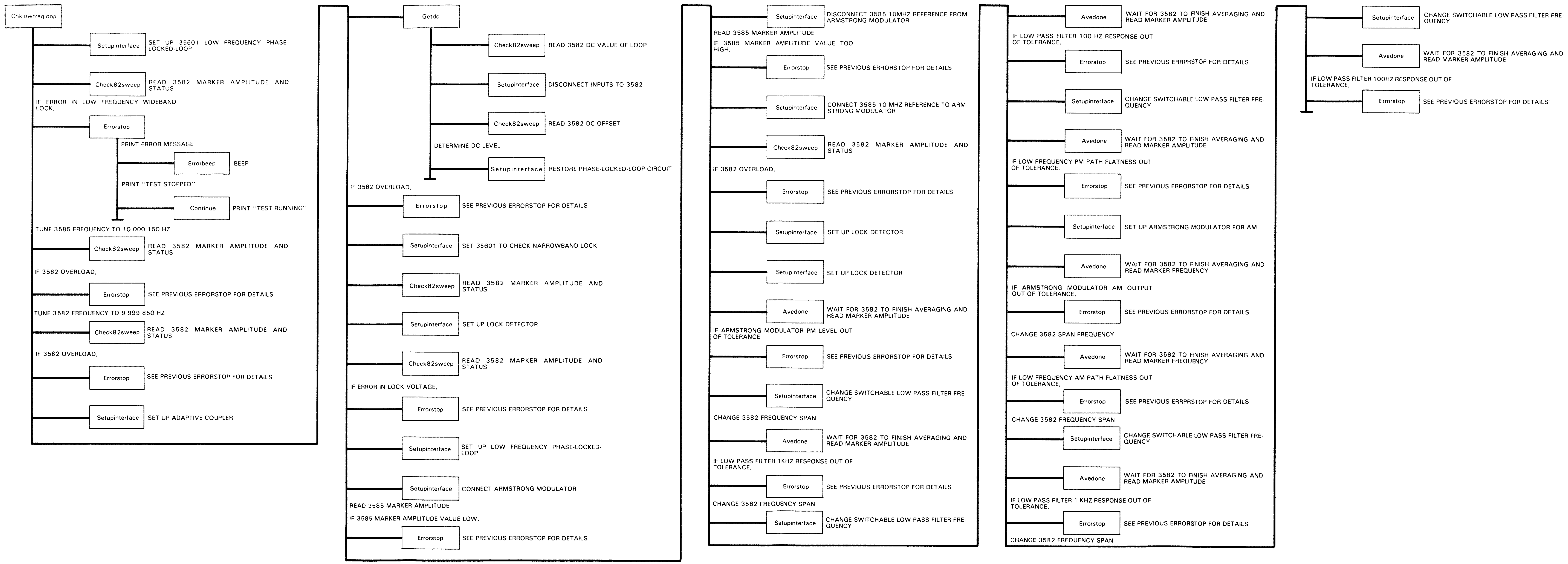
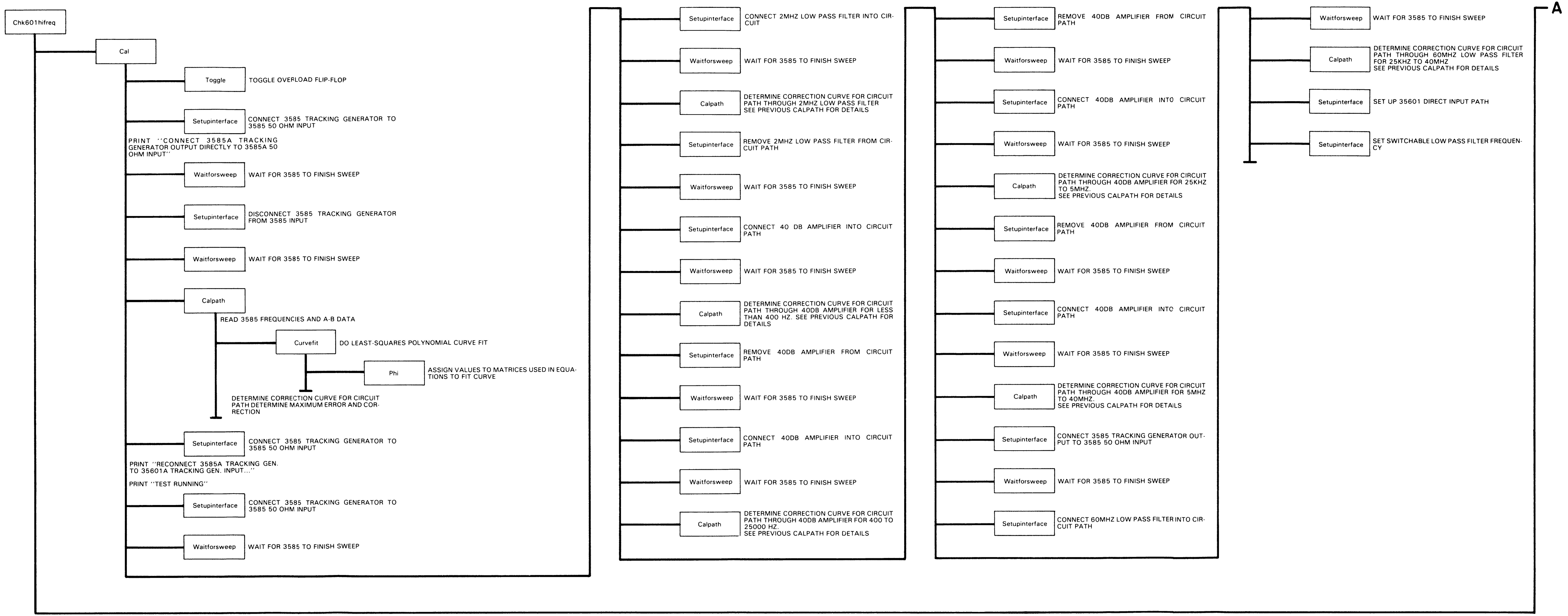


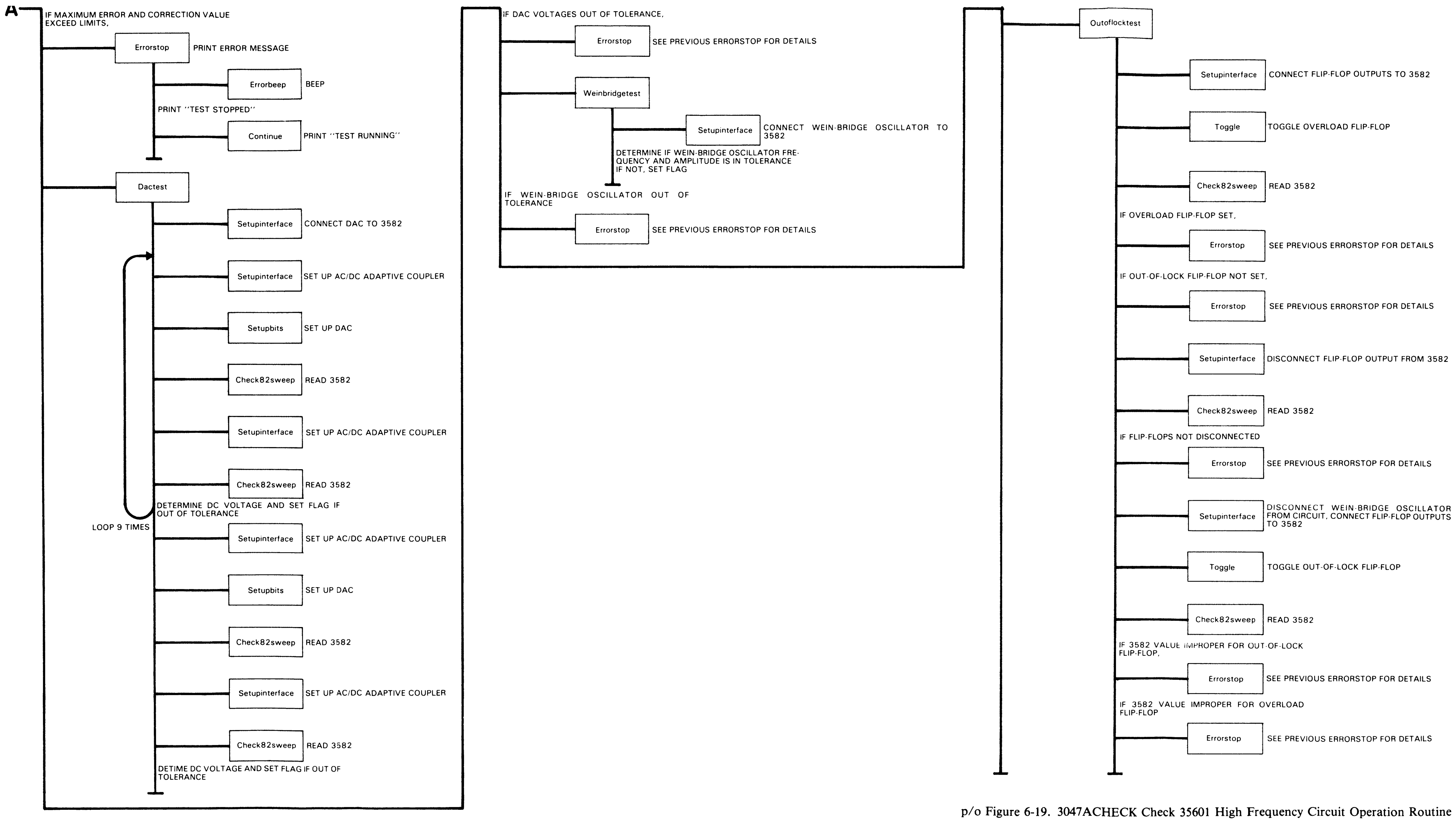
Figure 6-18. 3047ACHECK Check Low Frequency Phase-Locked-Loop Routine

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. 3047ACHECK 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. 3047ACHECK 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. Range82 is used to set the -hp- 3582A sensitivity and 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.

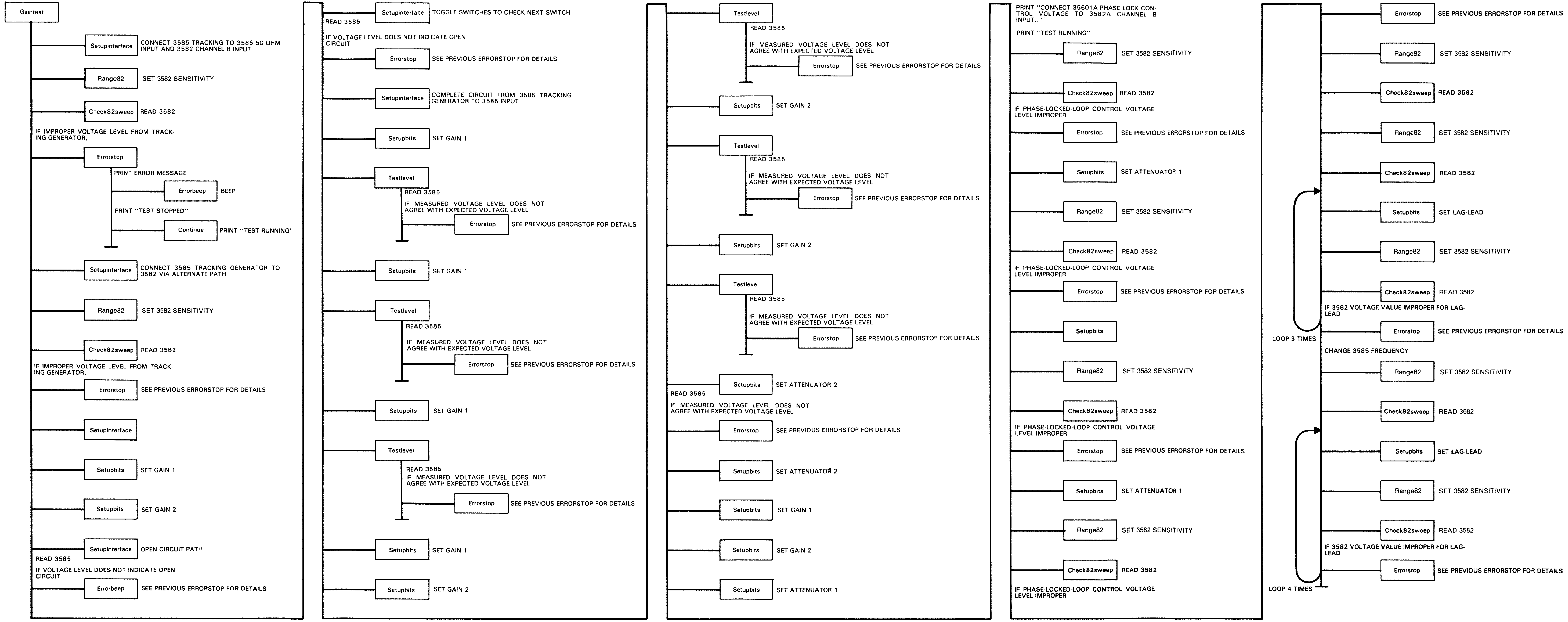


Figure 6-20. 3047ACHECK Gain Test Routine

6-6. 35601TEST PROGRAM

The 35601TEST 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 35601TEST block diagrams contained in this section. A description of the principle subroutines used in 35601TEST 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 35601TEST program are also an aid in understanding program operation.

Program operation is detailed in the -hp- 35601A Spectrum Analyzer Interface Operating and Service Manual. 35601TEST 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.

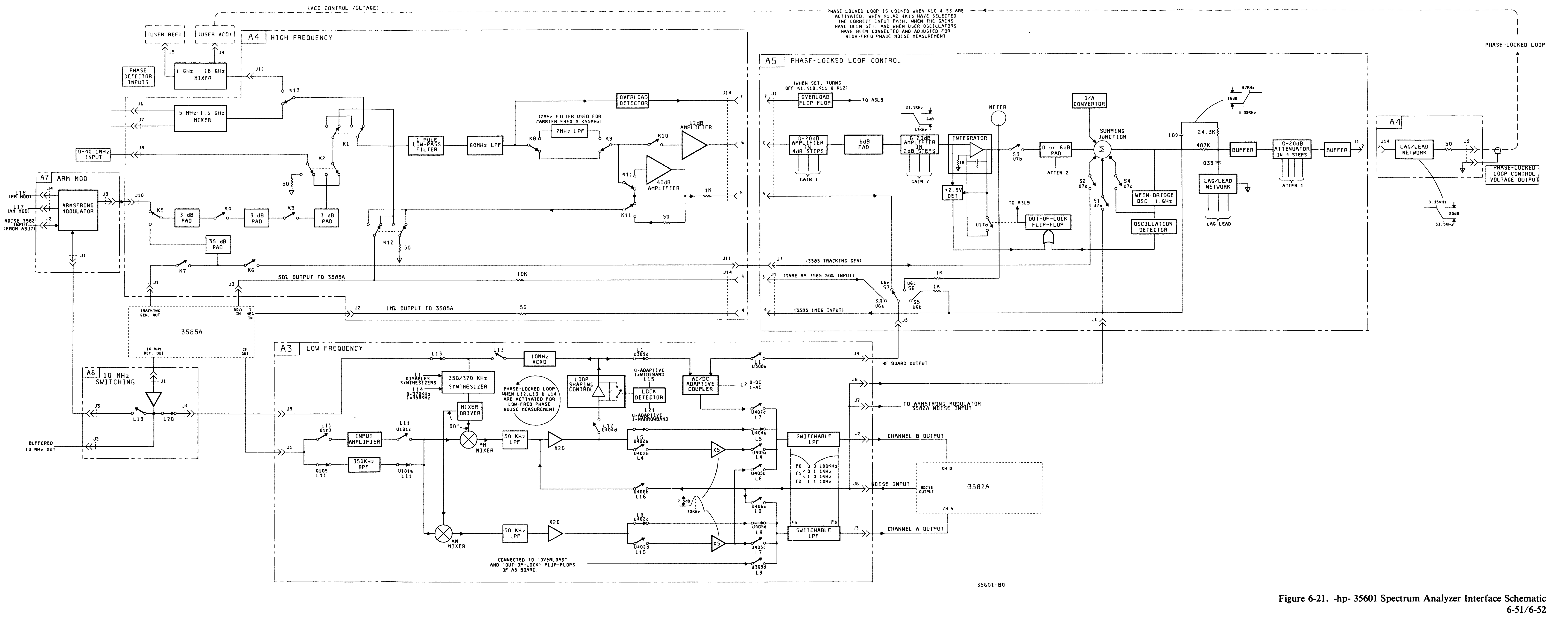
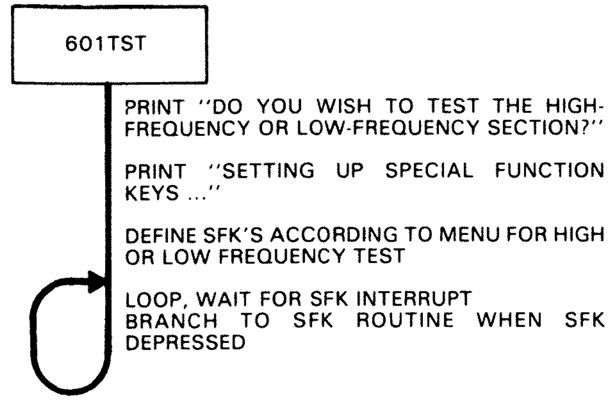


Figure 6-21. -hp- 35601 Spectrum Analyzer Interface Schematic

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 Attentuator	TEST # 7
SFK # 8: Test Wein-bridge Oscillator	TEST # 8
SFK # 9: Test 3582 Noise Source Input to Summing Jct	TEST # 9
(SHIFT) SFK # 0: Test Tracking Generator Input to Summing Jct	TEST #10
(SHIFT) SFK # 1: Test Output Path to 3582-3585	TEST #11
(SHIFT) SFK # 2: Test Programmable Gains	TEST #12
(SHIFT) SFK # 3: Test 1.5 GHz Mixer DC Offset (requires hookup)	TEST #13
(SHIFT) SFK # 5: RE-START TEST PROGRAM...YOU MAY CHOOSE TO TEST EITHER SECTION	
(SHIFT) SFK # 6: Manual Switch Routine	SWITCH

(SHIFT) SFK#0 THROUGH (SHIFT) SFK#6 DESIGNATED SFK#10 THROUGH SFK#16 IN DIAGRAMS

HIGH FREQUENCY MENU SFK INTERRUPT

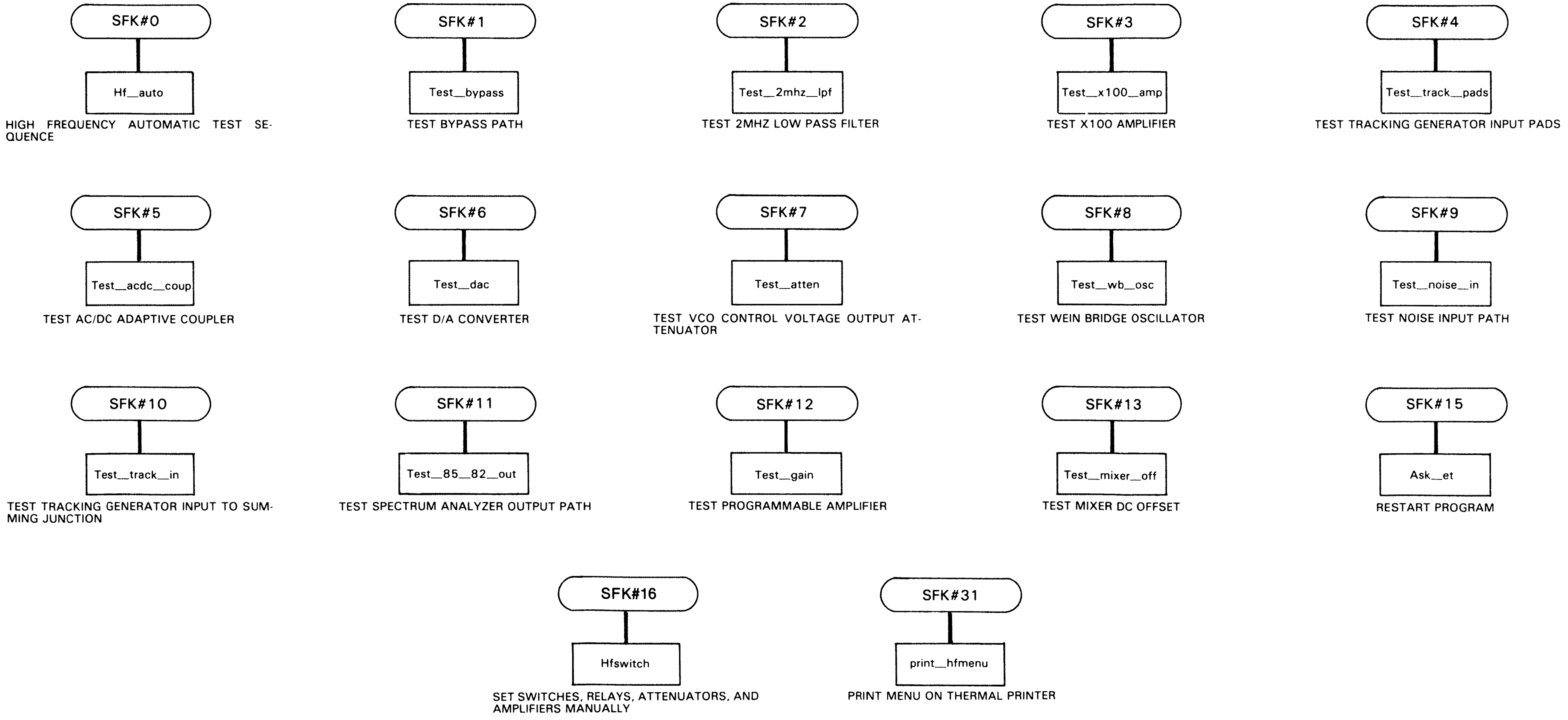


Figure 6-22. Index to 35601TEST High Frequency Special Function Key Routines

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.

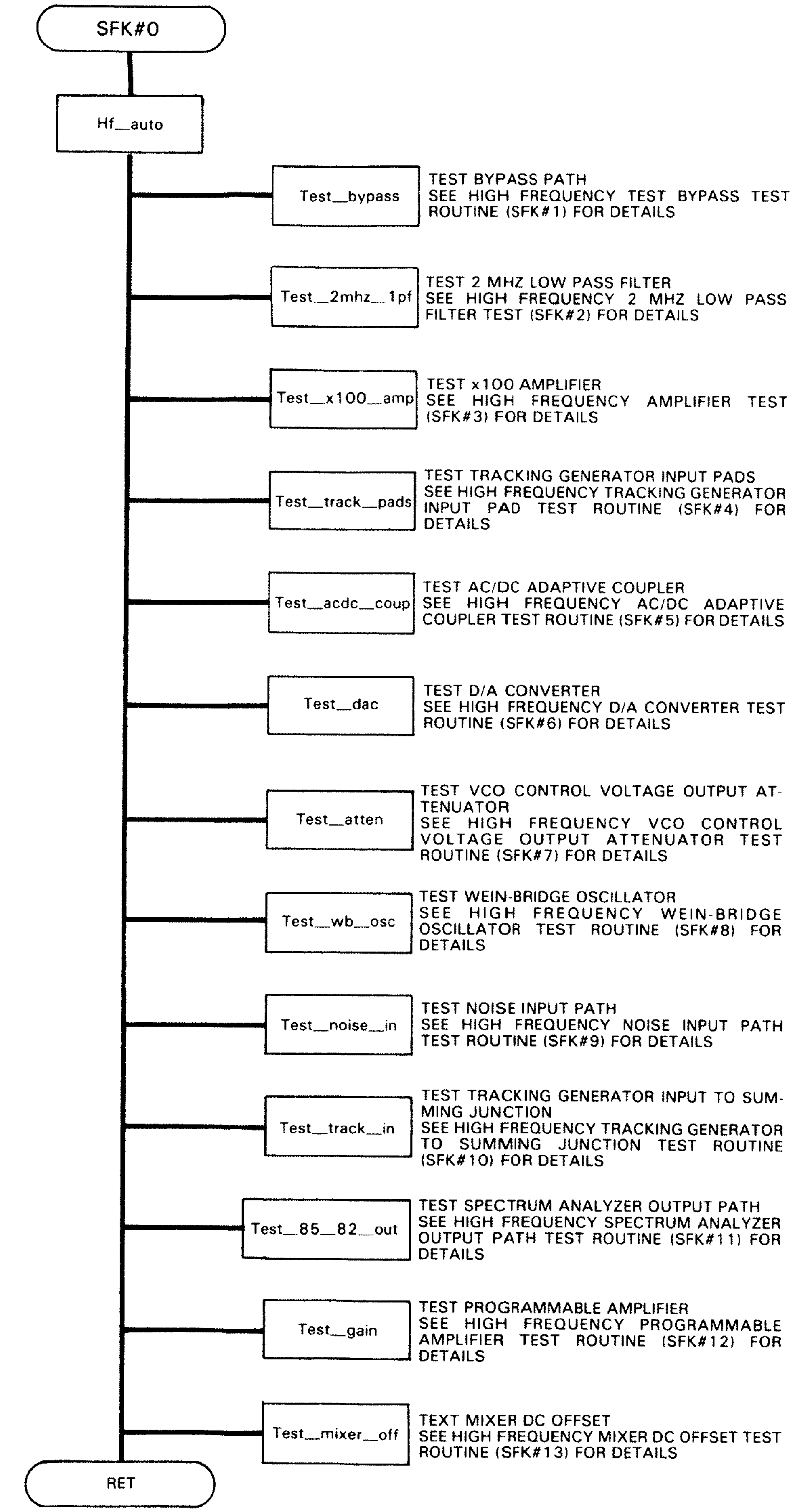


Figure 6-23. High Frequency Automatic Test Routine (SFK#0)

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.

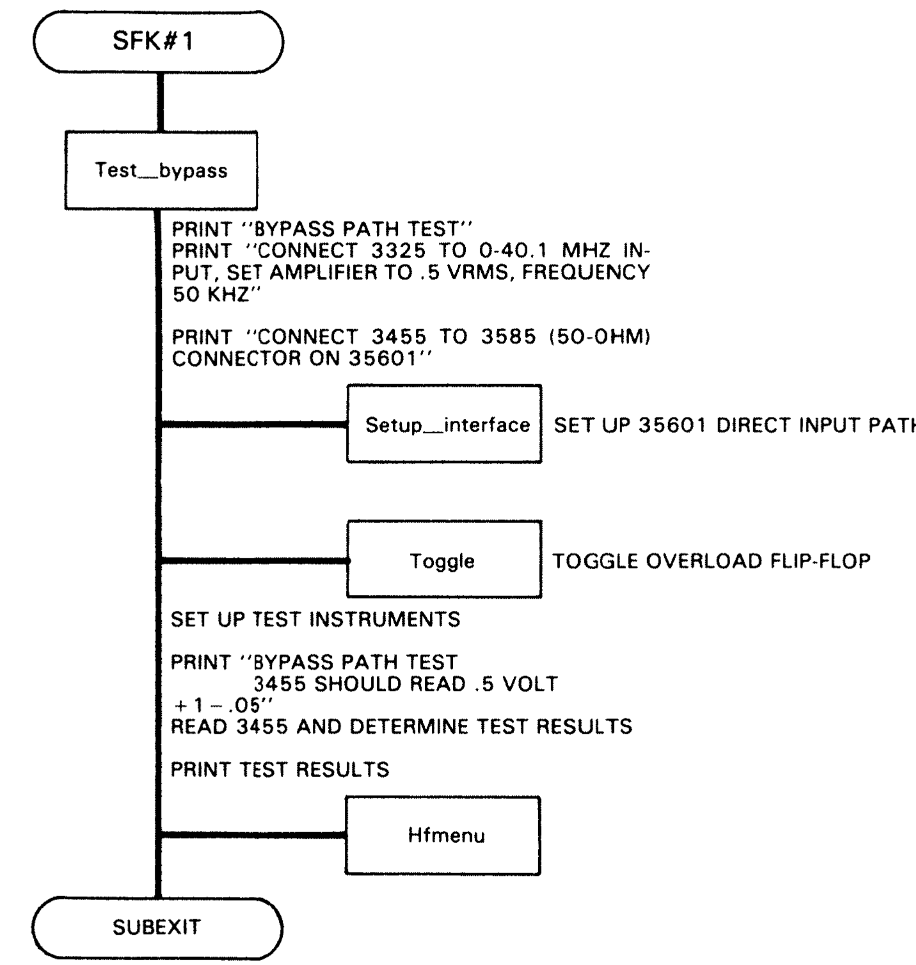


Figure 6-24. High Frequency Bypass Test Routine (SFK#1)

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.

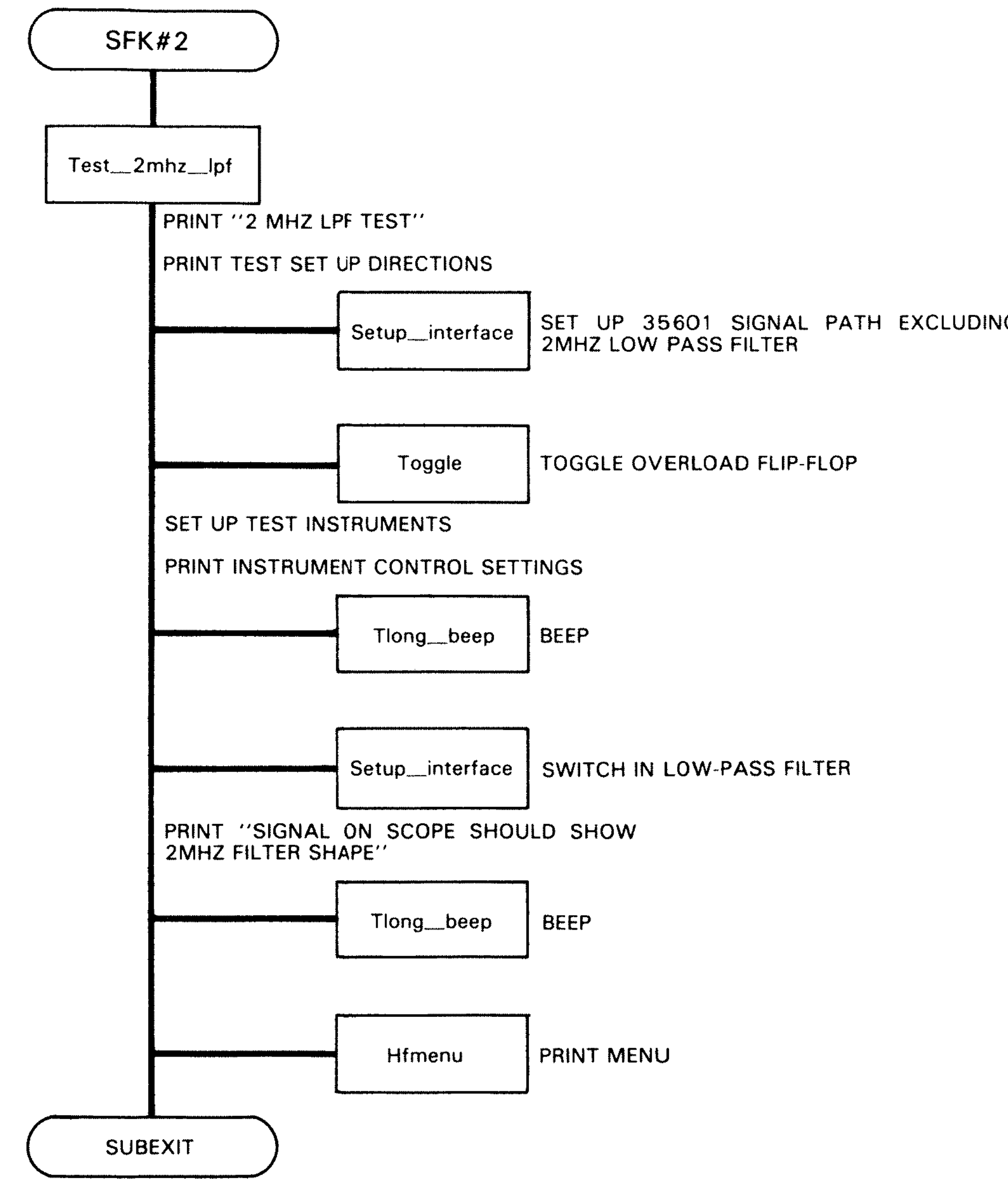


Figure 6-25. High Frequency 2MHz Low Pass Filter Test Routine (SFK#2)

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.

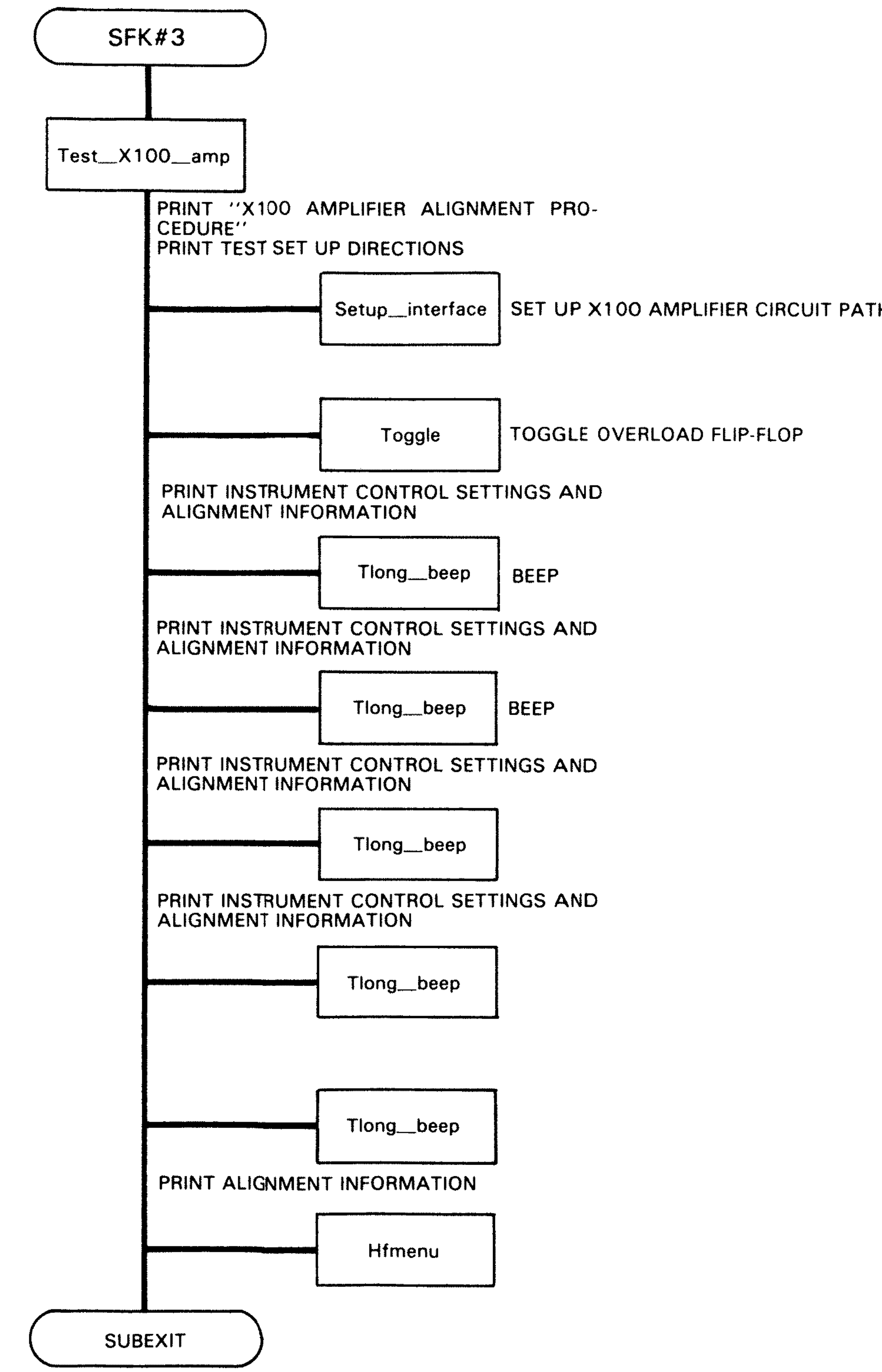


Figure 6-26. High Frequency Amplifier Test Routine (SFK#3)

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.

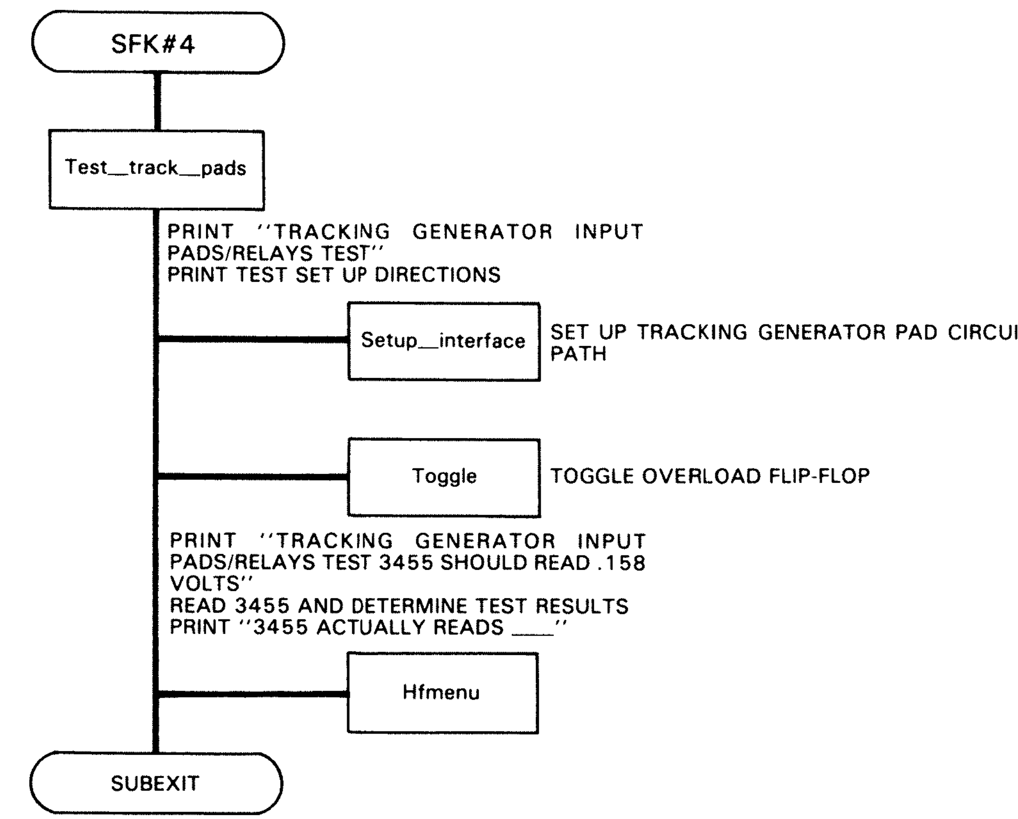


Figure 6-27. High Frequency Tracking Generator Input Pad Test Routine (SFK#4)

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.

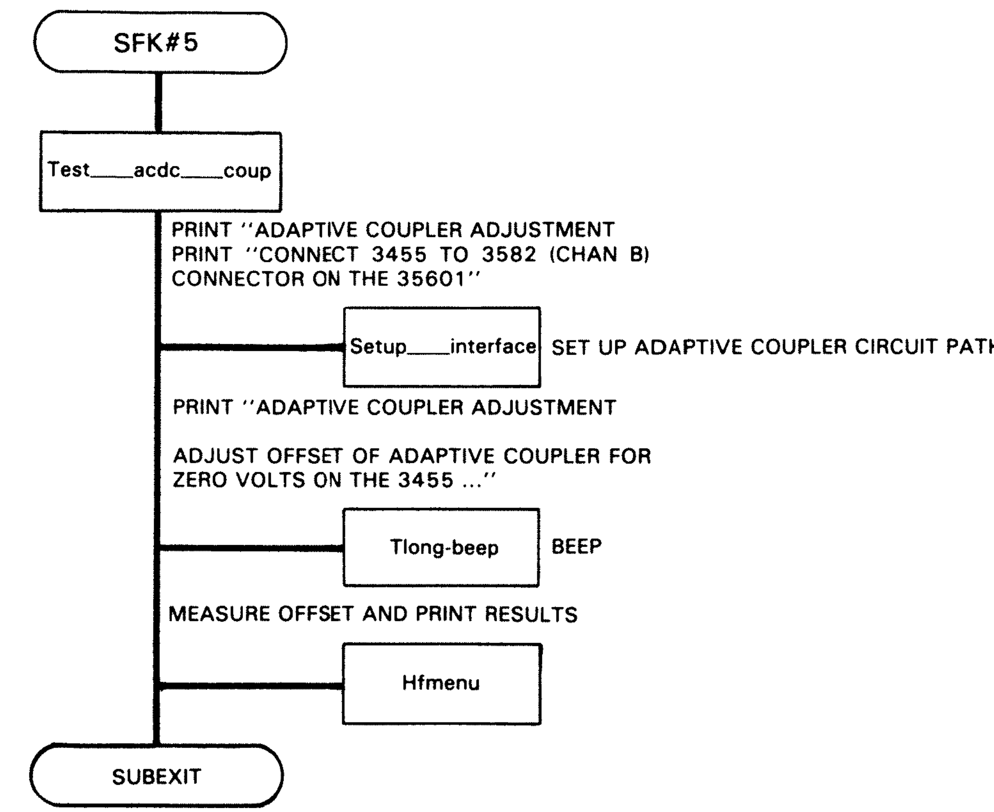


Figure 6-28. High Frequency AC/DC Adaptive Coupler Test Routine (SFK#5)

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.

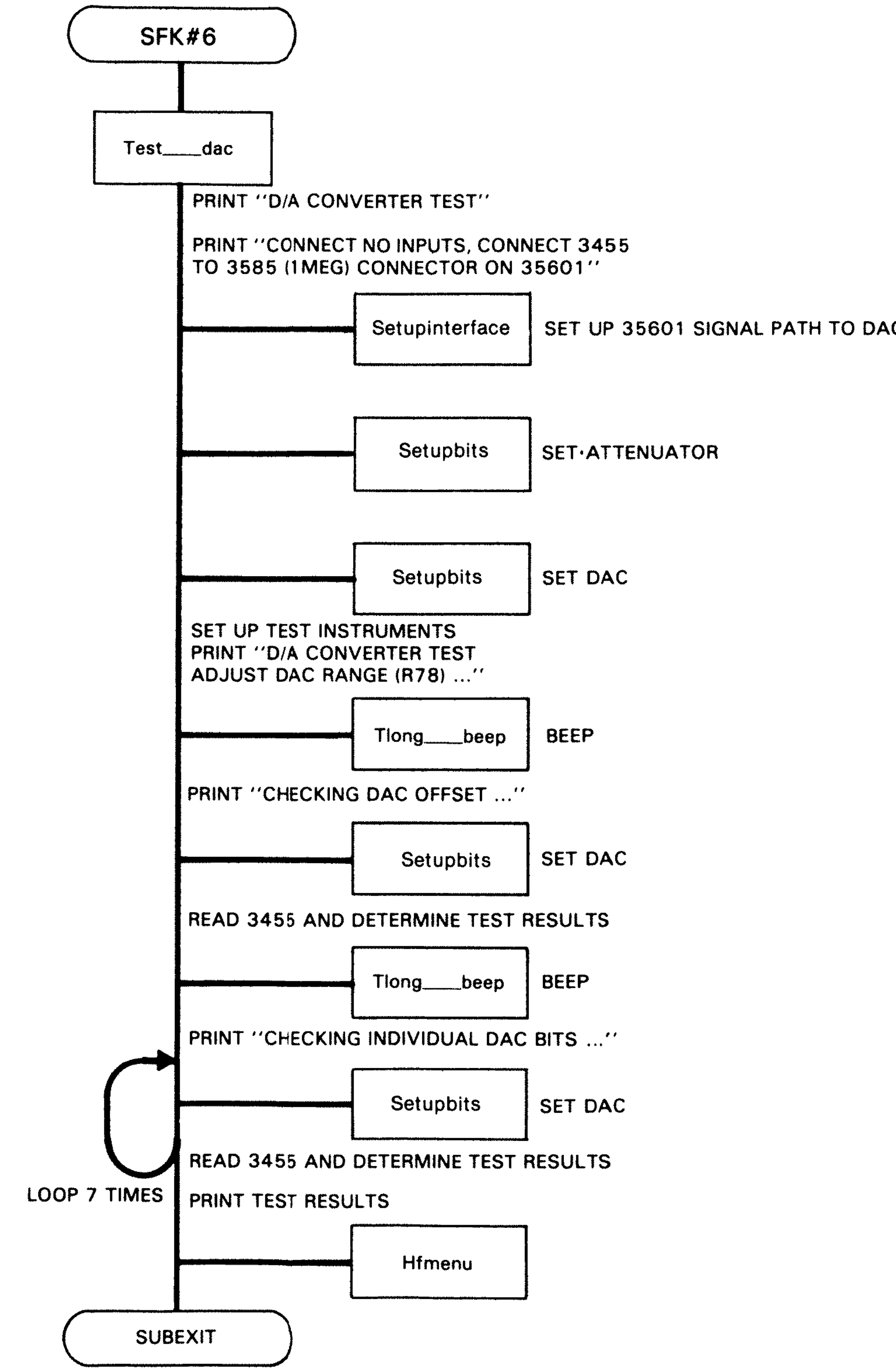


Figure 6-29. High Frequency D/A Converter Test Routine (SFK#6)

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. Setupbits is used to set the D/A converter and attenuator.

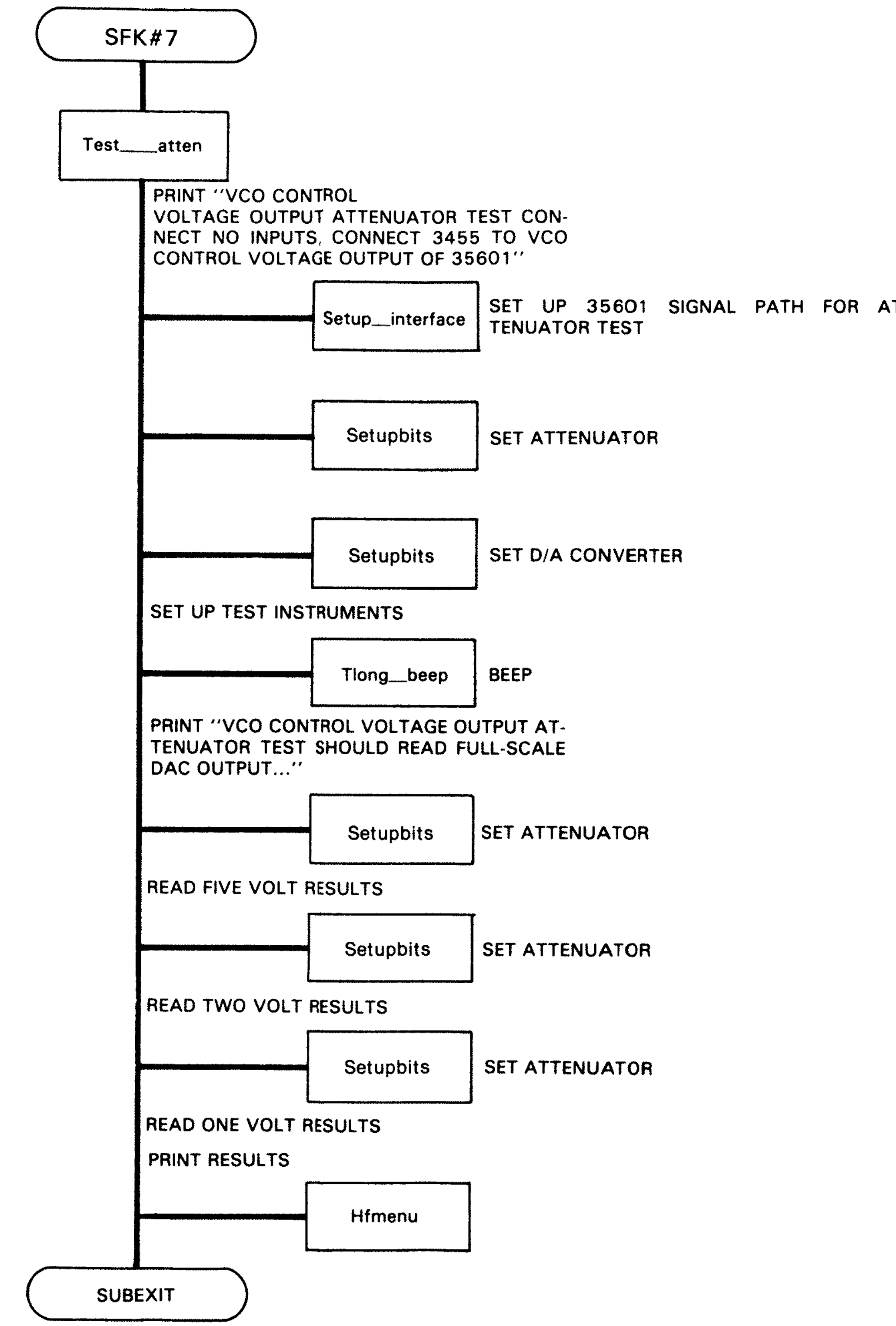


Figure 6-30. High Frequency VCO Control Voltage Output Attenuator Test Routine (SFK#7)

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 -hp- 35601A. Setupbits is used to set the D/A converter and attenuator.

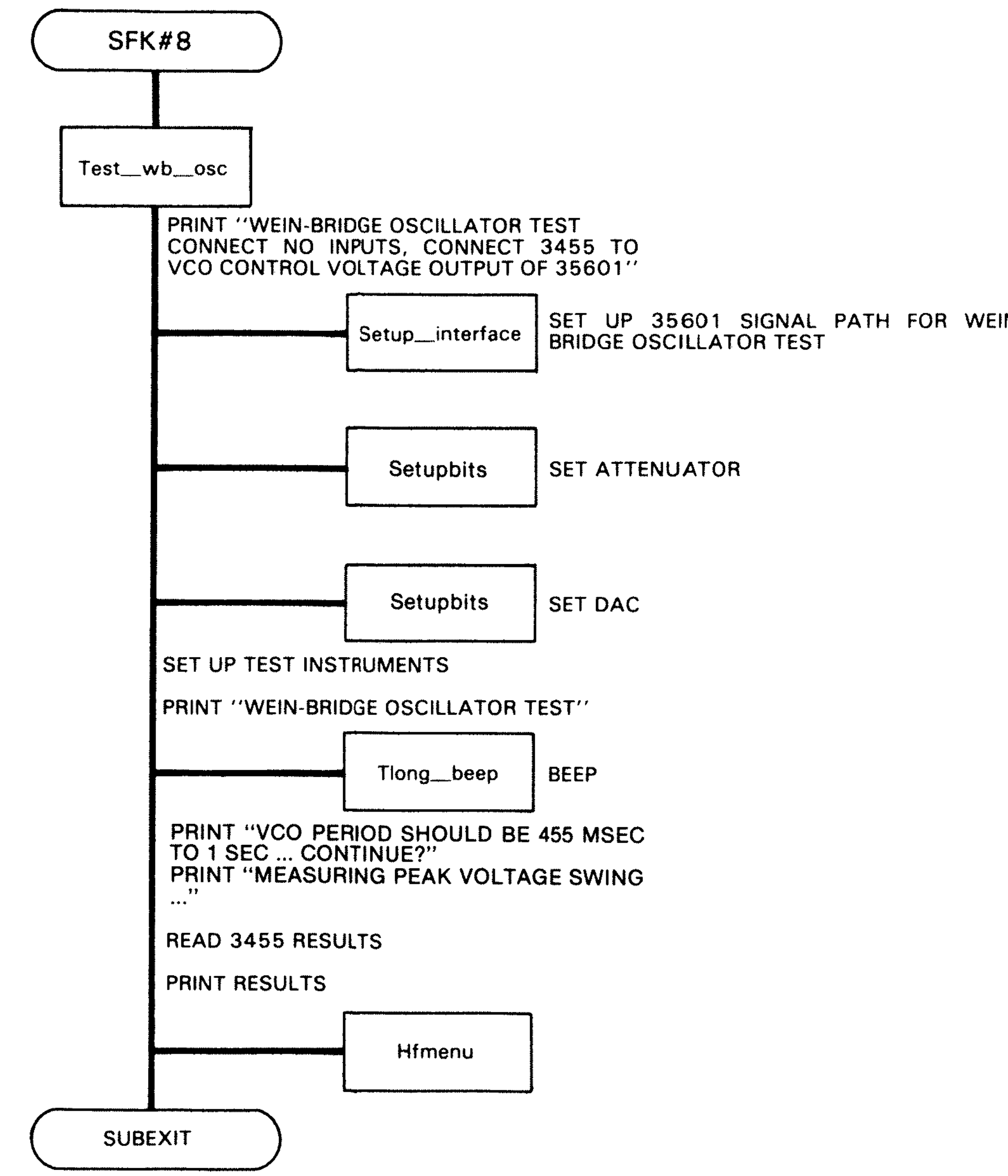


Figure 6-31. High Frequency Wein-Bridge Oscillator Test Routine (SFK#8)

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. Setupbits is used to reset the D/A converter and attenuator.

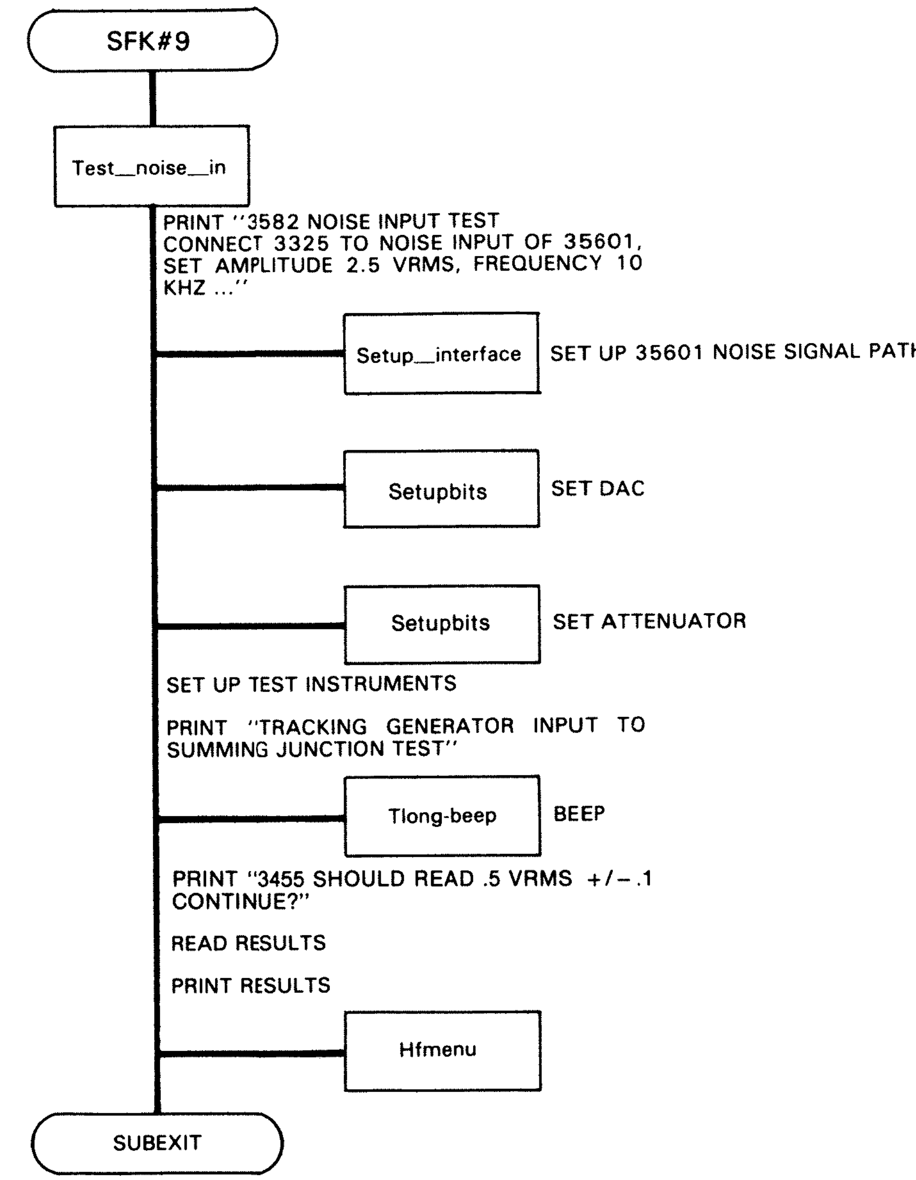


Figure 6-32. High Frequency Noise Path Test Routine (SFK#9)

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. Setupbits is used to reset the D/A converter and attenuator.

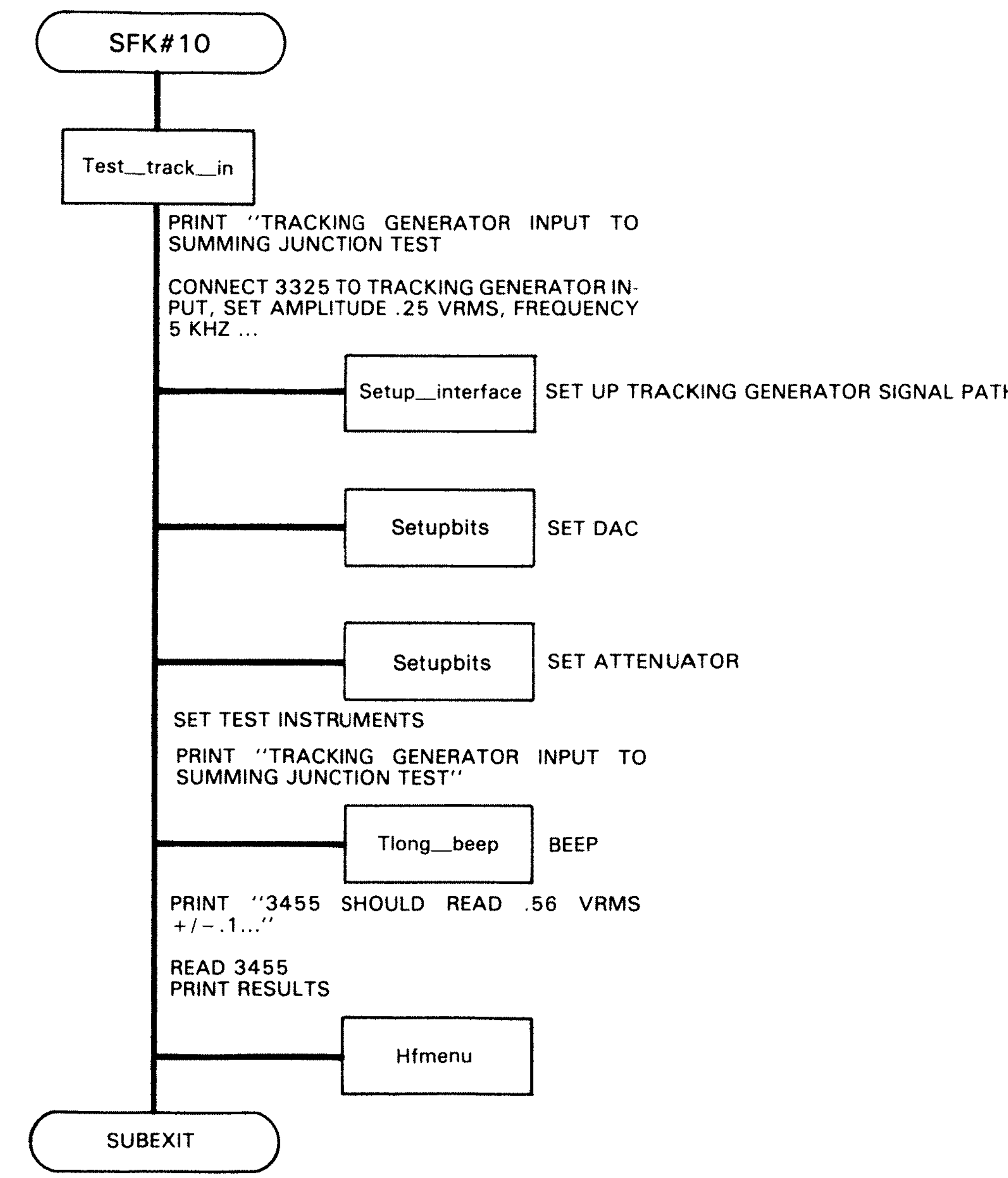


Figure 6-33. High Frequency Tracking Generator To Summing Junction Test Routine (SFK#10)

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. Setupbits is used to set the D/A converter.

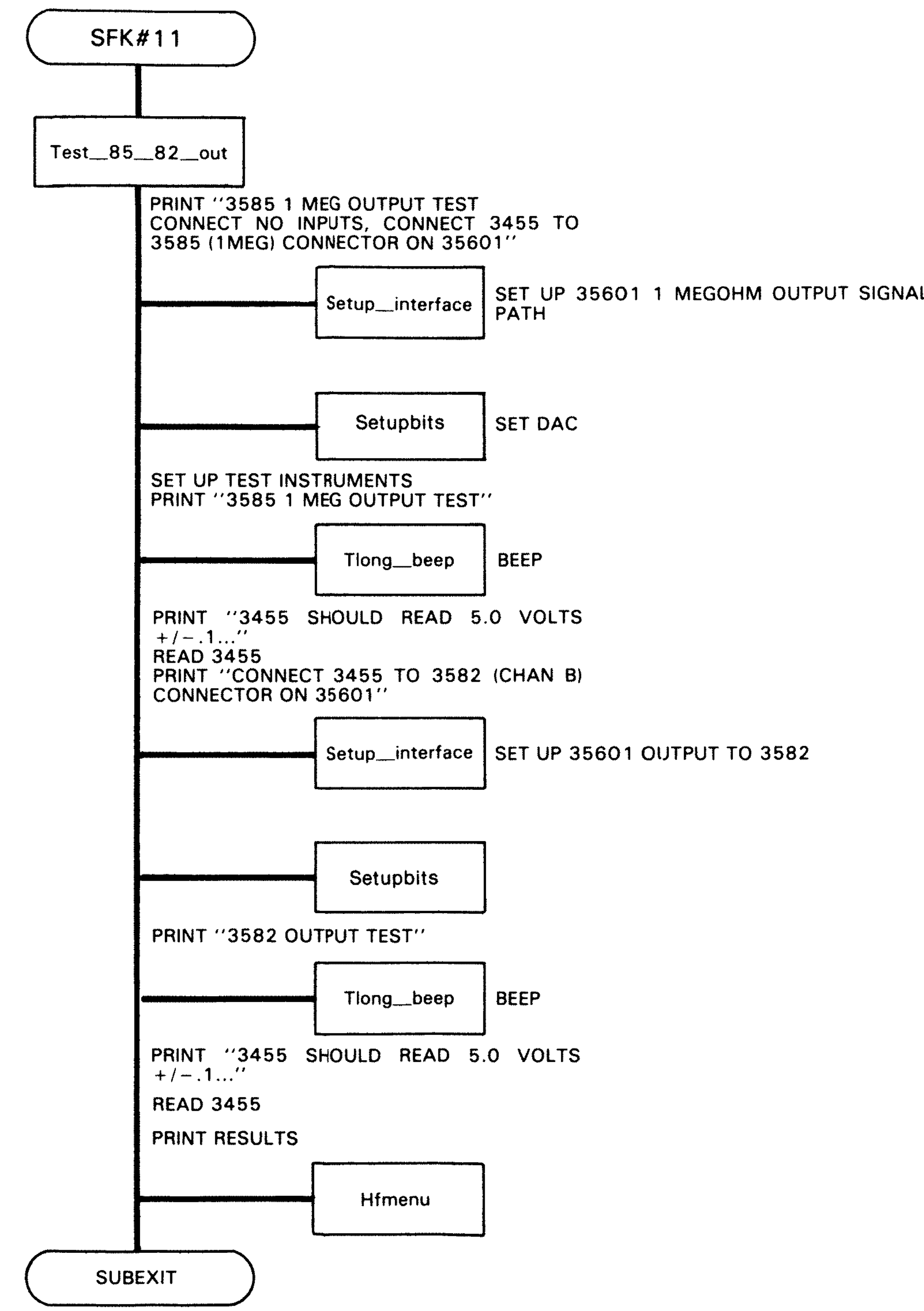


Figure 6-34. High Frequency Spectrum Analyzer Output Path Test Routine (SFK#11)

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. Setupbits 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.

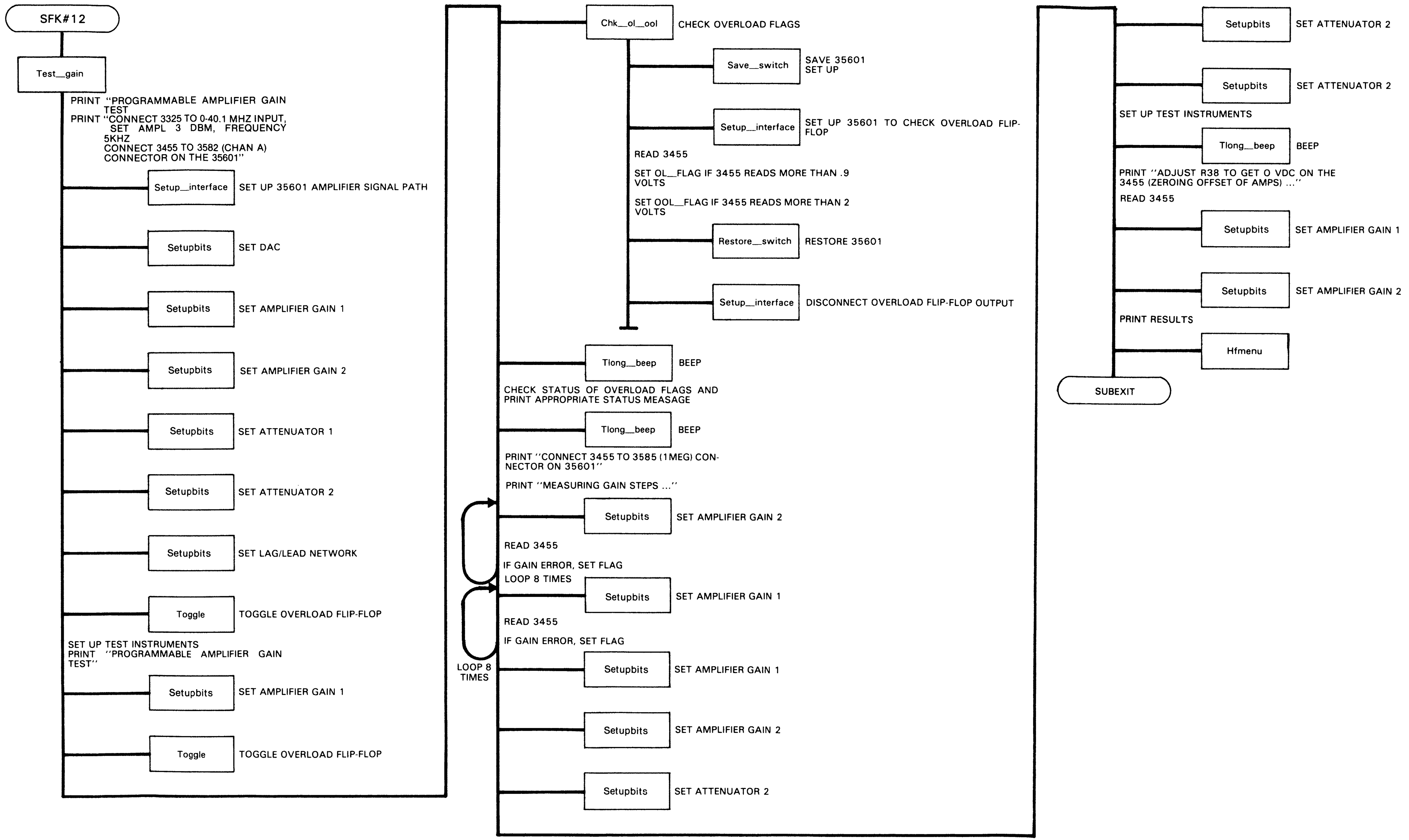


Figure 6-35. High Frequency Programmable Amplifier Test Routine (SFK#12)

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.

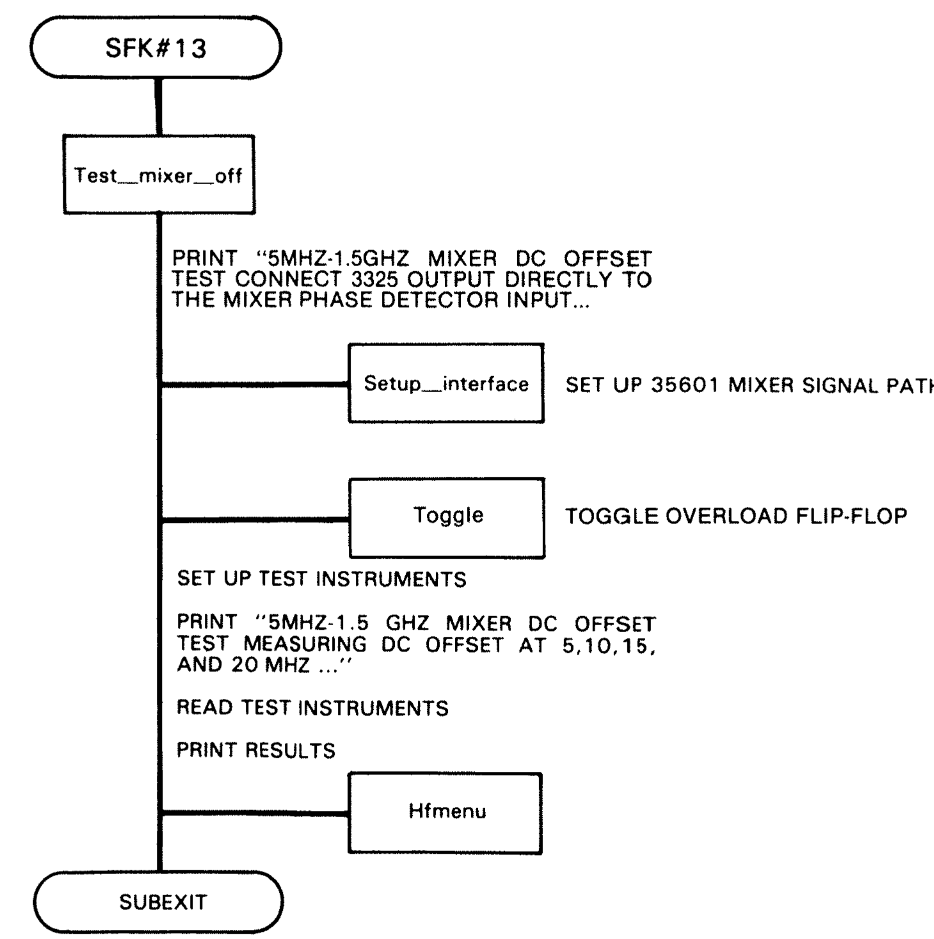


Figure 6-36. High Frequency Mixer DC Offset Test Routine (SFK#13)

HFSWITCH (SFK #16 or (SHIFT) SFK #6): 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.

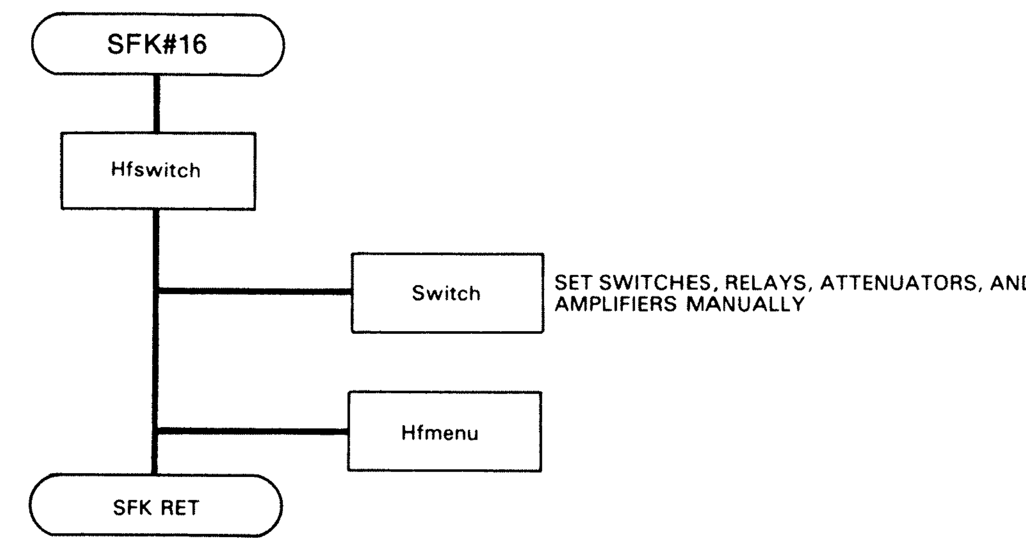


Figure 6-37. High Frequency Switch Routine (SFK#16)

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.

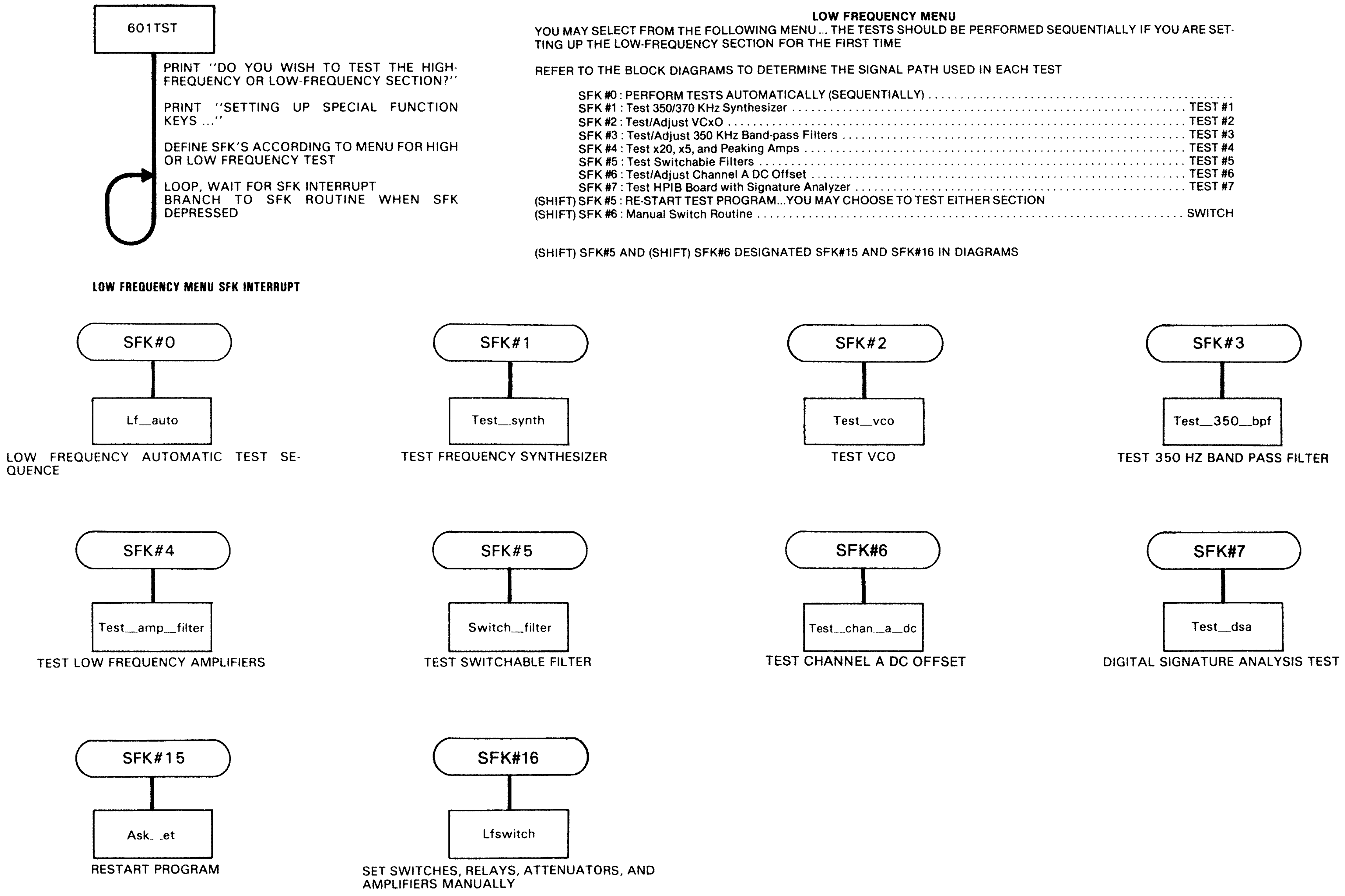


Figure 6-38. Index to 601TST Low Frequency Special Function Key Routines

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, Switch_filter, and Test_chan_a_dc. These routines are detailed in the illustrations. Lf_auto returns control to the main program after completion of all the test routines.

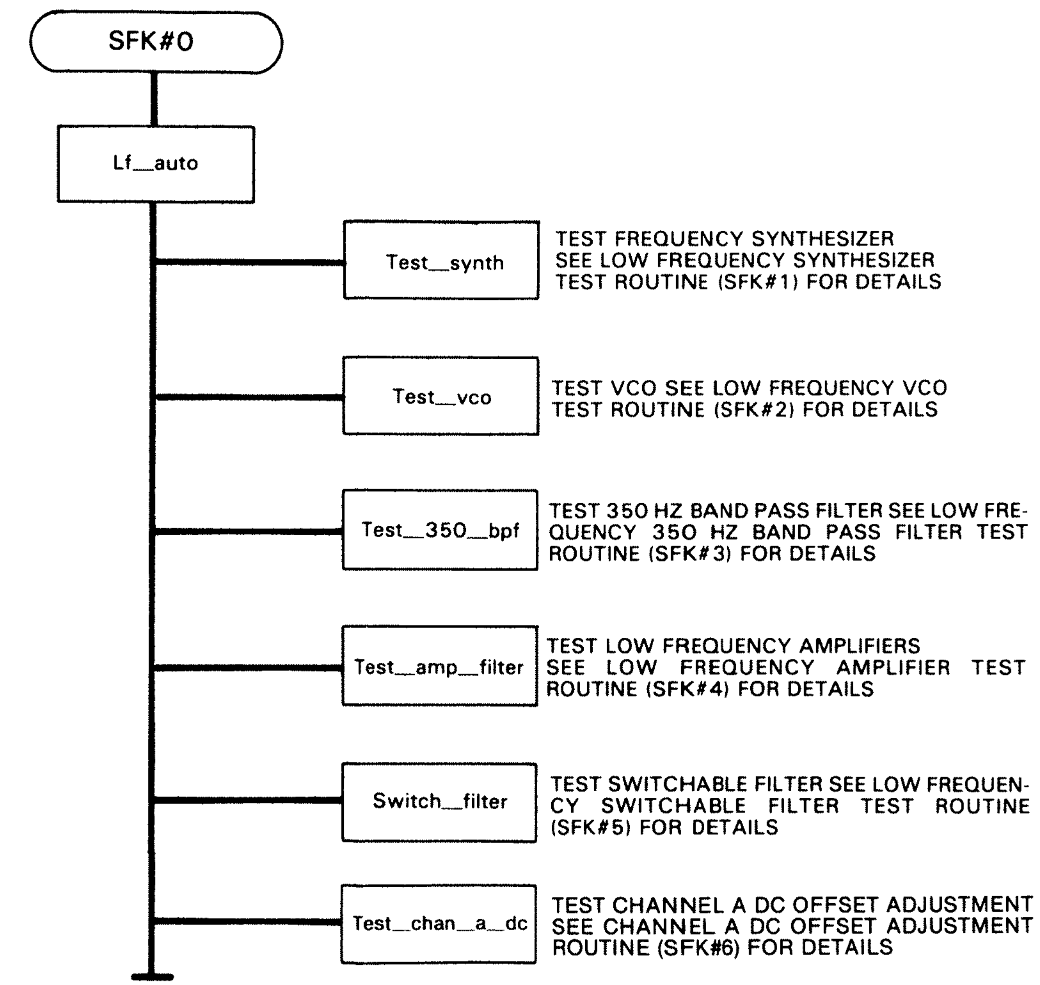


Figure 6-39. Low Frequency Automatic Test Routine (SFK#0)

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.

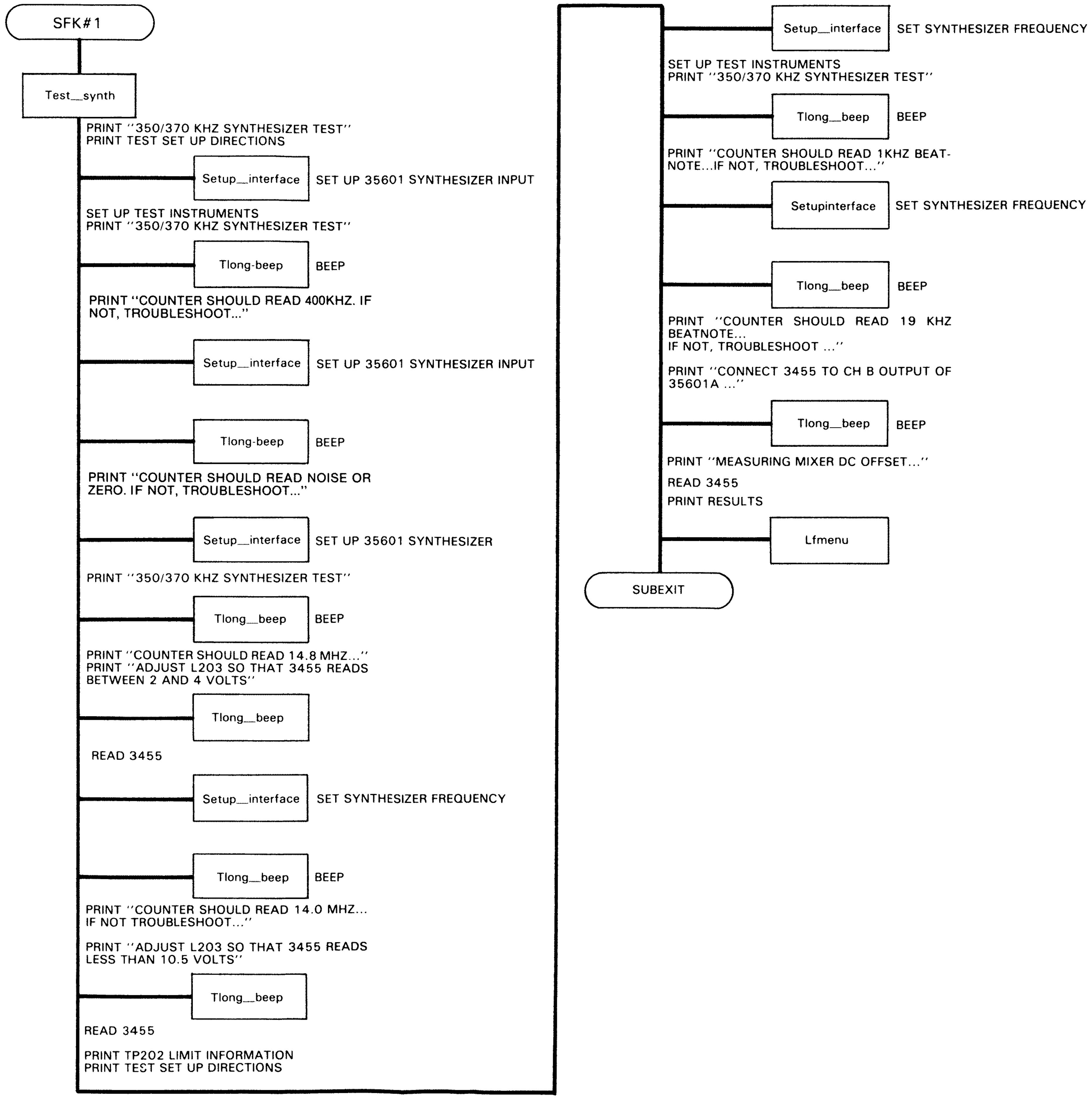


Figure 6-40. Low Frequency Synthesizer Test Routine (SFK#1)

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.

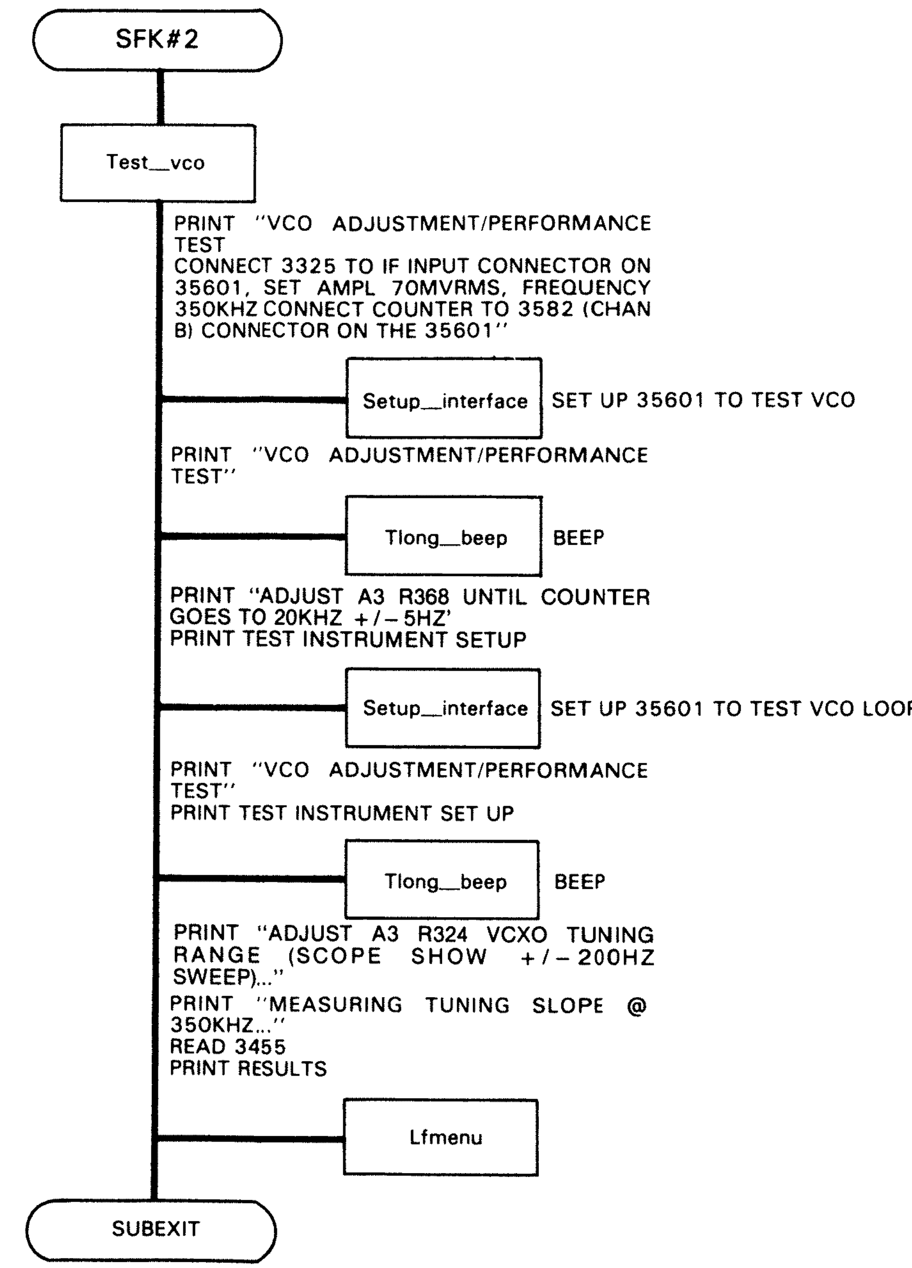


Figure 6-41. Low Frequency VCO Test Routine (SFK#2)

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.

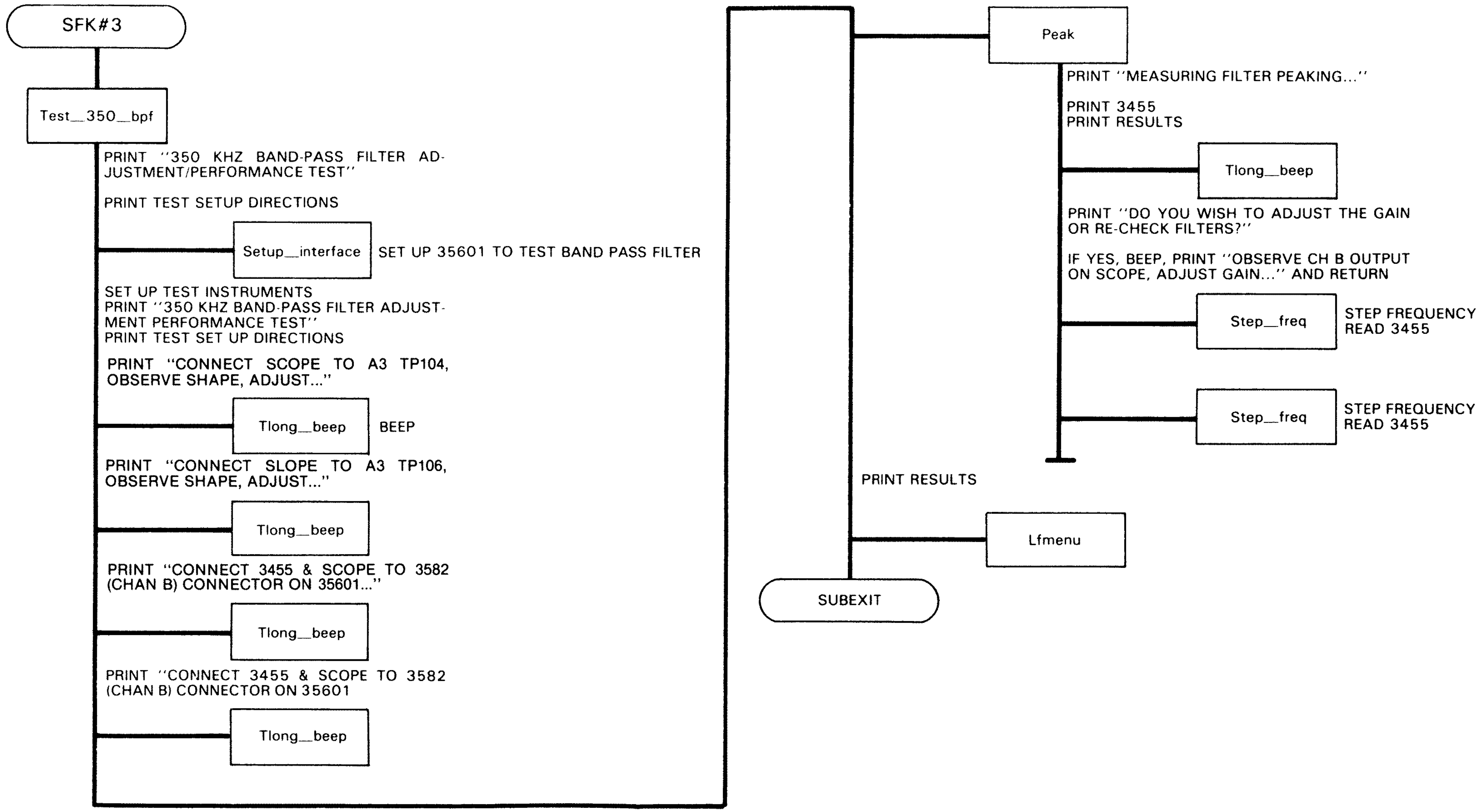


Figure 6-42. Low Frequency 350 Hz Band Pass Filter Test Routine (SFK#3)

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.

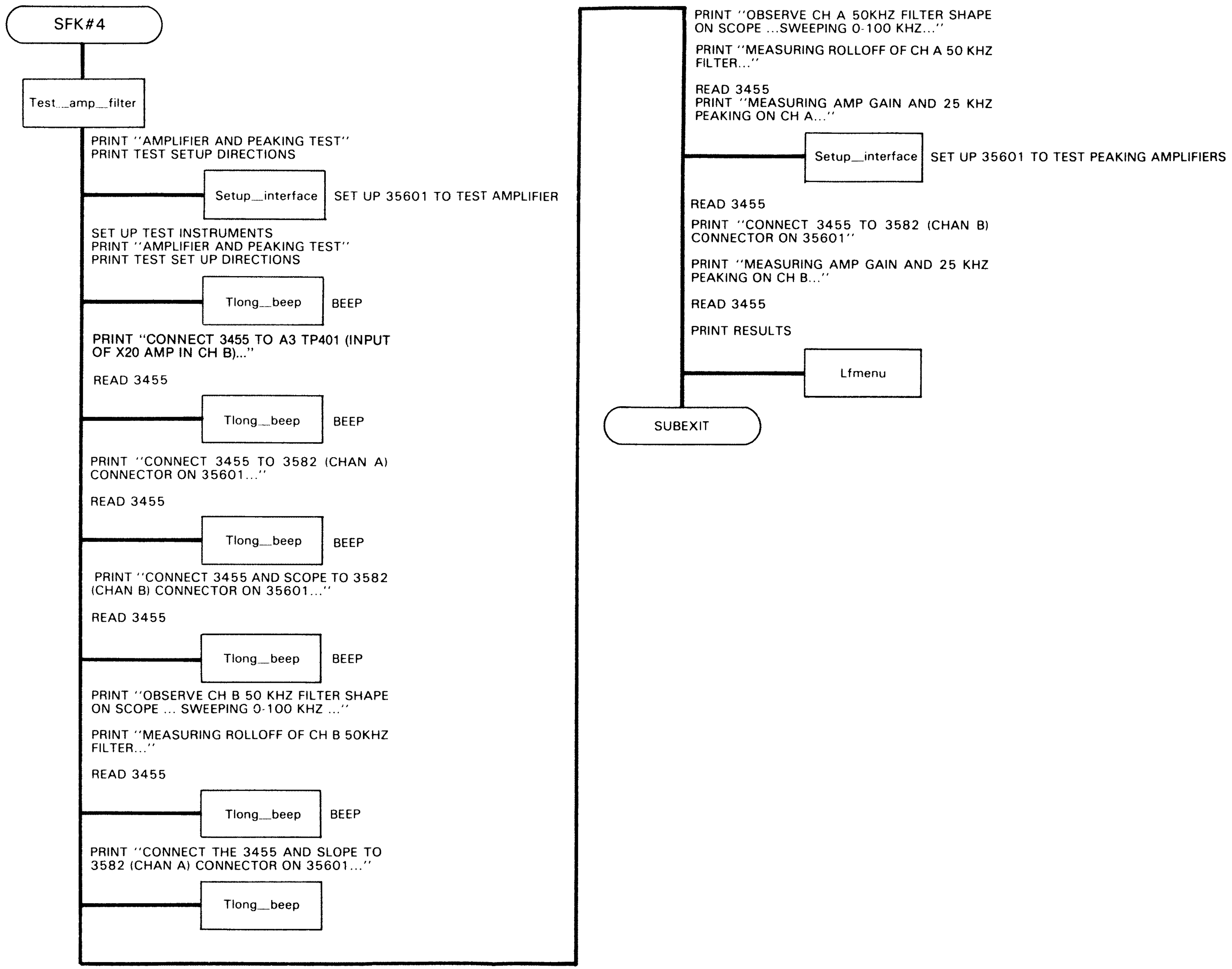


Figure 6-43. Low Frequency Amplifier Test Routine (SFK#4)

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.

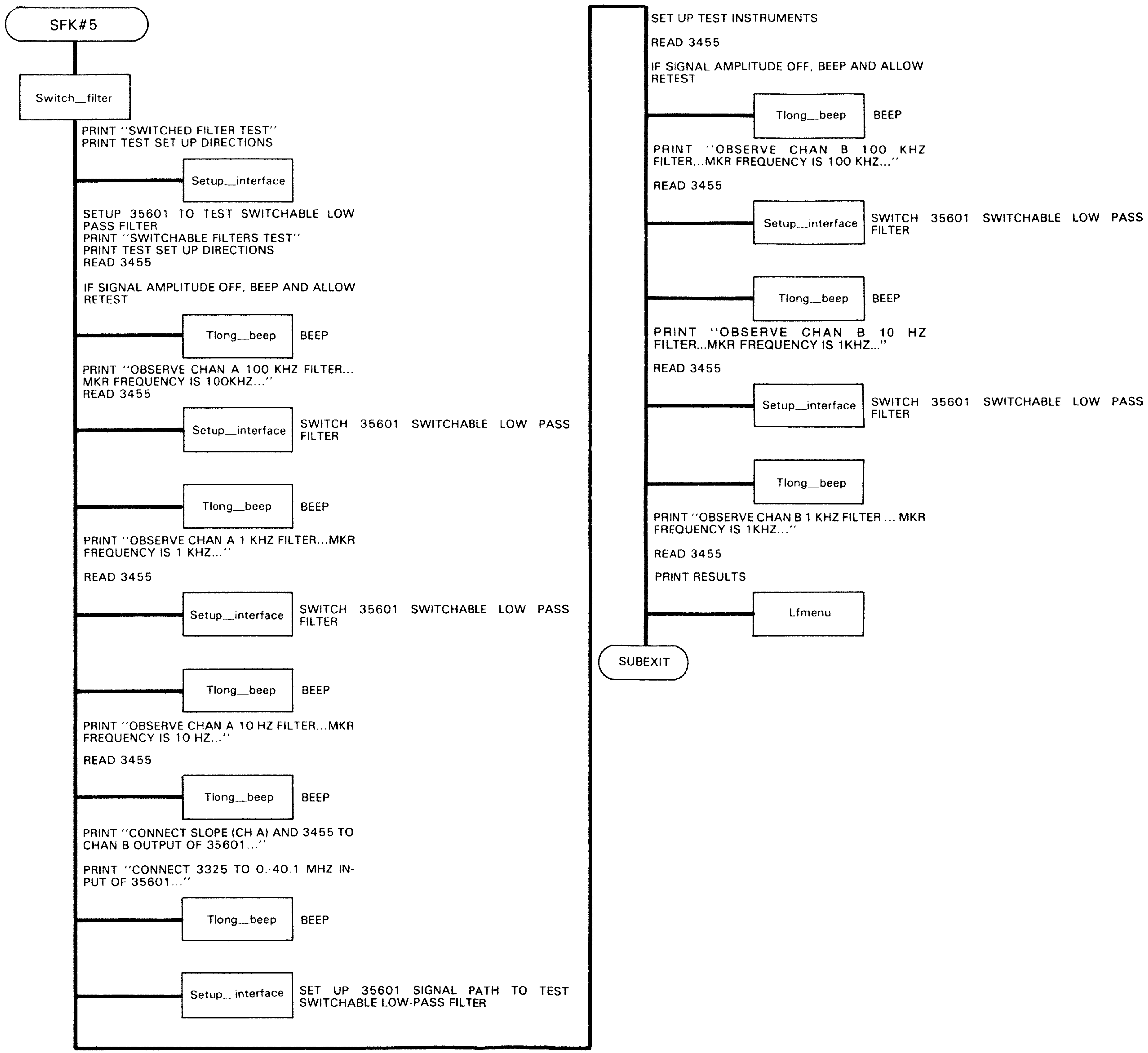


Figure 6-44. Low Frequency Switchable Filter Test Routine (SFK#5)

TEST__CHAN__A__DC (SFK #6): The Test__chan__a__dc routine configures the -hp-35601A for adjustment of the dc offset of the channel A output to the -hp-3582A. Setup__interface is used to configure the -hp-35601A circuit.

TEST__DSA (SFK #7): 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 #16 or (SHIFT) SFK #6): 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.

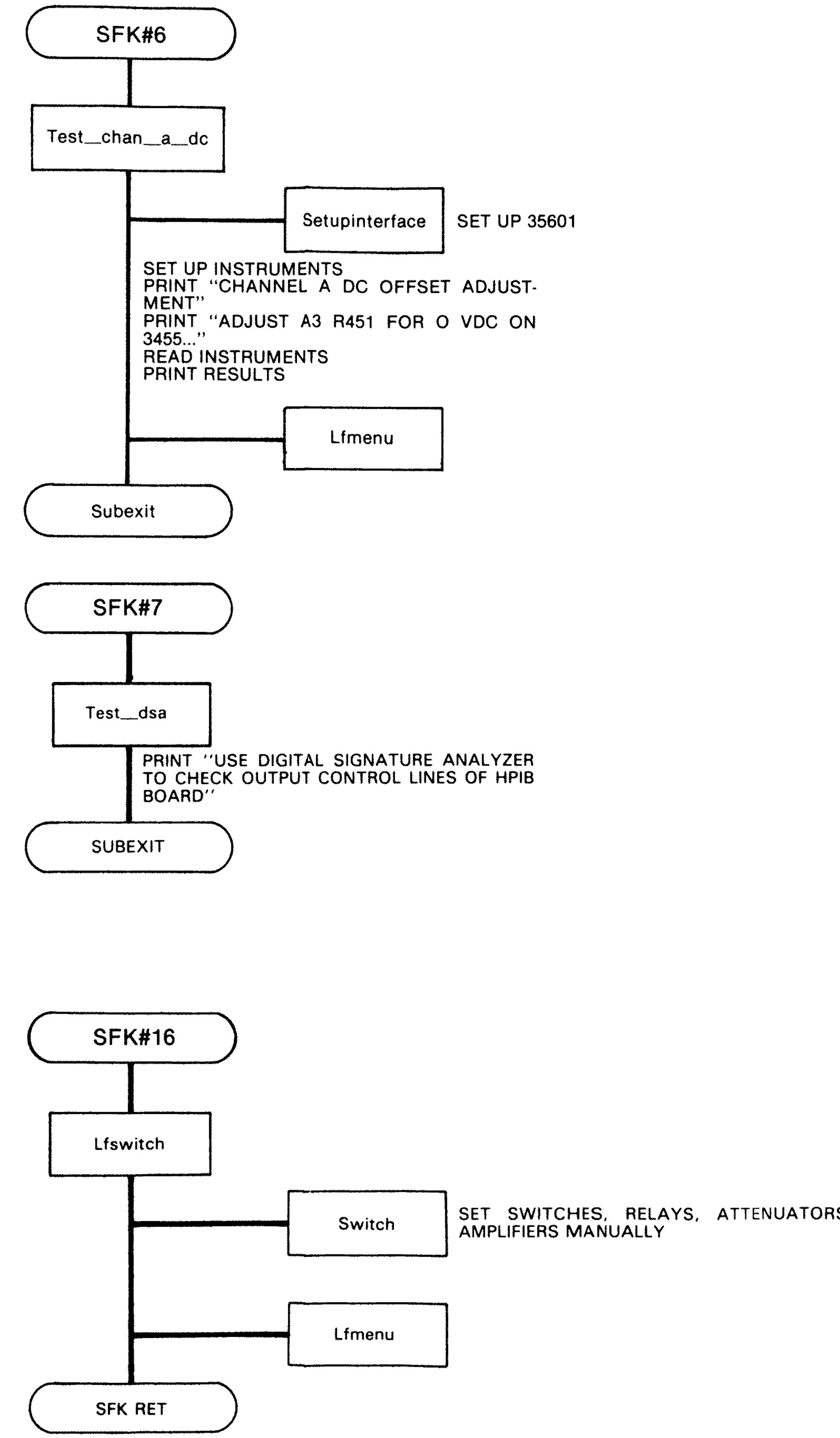


Figure 6-45. Low Frequency Channel A DC Offset Adjustment, Digital Signature Analysis, and Switch Routines (SFK#6, 7, 16)

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

7-5. DIRECT SPECTRUM ANALYSIS PERFORMANCE TESTS

7-6. INTRODUCTION

Five tests are required to verify the performance of the Direct Spectrum Analysis measurement portion of your -hp- 3047A Spectrum Analyzer System. A complete performance test can be accomplished in approximately 30 minutes.

Each test is completely self-contained and can therefore be performed at anytime without regard to other test. We do however suggest that the tests be performed in the order given. This will save testing time and establish a repeatable method for conducting the tests.

7-7. PRELIMINARY SET-UP PROCEDURES

Before attempting to perform any of the Performance Tests, the following preliminary procedures should be accomplished.

a. Allow all system components to warm up at least 30 minutes before performing any tests.

b. Set the -hp- 3582A controls as follows:

DISPLAY AMPLITUDE.................B
DISPLAY SCALE.......................10 dB/DIV
AMPLITUDE REFERENCE LEVEL......norm
PHASE...............................off
COHER...............................off
PASSBAND SHAPE...................Flat Top
AVERAGE............................off
MARKER.............................on
REL MARKER.........................on
FREQUENCY MODE..................0 START
FREQUENCY SPAN...................250 Hz
CHANNEL A & B SENSITIVITY.........+30 dBV
INPUT MODE.........................B
CHANNEL A & B COUPLING...........ac (~)
GROUND.............................CHAS
TRIGGER.............................Repetitive

c. Set the -hp- 3585A controls as follows:

INSTRUMENT PRESET

d. Remove all Phase Detector and Signal Inputs to the -hp- 35601A Spectrum Analyzer Interface.

e. LOAD and RUN the Direct Spectrum Analysis program "DIRECT". Follow the program prompts until the MAIN MENU is reached.

NOTE

When performing Direct Spectrum Analysis performance tests, press and hold -hp- 3582A keys until the computer beeps. All -hp- 3582A front panel keys are monitored and controlled by the computer.

7-8. AMPLITUDE ACCURACY TEST (Direct Spectrum)

Equipment Required

Frequency Synthesizer.................... -hp- 3325A

Test Procedure

a. Set the -hp- 3325A controls as follows:

FREQUENCY .... 20 MHz
AMPLITUDE .... +10 dBm
MODULATION .... off
SWEEP .... off
FUNCTION .... sinewave (~)

b. Connect the -hp- 3325A Signal output to the -hp- 35601A 50Ω Signal Input.

c. Set the -hp- 3585A controls as follows:

INSTRUMENT PRESET
COUNTER .... on
MKR-CF
MKR-REF LVL
SWEEP .... manual

d. Record the -hp- 3585A marker level (See Figure 7-1) on the Performance Test Record card.

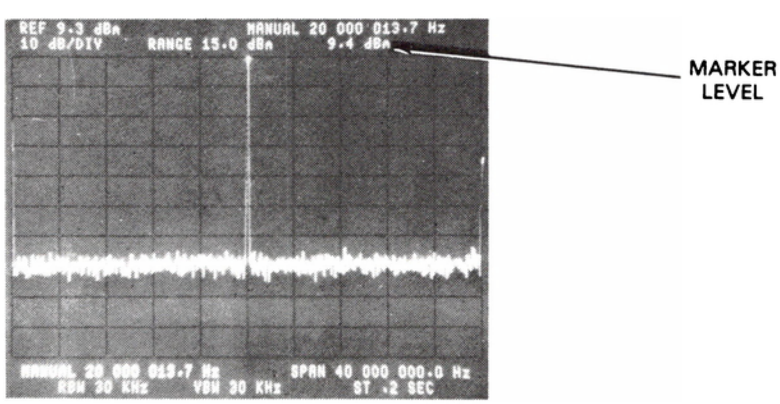


Figure 7-1. -hp- 3585A Marker Level

e. Press measurement option K0 on the computer.

f. Measure the level of the 20 MHz signal displayed on the -hp- 3582A (See Figure 7-2). This level should be within ± 0.9 dB of that measured in step d. Record the signal level on the Performance Test Record card.

g. Press measurement option SHIFT K9 on the computer. This will return you to the MAIN MENU.

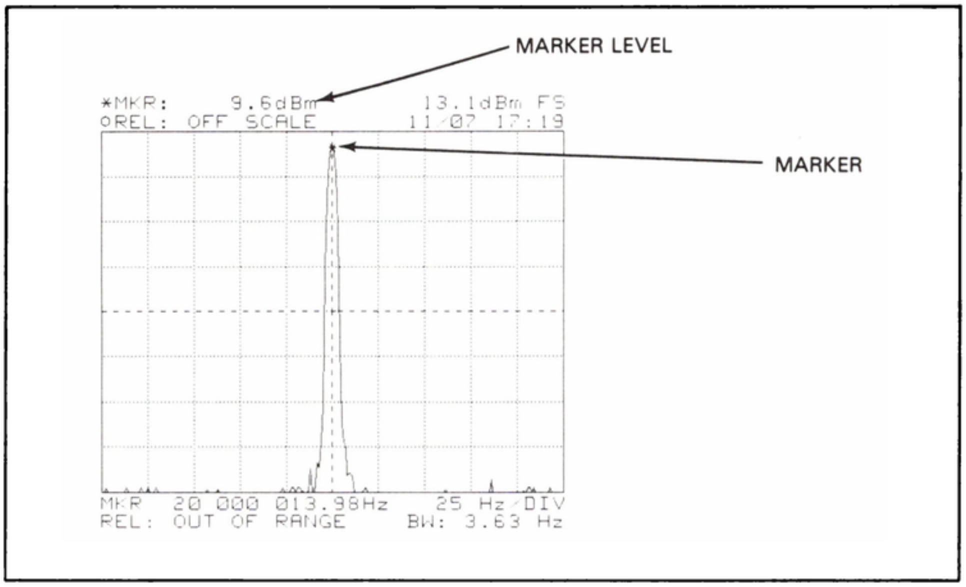


Figure 7-2. 20 MHz Signal Level

7-9. FREQUENCY FLATNESS TEST (Direct Spectrum)

Equipment Required

Frequency Synthesizer....................-hp- 3325A

Test Procedure

a. Set the -hp- 3325A controls as follows:

FREQUENCY .... 20 MHz
AMPLITUDE .... +10 dBm
MODULATION .... off
SWEEP .... off
FUNCTION .... sinewave (~)

b. Connect the -hp- 3325A Signal output to the -hp- 35601A 50Ω Signal Input.

c. Set the -hp- 3585A controls as follows:

INSTRUMENT PRESET
COUNTER .... on
MKR-CF

d. Press measurement option K0 on the computer. Wait until the MEASURE MENU is displayed.

e. Set the -hp- 3582A controls as follows:

FREQ SPAN........................... 10 kHz
SCALE .... 2 dB/DIV
MARKER POSITION...................peak of signal

f. Adjust the -hp- 3325A amplitude until the marker is at center graticule on the -hp-3582A (See Figure 7-3).

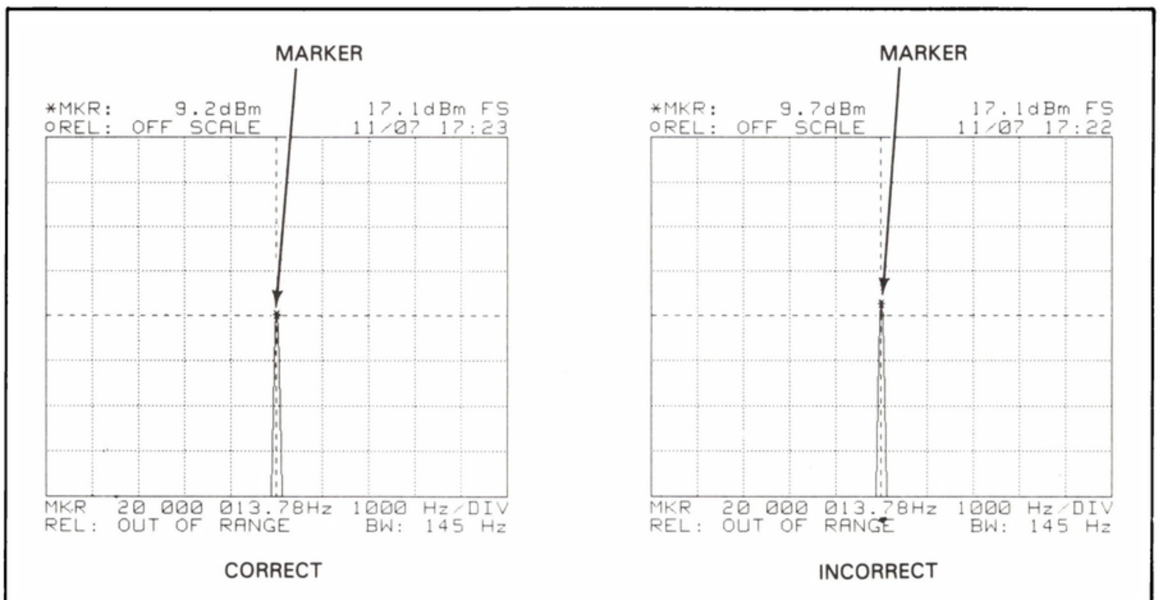


Figure 7-3. Frequency Flatness Test Adjustments

g. Set the -hp- 3582A controls as follows:

AVERAGE . . . . peak
NUMBER of AVERAGES . . . . EXP (blue shift)
RESTART

h. Set the -hp- 3325A controls as follows:

SWEEP START FREQ . . . . 19.995 MHz
SWEEP STOP FREQ . . . . 20.005 MHz
SWEEP TIME . . . . 99 sec
START SWEEP (resets sweep)
START SWEEP (starts sweep)

i. After the -hp- 3582A sweep has been completed, press SET REF on the -hp- 3582A.

j. Check the level deviation ± 1 kHz from the center frequency. This level should not vary more than ± .5 dB. Sketch the result on the Performance Test Record card.

k. Check the level deviation from ± 1 kHz to ± 5 kHz from the center frequency. This level should not vary more than ± .5 dB + .5 dB/kHz. Sketch the result on the Performance Test Record card.

l. Press measurement option SHIFT K9 on the computer. This will return you to the MAIN MENU.

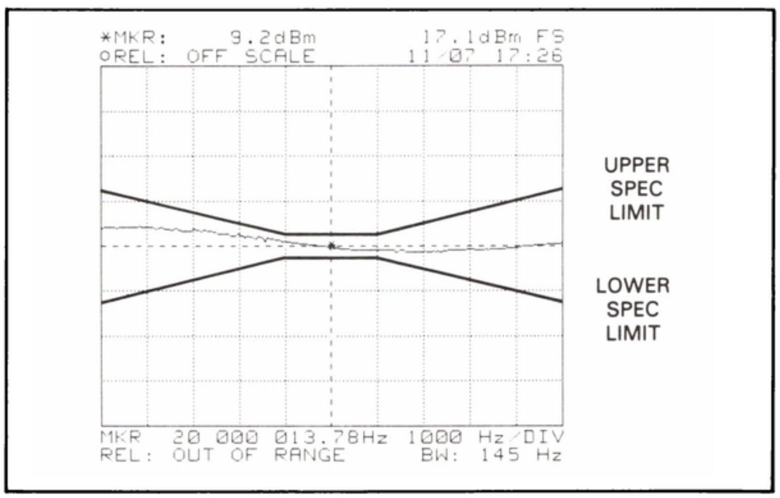


Figure 7-4. Frequency Flatness Test Sample Results

7-10. INTERMODULATION DISTORTION TEST (Direct Spectrum)

Equipment Required

Frequency Synthesizer....................-hp- 3325A
Quadrature Test Fixture..................03047-84401

Test Procedure

a. Set the -hp- 3325A controls as follows:

FREQUENCY .... 10 000 100.0 Hz
AMPLITUDE .... +15 dBm
MODULATION .... off
SWEEP .... off
FUNCTION .... sinewave (~)

b. Connect equipment as shown in Figure 7-5. Intermodulation Distortion Test Set-up.

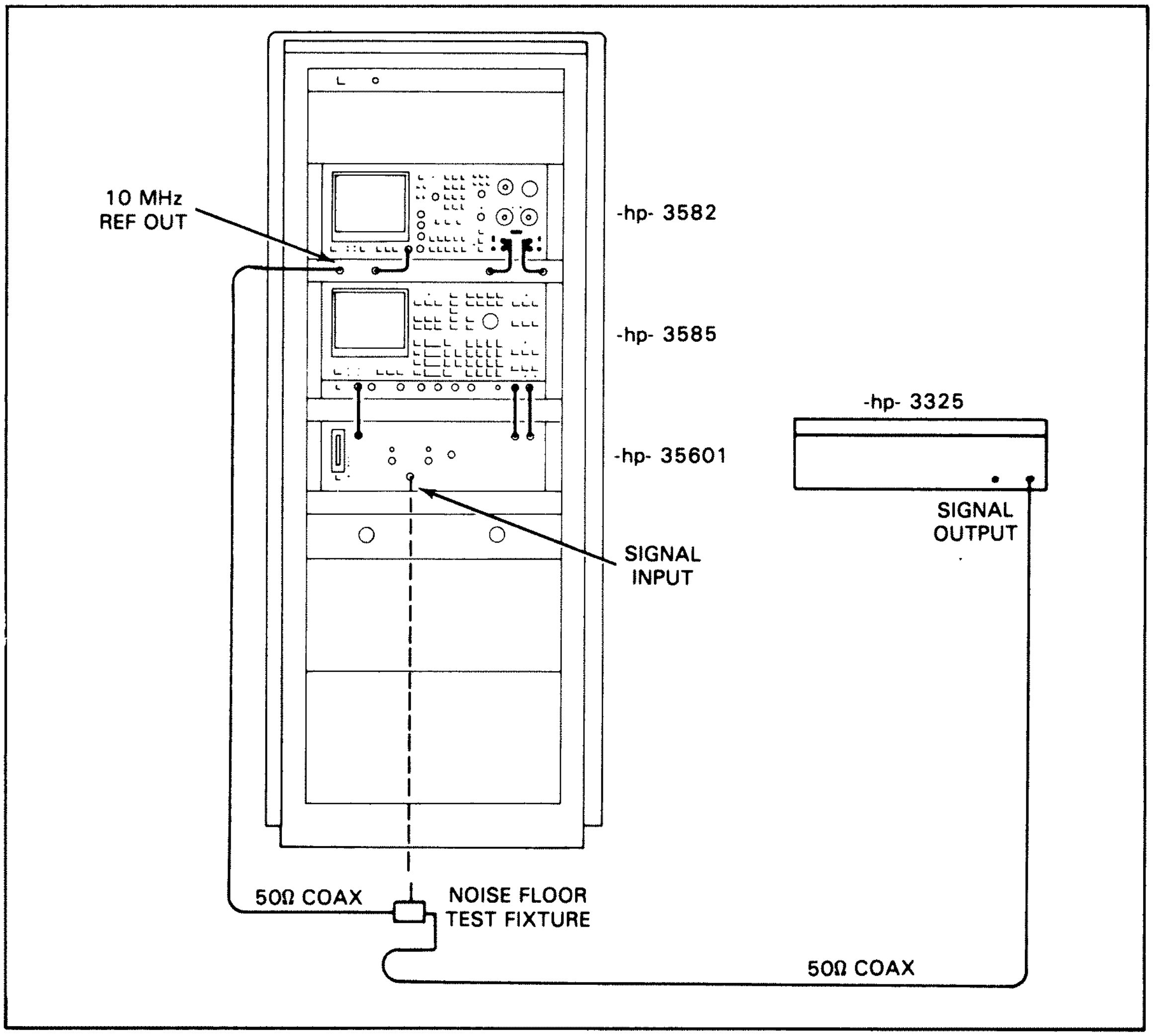


Figure 7-5. Intermodulation Distortion Test Set-up.

c. Set the -hp- 3585A controls as follows:

INSTRUMENT PRESET
CENTER FREQUENCY .... 10 MHZ
COUNTER .... on
MKR-CF

d. Press measurement option K0 on the computer. Wait until the MEASURE MENU is displayed.

e. Set the -hp- 3582A controls as follows:

DISPLAY SCALE .... 10 dB/DIV
FREQ SPAN .... 1 kHz
AVERAGE .... off
MARKER POSITION .... 10 MHz
SET REF

f. Move the -hp- 3582A marker to the peak of the signal at approximately 10 000 100.0 Hz and adjust the -hp- 3325A amplitude until the signal level matches that of the 10 MHz reference signal (See Figure 7-6).

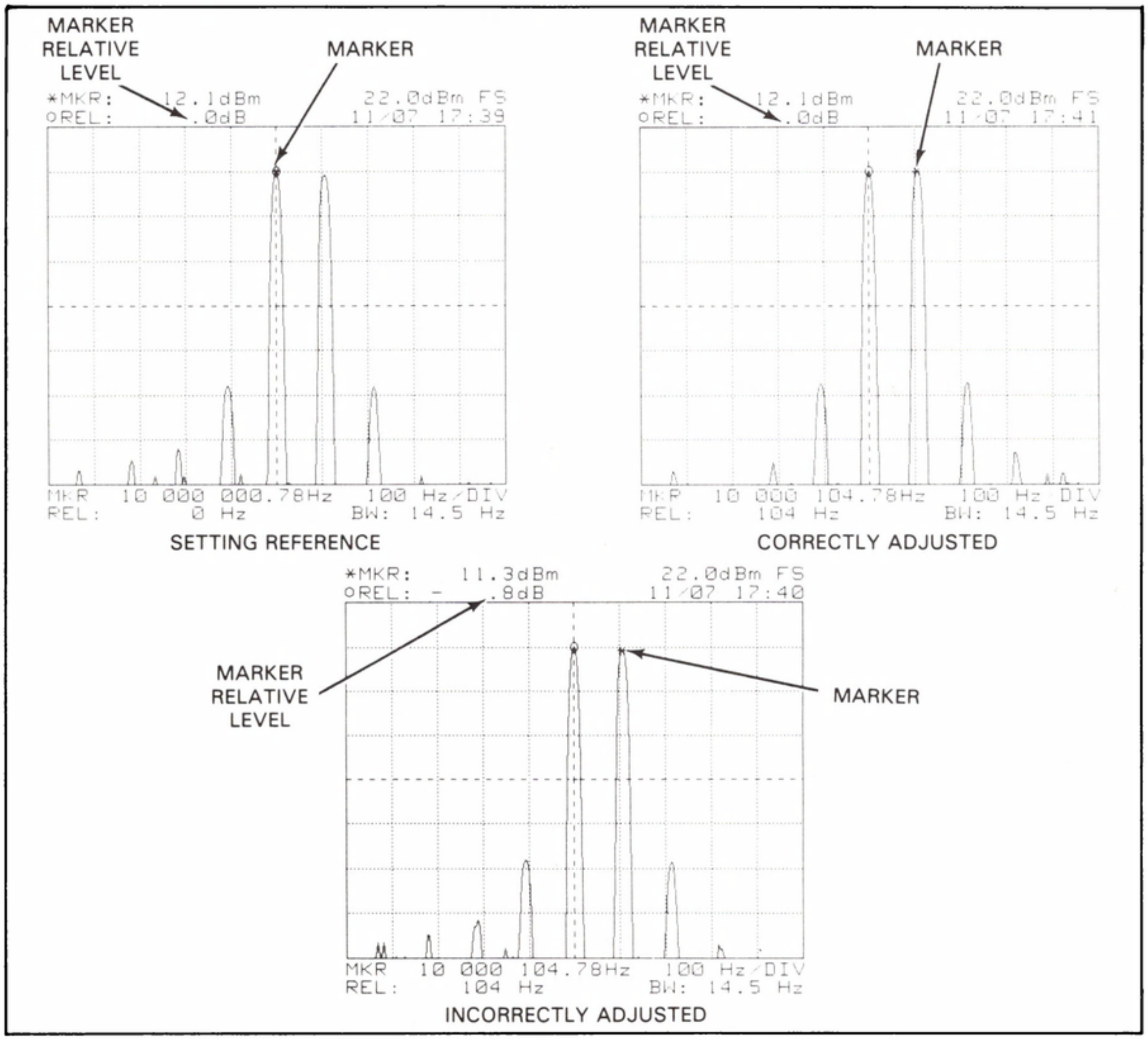


Figure 7-6. Intermodulation Distortion Test Adjustments

g. Move the -hp- 3582A marker to the peak of the signal at approximately 10 000 200.0 Hz. Measure the relative signal level and record the result on the Performance Test Record card. The signal should be at least 40 dBm below the 10 MHz reference signal (See Figure 7-7).

h. Press measurement option SHIFT K9 on the computer. This will return you to the MAIN MENU.

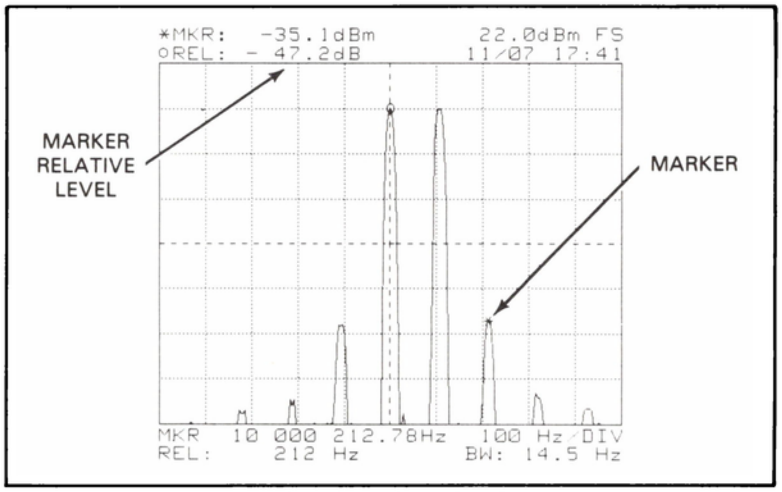


Figure 7-7. Intermodulation Distortion Test Sample Results

7-11. NOISE FLOOR TEST (Direct Spectrum)

Equipment Required

50 OHM Termination. -hp- 11048

Test Procedure

a. Install the 50 OHM Terminator on the -hp- 35601A 50Ω Signal Input connector.

b. Set the -hp- 3585A controls as follows:

INSTRUMENT PRESET
CENTER FREQUENCY. . . . . 24 MHz
REF LVL. . . . . -65 dBm

c. Press measurement option K0 on the computer. Wait until the MEASURE MENU is displayed.

d. Set the -hp- 3582A controls as follows:

FREQ SPAN. . . . . 250 Hz
AVERAGE. . . . . RMS
NUMBER of AVERAGES. 64
RESTART

e. Wait approximately one minute for the averaging to terminate. (Data Loading Light stays off)

f. Place the -hp- 3582A marker on the highest level signal (See Figure 7-8). The marker should be ≤ -130 dBm. Record the measured level on the Performance Test Record card.

g. Press measurement option SHIFT K9 on the computer. This will return you to the MAIN MENU.

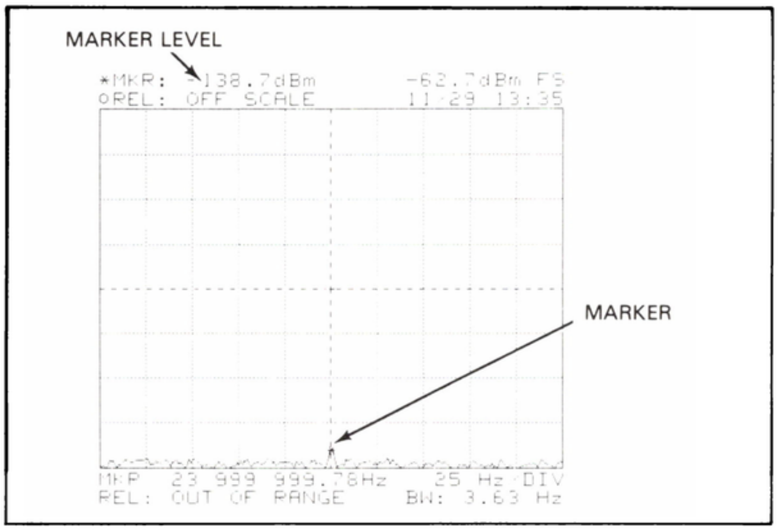


Figure 7-8. Noise Floor Test Sample Results

NOTE

This test may be repeated at any frequency between 19.5 kHz and 40.095 MHz by using measurement option K1 in step c.

7-12. IMAGE REJECTION TEST (Direct Spectrum)

Equipment Required

Frequency Synthesizer. -hp- 3325A

Test Procedure

a. Set the -hp- 3325A controls as follows:

FREQUENCY . . . . 10 MHz
AMPLITUDE . . . . 0 dBm
MODULATION . . . . off
SWEEP . . . . off
FUNCTION . . . . sinewave (~)

b. Connect the -hp- 3325A Signal output to the -hp- 35601A 50Ω Signal Input.

c. Set the -hp- 3585A controls as follows:

INSTRUMENT PRESET
CENTER FREQUENCY. . . . . 10 MHz
COUNTER . . . . on
MKR-CF
MKR-REF LVL

d. Press measurement option K0 on the computer. Wait until the MEASURE MENU is displayed.

e. Set the -hp- 3582A controls as follows:

FREQ SPAN. . . . . 250 Hz
AVERAGES. . . . . RMS
NUMBER OF AVERAGES. 4
RESTART

f. Set the -hp- 3582A marker to the peak of the signal (See Figure 7-9).

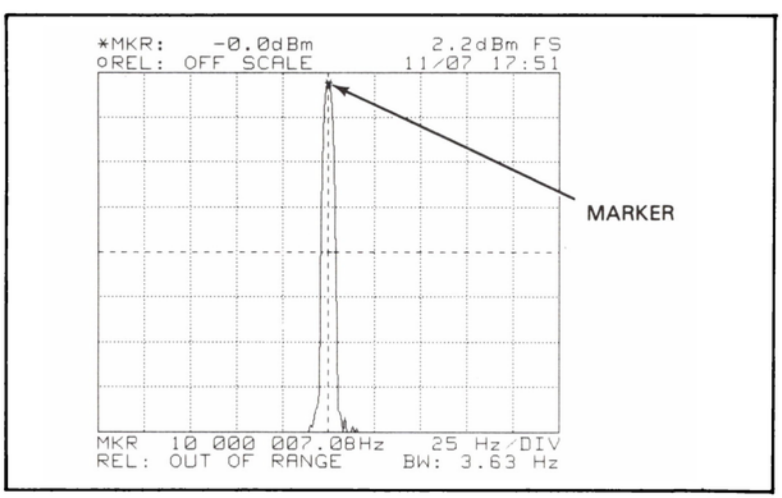


Figure 7-9. Image Rejection Test Adjustments

g. Set the -hp- 3325A controls as follows:

FREQUENCY .... 9.960 MHz

h. Press RESTART on the -hp- 3582A.

i. Check that the -hp- 3582A marker level is ≤ -70 dBm (See Figure 7-10). Record the level on the Performance Test Record card.

j. Press measurement option SHIFT K9 on the computer. This will return you to the MAIN MENU.

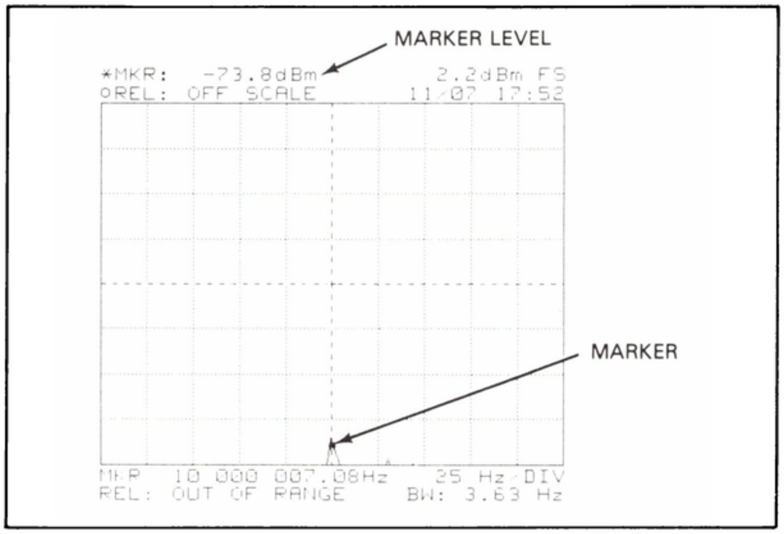


Figure 7-10. Image Rejection Test Sample Results

7-13. AM/PM NOISE ANALYSIS PERFORMANCE TESTS

7-14. INTRODUCTION

Five tests are required to verify the performance of the AM/PM Noise Analysis measurement portion of your -hp- 3047A Spectrum Analyzer System. A complete performance test can be accomplished in approximately 3 hours.

Each test is independent of the other tests in this section; therefore, tests do not have to be performed in any specific order. We do however suggest that the tests be performed in the order given. This will save testing time and establish a repeatable method for conducting the tests.

7-15. PRELIMINARY SET-UP PROCEDURES

Before attempting to perform any of the Performance Tests, the following preliminary procedures should be accomplished.

a. Allow all system components to warm up at least 30 minutes before performing any tests.

b. Set the -hp- 3582A controls as follows:

DISPLAY AMPLITUDE.................B
DISPLAY SCALE.......................10 dB/DIV
AMPLITUDE REFERENCE LEVEL......norm
PHASE................................off
COHER................................off
PASSBAND SHAPE....................flat top
AVERAGE............................off
MARKER..............................on
REL MARKER.........................on
FREQUENCY MODE...................0 START
FREQUENCY SPAN....................25 kHz
CHANNEL A & B SENSITIVITY......... +30 dBV
INPUT MODE.........................B
CHANNEL A & B COUPLING...........ac (~)
GROUND.............................CHAS
TRIGGER.............................Repetitive

c. Set the -hp- 3585A controls as follows:

INSTRUMENT PRESET

d. Remove all Phase Detector and Signal Inputs to the -hp- 35601A Spectrum Analyzer Interface.

e. LOAD and RUN the AM/PM Noise Analysis program "AND_AND_PM". Follow the program prompts until the MAIN MENU is reached.

7-16. AM NOISE FLOOR/SPUR TEST (AM/PM Noise Analysis)

Equipment Required

none

Test Procedure

a. Connect the 10 MHz Reference output on the patch panel to the -hp- 35601A 50Ω Signal Input connector. (See Figure 7-11)

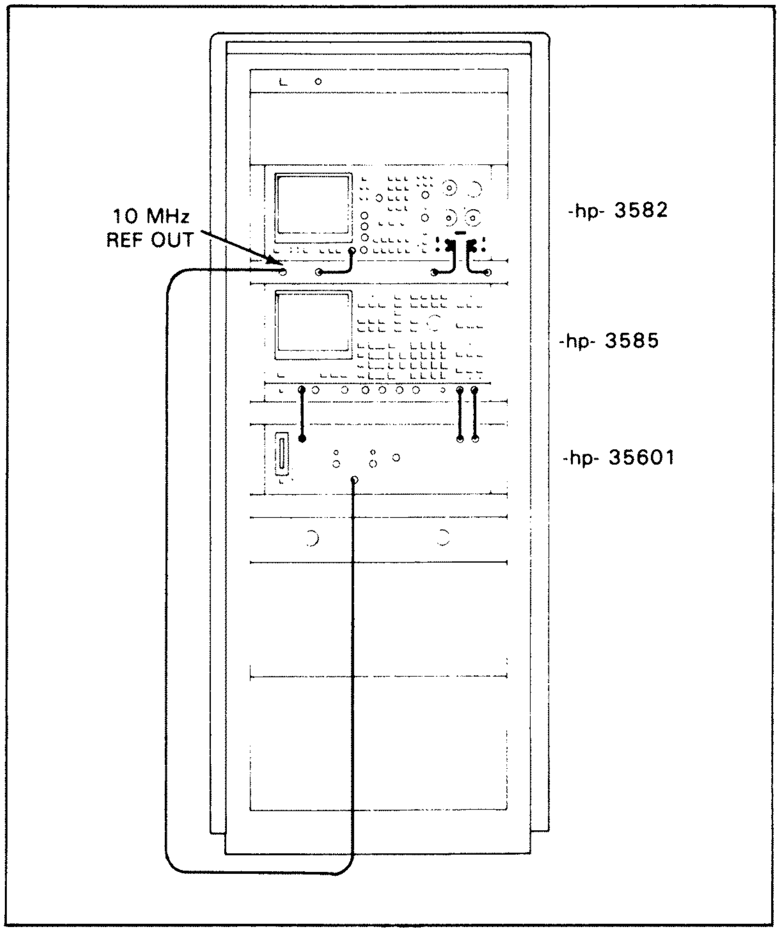


Figure 7-11. AM Noise Floor/Spur Test Set-up

b. Set the -hp- 3585A controls as follows:

INSTRUMENT PRESET
CENTER FREQUENCY.................10 MHz
COUNTER.............................on
MKR-CF
MKR-REF LVL

c. Press measurement option K1 on the computer.

d. Select BW Option 1 when instructed to do so by program prompts.

NOTE

When asked if you wish to change parameters, answer yes.

e. Set MEASUREMENT PARAMETERS as follows:

3585A MARKER FREQUENCY . . . . 10 MHz
CARRIER FREQ . . . . 10 MHz
START FREQ . . . . 0.02 Hz
STOP FREQ . . . . 25 kHz
NUMBER of AVERAGES 4

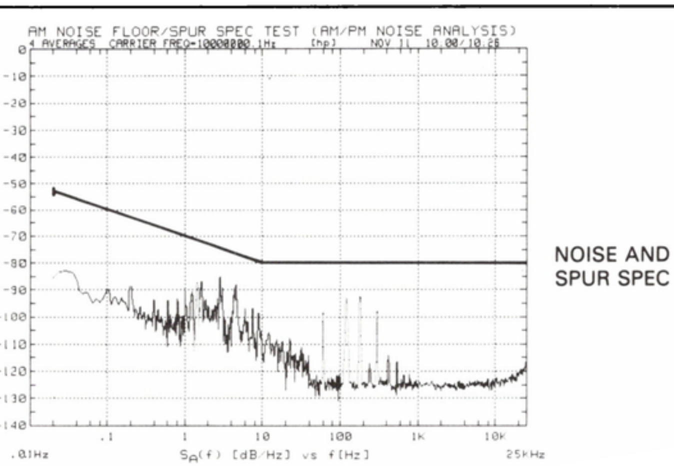
f. Set PLOT PARAMETERS as follows:

PLOTTER TYPE 9836
Y-AXIS MIN . . . . -140
Y-AXIS MAX 0
X-AXIS MIN 0.01
X-AXIS MAX . . . . 25 kHz
TITLE . . . . AM NOISE FLOOR/ SPUR SPEC TEST (AM/PM NOISE ANALYSIS)

g. When instructed by the program, press K8 on the computer to display the Noise Floor plot.

h. When the plot is complete (approximately 40 minutes), press (SHIFT) GRAPHICS on the computer to generate a hardcopy of the measurement result. Attach the copy to the Performance Test Record card.

i. Press measurement option SHIFT K9 on the computer. This will return you to the MAIN MENU.



NOTE

Actual noise floor may be expected to be as much as 30dB below spec line.

Figure 7-12. AM Noise Floor/Spur Test Sample Results

7-17. PM NOISE FLOOR/SPUR TEST (AM/PM Noise Analysis)

Equipment Required

none

Test Procedure

a. Connect the 10 MHz Reference output on the patch panel to the -hp- 35601A 50Ω Signal Input connector. (See Figure 7-13)

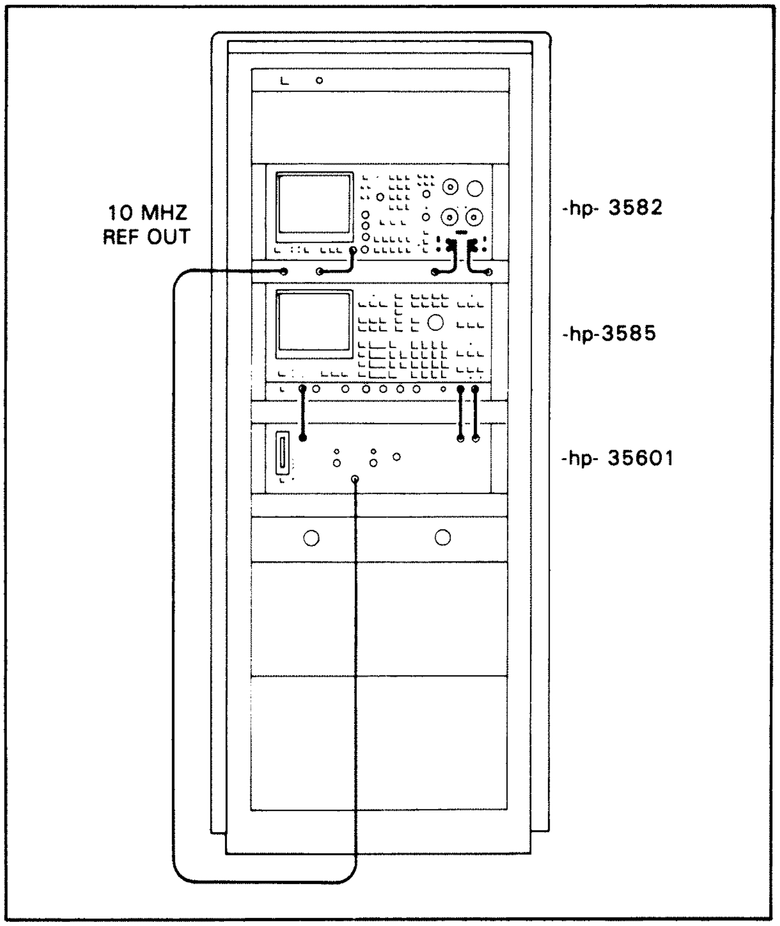


Figure 7-13. PM Noise Floor/Spur Test Set-up

b. Set the -hp- 3585A controls as follows:

INSTRUMENT PRESET
CENTER FREQUENCY . . . . 10 MHz
COUNTER . . . . on
MKR-CF
MKR-REF LVL

c. Press measurement option K0 on the computer.

d. Select BW Option 1 when instructed to do so by program prompts.

NOTE

When asked if you wish to change parameters, answer yes.

e. Set MEASUREMENT PARAMETERS as follows:

3585A MARKER FREQUENCY . . . . 10 MHz
CARRIER FREQ . . . . 10 MHz
START FREQ . . . . 0.02 Hz
STOP FREQ . . . . 25 kHz
NUMBER of AVERAGES 4

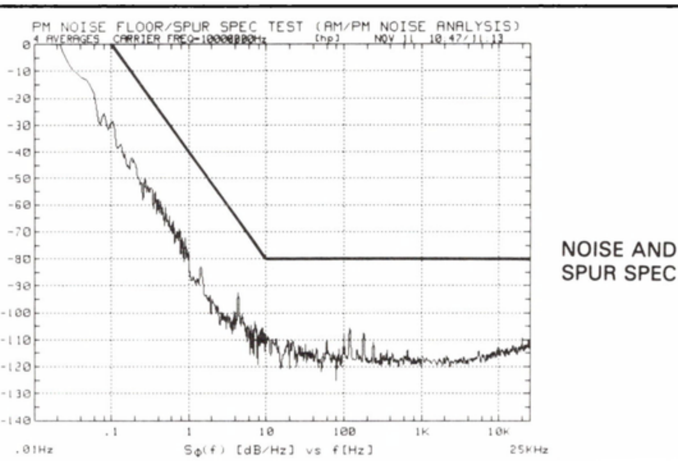
f. Set PLOT PARAMETERS as follows:

GRAPH TYPE 1
PLOTTER TYPE 9836
Y-AXIS MIN . . . . -140
Y-AXIS MAX 0
X-AXIS MIN 0.01
X-AXIS MAX . . . . 25 kHz
TITLE . . . . PM NOISE FLOOR/ SPUR SPEC TEST (AM/PM NOISE ANALYSIS)

g. When instructed by the program, press K8 on the computer to display the Noise Floor plot.

h. When the plot is complete (approximately 40 minutes), press (SHIFT) GRAPHICS on the computer to generate a hardcopy of the measurement result. Attach the copy to the Performance Test Record card.

i. Press measurement option SHIFT K8 on the computer. This will return you to the MAIN MENU.



NOTE

Actual noise floor may be expected to be as much as 30dB below spec line.

Figure 7-14. PM Noise Floor/Spur Test Sample Results

7-18. PM DISCRETE TONE ACCURACY TEST (AM/PM Noise Analysis)

Equipment Required

Frequency Synthesizer....................-hp- 3325A
Function Generator......................-hp- 3312A

Test Procedure

a. Set the -hp- 3325A controls as follows:

FREQUENCY .... 20 MHz
AMPLITUDE .... 10 dBm
PHASE MODULATION.................on
AMPLITUDE MODULATION...........off

b. Set the -hp- 3312A controls as follows:

FREQUENCY (approximately)...........20 Hz
AMPLITUDE .... minimum
FUNCTION .... sinewave (~)
SYMMETRY .... calibrate *
OFFSET .... calibrate *

*calibrate = blue button pressed in

NOTE

See Figure 7-15. PM Discrete Tone Accuracy Test Set-up for steps c through e.

c. Connect the -hp- 3312A Vp-p 50Ω output to the -hp- 3325A PHASE MOD input (backpanel).

d. Connect the -hp- 3325A Signal output to the -hp- 35601A 50Ω Signal Input.

e. Connect the System Patch Panel 10 MHz REF output to the -hp- 3325A EXT REF IN (backpanel).

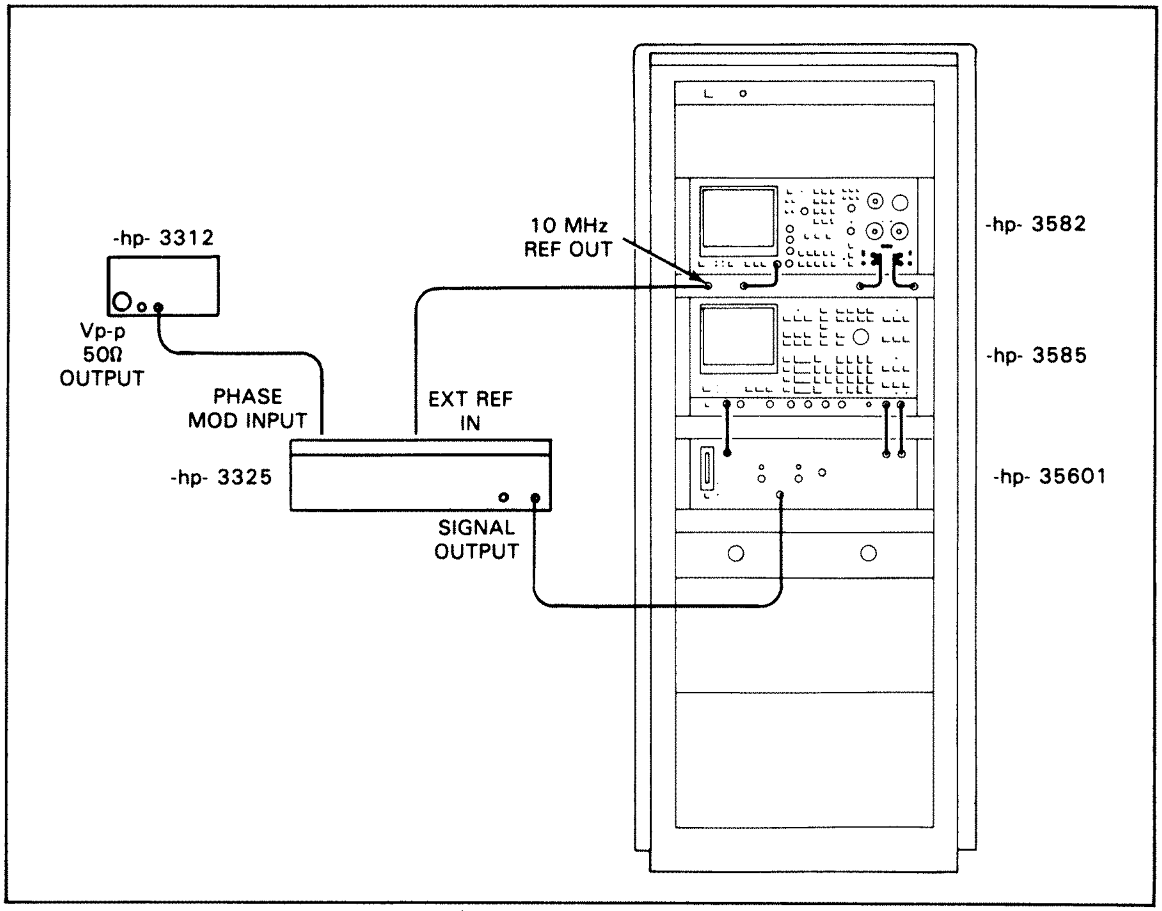


Figure 7-15. PM Discrete Tone Accuracy Test Set-up

f. Set the -hp- 3585A controls as follows:

INSTRUMENT PRESET	
FREQUENCY SPAN	50 Hz
MARKER	peak of signal (20 MHz)
MKR-CF	
MKR-REF LVL	
OFFSET	on
ENTER OFFSET	
MARKER	peak of lower sideband

g. Adjust the -hp- 3312A amplitude until the 20 Hz sidebands are approximately 40 dB below the 20 MHz carrier. (See Figure 7-16)

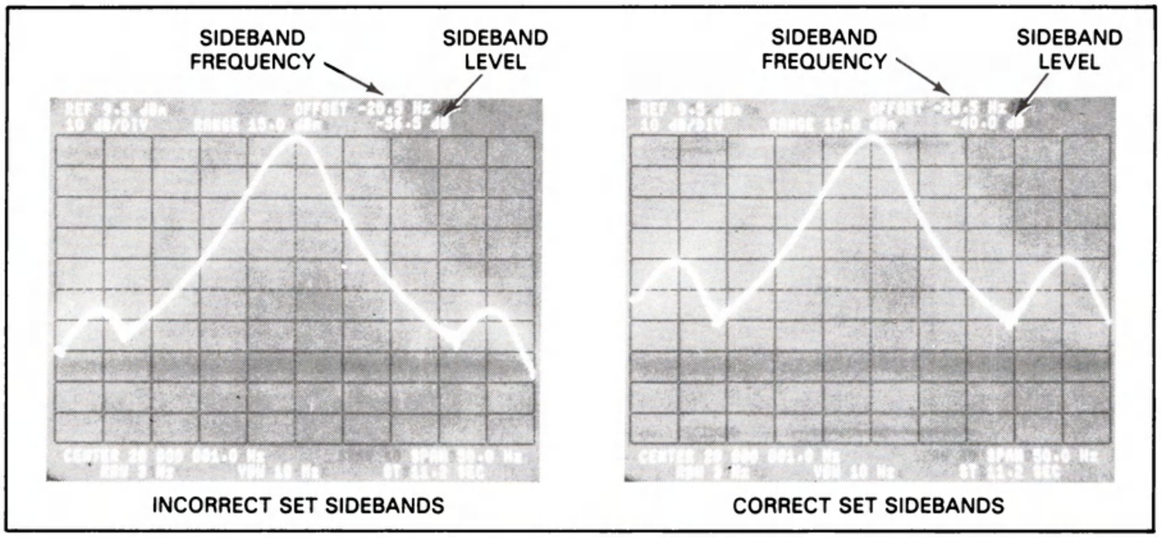


Figure 7-16. PM Discrete Tone Accuracy Test Adjustments

Note

For the purpose of establishing a reference level, the 0.2 Hz and 2 Hz sideband frequencies use the same levels as that measured for the 20 Hz sideband.

h. Measure the upper and lower sidebands and record their relative levels (dBc) on the Performance Test Record card for the 20 Hz, 2 Hz, and 0.2 Hz sideband frequencies. (See Figure 7-17)

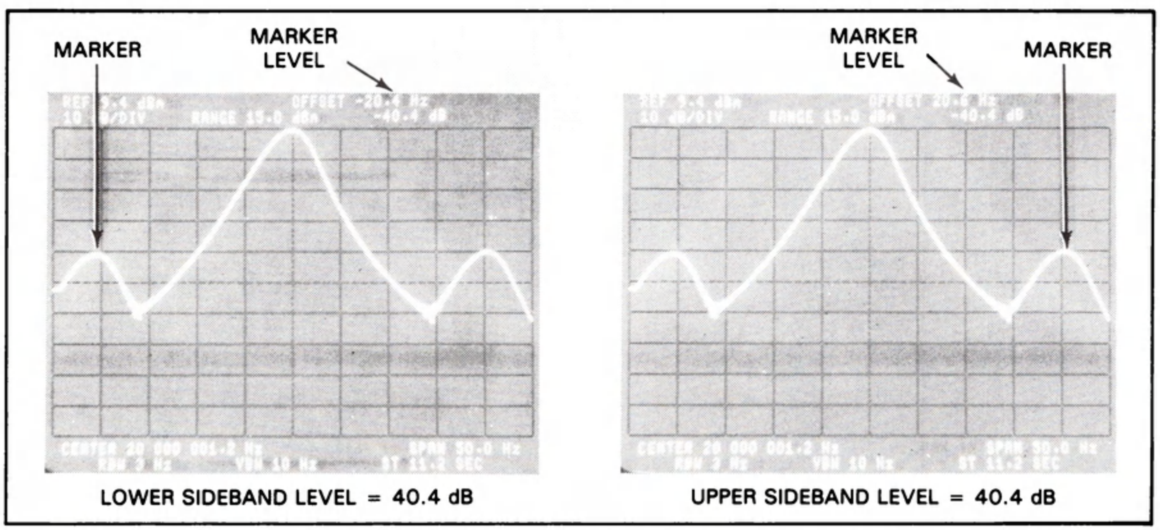


Figure 7-17. Upper and Lower PM Sideband Relative Levels

i. Without re-adjusting the -hp- 3312A output level, select the remaining sideband frequencies shown in the chart and repeat the measurement made in step h. Use the -hp- 3585A Frequency Span indicated.

Sideband Frequency	-hp- 3585A Frequency Span
200 Hz	500 Hz
2 kHz	5 kHz
20 kHz	50 kHz

j. Average the upper and lower sideband levels for each frequency and record the results on the Performance Test Record card.

k. Set the -hp- 3312A for a sideband of 200 Hz.

l. Set the -hp- 3585A controls as follows:

INSTRUMENT PRESET
COUNTER............................on
MKR-CF
MKR-REF LVL

m. Select the PM Noise Measurement by pressing K0 on the computer.

n. Select BW option 1 on the computer.

o. Measurement and Plot parameters are not used in this test. Press continue when prompted to change these parameters.

NOTE

The system requires approximately 4 minutes to calibrate and setup for the measurement.

p. Once the MEASURE MENU is displayed, press K1 to stop the measurement, set the -hp- 3312A to 20 kHz, and then press K3 on the computer to enter the Single Point Measurement mode.

q. Select -hp- 35601A filter option 0.

r. Set the -hp- 3582A controls as follows:

CHANNEL B SENSITIVITY............optimum *
AVERAGE............................RMS
NUMBER of AVERAGES................4
RESTART

*optimum = maximum input level without overload

s. Wait until the -hp- 3582A Loading Data light goes out, then set the marker to the peak of the 20 kHz sideband spur.

t. Press K1 on the computer. Record the spur amplitude (dBc) on the Performance Test Record card.

u. Repeat steps q through t for the remaining sidebands. Use -hp- 3582A FREQ SPANs and -hp- 35601A Filter Options as indicated below.

Sideband Frequency	**-hp- 3582A FREQ SPAN**	**-hp- 35601A Filter Opt.**	**Test Time in Seconds**
20 kHz	0-25 kHz	0	.04
2 kHz	0-2.5 kHz	0	.4
200 Hz	0-250 Hz	0	4
20 Hz	0-25 Hz	0	40
2 Hz	0-2.5 Hz	0	400
0.2 Hz*	0-1 Hz	2**	1000***

* when measuring sidebands <1 Hz, set the -hp- 3582A channel B Coupling to dc

** change the -hp- 35601A filter option by pressing K0 when in the Single Point Menu

*** measurement can be made as soon as the signal appears on the -hp- 3582A display (approximately 250 seconds)

v. Press Single Point Measurement option SHIFT K9 on the computer. This will return you to the MEASURE MENU.

w. Press measurement option SHIFT K9 on the computer. This will return you to the MAIN MENU.

7-19. AM DISCRETE TONE ACCURACY TEST (AM/PM Noise Analysis)

Equipment Required

Frequency Synthesizer....................-hp- 3325A
Function Generator......................-hp- 3312A

Equipment Required

Frequency Synthesizer....................-hp- 3325A
Function Generator......................-hp- 3312A

Test Procedure

a. Set the -hp- 3325A controls as follows:

FREQUENCY .... 20 MHz
AMPLITUDE .... 10 dBm
AMPLITUDE MODULATION...........on
PHASE MODULATION.................off

b. Set the -hp- 3312A controls as follows:

FREQUENCY (approximately)............20 Hz
AMPLITUDE .... minimum
FUNCTION .... sinewave (~)
SYMMETRY .... calibrate *
OFFSET .... calibrate *

*calibrate = blue button pressed in.

NOTE

See Figure 7-18. AM Discrete Tone Accuracy Test Set-up for steps c through e.

c. Connect the -hp- 3312A Vp-p 50Ω output to the -hp- 3325A PHASE MOD input (backpanel).

d. Connect the -hp- 3325A Signal output to the -hp- 35601A 50Ω Signal Input.

e. Connect the System Patch Panel 10 MHz REF output to the -hp- 3325A EXT REF IN (backpanel).

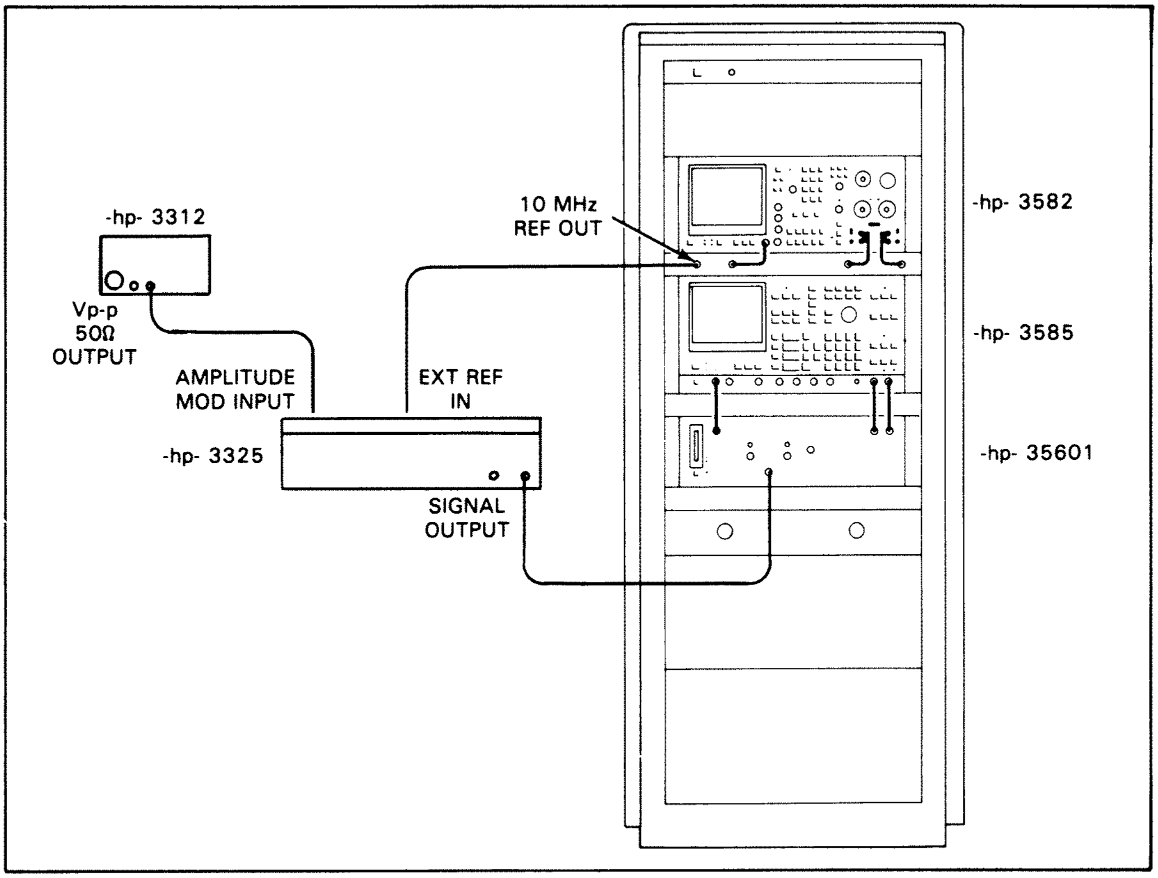


Figure 7-18. AM Discrete Tone Accuracy Test Set-up

f. Set the -hp- 3585A controls as follows:

INSTRUMENT PRESET	
FREQUENCY SPAN	50 Hz
MARKER	peak of signal (20 MHz)
(wait for full sweep)	
MKR-CF	
MKR-REF LVL	
OFFSET	on
ENTER OFFSET	
MARKER	peak of lower sideband

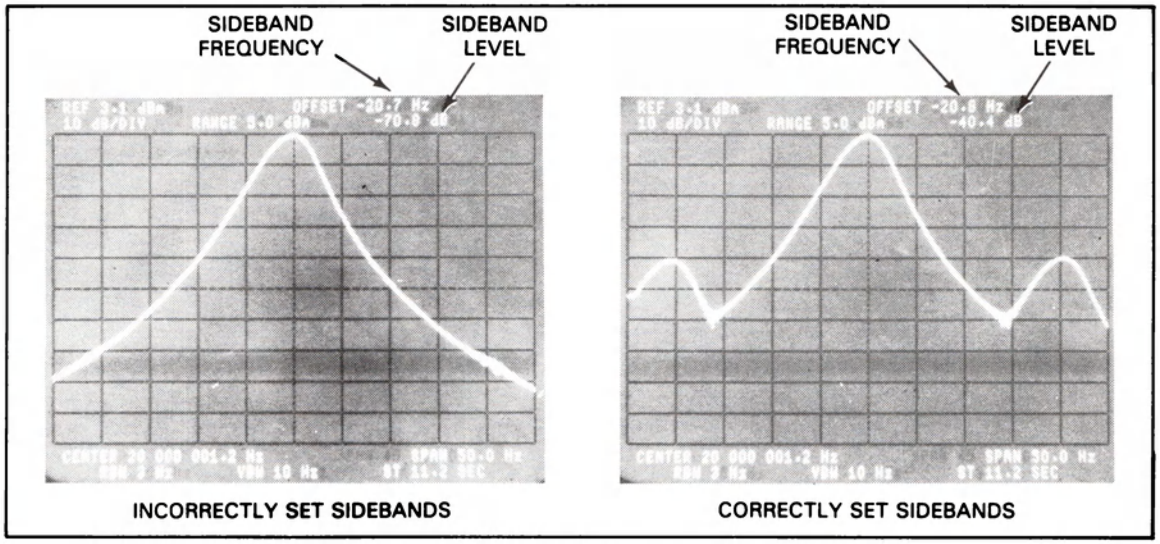


Figure 7-19. AM Discrete Tone Accuracy Test Adjustments

g. Adjust the -hp- 3312A amplitude until the 20 Hz sidebands are approximately 40 dB below the 20 MHz carrier. (See Figure 7-19)

NOTE

For the purpose of establishing a reference level, the 0.2 Hz and 2 Hz sideband frequencies use the same levels as that measured for the 20 Hz sideband.

h. Measure the upper and lower sidebands and record their relative levels (dBc) on the Performance Test Record card for the 20 Hz, 2 Hz, and 0.2 Hz sideband frequencies. (See Figure 7-20)

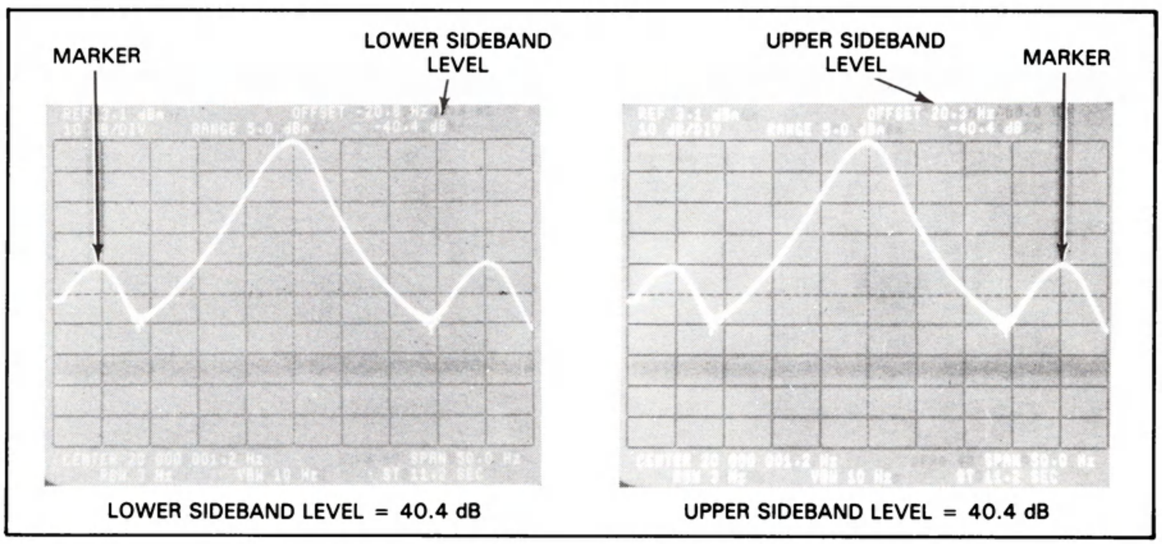


Figure 7-20. Upper and Lower AM Sideband Relative Levels

i. Without re-adjusting the -hp- 3312A output level, select the remaining sideband frequencies shown in the chart and repeat the measurement made in step h. Use the -hp- 3585A Frequency Span indicated.

Sideband Frequency	**-hp- 3585A Frequency Span**
200 Hz	500 Hz
2 kHz	5 kHz
20 kHz	50 kHz

j. Average the upper and lower sideband levels for each frequency and record the results on the Performance Test Record card.

k. Set the -hp- 3312A for a sideband of 200 Hz.

l. Set the -hp- 3585A controls as follows:

INSTRUMENT PRESET
COUNTER .... on
MKR-CF
MKR-REF LVL

m. Select the PM Noise Measurement by pressing K0 on the computer.

n. Select BW option 1 on the computer.

o. Measurement and Plot parameters are not used in this test. Press continue when prompted to change these parameters.

NOTE

The system requires approximately 4 minutes to calibrate and setup for the measurement.

p. Once the MEASURE MENU is displayed, press K1 to stop the measurement, set the -hp- 3312A to 20 kHz, and then press K3 on the computer to enter the Single Point Measurement mode.

q. Select -hp- 35601A filter option 0.

r. Set the -hp- 3582A controls as follows:

CHANNEL B SENSITIVITY .... optimum *
AVERAGE .... RMS
NUMBER of AVERAGES 4
RESTART

*optimum = maximum input level without overload

s. Set the -hp- 3582A marker to the peak of the 20 kHz sideband spur.

t. Press K1 on the computer. Record the spur amplitude (dBc) on the Performance Test Record card.

u. Repeat steps q through t for the remaining sidebands. Use -hp- 3582A FREQ SPANs and -hp- 35601A Filter Options as indicated below.

Sideband Frequency	**-hp- 3582A FREQ SPAN**	**-hp- 35601A Filter Opt.**	**Test Time in Seconds**
20 kHz	0-25 kHz	0	.04
2 kHz	0-2.5 kHz	0	.4
200 Hz	0-250 Hz	0	4
20 Hz	0-25 Hz	0	40
2 Hz	0-2.5 Hz	0	400
0.2 Hz*	0-1 Hz	2**	1000***

* when measuring sidebands < 1 Hz, set the -hp- 3582A channel B Coupling to dc

** change the -hp- 35601A filter option by pressing K0 when in the Single Point Menu

*** measurement can be made as soon as the signal appears on the -hp- 3582A display (approximately 250 seconds)

v. Press Single Point Measurement option SHIFT K9 on the computer. This will return you to the MEASURE MENU.

w. Press measurement option SHIFT K9 on the computer. This will return you to the MAIN MENU.

7-20. VCXO TUNING RANGE TEST (AM/PM Noise Analysis)

Equipment Required

Frequency Synthesizer....................-hp- 3325A

Test Procedures

a. Set the -hp- 3325A controls as follows:

FREQUENCY	10 MHz
AMPLITUDE	0 dBm
MODULATION	off
SWEEP	off
FUNCTION	sinewave (~)

b. Connect the -hp- 3325A Signal output to the -hp- 35601A 50Ω Signal Input.

c. Set the -hp- 3585A controls as follows:

INSTRUMENT PRESET	
CENTER FREQUENCY	10 MHz
COUNTER	on
MKR-CF	
MKR-REF LVL	

d. Press measurement option K0 on the computer. .

e. Select BW Option 1 when instructed to do so by the program prompts.

f. Measurement and Plot Parameters are not used. Press continue when asked to change the parameters.

NOTE

The system requires approximately 4 minutes to calibrate and set-up for the measurement.

g. When the MEASURE MENU is displayed, press K1 to stop the measurement.

h. Select Single Point Measurement by pressing K3 on the computer.

i. Select Input Filter Option 0.

j. Set the -hp- 3582A controls as follows:

CHANNEL B SENSITIVITY	+10 dBV
FREQUENCY SPAN	500 Hz
AVERAGE	off
CHANNEL B COUPLING	ac (~)

k. Set the -hp- 3325A controls as follows:

MODIFY .... 1 Hz digit

NOTE

It is necessary that the -hp- 3325A frequency be changed in 1 Hz increments to ensure that the VCXO can track the rate of change.

l. Press and hold the -hp- 3325A increment (arrow up) key while observing the Channel B overload light on the -hp- 3582A. Release the increment key as soon as the overload light illuminates.

m. Record the -hp- 3325A frequency on the Performance Test Record card. The -hp- 3325A frequency should be offset from 10 MHz by ≥ +170 Hz.

n. Press and hold the -hp- 3325A decrement (arrow down) key and cycle the -hp- 3325A frequency back to 10 MHz. Continue decrementing the frequency while observing the Channel B overload light on the -hp- 3582A. Release the decrement key as soon as the overload light illuminates.

o. Record the -hp- 3325A frequency on the Performance Test Record card. The -hp- 3325A frequency should be offset from 10 MHz by ≥ -170 Hz.

p. Press Single Point Measurement option K9 on the computer. This will return you to the MEASURE MENU.

q. Press measurement option SHIFT K9 on the computer. This will return you to the MAIN MENU.

7-21. PHASE NOISE ANALYSIS PERFORMANCE TESTS

7-22. INTRODUCTION

Four tests are required to verify the performance of the Phase Noise Analysis measurement portion of your -hp- 3047A Spectrum Analyzer System. A complete performance test can be accomplished in approximately 2 hours.

Each test is independent of the other tests in this section; therefore, tests do not have to be performed in any specific order. We do however suggest that the tests be performed in the order given. This will save testing time and establish a repeatable method for conducting the tests.

7-23. PRELIMINARY SET-UP PROCEDURES

Before attempting to perform any of the Performance Tests, the following preliminary procedures must be accomplished.

a. Allow all system components to warm up at least 30 minutes before performing any tests.

b. Set the -hp- 3582A controls as follows:

DISPLAY AMPLITUDE.................B
DISPLAY SCALE.......................10 dB/DIV
AMPLITUDE REFERENCE LEVEL......norm
PHASE...............................off
COHER...............................off
PASSBAND SHAPE....................Flat Top
AVERAGE............................off
MARKER.............................on
REL MARKER.........................on
FREQUENCY MODE...................0 START
FREQUENCY SPAN....................25 kHz
CHANNEL A & B SENSITIVITY.........+30 dBV
INPUT MODE.........................B
CHANNEL A & B COUPLING...........ac (~)
GROUND.............................CHAS
NOISE SOURCE.......................periodic (max. level)
TRIGGER.............................repetitive

c. Set the -hp- 3585A controls as follows:

INSTRUMENT PRESET

d. Remove all Phase Detector and Signal Inputs to the -hp- 35601A Spectrum Analyzer Interface.

e. LOAD and RUN the Phase Noise Analysis program "PHASE". Follow the program prompts until the MAIN MENU is reached.

7-24. MIXER CONVERSION LOSS TEST (5 MHz to 1.6 GHz)

Equipment Required

Frequency Synthesizer .... -hp- 3325A
Frequency Synthesizer(Generator) .... -hp- 3325A
(-hp- 8640B)

Test Procedure

NOTE

For steps a through d see Figure 7-21

a. Set the -hp- 3325A as follows:

FREQUENCY .... 5.0 MHz
AMPLITUDE .... -5 dBm

b. Connect the -hp- 3325A signal output to the -hp- 35601A R-Port input.

c. Set the second -hp- 3325A(-hp- 8640B) as follows:

FREQUENCY .... 5.1 MHz
AMPLITUDE .... +15 dBm

d. Connect the second -hp- 3325A(-hp- 8640B) signal output to the -hp- 35601A L-Port input.

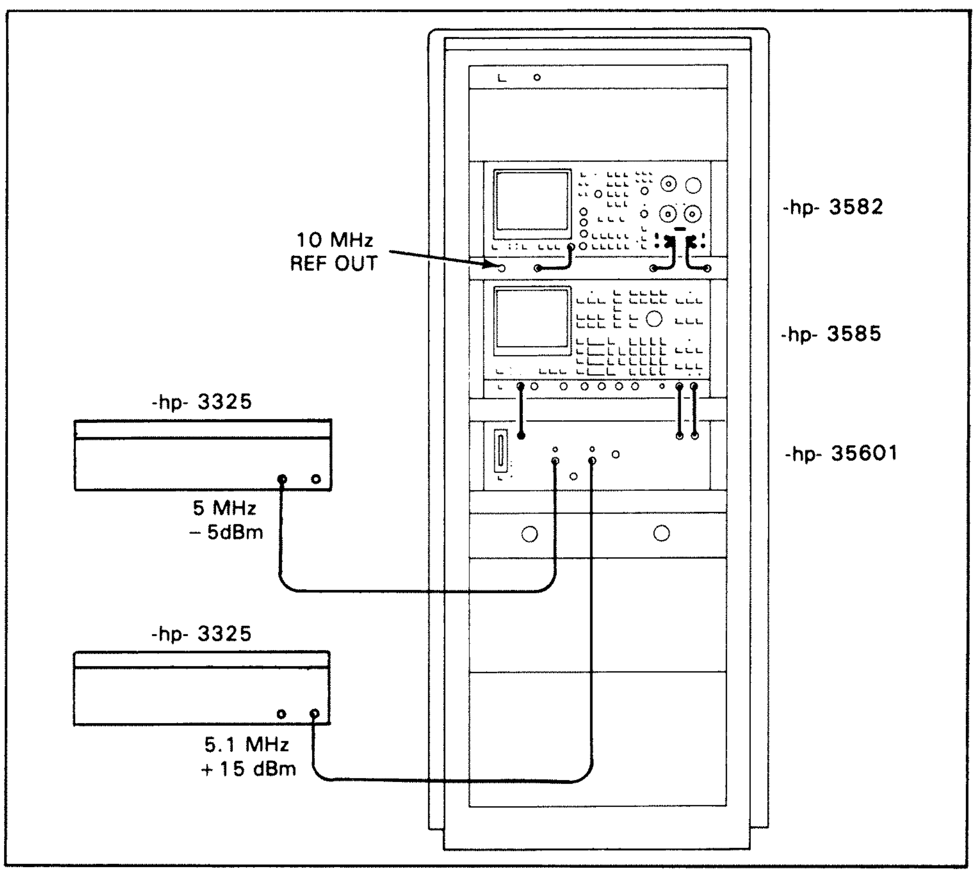


Figure 7-21. Mixer Conversion Loss Test Set-up (5 MHz to 1.6 GHz)

e. Set the -hp- 3585A as follows:

INSTRUMENT PRESET
CENTER FREQUENCY.................100 kHz
FREQUENCY SPAN....................100 kHz
MARKER..............................peak of beatnote (about 100 kHz)
MKR-CF
MKR-REF LEVEL

f. Signal level must be ≥ -18 dBm (See Figure 7-22). Record the signal level on the Performance Test Record card.

NOTE

This test may be repeated at any frequencies between 5 MHz and 1.6 GHz. The beatnote frequency must be ≤ 40 MHz.

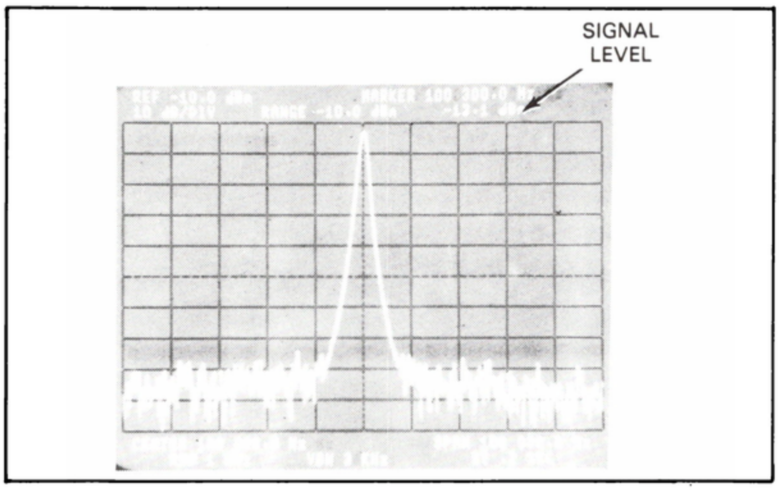


Figure 7-22. Mixer Conversion Loss Test Adjustment

7-25. MIXER CONVERSION LOSS TEST (1.2 GHz to 18 GHz)

Equipment Required

Synthesized Signal Generator .... -hp- 8660A (86602B)
Synthesized Signal Generator .... -hp- 8660A (86602B)
Fixed Attenuator (10 dB) .... -hp- 8493A (option 010)

Test Procedure

a. Select measurement option K1 on the computer.

NOTE

When asked if you wish to change parameters, answer yes.

b. Set the USER'S OSCILLATORS CHARACTERISTICS as follows:

PHASE DETECTOR INPUT FREQ .... 2 GHz

NOTE

All other Oscillator Characteristics, Measurement Parameters, and Plot Parameters constitute a don't care condition.

c. Press the continue key on the computer until instructed to CONNECT SIGNALS PER SECTION V OF MANUAL.

NOTE

From this point, the measurement software is no longer used. Steps b and c above were used to configure the -hp- 35601A Phase Detector Inputs to the 1.2 GHz to 18 GHz mixer.

For steps d through h, see Figure 7-23.

d. Set the -hp- 8660A as follows:

FREQUENCY .... 1.2 GHz
AMPLITUDE .... 10 dBm

e. Connect the -hp- 8493A 10 dB attenuator to the R-port of the 1.2 GHz to 18 GHz Phase Detector Input.

f. Connect the -hp- 8660A signal output through the 10 dB attenuator to the -hp- 35601A R-port input.

g. Set the second -hp- 8660A as follows:

FREQUENCY .... 1.22 GHz
AMPLITUDE .... +7 dBm

h. Connect the second -hp- 8660A signal output to the -hp- 35601A L-Port input.

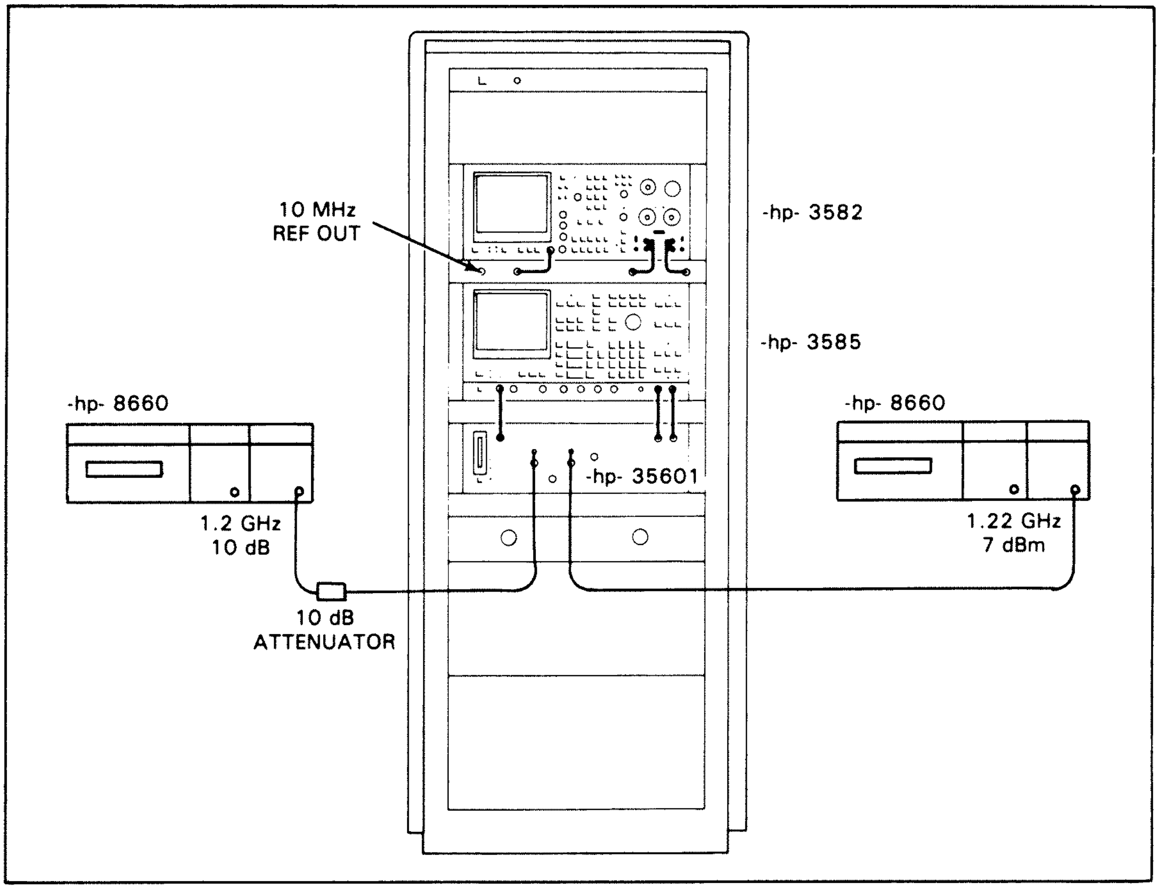


Figure 7-23. Mixer Conversion Loss Test Set-up (1.2 GHz to 18 GHz)

i. Set the -hp- 3585A as follows:

INSTRUMENT PRESET
MARKER .... peak of beatnote (about 20 MHz)
MKR-CF
MKR-REF LEVEL

j. Signal level must be ≥ -10 dBm (See Figure 7-24). Record the signal level on the Performance Test Record card.

k. Press measurement option SHIFT K9 on the computer. This will return you to the MAIN MENU.

NOTE

This test may be repeated at any frequencies between 1.2 GHz and 18 GHz. The beatnote frequency must be ≤ 40 MHz.

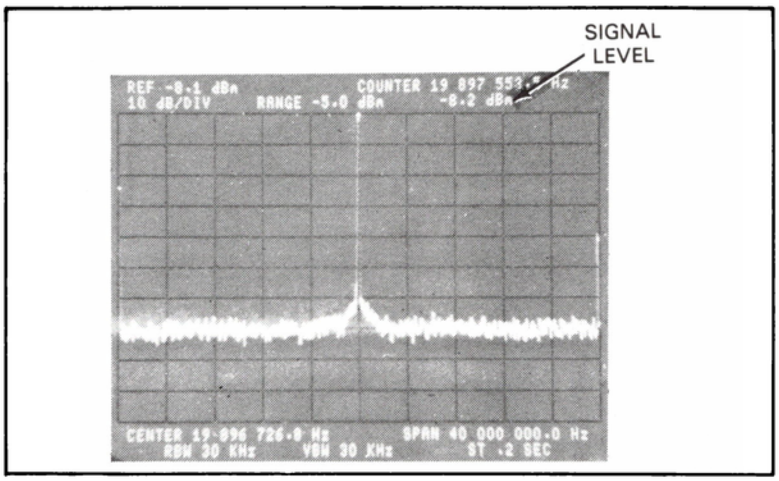


Figure 7-24. Mixer Conversion Loss Test Adjustment

7-26. NOISE FLOOR/SPUR TEST (Phase Noise)

Equipment Required

Signal Generator..........................-hp- 8640B
Quadrature Test Fixture..................03047-84401

Test Procedure

a. Select measurement option K1 on the computer.

NOTE

When asked if you wish to change parameters, answer yes.

b. Set USER's OSCILLATOR CHARACTERISTICS as follows:

PHASE DETECTOR INPUT FREQ.......385 MHz
CARRIER FREQ.......................385 MHz
MIXER IS............................Internal
CALIBRATION OPTION................1

c. Set MEASUREMENT PARAMETERS as follows:

START FREQ.........................0.02 Hz
STOP FREQ...........................40 MHz
NUMBER OF AVERAGES...............4

d. Set PLOT PARAMETERS as follows:

GRAPH TYPE..........................1
PLOTTER TYPE.......................9836
Y-AXIS MIN...........................-200
Y-AXIS MAX..........................0
X-AXIS MIN...........................0.01
X-AXIS MAX..........................40 MHz
TITLE.................................NOISE FLOOR/ SPUR SPEC TEST (PHASE NOISE)

e. Set-up equipment as shown in Figure 7-25. Noise Floor Equipment Set-up.

f. Set the -hp- 8640B as follows:

FREQUENCY..........................385 MHz (approx)
AMPLITUDE..........................≥ 19 dBm
AM....................................off
PM....................................off

g. Continue following program prompts.

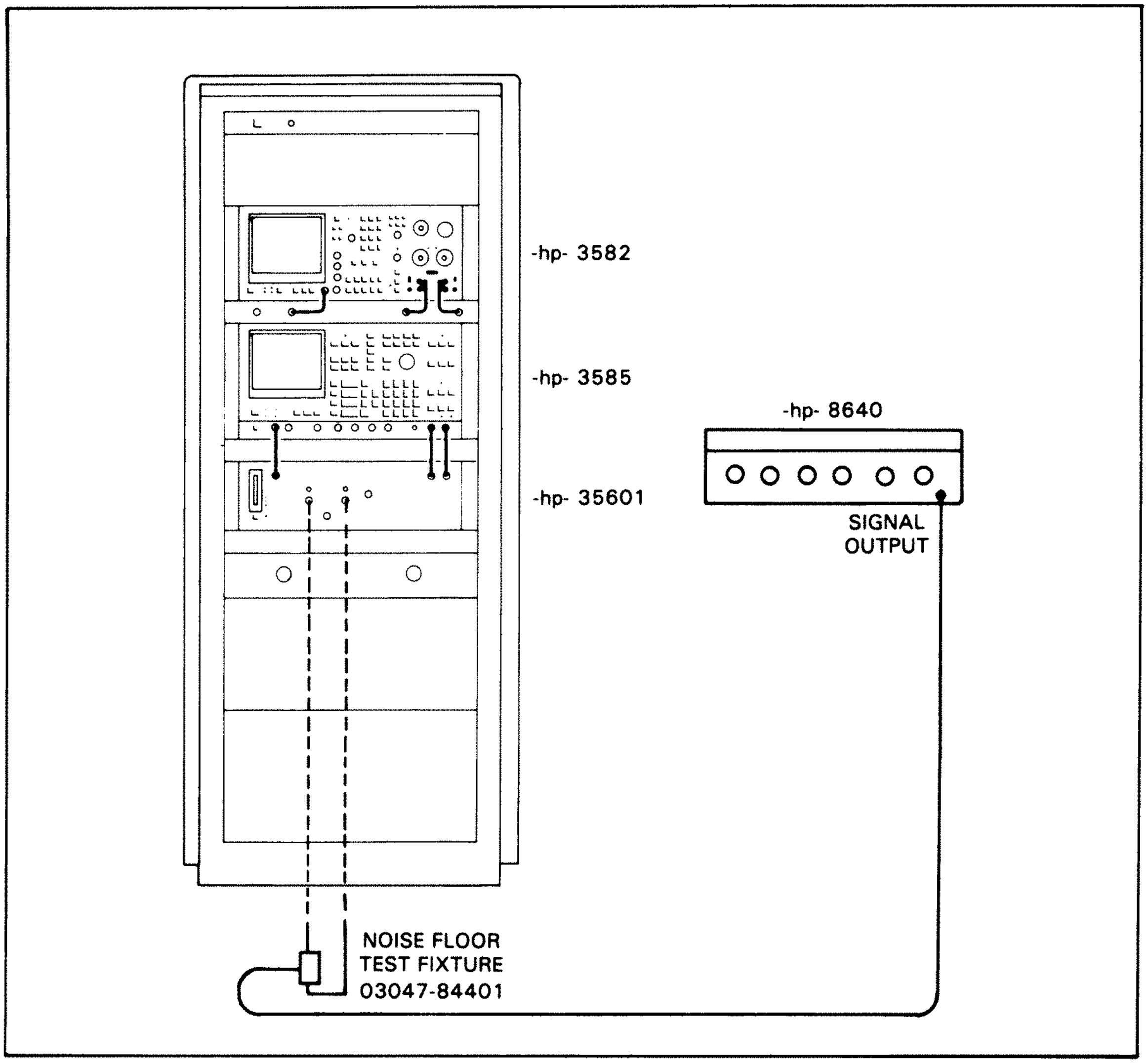


Figure 7-25. Noise Floor/Spur Equipment Set-up

h. Enter Phase Slope of .6 volts/radian.

i. When instructed by the program, press K8 to display the Noise Floor plot.

j. When the plot is complete (approximately 40 minutes), press (SHIFT) GRAPHICS on the computer to generate a hardcopy of the measurement result. Attach the copy to the Performance Test Record card.

k. Press measurement option SHIFT K9 on the computer. This will return you to the MAIN MENU.

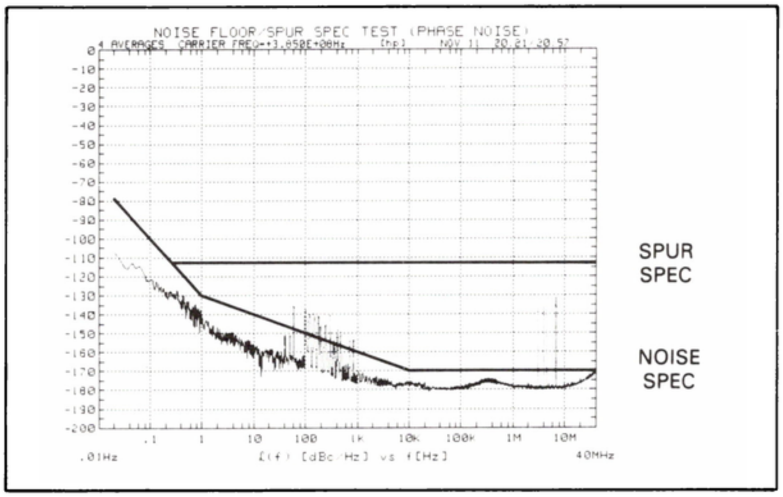


Figure 7-26. Phase Noise Floor/Spur Test Sample Results

7-27. DISCRETE TONE ACCURACY TEST (Phase Noise)

Equipment Required

Frequency Synthesizer....................-hp- 3325A
Function Generator.......................-hp- 3312A
Signal Generator.........................-hp- 8640B

Test Procedure

a. Set the -hp- 3325A as follows:

FREQUENCY .... 20 MHz
AMPLITUDE .... 10 dBm
PHASE MODULATION.................on
AMPLITUDE MODULATION...........off

b. Set the -hp- 3312A as follows:

FREQUENCY .... 20 Hz
AMPLITUDE .... minimum
FUNCTION .... sinewave (~)
SYMMETRY .... calibrate *
OFFSET .... calibrate *

*calibrate = blue button pressed in.

NOTE

See Figure 7-27. Phase Noise Discrete Tone Accuracy Test Set-up (part A) for steps c and d.

c. Connect the -hp- 3312A V p-p 50Ω output to the -hp- 3325A PHASE MOD input (backpanel).

d. Connect the -hp- 3325A Signal output to the -hp- 3585A 50Ω Terminated input.

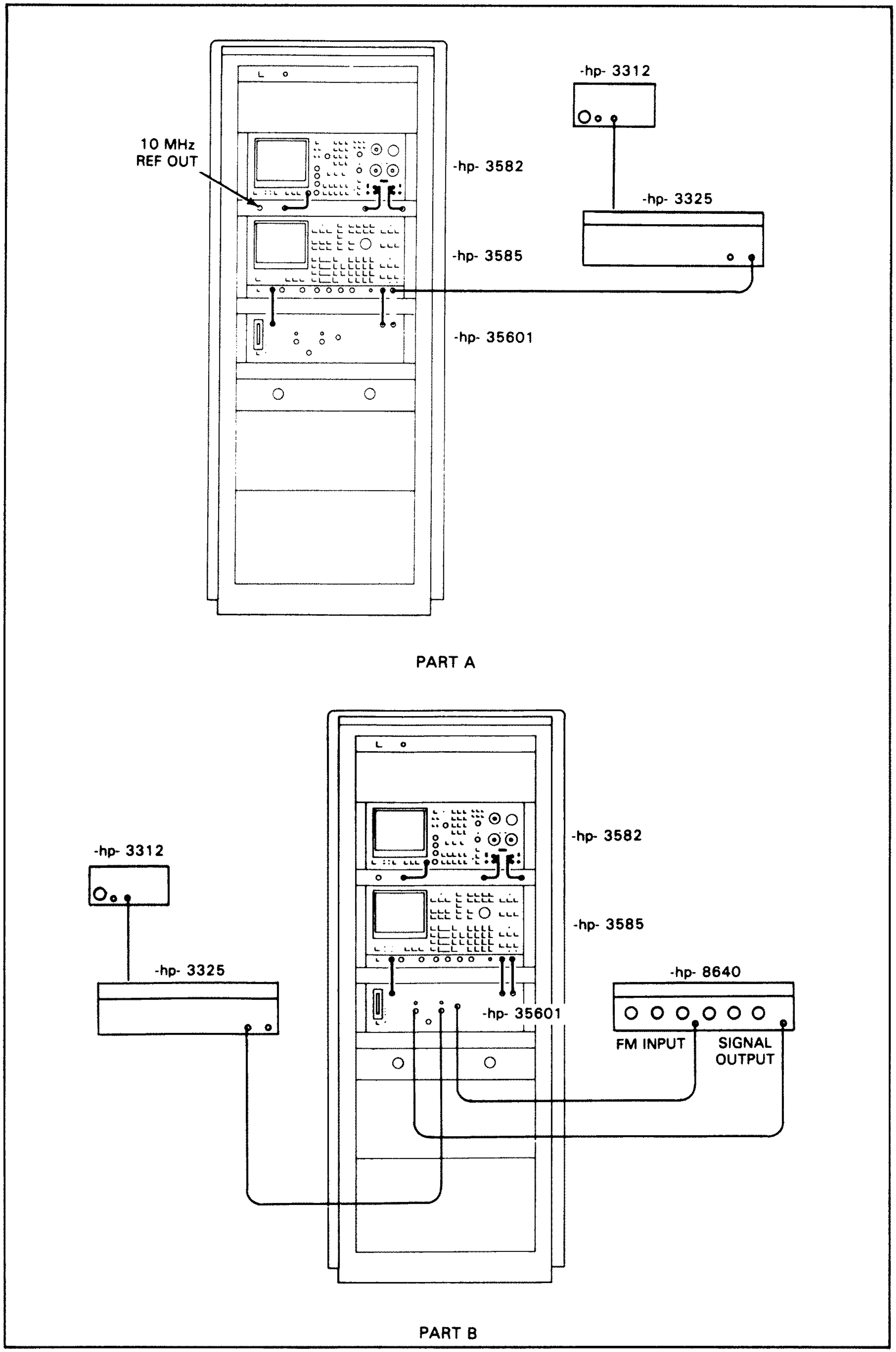


Figure 7-27. Phase Noise Discrete Tone Accuracy Test Set-up

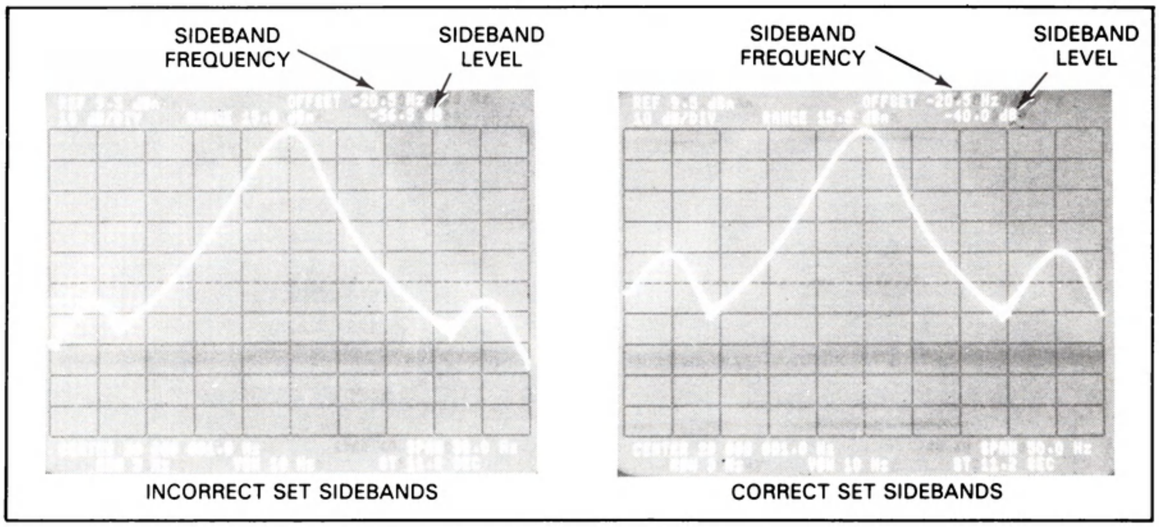


Figure 7-28. Phase Noise Discrete Tone Accuracy Test Adjustments

e. Set the -hp- 3585A controls as follows:

INSTRUMENT PRESET
FREQUENCY SPAN .... 50 Hz
MARKER .... peak of signal (20 MHz)
MKR-CF
MKR-REF LVL
OFFSET .... on
ENTER OFFSET
MARKER .... peak of lower sideband

f. Adjust the -hp- 3312A amplitude until the 20 Hz sidebands are approximately 40 dBm below the 20 MHz carrier. (See Figure 7-28)

g. Measure the upper and lower sidebands and record their relative levels (dBc) on the Performance Test Record card. (See Figure 7-29)

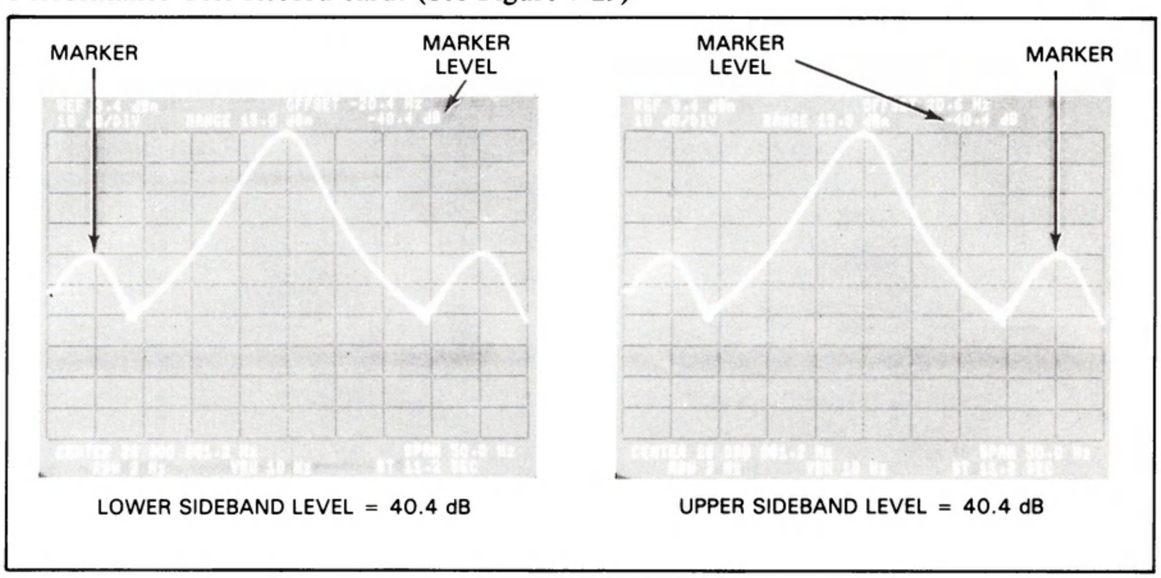


Figure 7-29. Upper and Lower Sideband Relative Levels

h. Without readjusting the -hp- 3312A output level, select each of the sideband frequencies shown in the chart and repeat the measurements made in step h. Use the 3585A Frequency Span indicated.

Sideband Frequency	3585A SPAN
200 Hz	500 Hz
2 kHz	5 kHz
20 kHz	50 kHz

i. Average the upper and lower sideband levels for each frequency and record the results on the Performance Test Record card.

j. Set the -hp- 3312A for a sideband of 200 Hz.

NOTE

See Figure 7-27. Phase Noise Discrete Tone Accuracy Test Set-up (part B) for steps k, m, and n.

k. Connect the -hp- 3325A SIGNAL output to the -hp- 35601A R-Port input. Reconnect the cable from the -hp- 35601A to the -hp- 3585A 50Ω Terminated input.

l. Set the -hp- 8640B as follows:

FREQUENCY .... 20 MHz
AMPLITUDE .... +17 dB
FM .... DC
PEAK DEVIATION..................... 40 kHz
FM VERINER.......................... fully clockwise

m. Connect the -hp- 8640B RF output to the -hp- 35601A L-Port input.

n. Connect the -hp- 35601A Control Voltage output to the -hp- 8640B FM input.

o. Select Phase Noise Analysis option K0 on the computer.

NOTE

When asked if you wish to change parameters, answer yes.

p. Set USER's OSCILLATOR Parameters as follows:

CENTER VOLTAGE OF TUNING CURVE = 0 Volts
VOLTAGE TUNING RANGE = ± 1 Volts
TOTAL FREQUENCY TUNING RANGE IS ≤ 1 MHz
PHASE DETECTOR INPUT FREQUENCY = 20 000 000 Hz
CARRIER FREQ = 20 000 000 Hz
INTERNAL MIXER IS 0, (5MHz-1.6 GHz)

NOTE

Measurement and Plot Parameters are not used for this test.

q. Set the -hp- 3585A as follows:

START FREQ..........................0 Hz
STOP FREQ...........................10 kHz

r. Adjust the -hp- 8640B frequency until the beatnote displayed on the -hp- 3585A (largest signal) is less than 1 kHz. (See Figure 7-30)

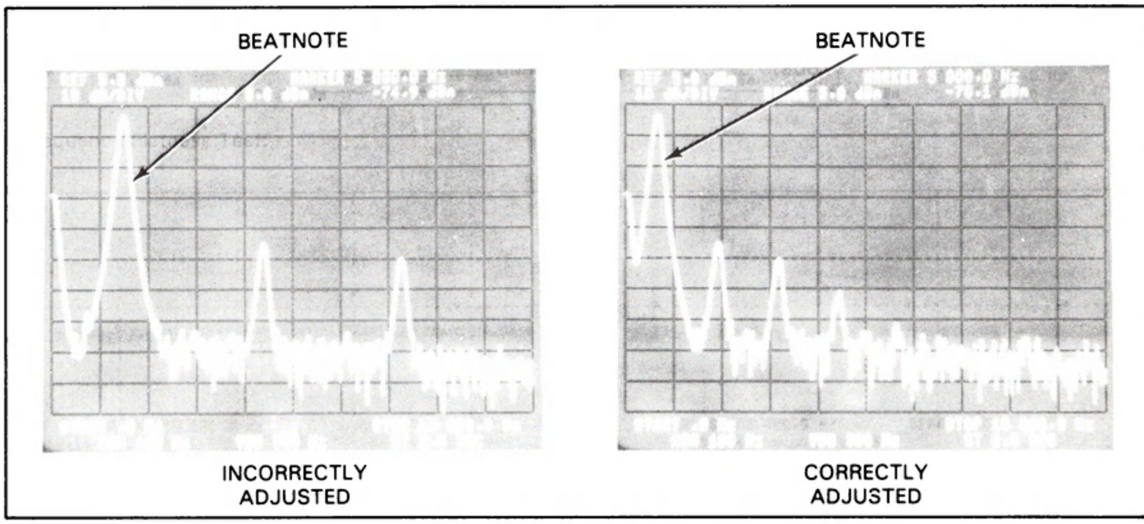


Figure 7-30. Beatnote Adjustment

s. Press continue on the computer. When the MEASURE MENU is displayed, press K1 to stop the measurement and then K3 to enter the Single Point Measurement mode.

t. Set the -hp- 3312A for a 20 KHz sideband.

u. Set the -hp- 3582A as follows:

CHANNEL B SENSITIVITY.............optimum *
AVERAGE.............................RMS
NUMBER of AVERAGES................4
RESTART

*optimum = maximum input level without overload

v. Set the -hp- 3582A Marker to the peak of the signal at approximately 20 Hz.

w. Check that the -hp- 35601A Out of Lock light is off. If on, abort the measurement (press K9 then SHIFT K9) and repeat the test from step o.

x. Press K0 on the computer. Record the spur amplitude on the Performance Test Record card.

y. Repeat steps u through x for the remaining sidebands. Use -hp- 3582A FREQ SPANs as indicated below.

Sideband Frequency	-hp- 3582A FREQ SPAN	Test Time in Seconds
20 kHz	0-25 kHz	.04
2 kHz	0-2.5 kHz	.4
200 Hz*	0-250 Hz	4
20 Hz*	0-25 Hz	40

* For sideband frequencies of 200 Hz and 20 Hz, set the -hp- 3582A Input Signal to FREQ. FLUCTUATIONS by pressing K2 on the computer.

z. Press Single Point Measurement option K9 on the computer. This will return you to the MEASURE MENU.

aa. Press measurement option SHIFT K9 on the computer. This will return you to the MAIN MENU.

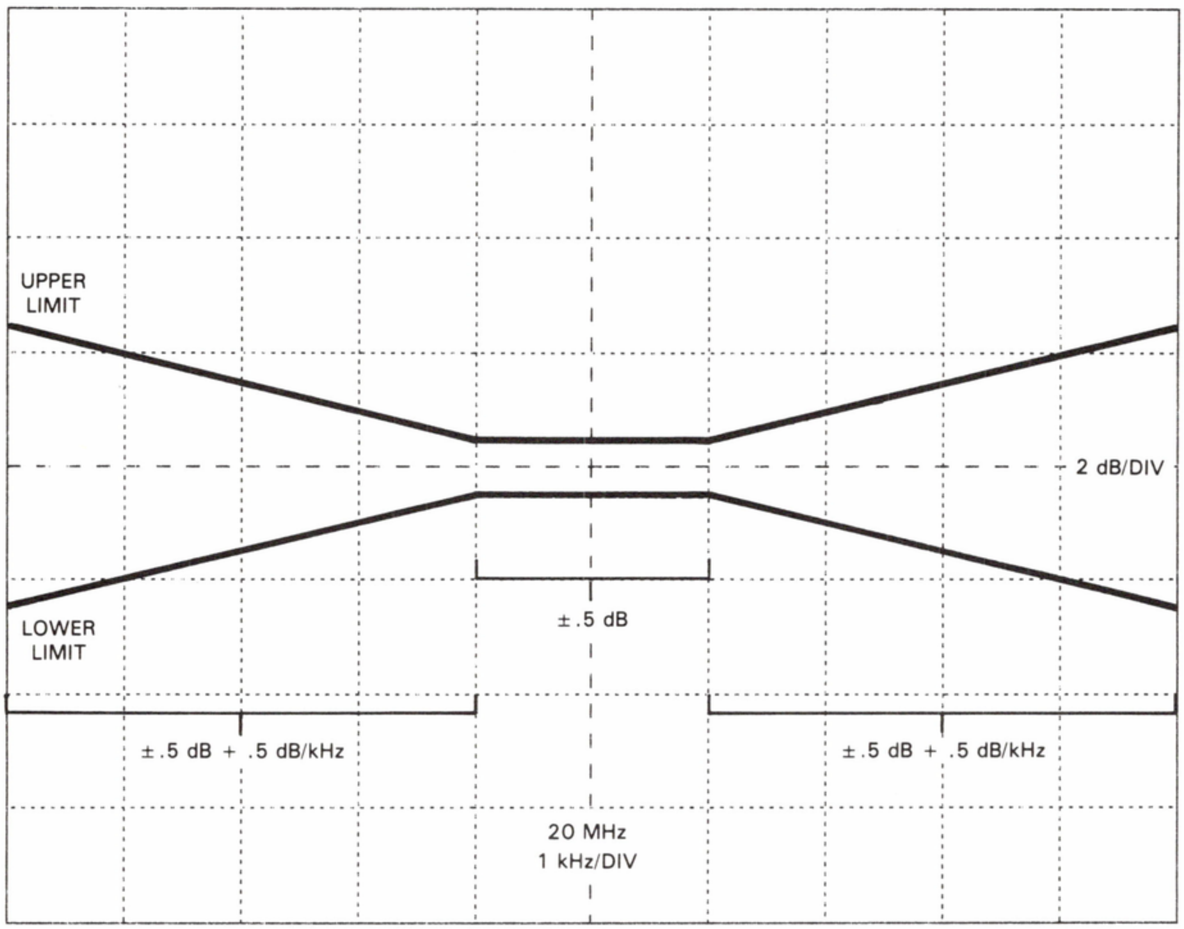
PERFORMANCE TEST RECORD

Direct Spectrum Analysis

Amplitude Accuracy Test:

-hp- 3585A Marker Level	Measured Level	Tolerance
____________ dBm	_____ dBm	±0.9dB

Frequency Flatness Test:



Intermodulation Distortion Test:

Measured Signal Level	Tolerance
___________ dBm	≤ − 40 dBc

Noise Floor Test:

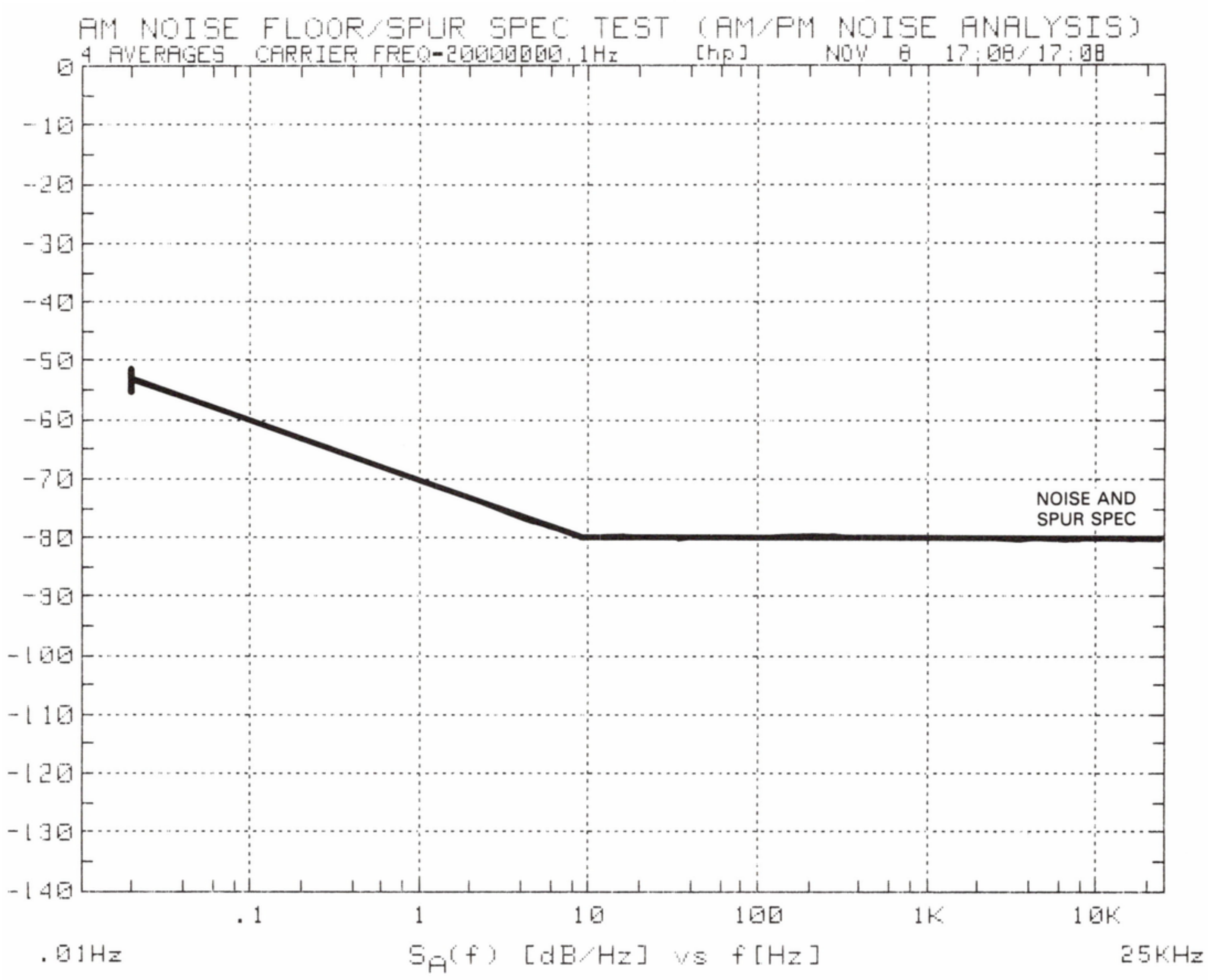
Center Frequency	Measured Level	Tolerance
20MHz	______ dBm	≤ 130 dBm
_____________	______ dBm	
_____________	______ dBm	
_____________	______ dBm	

Image Rejection Test:

Measured Level	Tolerance
______ dBm	≤ − 70 dBm

AM/PM Noise Analysis

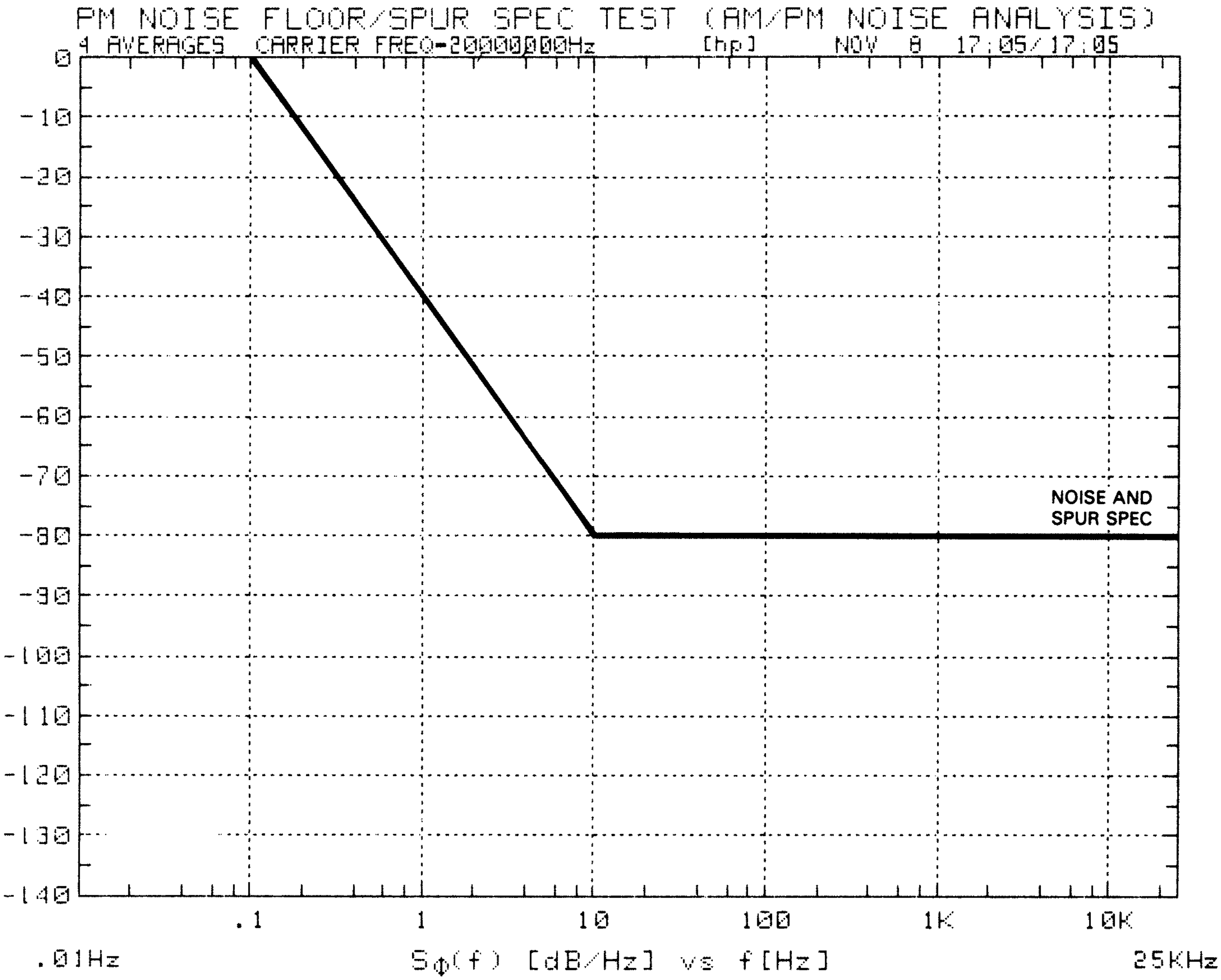
AM Noise Floor/Spur Test:



AM NOISE ANALYSIS
NOISE FLOOR AND SPUR SPECIFICATIONS

ATTACH COPY OF AM NOISE FLOOR/SPUR SPEC TEST HERE

PM Noise Floor/Spur Test:



PM NOISE ANALYSIS
NOISE FLOOR AND SPUR SPECIFICATION

ATTACH COPY OF PM NOISE FLOOR/SPUR SPEC TEST HERE

PM Discrete Tone Accuracy Test:

Sideband Frequency	Lower Sideband Level	Upper Sideband Level	Average Sideband Level	Spur Amplitude	Tolerance
0.2 Hz*	______ dBc	______ dBc	______ dBc	______ dBc	
2 Hz*	______ dBc	______ dBc	______ dBc	______ dBc	
20 Hz	______ dBc	______ dBc	______ dBc	______ dBc	Average Level
200 Hz	______ dBc	______ dBc	______ dBc	______ dBc	± 1.5 dB
2 kHz	______ dBc	______ dBc	______ dBc	______ dBc	
20 kHz	______ dBc	______ dBc	______ dBc	______ dBc	

* Enter the 20Hz sideband level as the level of the 0.2Hz and 2Hz sidebands.

AM Discrete Tone Accuracy Test:

Sideband Frequency	Lower Sideband Level	Upper Sideband Level	Average Sideband Level	Spur Amplitude	Tolerance
0.2 Hz*	______ dBc	______ dBc	______ dBc	______ dBc	
2 Hz*	______ dBc	______ dBc	______ dBc	______ dBc	
20 Hz	______ dBc	______ dBc	______ dBc	______ dBc	Average Level
200 Hz	______ dBc	______ dBc	______ dBc	______ dBc	± 1.5 dB
2 kHz	______ dBc	______ dBc	______ dBc	______ dBc	
20 kHz	______ dBc	______ dBc	______ dBc	______ dBc	

* Enter the 20Hz sideband level as the level of the 0.2Hz and 2Hz sidebands.

VCXO Tuning Range Test:

ΔFrequency Incrementing	ΔFrequency Decrementing	Tolerance
+ ________ Hz	− ________ Hz	≥ ± 170Hz

Phase Noise Analysis

Mixer Conversion Loss Test: (5 MHz to 1.6 GHz)

Beatnote	Tolerance
_____ dBm	≥ – 18 dBm

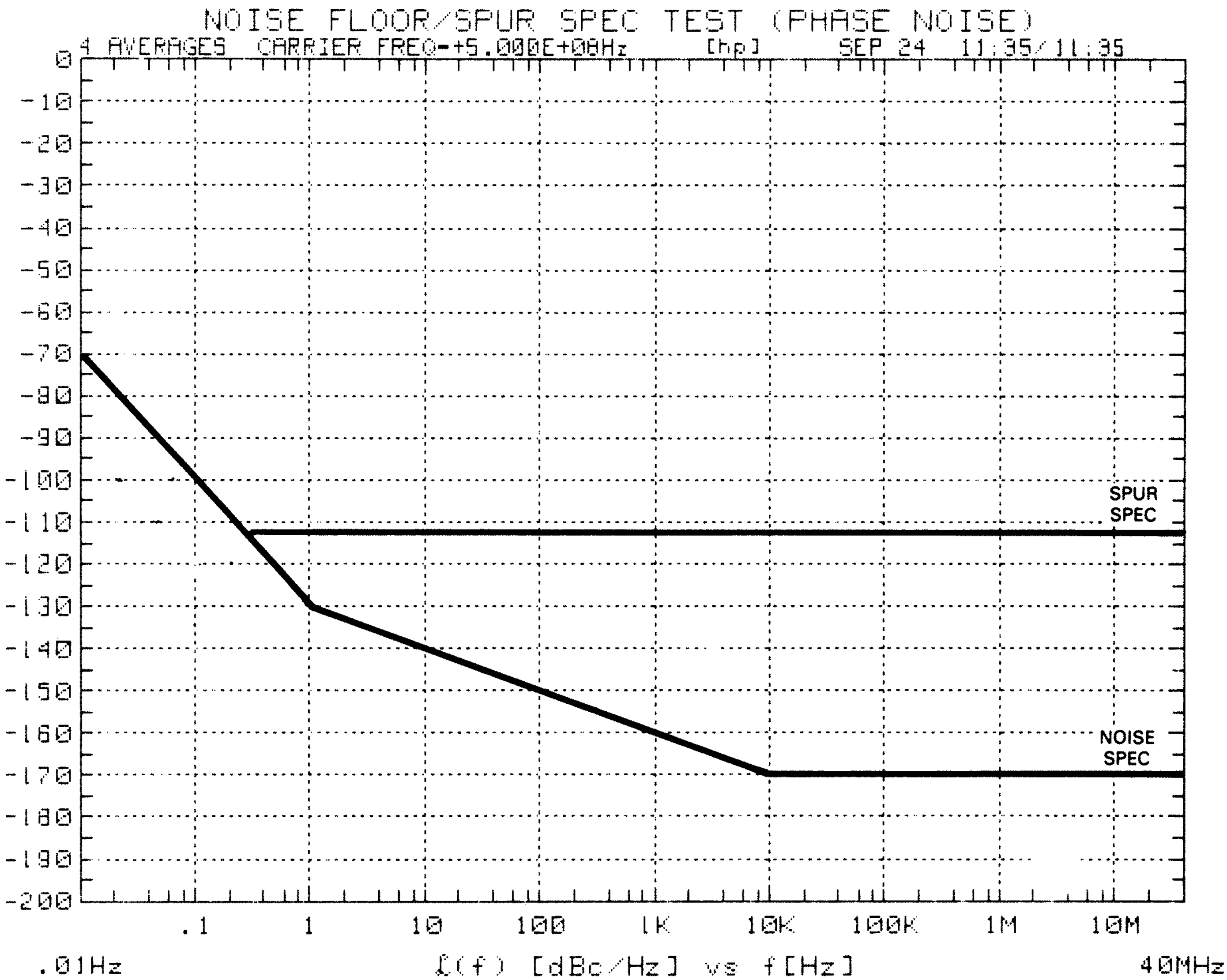
Mixer Conversion Loss Test: (1.2 GHz to 18 GHz)

Beatnote Level	Tolerance
_____ dBm	≥ – 10 dBm

Discrete Tone Accuracy Test:

Sideband Frequency	Lower Sideband Level	Upper Sideband Level	Average Sideband Level	Spur Amplitude	Tolerance
20 Hz	________ dBc	________ dBc	________ dBc	________ dBc	
200 Hz	________ dBc	________ dBc	________ dBc	________ dBc	Average Level
2 kHz	________ dBc	________ dBc	________ dBc	________ dBc	± 2.0 dB
20 kHz	________ dBc	________ dBc	________ dBc	________ dBc	

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 enchancing 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 K8. Enter the command strings K1, K12, and K11 with the ENTER SETTING SFK (K8) to switch the low noise amplifier into the circuit (Figure 8-1). Exit switch by depressing K9. 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.

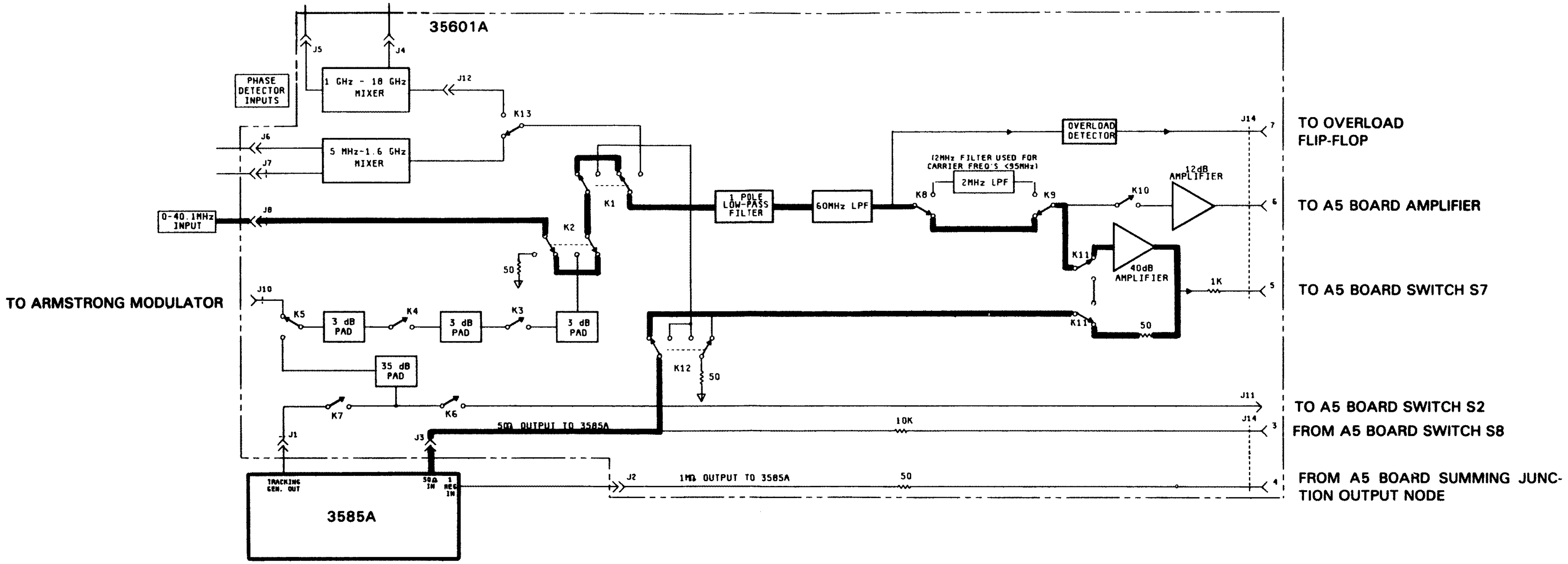


Figure 8-1. Signal Path for Reducing System Noise Floor in AM/PM and Direct Spectrum Measurements

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 SFK SHIFT K8. 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) with the ENTER SETTING SFK (K8). Exit switch by depressing SFK K9. 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.

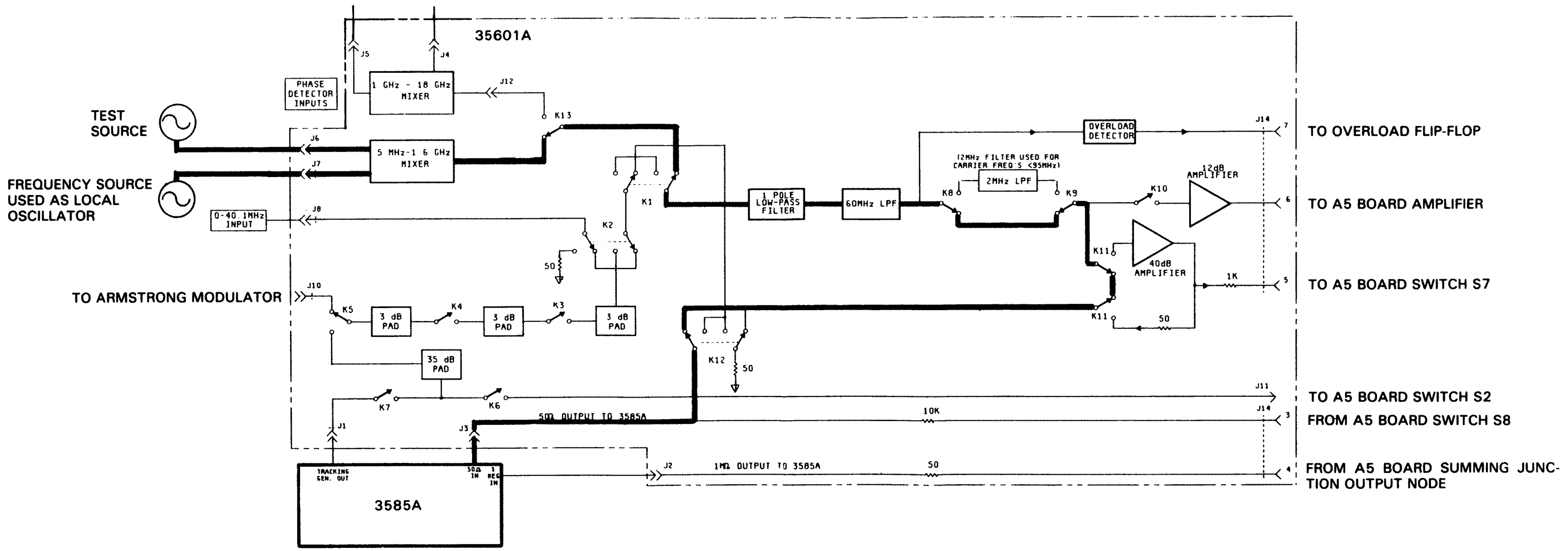


Figure 8-2. Signal Path for Extending the Frequency Range of Direct Spectrum and AM/PM Noise Measurements

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.

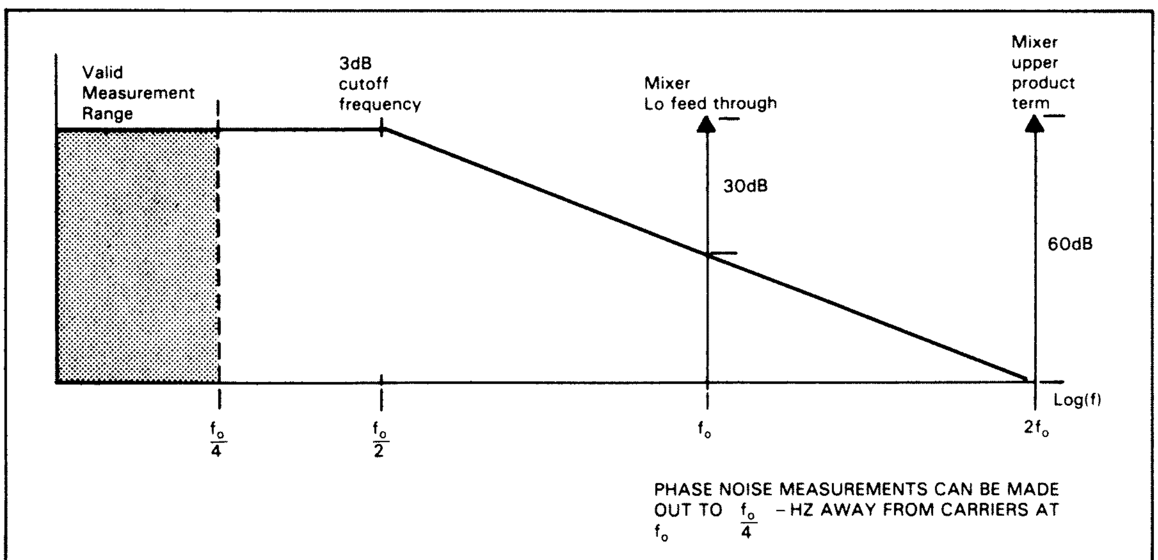


Figure 8-3. Low Pass Filter Requirements

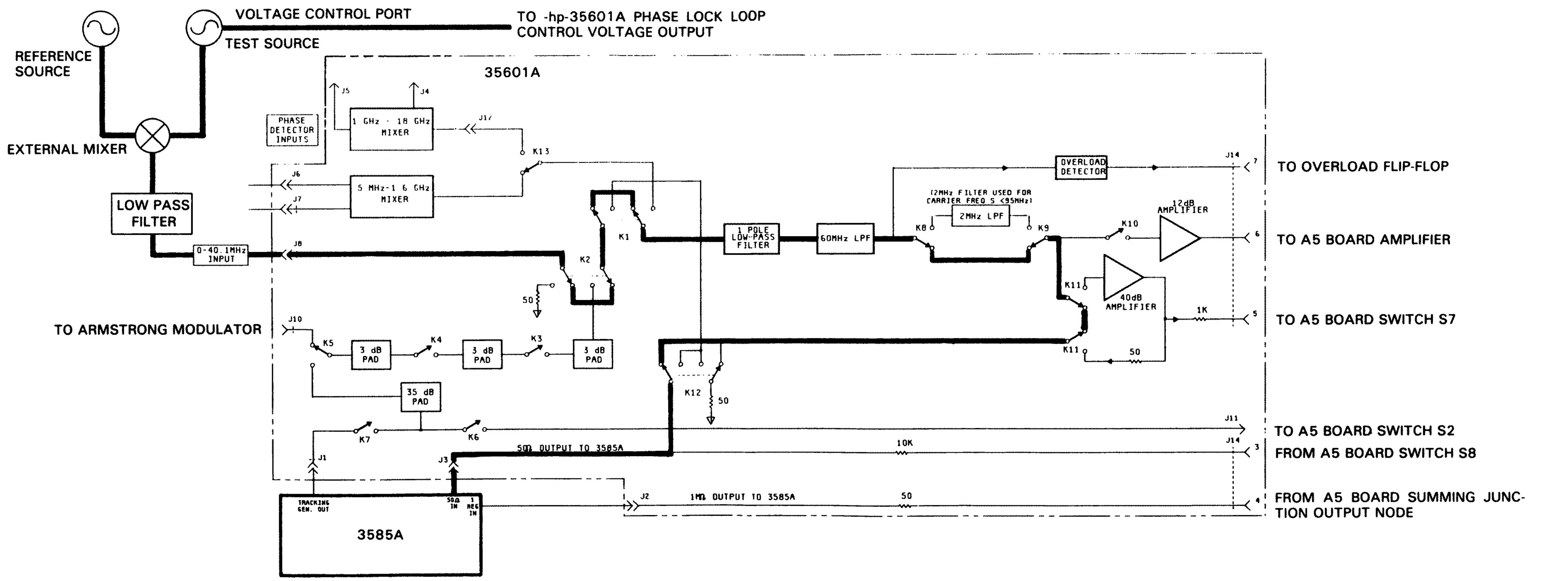


Figure 8-4. Hardware Setup and Signal Path for Extending Frequency Range of Phase Noise Analysis Measurements

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.

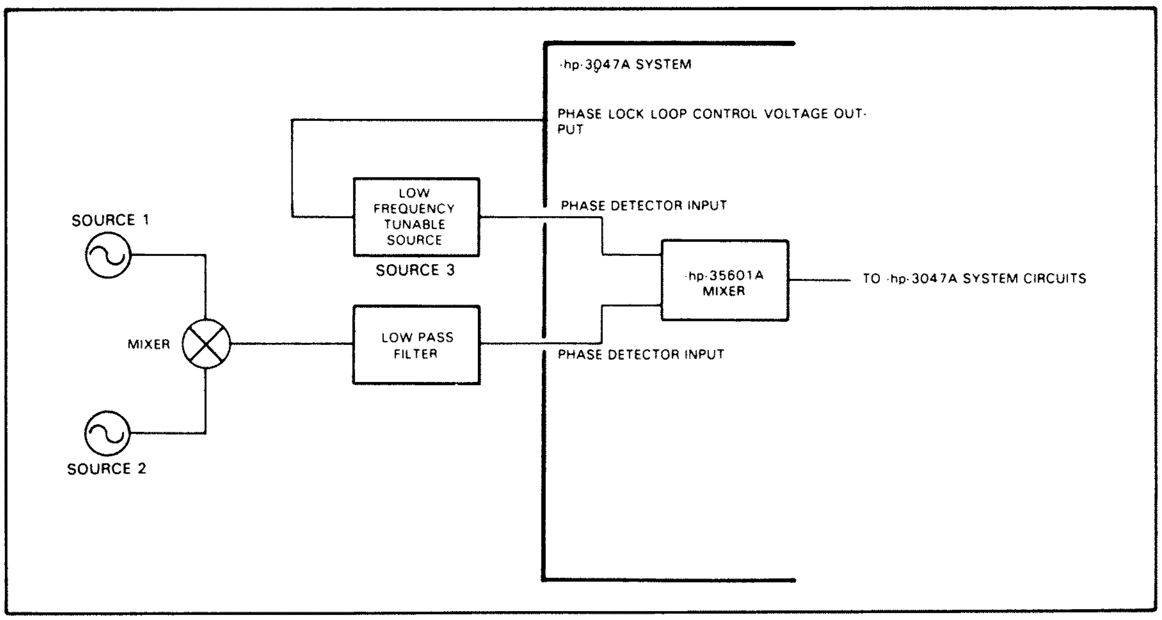


Figure 8-5. Low Pass Filter Requirements for Mixing Non-voltage Controlled Sources

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.

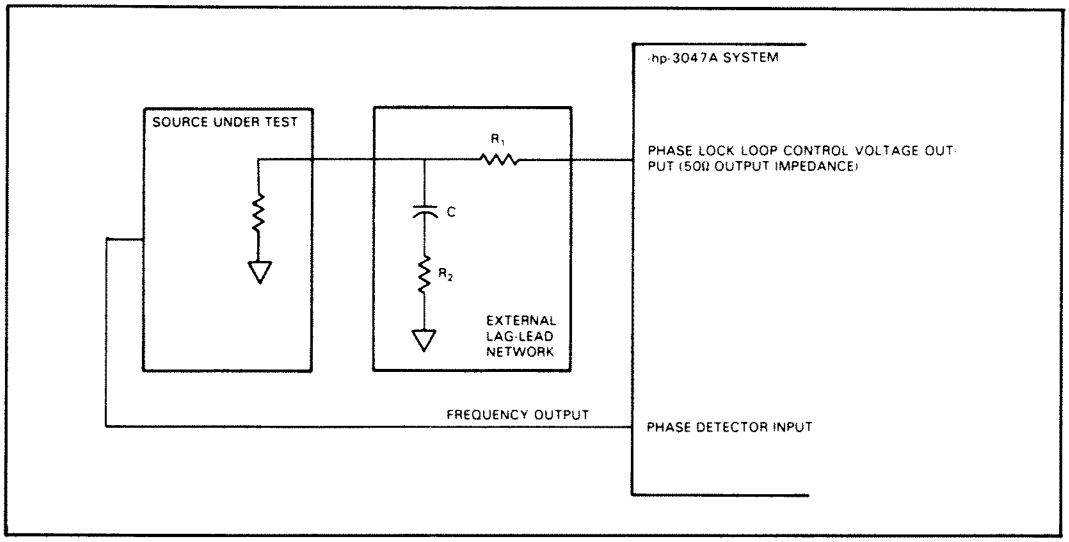
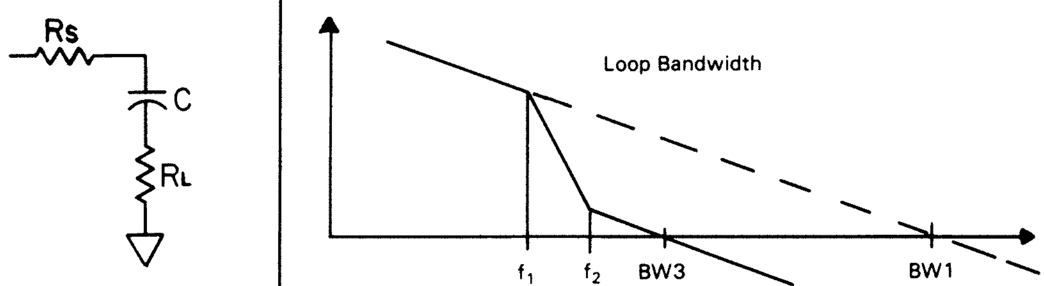


Figure 8-6. Lag-lead Network



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

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

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

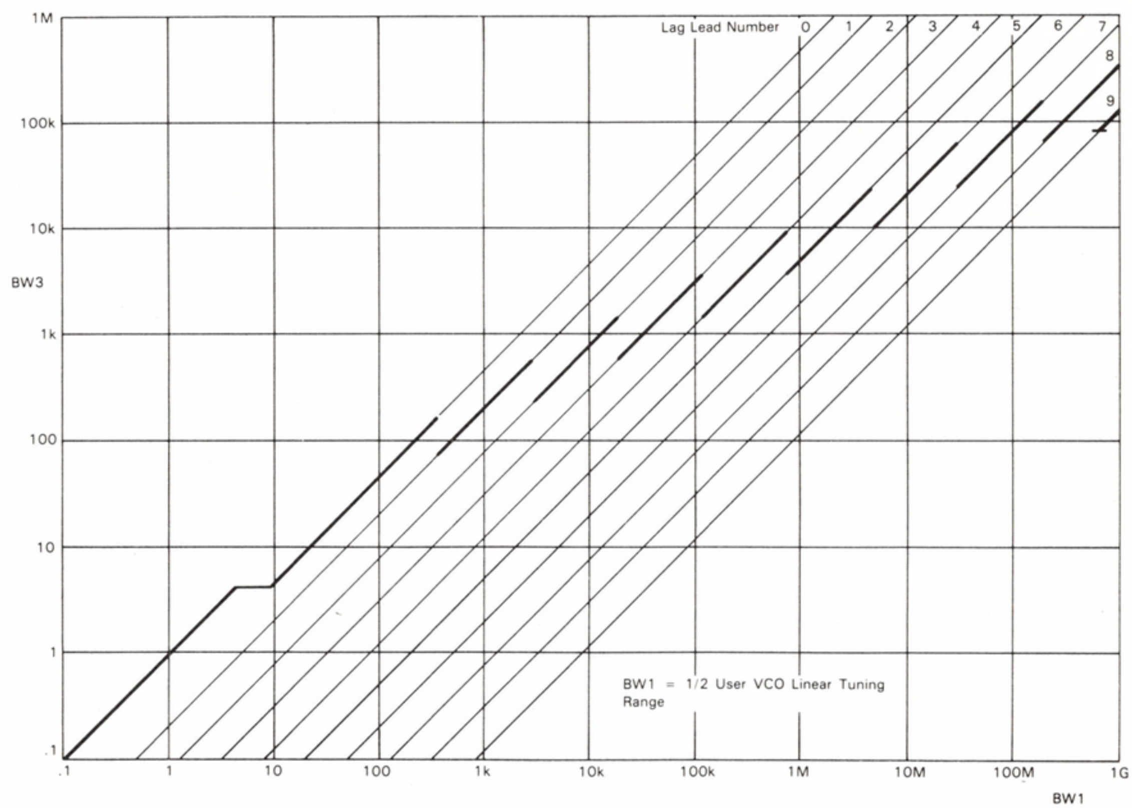


Figure 8-8. Lag-lead Number as a Function of Tuning Curve

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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