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## 8-21. Initialization and Front Panel Interpretation

8-22. The goal of this section is to provide servicing personnel with information on how a HP 3586A, B, or C should respond when power is applied, and how to interrogate the front panel as a way to identify the cause of instrument malfunctions. Problems in the HP 3586A/B/C can often be isolated to a circuit board level by using internal self tests and interpreting front panel results.

8-23. For the technician who is unfamiliar with the instrument or if the malfunction is not clearly defined, it is recommended that a review of the topics contained in this section before proceeding to the Troubleshooting section.

8-24. A technician familiar with the instrument may wish to use the Turn-On Troubleshooting Flowchart (figure 8-3) at the end of this section or proceed to Troubleshooting Hints in the next section.

### 8-25. HP 3586A/B/C Unique Terminology

8-26. Throughout Section VIII (Service) some terms, describing unique modes or conditions of the HP 3586A/B/C, are used frequently. These terms are defined as follows.

<b>FULL SCALE</b>	The Full Scale setting of the instrument is the number of dB referenced to 0 dBm on the front panel meter. It also represents the upper limit of the input signal level in dB that can be measured by the True RMS to DC Detector/Logger circuits in their distortion free region. The Full Scale setting together with AUTO/ENTRY, 10/100 dB RANGE selections determine how much gain or attenuation is applied to the input signals to obtain the proper input level for linear operation of the Detector/Logger circuits. When AUTO 10 or AUTO 100 are selected, the instrument is allowed to AUTO-RANGE (i.e. select its own Full Scale setting according to the largest signal present at the instrument's input port). When ENTRY 10 or ENTRY 100 are selected, the operator manually enters the desired Full Scale setting which then remains fixed.
<b>RANGE</b>	The status of the operating range, 10 dB or 100 dB, of the IF Detector/Logger circuit on A21. When 10 dB is selected, the entire linear range of the Detector is used, measuring from the current Full Scale setting (upper limit) to 10 dB below that setting (lower limit), which allows amplitude measurement readings with 0.01 dB resolution to be made. When 100 dB is selected, the detector range must cover up to 100 dB below the Full Scale setting and therefore only 0.1 dB resolution is obtained.
<b>AUTORANGE</b>	A term used to describe the Controller's ability to choose its own Full Scale setting automatically. The processor receives an indication of the broad-band power level from the A4 board and sets the Full Scale setting to the next 5 dB increment higher than that value. Depending on whether the 10 dB or 100 dB Range is selected, different combinations of RF and IF gain (or attenuation) is set up by the processor to control the detector's operation over its most linear operating range.

- ENTRY 10** Use of this term is telling the operator to select the manual (ENTRY) method of entering a Full Scale setting and to select the 10 dB Range for the Detector/Logger circuit on A21. Usually, the Full Scale setting entered by the operator is 5 dB higher than the highest expected discrete frequency signal amplitude to be applied to the HP 3586A/B/C as an input. The key sequence for selecting ENTRY 10 is:
- [ 10 dB ] [ ENTRY ] [ FULL SCALE ] [ 0 ] [ kHz/+dB ] [ MEAS CONT ]
- ENTRY 100** Same as ENTRY 10 except the 100 dB Range of the A21 Detector/Logger is selected. The key sequence for selecting ENTRY 100 is:
- [ 100 dB ] [ ENTRY ] [ FULL SCALE ] [ 0 ] [ kHz/+dB ] [ MEAS CONT ]
- AUTO 10** Use of this term is telling the operator to select the automatic (AUTO) method for determining Full Scale setting (processor-determined) and to select the 10 dB Range for the Detector/Logger circuit on A21.
- AUTO 100** Same as AUTO 10 except the 100 dB Range of the A21 Detector/Logger is selected.
- TURN ON CONDITIONS** When the HP 3586A/B/C is first turned on and after the automatic self-test and calibration cycle is completed, the instrument is in the "turn-on configuration." This configuration includes the following automatic selections and settings (no input signal applied):
- AUTO CAL on, AUTO 10, AVE off, dBm, OFFSET off, CARRIER, USB, COUNTER off, LO DIST mode, 10 k $\Omega$ , 1 MHz, FREQ STEP = 1 Hz, Full Scale = 120, Threshold = 0 dBm, Time = 5 minutes, FREQ TUNE off, 3100 Hz.
- Whenever RECALL and then 0 are pressed, the HP 3586A/B/C will return to the preceding turn-on conditions without having to cycle the POWER switch.
- MANUAL CAL** Manual (or Forced) Calibration is the procedure of initiating a Calibration cycle instead of waiting up to three minutes for the Auto-Calibration process. If AUTO-CAL is off, pressing AUTO CAL once will force an immediate CAL cycle. If AUTO CAL is on and the three minute timing period is underway, pressing AUTO CAL twice will force an immediate CAL cycle and then begin a new three minute timing period.

## 8-27. Turn-On and Calibration.

**8-28. Pre Turn-On Verification.** Before plugging the instrument into the line voltage, verify that the power switch is in the STBY position and that the rear panel line switches are set for the proper line voltage. Next, apply the line power to the instrument and verify that the STBY light on the front panel turns on. If the STBY light is not on, check the line fuse for proper value and condition. If the line fuse is good, proceed to Service Group J and troubleshoot the +23V power supply.

**8-29. Turn-On Initialization Sequence.** Watch the front panel of the HP 3586A/B/C at turn on. The following sequence of events should occur and the total time to complete them is normally about 9 seconds.

1. The instrument cooling fan should begin to run and the STBY light should go out. All other front panel LED's should light including all segments of the seven-segment LED's, all annunciators (except STBY), and all key LED's.\* (2.5 seconds.)
2. The condition of "all LED's lit" is replaced by the display sequence shown in table 8-3. (6.5 seconds.)

**Table 8-3. Numeric Display Sequence.**

Measurement/Entry	Frequency/Entry	Time Displayed***
blank	HP 3586 X YY **	1.0 second
CAL	HP 3586 X YY	2.2 seconds
CAL	1 000 000.0 Hz	3.3 seconds
< - 116 dBm*	1 000 000.0 Hz	(continuous)
Notes: * Assumes no input signal.		
** X=A,B, or C (Model number) YY=OP if option 003 installed (A70 board HP 3586A/B only).		
*** Time is approximate due to differing Controller clock frequencies.		

### Note



If the cooling fan does not run, check the line fuse for proper value and condition. If a good fuse (see table 8-2) does not restore operation, set the power switch to STBY, proceed to Service Group J, and troubleshoot the input power. If the cooling fan runs but one of the following conditions exist, proceed to primary Troubleshooting (paragraph 8-89):

- a. The front panel indicators are all dark.
- b. The CAL cycle did not complete successfully.
- c. The front panel indicators are frozen in some condition.
- d. The front panel indicators are continually cycling.

**8-30. Instrument Calibration.** During the turn-on sequence, a "turn on CAL" occurs in which the processor reads from ROM memory, writes into and reads out of RAM memory, and verifies correct operation of the display timing clock. It then calibrates the instrument in both WIDEBAND and LO DIST modes, at 1 MHz, for all Full Scale settings from - 35 to +25 dBm. The processor stores away calibration constants for each setting, to be applied to all incoming signals.

8-31. A successful Turn-On and CALibration is indicated by the instrument noise floor being ( $< -116$  dBm) displayed in the MEASUREMENT/ ENTRY area, and the initialization frequency of 1 MHz displayed in the FREQUENCY/ENTRY area. Also, the following annunciators and key LED's are lit as the result of a successful initialization process:

Annunciators: dBm, CENTER, Hz  
Keys: AUTO CAL, 10 dB, AUTO, dBm, CARRIER, ,  
LO DIST, 75 (Rev. A) or 10k (Rev. B), 3100 Hz

(See also paragraph 8-48.)

**8-32. Additional Calibration Cycles.** The Turn-On CALibration described above is one of four calibration cycles. The other three: AUTO-CAL, Manual (Forced) CAL, and Fast-CAL are explained below.

**AUTO-CAL.** AUTO-CAL is where the processor calibrates the instrument in the mode it's in, at the tuned frequency, for all Full Scale settings at timed three minute intervals.\*

**Manual (Forced) CAL.** Manual (Forced CAL) is where the operator tells the processor through AUTO-CAL switch depression (or via HP-IB) than an AUTO-CAL cycle is desired now instead of at the next three minute interval.

**Fast-CAL.** Fast-CAL, which is commandable over HP-IB only, is where the processor calibrates the instrument only at the tuned frequency for the presently selected Full Scale settings. In addition, any time AUTO-CAL is ON and the operator changes the tuned frequency by 1 MHz or more, or changes from any other mode to WIDEBAND mode, the AUTOCAL cycle occurs at that time and a new three minute interval begins.

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**Note**

Additional information on interpreting the various calibration modes and associated failures can be found in Service Note HP 3586A/B/C-3A. Refer to Section VII for instructions on obtaining this service note and for information on other available service notes.

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**8-33. Turn-On CAL Failures**

8-34. If both of the display areas immediately fill with the letter "r", the turn-on write/read test for RAM memory has failed. The problem is on the A60 board. The internal self-tests cannot be run under this condition. Proceed to Service Group C to troubleshoot the A60 board.

8-35. If the display area contains a single letter "d", the processor did not receive the interrupt clock signal from the display timing circuit. The problem is on the A60 board. Proceed to Service Group C.

**8-36. LED Check.**

8-37. After Completion of the RAM write/read test and the display timing circuit test which occur during turn-on Cal, the processor will momentarily light up all front panel LED's including all segments of the digital display areas. To locate and identify bad LED'S, perform the Display Checks in Service Group C which allow a greater length of time to observe specific groups of annunciators and each digit individually.

**8-38. Calibration Error Codes.**

8-39. If the CAL cycle stops with a Calibration Error Code displayed in the MEASUREMENT display area, use table 8-4 to determine the cause and the most likely area(s) where the problem may be found. Failure of any step in the CAL cycle is justification for running the two most significant internal self-tests (paragraph 8-48). A calibration error occurs when the number generated by the A/D converter (at the time the calibration signal was switched in) was not within  $\pm 3$  dB of the expected value. The CAL error format is CE-N where N is a number or letter listed in table 8-4. When all CAL errors occur sequentially, the problem is likely to be a break in the major analog signal path.

**Note**



Calibration errors are legitimate instrument failures and indicate a problem exists within the instrument.

**Table 8-4. Calibration Error Codes.**

Format is CE-N where N =	Item Under Cal	Suspect Cards
0 to 9,A,b C D E F	RF Gain, step N 400 Hz Filter 20 Hz Filter 10/100 dB (or WIDEBAND) Weighted Filter	A2* A10, A20 A20 A21, (A41)** A21, A22, A70 ***
<p>*If any RF Gain step fails, check the input attenuator on A2. Press MEAS CONT to exit the CAL cycle and run the internal analog self-test in paragraph 8-81 (TF13).</p> <p>**If CAL is performed in WIDEBAND, the A4 BBP circuits are calibrated instead of the normal IF signal path through the A21 10/100 dB amplifier.</p> <p>*** If A60S2(2) is OPEN and an A70 Impairments board (Option 003) is not installed, CE-F will always occur during the CAL cycle.</p>		

**8-40. Mode Errors.**

8-41. The HP 3586A/B/C continually monitors itself for correct operation and for proper selection and implementation of the many possible mode combinations. Detected malfunctions and operator errors are presented as error codes on the front panel in the MEASUREMENT/ENTRY display area. Refer to table 8-5 to identify the cause of a displayed error code.

**8-42. Operator Errors.** An error code which was generated by an improper key depression by the operator may be cleared by depressing the MEASurement CONTInue key.

**8-43. Instrument Failures.** Some error codes indicate definite circuit malfunctions, while others indicate possible circuit malfunctions. Both cases provide direction in table 8-5 to a specific service group for troubleshooting.

Table 8-5. Mode Error Codes.

Code	Definition
Err 1	Operator Error. Attempt made to manually change the FULL SCALE while in AUTO range.
E 1.2	Operator error. Attempt made to select 10 dB range while in WIDEBAND or IMPULSE noise, or to choose ENTRY (Full Scale) while in $\phi$ JITTER.
E 2.2	$\phi$ JITTER selected end input signal level as measured at the output of the A21 "10/100 dB DC Amplifier" is 40 dB or more below Full Scale. Instrument failure is indicated if a valid signal is present at the input to A1. Perform Internal Self-Test TF13 (paragraph 8-81).
E 2.3	$\phi$ JITTER selected and there is no 1 kHz (+60 – 40 Hz) tone present as determined by the A70 "Valid Frequency Detector" circuit. Instrument failure is indicated if a valid signal tone is present at the input to A1. Perform Internal Self Test TF13 (paragraph 8-81). If TF13 passes, proceed to Service Group G and troubleshoot $\phi$ jitter circuits.
E 2.9	$\phi$ JITTER selected and the output of the A70 "Peak-to-Peak Detector" is not between – 2 volts and 0 volts. Possible causes are: <ul style="list-style-type: none"> <li>1. Phase Jitter of test tone exceeds 40° p-p</li> <li>2. Failure of Phase Jitter circuits on A70.</li> <li>3. Failure of A70 input to A22 board. Perform TF13 (paragraph 8-81) and, if it passes, proceed to Service Group G and troubleshoot <math>\phi</math> Jitter circuits (if phase jitter of signal tone is known to be less than 40° p-p).</li> </ul>
E 3.N	One of the following loops is unlocked: <ul style="list-style-type: none"> <li>N = 1 Second Local Oscillator (Service Group B)</li> <li>N = 2 Sum Loop (Service Group D)</li> <li>N = 4 Fractional-N Loop (Service Group E)</li> <li>N = 8 Step Loop (Service Group D)</li> </ul> A definite instrument failure is indicated. Proceed to the indicated service group for troubleshooting.
E 4.1	The Impulse counter did not start on command. Instrument failure. Proceed to Service Group G.
E 4.2	The Impulse counter did not stop after completing the selected time interval. Instrument failure. Proceed to Service Group G.
E 5	Operator error. Attempt made to manually change mode or frequency while in REMOTE, or; LOCAL key pressed while in LOCAL LOCKOUT.
E 6.1	Operator error. START pressed while Impulse Threshold is equal to or less than 60 dB below Full Scale.
E 6.2	Operator error. START pressed while Impulse Threshold is above the Full Scale.
Err 7	The Analog to Digital Converter was unable to make a Conversion within two seconds. Instrument failure. If error code is constantly displayed, proceed to Service Group C and troubleshoot the A22 board. If it only flashes briefly, during a mode change, condition may be transient-related and acceptable as normal operation. (Note: A short on the – 12V supply can also cause Err 7.)
Err 8	The Frequency Reference Loop is unlocked. Verify that problem is not caused by an invalid External Frequency Reference, then proceed to Service Group H and troubleshoot the A40 board. (See Note)
<p>Note: "Err8" at turn on is normal if internal oven is installed. The Err 8 should go away after 15 seconds when the HP 3586 and the frequency reference obtain phase lock. Service Note 3586A/B/C-4 contains additional information on the "ERR 8" display. See Section VII for instructions on obtaining this service note and for information on other available service notes.</p>	

#### 8-44. Problems at Turn-On.

**8-45. Power Circuits.** Figure 8-3 is a flowchart designed to help the service technician handle the condition where the HP 3586A/B/C does not do what it is supposed to do when it is first turned on. The HP 3586A/B/C does not have a true “OFF” condition where input power is completely disconnected from all components in the instrument. It does have STANDBY (STBY) and ON as previously mentioned. In STANDBY, line power is applied to power transformer A99T1 and to the rectifier circuits. The +23 VDC in the power supply (see Service Group J) is always available when the instrument is plugged in. This voltage is applied to the battery (A80BT1) charging circuit and also to the 10 MHz Frequency Reference board (A16), if installed, to keep the reference oscillator oven warmed up and ready for immediate use. The other A99 rectified DC voltages (– 23 VDC, ± 18 VDC, and +8.5 VDC) are applied to the voltage regulator circuits on A80 and only need a ground from the ON position of the POWER switch (A98S300) to supply regulated DC voltages of ± 12 VDC and +5 VDC to the rest of the instrument. Failure of any of these circuits at turn-on will be immediately noticeable by failure of the HP 3586A/B/C to complete the turn-on initialization sequence. It is good, standard troubleshooting procedure to check power supply voltages as the first step in any troubleshooting sequence. See Service Group J for power supply checks.

#### 8-45. Interrogating The Front Panel.

8-47. Before making a final decision as to what troubleshooting strategy will be used on a malfunctioning instrument, the service technician should determine if any additional information can be gained from interrogating the front panel operational controls. If the HP 3586A/B/C has undergone a successful turn-on sequence (paragraph 8-31), the technician can activate several instrument self tests via the front panel. These internal self tests (designated as Test/Functions, TF) are built into the instrument software and can verify functional operation of the instrument’s circuits and assist in troubleshooting specific problems. Instructions for accessing, and detailed descriptions of the tests are given beginning at paragraph 8-49.

**8-48. Operational Confidence Check.** Following a successful turn-on sequence, a check of the overall operational status of the HP 3586A/B/C can be obtained by running internal self tests TF13 and TF14. The tests (one digital, one analog) take only two minutes to perform (with no failures), yet they can tell the technician a great deal about instrument performance. If successful testing (all PASS) of these two functions is obtained, basic HP 3586A/B/C operation is probably normal (barring intermittent failures and/or temperature problems) and known problems may be pursued by proceeding to Troubleshooting Hints in the next section. Refer to paragraphs 8-81 and 8-82 for procedures on running these two tests.

#### 8-49. Internal Self-Tests.

8-50. The HP 3586A/B/C has built-in self-test capability that can verify functional operation of a very large portion of the instrument circuits. In addition, there are several general purpose functions and capabilities that can be called upon to assist in troubleshooting specific problems.

8-51. The internal self-tests are accessed by a four-key sequence entry. These entries are either [ **RECALL** ], [ **●** ] (decimal point), [ **CNTR → FREQ** ], N or else [ **RECALL** ], [ **●** ] (decimal point), [ **RDNG → OFFSET** ], N where “N” is a number key.

8-52. For ease of referral in later paragraphs, the individual tests/functions have been assigned a Test/Function (TF) numeric designator. Table 8-6 is a condensed listing of these tests/functions for quick reference by those familiar with their use. A more detailed description of each one is contained in the following paragraphs. Details for use of each test/function capability are contained in the specific service groups where they are most useful for troubleshooting.

### 8-53. Test/Function Capabilities.

8-54. The following set-up provides a good starting point for most of the test functions. Select ENTRY (FULL SCALE) and 100 dB (RANGE). Turn AUTO CAL OFF. Enter a Full Scale setting of – 35 dBm.

8-55. **TF1.** Key sequence to activate is [ **RECALL** ], [ **●** ], [ **CNTR → FREQ** ], [ **0** ]. This function may be used, after deactivating AUTO CAL, to clear out (set to zero) all of the calibration constants stored in memory after the last calibration cycle. The operator may then view the exact gain of the instrument (uncompensated) by activating either TF2 or TF12.

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#### Note



Another way to zero the constants is to disconnect cable W1 between A4 and A2 and force a CAL. When unable to CAL (signal error >3 dB), the A60 processor sets the constants to zero.

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8-56. The CALibration cycle can correct for amplitude errors in the analog signal path of the instrument up to  $\pm 3$  dB. An instrument which is a borderline failure can be identified using TF1. As mentioned in the paragraph above, TF1 zeros out the current set of calibration constants so that the technician can view the actual gain of the instrument. In order to view the gain, first turn AUTO CAL off and then activate TF1. Next, either activate TF2 to use the precision CAL signal or use a calibrated external source to provide an accurate input signal (e.g., 1 MHz at – 40 dBm). The level reading displayed subtracted from the precision input, yields the gain or attenuation error of the analog signal path. For example, if a precise – 40.00 dBm signal is input to the instrument after the CAL constants are zeroed out, and the measured amplitude reading is – 42.87 dBm in AUTO 10, the analog signal path is attenuating the input signal (a fixed loss) by 2.87 dB. This is a large measurement error but it is still within the calibration compensation range ( $\pm 3$  dB) of the HP 3586.

This hypothetical example, however, would indicate that a significant signal degradation condition exists and suggests that one or more components may have changed value due to temperature, stress, shock, or some other reason. If the degradation continues until the error exceeds 3 dB, the instrument will fail CAL and will need additional repair.

**Table 8-6. Test/Function Capabilities.**

Paragraph	T/F Desig	Key Seq*	Test/Function	Exit**
8-55	TF 1	CF, 0	Clears CAL constants	—
8-58	TF 2	CF, 1	Tracking CAL signal ON Input signal OFF	TF 3
8-66	TF 3	RO, 1	Input signal ON Tracking CAL signal OFF	—
8-67	TF 4	CF, 2	Hundredths digit ON	TF 5
8-68	TF 5	RO, 2	Hundredths digit OFF	—
8-69	TF 6†	CF, 3	First L.O. 1000 point sweep	MC
8-70	TF 7	CF, 4	RF Gain, 12 step cycle	MC
8-73	TF 8	RO, 4	— 12 volt supply and A/D check (– 125.50 to – 130.30)(X.0938) Range – 120 dB	PWR
8-74	TF 9	CF, 5	IF GAIN, 22 step cycle	MC
8-77	TF 10	RO, 5	Right # = A/D converter offset Left # = Offset/input difference	MC
8-78	TF 11	RO, 6	Display Scan Rate (100 ± 10 Hz)	MC
8-79	TF 12	CF, 7	1 MHz CAL signal ON Input signal OFF	AC
8-81	TF 13	CF, 8	<u>Receiver Test</u>  1.0-1.11 RF Gain 2.0-2.13 IF Gain 3.1-3.2 Detector/Counter 4.1-4.32 Flatness 5.0 Audio	MC
8-82	TF 14	CF, 9	<u>Digital Test</u>  10 dB ROM (U7) 100 dB ROM (U7) AUTO ROM (U7) ENTRY ROM (U7) AVE ROM (U7) dBm ROM (U7) (other) RAM	MC
<p>* All key sequences include RECALL, ● (decimal point) first. CF = CNTR → FREQ      RO = RDNG → OFFSET ** MC = MEAS CONT      PWR = Cycle POWER switch      AC = AUTO CAL † Available in Revision "A" ROM software only.</p>				

8-57. If AUTO CAL is now turned on, with the reading of – 42.87 dBm present, the reading should correct to – 40.00 dBm. This would show how the instrument has stored a calibration constant of +2.87 dB which it will add to all incoming signals as long as it stays on the selected Full Scale setting and at the selected frequency. Other constants are stored for different full scale settings, but if the frequency is changed by more than 1 MHz from the frequency at which the last CAL cycle occurred, calibration will automatically occur again.

**8-58. TF2.** Key sequence is [ **RECALL** ], [ **•** ], [ **CNTR → FREQ** ], [ **1** ]. This function provides a precision internal source for testing the analog signal path in the receiver input section by switching out the input signal at the front of the Input Amplifier (A2) and switching in the calibration signal from A4. This signal has the same frequency as shown in the FREQUENCY/ENTRY display. The amplitude of this signal is – 40 dBm for FULL SCALE settings of 0 dBm or lower and – 20 dBm for FULL SCALE settings of +5 dBm or higher. In addition, anytime CAL is selected, the A22 board switches in a CAL oscillator frequency to beat with the second I.F. signal (15.625 kHz) and to produce an audio signal of 800 Hz (HP 3586A) or 1000 Hz (HP 3586B) to test the IMPAIRMENTS options on the A70 board. To exit this function, use TF3. (See also paragraph 8-79).

**8-59. Frequency Response, Gain, and Signal Path Checks.** Assuming that the instrument has completed the turn-on cycle (paragraph 8-31) with no failures, the technician has two possible methods of making additional front panel functional checks. Activating TF2 can provide a tracking CAL signal for checking any desired frequency or, the technician may elect to input a signal from an external source.

8-60. Whatever the source of the signal, first set up the HP 3586A/B/C to measure that signal at full scale. For example, if TF2 is used, select ENTRY 100 and enter a Full Scale setting of – 40 dBm (the CAL signal is – 40 dBm with this full scale setting). If an external signal is used, match the full scale setting to the amplitude of the input signal. Now, by changing the tuned frequency of the HP 3586A/B/C (TF2 used), the frequency response of the instrument may be checked (except for A1 which is bypassed). By changing the external source frequency (if used) and holding the tuned frequency constant, the 3 dB bandwidth of the selected bandwidth filter may be checked. Switching bandwidths will verify all possible IF signal paths.

8-61. Changing the full scale setting with a constant test signal amplitude allows the technician to check different RF and IF gain configurations for the instrument (refer to the gain/attenuation tables in Service Groups A and B).

8-62. Changing measurement modes allows a check of certain other circuits/boards. For example, selecting WIDEBAND allows a check of the BBP signal path (see figure 8-F-1). For a clean, single frequency input signal (or TF2), WIDEBAND signal amplitude should be about the same as LO DIST signal amplitude.

8-63. Switching between AUTO 10 and AUTO 100 checks the capability of the instrument to autorange correctly which exercises the BBP Overload/Underload detection circuits on the A4 board. If the mode is switched from LO DIST to LO NOISE, the Trip Point Reference circuits are also checked on A4. The signal amplitude should be about the same between AUTO 10 and AUTO 100 which would prove that the A21 Detector/Logger circuit is working in both 10 and 100 dB ranges. When using TF2 and changing tuned frequencies and the measured test signal amplitude is always about the same, it shows that the First L.O. signal is tracking correctly and the A15/A4 CAL signal path is functioning correctly.

8-64. By injecting an external signal and using COUNTER, the input signal frequency measurement path bypasses the A21 logger circuits and the A22 A/D conversion circuits. If the frequency COUNTER works, there is a good chance that an amplitude problem may be due to one of the bypassed circuits.

8-65. To check the A1 board, an external 50Ω or 75Ω source can be used to check all of the input termination impedances. See paragraph 8-A-70 in Service Group A for impedance mismatch correction information. A frequency response problem can also be checked using an external source through the A1 board to see if it is the problem. If there is a frequency response problem using an external source but not when using the TF2 tracking CAL signal (see paragraph 8-60), A1 is probably bad.

**8-66. TF3.** Key sequence is [ **RECALL** ], [ ● ], [ **RDNG → OFFSET** ], [ **1** ]. This function switches out the Tracking CAL signal (see TF2) and switches in the input signal at the front of the Input Amplifier (A2).

**8-67. TF4.** Key sequence is [ **RECALL** ], [ ● ], [ **CNTR → FREQ** ], [ **2** ]. This function turns the hundredths digit ON in the amplitude display for comparison measurements in modes which normally only display amplitude levels to the nearest tenth of a dB. This function may be used anytime the RANGE selection is 100 dB or WTD filter is selected. To exit this function, use TF5.

**8-68. TF5.** Key sequence is [ **RECALL** ], [ ● ], [ **RDNG → OFFSET** ], [ **2** ]. This function turns the hundredths digit OFF in the level display anytime the RANGE selection is 100 dB or WTD filter is selected.

**8-69. TF6.** Key sequence is [ **RECALL** ], [ ● ], [ **CNTR → FREQ** ], [ **3** ]. This function provides a 1000 point, sweep frequency generator capability. It begins immediately, starting at the existing first local oscillator frequency and stepping the first L.O. frequency 1000 times in increments equal to the FREQ STEP setting. The sweep is continuous, taking approximately 20 seconds to complete one cycle. A synchronization pulse is generated at the beginning of each sweep for scope applications and this pulse may be accessed at the SYNC test point (TP1) on the A60 Controller board. To exit this function, press [ **MEAS CONT** ].

This function, when used in association with a spectrum analyzer, is useful for examining and adjusting filter shapes.

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**Note**

TF6 is only available when ROM's with Revision A software are installed. See Service Group C for method of identifying Revision A ROM's.

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**8-70. TF7.** Key sequence is [ **RECALL** ], [ **•** ], [ **CNTR → FREQ** ], [ **4** ]. This function steps through the 12 combinations of RF GAIN/ATTENUATION on the Input Amplifier (A2) board. The input signal remains connected and the function is cyclic, beginning at  $-40$  dB and incrementing in  $+5$  dB steps to  $+15$  dB. To exit this function, press [ **MEAS CONT** ]

8-71. A2/A21 RF checks can be made using TF7 and following the procedure outlined below:

1. Using a  $75\Omega$  external source, input a 1 MHz signal at  $-45$  dBm into the HP 3586A/B/C ( $75\Omega$  termination).
2. On the HP 3586A/B/C, press [ **RECALL** ] and , [ **0** ]. Select LO DIST, ENTRY 100, and a full scale setting of  $-45$  dBm. Re-select  $75\Omega$  instead of  $10\text{ k}\Omega$  if the instrument has Revision B software (paragraph 8-C-27).
3. Activate TF7.
4. The front panel meter should step from  $-60$  dBm to 0 dBm (Full Scale) in 11 steps (12 levels) of 5 dB each (RF00 to RF11).
5. Press MEAS CONT to exit TF7 at the end of the next cycle.
6. Repeat steps 1-5 for an input signal of  $-40$  dBm (Full Scale also  $-40$  dBm) and then again for  $-35$  dBm.
7. The results, using  $-40$  dBm and  $-35$  dBm, should be the same as for  $-45$  dBm.

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**Note**



This test will not work exactly the same way for any other input/full scale levels. Use only the values given.

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8-72. If the twelve 5 dB steps can be clearly seen on the meter in the test sequence of paragraph 8-71, the technician knows that all of the switchable gain/attenuation stages on the A2 board are switching correctly and that the A2 board is providing a full 5 dB change to signal amplitude for each step. Also, the A21 board is providing additional 5 dB step changes for at least 3 full scale settings correctly. By contrast, if twelve steps are visible but are not in 5 dB increments or, if the twelve steps are not uniform, the problem is on A2. If the steps are 5 dB but start higher than  $-60$  dBm and end higher than 0 dBm (Full Scale), the problem is most likely in one of the IF stages rather than on A2 since that is the only way increased gain can occur. If the range of the steps is from below  $-60$  dBm to below full scale, the problem could be signal loss in A1 or in the output buffers of A2 as well as an IF problem. See paragraph 8-74 for a way to check the IF section (TF9). Use Service Group A to troubleshoot a problem with A1 or A2.

**8-73. TF8.** Key sequence is [ **RECALL** ], [ **●** ], [ **RDNG → OFFSET** ], [ **4** ]. This function provides a confidence check of the A/D converter on A22 by selecting a fixed negative D.C. voltage off a voltage divider and converting it to a digital readout. If the readout is between  $-125.50$  and  $-130.30$ , the technician knows the whole path from the A/D input multiplexer to the A/D counter output is working. Also, by multiplying the readout by  $.0938$ , a close ( $\pm 250\text{mV}$ ) approximation of the  $-12\text{ VDC}$  regulated supply voltage is obtained. If the  $-12\text{V}$  supply is good, then by inference so is the  $+12\text{V}$  supply good since it is used as a reference for the  $-12\text{V}$  supply.

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**Note**

The instrument must not have any input signal applied for this test to work. It also must either be in AUTO 10 or in ENTRY 10 with a Full Scale setting of  $-120\text{ dBm}$ .

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**8-74. TF9.** Key sequence is [ **RECALL** ], [ **●** ], [ **CNTR → FREQ** ], [ **5** ]. This function steps through all IF GAIN configurations for the A20 and A21 boards. The input signal remains connected and the function is cyclic, beginning at  $0\text{ dB}$  and incrementing in  $+5\text{ dB}$  steps to  $+95\text{ dB}$ . It then checks two special configurations of  $+35\text{ dB}$  and  $+25\text{ dB}$  gain and then repeats the cycle. To exit this function press [ **MEAS CONT** ].

8-75. A20/A21 IF checks can be made using TF9 and following the procedure outlined below:

1. Using a  $75\Omega$  external source, input a  $1\text{ MHz}$  signal at  $-55\text{ dBm}$  into the HP 3586A/B/C ( $75\Omega$  termination).
2. On the HP 3586A/B/C, press [ **RECALL** ] and [ **0** ]. Select LO DIST, ENTRY 100, and a full scale setting of  $-20\text{ dBm}$ . Re-select  $75\Omega$  instead of  $10\text{ k}\Omega$  if the instrument has Revision B software (paragraph 8-C-27).
3. Activate TF9.
4. The front panel meter should step from  $-85\text{ dBm}$  to  $+15\text{ dBm}$  in 19 steps (20 levels) of  $5\text{ dB}$  each (IF 00 to IF 19). The meter should then briefly jump to about  $-45\text{ dBm}$  for IF 20 and then to  $-55\text{ dBm}$  for IF 21 and then the cycle should repeat.

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**Note**

This test will not work exactly the same for other combinations of input signal level and full scale settings. Use only the values given.

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8-76. If the nineteen 5 dB steps and the two other steps can be clearly seen on the meter in the test sequence of paragraph 8-75, the technician knows that the switchable gain stages on the A20 and A21 boards are working correctly. It is also known that a full 5 dB of gain is being provided for each step. By contrast, if all the steps are visible but are not exactly 5 dB, the problem is either on A21 or in the 10/35 dB output amplifier stage on A20. If the steps are visible but start at less than  $-85$  dBm and end at less than  $+15$  dBm the problem could be signal loss anywhere in the receiver section of the instrument. If the steps are all exactly 5 dB, the problem is most likely not in the 10/35 dB amplifier on A20 nor on A21 (unless the IF logger circuit offset is misadjusted). See paragraph 8-71 for a way to check the RF section. Use Service Group B to troubleshoot a problem with A20 or A21.

**8-77. TF10.** Key sequence is [ **RECALL** ], [ **•** ], [ **RDNG → OFFSET** ], [ **5** ]. This function is used to adjust the amplitude display accuracy (see Volume I, paragraph 5-8). The right hand number is the raw A/D Converter offset that exists with the A/D input grounded. The left-hand number is the signal from the IF logger minus the offset. To exit this function, press [ **MEAS CONT** ].

**8-78. TF11.** Key sequence is [ **RECALL** ], [ **•** ], [ **RDNG → OFFSET** ], [ **6** ]. This function shows the display scan rate. It should normally be 90-110 (Hz) although the instrument may work satisfactorily if the number is slightly outside this range. Symptoms of a slow scan rate would include slow display updating, slow audio test (TF13, group 5.0), slow measurement data sampling over HP-IB, slow turn-on initialization sequence, slow CAL cycle, etc. Symptoms of a scan rate that is too fast could include inaccurate measurement data sampling over HP-IB (only) due to insufficient settling times after switching transients have occurred. To exit this function press [ **MEAS CONT** ]

**8-79. TF12.** Key sequence is [ **RECALL** ], [ **•** ], [ **CNTR → FREQ** ], [ **7** ]. This function inserts a constant 1 MHz CAL signal into the CAL input of the A2 board. The 1 MHz is an output of the A40 Frequency Reference board, gated through the A15 board as a substitute for the Tracking CAL signal. Use of this signal allows the first L.O. to be tuned around the 1 MHz CAL signal using the front panel frequency keys. In this way detailed checks can be made of the filter shapes. This function will be automatically exited any time a manual or automatic CAL cycle occurs.

**8-80. A70 Circuits Check.** Circuits on the A70 board (option 003) can be checked using TF12 as follows.

1. **Weighted Filter** - Press [ **RECALL** ] and [ **0** ]. Activate TF12. Turn AUTO CAL off. Switch between 3100 Hz and WTD 3100 Hz. In 3100 Hz, the 1 MHz test signal should be about  $-40$  dBm. In WTD 3100 Hz, the signal amplitude should drop about 2.3 dB (HP 3586A) or about 1.4 dB (HP 3586B). If it does, the Weighted filter works as does the Audio logger circuit on A70.
2. **Notch Filter** - Press [ **RECALL** ] and [ **0** ]. Activate TF12. Turn AUTO CAL off. In 3100 Hz, the 1 MHz test signal should be about  $-40$  dBm. Select NOISE/TONE (blue function key must be lit). If the signal amplitude drops about 60-70 dB, the notch filter is working.

3. Phase Jitter - Press [ **RECALL** ] and [ **0** ]. Activate TF12. Turn AUTO CAL off. Select TONE (ENTRY FREQUENCY - SSB CHANNEL). Select  $\phi$ JITTER (blue function key must be lit). If a residual phase jitter of less than  $0.5^\circ$ p-p is displayed, the phase jitter circuitry is at least functional.
4. Impulse - Press [ **RECALL** ] and [ **0** ]. Set THRESHOLD to  $-116$  dBm. Select IMPULSE (blue function key must be lit) and press START. If the impulse counter begins counting, the IMPULSE circuits are probably working.

**8-81. TF13.** Key sequence is [ **RECALL** ], [ **•** ], [ **CNTR → FREQ** ], [ **8** ]. This function provides a confidence test of the main signal path through the receiver sections of the instrument. The test is similar to the CALibration cycle in that the processor causes a calibrated test signal to be injected into the Input Amplifier (A2). With this signal present, the processor then selectively changes the instrument's analog signal path configuration (gain/attenuation step, filter selection, etc.) in a controlled sequence. As it does this, it compares the resulting signal value (amplitude or frequency) that it receives from the analog-to-digital converter (A22) against known values, with appropriate tolerances, stored in ROM memory. The test will stop at any step that fails (identifying same), which allows the technician to determine the failing portion of the instrument. There are five groups in the test sequence, with a PASS or FAIL indication for each step in each group. If all steps in TF13 fail, it indicates that a break in the main signal path through the receiver exists. Refer to paragraph 8-98 in the troubleshooting section. To exit this function, press [ **MEAS CONT** ] during the Group 5.0 repeat cycle.

Descriptions of the individual TF13 tests are given below and their failure directions are summarized in table 8-7.

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**Note**

It is possible, in some cases, for the instrument to fail portions of TF13 and still pass AUTO-CAL and also meet all its performance specifications. This is true because CAL can compensate for analog signal path errors totaling up to  $\pm 3$  dB, while TF13 might reject a signal slightly less than 3 dB in error. Rather than being contradictory, this situation provides useful information. It indicates that the instrument is marginally within specification and that further degradation may produce an out-of-tolerance condition. The principal value of TF13 is to help the service technician isolate a solid failure to a particular section of the instrument.

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**Group 1.0 to 1.11:** The 1 MHz calibration signal (see TF12) is switched into the measurement signal path. Each of the 12 RF GAIN/attenuation steps from -40 dB to +15 dB is programmed, with the signal being checked for correct level at the detector for each 5 dB step. The 100 dB Range is used. Refer to Service Group A if any step from 1.0 to 1.11 fails.

**Group 2.0 to 2.13:** The 1 MHz calibration signal (see TF12) is switched into the measurement signal path. Some of the IF GAIN steps are programmed, with the signal being checked for correct level at the detector for each step. Each of the switchable IF GAIN stages is checked for switching but all combinations of all stages are not checked. Refer to Service Group B if any step from 2.0 to 2.13 fails.

**Group 3.1 to 3.2:** Test 3.2 checks the counter (A22U6) for the correct reading of the signal frequency. Test 3.1 checks the 10 dB Range for a correct level at the detector of the 1 MHz signal at -40 dBm. Refer to Service Group C for failure of step 3.2 and Service Group B for failure of step 3.1.

**Group 4.1 to 4.32:** The tracking CAL signal (see TF2) is switched into the measurement signal path. This signal is stepped at 1 MHz intervals from 1 MHz to 32 MHz at -40 dBm. Flatness is tested by checking the level at the detector for each step using the 10 dB Range. Refer to table 8-9 under "Frequency Measurements Incorrect" if any step from 4.1 to 4.32 fails.

**Table 8-7. TF13 Analog Test Steps.**

Group	Step(s)	Test Description	Troubleshooting Data	Service Group
1	1.0-1.11	RF Gain Test	Paragraph 8-A-14	A
2	2.0-2.13	IF Gain Test	Paragraph 8-B-25	B
3	3.1	10 dB Detector Range	Paragraph 8-B-61	B
	3.2	Frequency Counter	Paragraph 8-C-17	C
4	4.1-4.32	Flatness Test	See Note	
5	5.0	Audio Test	Paragraph 8-B-62	B

Note: 1. If all steps of TF13 fail, proceed to paragraph 8-98.

**Note**



If the flatness test (Group 4) in TF13 fails, the problem cannot be on A1 because A1 is bypassed for this test. It also cannot be past the A5 Input Mixer since the A5 output frequency is always 50 MHz (First I.F.). The problem, therefore, must be on A2 or A5, or must be due to a non-linear input to A5 from the First L.O. source (A51). One additional possibility is that the A4-derived calibration signal amplitude is non-linear. If the flatness test in TF13 passes but external input signals have poor frequency response (e.g., low frequency inputs at 0 dBm measure 0 dBm but high frequency inputs at 0 dBm measure < 0 dBm), the problem is probably on A1. For any flatness problem, set up the HP 3586A/B/C for a Full Scale reading at the failing frequency, and then measure signal amplitudes as shown in figure 8-A-7 (Service Group A).

**Group 5.0:** The finale from Beethoven's Symphony Number 9 is synthesized from memory by selectively switching the First L.O. frequency around the 1 MHz CAL signal. The function (TF13) repeats Group 5.0 until manually exited. Refer to Service Group B if any discrepancy in the audio is noted.

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**Note**

Service Note HP 3586A/B/C-3A contains additional information on interpreting TF13 failure codes. See Section VII for instructions on obtaining this service note and other available service notes.

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**8-82. TF14.** Key sequence is [ **RECALL** ], [ **●** ], [ **CNTR → FREQ** ], [ **9** ]. This function provides a confidence test of the digital sections of the instrument. The test gives a **PASS** or **FAIL** indication together with a displayed date of the latest version of ROM software. The test includes some fundamental read operations from ROM and write/read operations from RAM memory modules on the A60 Controller board. If **FAIL** is displayed, a lit key LED indicates the failed ROM (see table 8-8). Refer to Service Group C for procedures to follow if a **FAIL** condition exists. Successful completion (**PASS**) of TF14 is required in order to run TF13 (paragraph 8-81). This is true because the analog self-test relies on a correctly functioning digital Controller to provide valid analog test results. (See also Paragraph 8-C-42.)

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**Note**


The data displayed at the completion of this test identifies the ROM software revision where 7-23-79 is revision A and 6-30-80 is revision B.

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**Table 8-8. Digital Self-Test Failures.**

Key*	Failed Module
10 dB	ROM A60U7
100 dB	ROM A60U7
AUTO	ROM A60U7
ENTRY	ROM A60U7
AVE	ROM A60U7
dBm	ROM A60U7
*Any lit key LED other than those listed indicates a possible faulty RAM.	





