



AI-80 Calibration Verification Program



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AI-80 Verification Script Documentation

1 Scope

This document outlines the basic operation of the AI-80 verification script including cabling requirements, how to run the script, and what the display codes mean.

2 Revision History

Table 1 Document Revision History

Revision	Date	Author	Description
0.0	May 30, 2003	BM	Draft
1.0	June 4, 2003	BM	First Release
2.0	July 17, 2003	BM	Updated to 9600, no Parity



3 Introduction

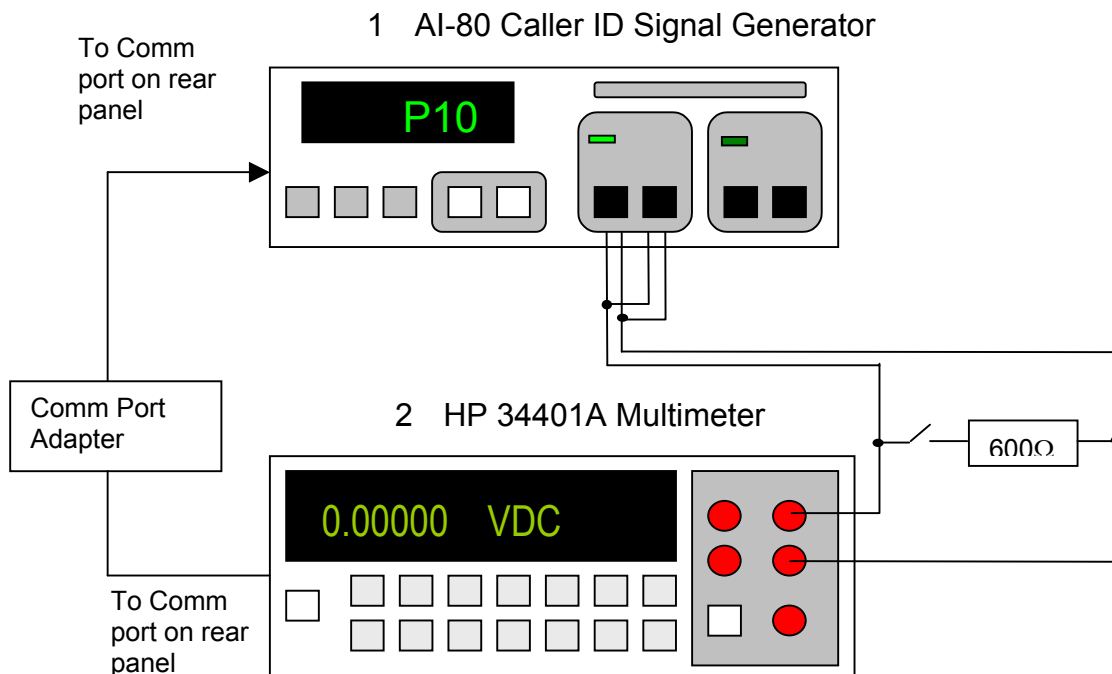
This document outlines the requirements and operation instructions for the "AI-80 Calibration Verification Script". This script is designed to work in conjunction with the Hewlett Packard 34401A multimeter to verify the operation and calibration of the AI-80. The following sections describe the required connections, equipment, and operating procedure.

4 Equipment Required

- One AI-80 unit to test.
- One Hewlett Packard 34401A multimeter (properly calibrated)
- One custom cable to connect two telephone jacks to the HP meter. This can be made using one standard telephone cable and two banana plugs.
- One Serial Cable
- One Serial Port Adapter. (see section 6).
- One 600 ohm reference load resistor (2 watt, $600\Omega \pm 1\%$).

5 Connection Diagram

The connections required for the verification program are shown in Figure 1.





The test script can be configured to test either PortA (the left pair of terminals) or PortB (the right pair of terminals). Connect the inner pair of the telephone line interface (labeled “Tel. Line”) to the inner pair of the CPE load connection for the desired port. Then connect the pair to the voltage measurement terminals on the front of the HP34401A multimeter. Part way through the program the testing requires the line to be terminated with a precision 600Ω resistor – the cable should have some means of connecting this resistor across the two telephone line conductors part way through the test. Before running the test, insure that the HP meter is selected to measure from the front terminals.

6 Serial Port Adapter

Communication between the HP meter and the AI-80 is accomplished using the COMM port connections on the back of each unit. The HP multimeter is configured as a DTE and the AI-80 is configured as a DTE. However, since the HP meter has unique handshaking requirements, an adapter is needed to allow the two devices to communicate. The adapter connections are shown in Figure 2.

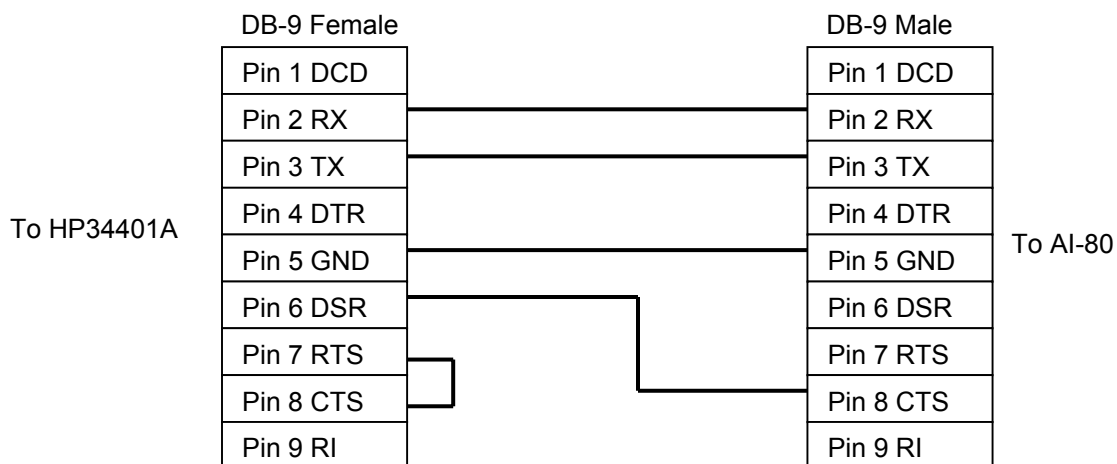


Figure 2 Serial Port Adapter

The only unusual connection in this adapter is the connection of the DSR line to the CTS line of the AI-80. This connection is required to allow the AI-80 to notify the meter that communication is possible.

7 Setting up and Running the Test

7.1 Load the program into flash memory

The test script is distributed as a .apf file called “ai80ver.apf” . Note the test is stored into flash as file number 90. If this file number is already in use insure that it is properly backed up.

1. Connect the AI-80 to a PC using the serial port and run AI-workbench.
2. After AI-Workbench has connected to the unit, select “View : Flash Memory Files” from the menu.



3. Then select "File : Load File Into Flash". A file dialog box will appear. Locate and select the file "ai80ver.apf" and click open.
4. After the file is stored close AI-workbench and disconnect the AI-80 from the PC.

7.2 Connect the AI-80 to the HP34401A Multimeter

After the test program has been stored into the flash memory of the AI-80, power off both the HP multimeter and the AI-80. Then connect the AI-80 to the multimeter as shown in Figure 1. Remember to use the serial port adapter when connecting the multimeter and AI-80. In order for the AI-80 to communicate with the HP multimeter, the RS-232 settings on the multimeter must be set to

- Interface: RS-232
- Baud: 9600
- Parity: None (8 bits)
- Language : SCPI

These settings must be changed through the I/O menu accessed through the front panel of the multimeter. See the user manual for the HP meter for details on changing these settings.

7.3 Power Up Sequence

After the telephone line and serial port connections have been made power on the AI-80 and wait a few seconds until the initialization sequence is complete - then power on the HP multimeter. If the units are powered on in the reverse order an error condition may occur on the HP multimeter.

7.4 Executing the Program

Now that the AI-80 and the multimeter are powered and correctly connected, use the + - keys on the front of the AI-80 until the test program is selected and the front panel reads "P90". Initiate the test by pressing the start button. Note: Before starting the test, insure that the telephone line is not terminated and the HP multimeter is selected to measure from the front terminals. The test can be stopped at any time by pressing the stop button.

Once executed the program will run a sequence of tests to verify the operation of the unit and then conclude with a test status message indicating if the unit passed or failed.

8 Program Operation

8.1 Initialization

When the test is executed by pressing the start key, the AI-80 briefly displays its current version number (i.e. r4.03). It then resets the HP meter, verifies the model number of the meter, and puts the meter in remote mode. The progress of the meter initialization is shown with "-" marks on the AI-80.

If the initialization is successful, then the multimeter will display the test "METER OK" and the test will continue. If the device did not respond then the front panel of the AI-80 will



read "CErr" (for communication error) and the Stop LED will be on. If meter communications were initialized correctly but the device identification string didn't match the expected string from the 34401A multimeter, then the front panel will display "CbAd" and the stop LED will be on. NOTE: All communication errors cause the test to be aborted on the next key press.

8.2 Port Selection Prompt

After the multimeter initialization is completed, then the AI-80 prompts the user to select the port to test. The unit should beep and the message "SEL PORT +/-" should appear on the multimeter display. The pause LED is on to indicate the program is waiting for user input. The test can be switched to port A or port B by pressing the + and – keys on the front panel. NOTE: Insure that the connections to the multimeter correspond with the selected port. Once the port is selected press and release the start button and the test will begin.

8.3 600Ω Termination Prompt

After the on hook tests have completed, the program will prompt the user to terminate the line with a precision 600 ohm load in order to verify several off hook conditions. The unit will beep and the multimeter will display "TERM 600R". The pause led will be on to indicate to the user that the program is waiting for user input. Connect a $600\Omega \pm 1\%$ 2 Watt resistor across the two conductors to terminate the line. Press and release start to continue testing.

9 Program Display

While the program is executing a test, the AI-80 will be display a three-digit number indicating which test is in progress. This number is also used to reference failures when they occur (see Table 4). The test numbers and descriptions are listed in Table 1.

Table 2 Test Numbers

Test Number	Group	Description
1.100	Tel. Interface	Verify on hook DC line voltage
1.200	Tel. Interface	Verify line reversal DC voltage
1.300	Tel. Interface	Verify OSI DC voltage
1.400	Tel. Interface	Verify hookswitch with CPE load
1.510	Tel. Interface	Verify CPE off hook voltage (low current setting)
1.520	Tel. Interface	Verify CEP off hook voltage (high current setting)
2.110	Ring Generator	Verify ringing generator level / flatness
2.120	Ring Generator	Verify CPE meter low gain level /flatness
2.200	Ring Generator	Verify ring trip
2.300	Ring Generator	Ring generator DC bias
3.110	On Hook	Verify tone generator level / flatness (600R OutputZ + On Hook)
3.120	On Hook	Verify TelInt measurement flatness (600R OutputZ + On Hook)
3.130	On Hook	Verify CPE meter high gain flatness (600R OutputZ + On Hook)



3.210	On Hook	Verify tone generator level / flatness (900R OutputZ + On Hook)
3.220	On Hook	Verify TelInt measurement flatness (900R OutputZ + On Hook)
3.230	On Hook	Verify CPE meter high gain flatness (900R OutputZ + On Hook)
3.300	On Hook	Verify level accuracy (level sweep)
3.400	On Hook	Verify the generator frequency accuracy
4.110	Off Hook	Verify 600R output impedance
4.120	Off Hook	Verify 900R output impedance
4.200	Off Hook	Verify the low current setting
4.300	Off Hook	Verify the high current setting

10 Test Failure Display

If one of the tests in the verification program fails the test pauses itself and a failure message is displayed using the AI-80 front panel and the multimeter display. The failure message consists of two to three messages that are displayed in sequence and consist of:

- The test number of the test that failed.
- The measurement that is out of the acceptable range
- The frequency at which the failure occurred (optional)

Table 3 Failure Message Display Format

Multimeter Display	AI-80 Display	Description
"FAIL"	Test Number (ie. 2.110)	This message displays that the test number of the test which failed.
"VALUE"	Test Measurement	This message displays the offending measurement that caused the test to fail
"FREQ"	Test Frequency	This message displays the frequency of the test point that failed. This may or not be displayed depending on the type of test

To continue the test, the user can press and then release the start button, however, the appearance of a failure message indicates that there could be a problem with the unit and it may require servicing. To stop the test immediately the user can press the stop button. The unit will then return to its power-on state.

Depending on the type of test that fails the test measurement as discussed above may have a different meaning. The meaning of the Value and frequency are listed in

Table 4 Failed Test Measurement Values and Error Conditions

Test Number	Units	Measurement Value	Error Condition
1.100	V DC	Nominal (normal polarity) DC line voltage	DC voltage is incorrect
1.210	V DC	Nominal (reversed) DC line voltage	Reversed voltage did not change polarity
1.220	V DC	Nominal (reversed) DC line voltage	Reversed DC voltage is incorrect
1.300	V DC	OSI line voltage	OSI voltage is too large
1.410		On hook telint.hookdetect value	Unit is off hook when CPE load is on hook
1.420		Off hook telint.hookdetect value	Unit is on hook when CPE load is off hook
1.510	VDC	Off hook CPE voltage (low current)	CPE voltage is incorrect



1.520	VDC	Off hook CPE voltage (high current)	CPE voltage is incorrect
2.110	VAC	Ring generator level (HP) (at frequency indicated by freq display)	Ring generator level as measured by HP meter is incorrect
2.120	dB	Difference in measurement from HP and CPE load (at frequency indicated by freq display)	Difference in measurement between HP and CPE load is too large
2.200	ms	Ring trip delay (at frequency indicated by freq display)	Ring trip delay is too large
2.300	Vdc	Ring generator DC bias	Ring Generator DC bias is out of acceptable range
3.110	Vrms	AC Level at test frequency indicated by display (600Ω outputZ)	AC level is out of valid range
3.120	dB	Difference between HP and TelInt Measurements (600Ω outputZ)	TelInt measurement deviates too far from the HP meter measurement
3.130	dB	Difference between HP and CPE Measurements (600Ω outputZ)	CPE measurement deviates too far from the HP meter measurement
3.210	Vrms	AC Level at test frequency indicated by display (900Ω outputZ)	AC level is out of valid range
3.220	dB	Difference between HP and TelInt Measurements (900Ω outputZ)	TelInt measurement deviates too far from the HP meter measurement
3.230	dB	Difference between HP and CPE Measurements (900Ω outputZ)	CPE measurement deviates too far from the HP meter measurement
3.3x1	Vrms	Tone generator AC voltage at point in level sweep (x specifies the test point number)	Difference between tone level and set point is too large
3.3x2	dB	Difference between the Telint and the HP measurment (x specifies the test point number)	Difference between HP and TelInt measurement is too large
3.3x3	dB	Difference between the CPE and the HP measurment (x specifies the test point number)	Difference between HP and CPE measurement is too large
Note: the x in the 3.3x1 specification denotes the test level used in the level sweep. The values 1 to 5 represent the levels 6.021,0.00,-6.021,-12.04,-18.062 dBV respectively.			
4.110	ohms	Measured output impedance (600Ω setting) at 1kHz	Measured output impedance is out of the acceptable range
4.120	ohms	Measured output impedance (900Ω setting) at 1kHz	Measured output impedance is out of the acceptable range
4.200	mA	Off hook current (26mA setting)	Off hook current (low current setting) is out of the acceptable range
4.300	mA	Off hook current (45mA setting)	Off hook current (high current setting) is out of the acceptable range

11 Test Result Display

Once all of the tests have been completed the AI-80 indicates the results of the testing. The front of the multimeter will read "TEST DONE" and the AI-80 will show either "PASS" or "FAIL". The user can either press start or stop to finish the test. The unit will then reset itself to its power-on state.

If the unit displays a test status of "PASS" then the unit is operating within calibration limits. If the unit displays a test status of "FAIL" then the unit may require servicing.