HP 82000 IC Evaluation System

Maintaining the HP 82000

HP 82000 Models D50/100/200/400

SERIAL NUMBERS

This manual affects all systems.

A B C D E

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Purpose

The purpose of this manual is to describe maintenance procedures for the HP82000 IC Evaluation System.

Audience

This manual is for users of the HP 82000 and for Customer Engineers who wish to carry out preventive maintenance on the system.

Contents

This manual contains 6 chapters and 2 appendices:

1	Scheduling Preventive Maintenance.
2	Periodic Hardware Maintenance.
3	Periodic Software Maintenance.
4	Diagnostics.
5	Calibration Description.
6	Calibrating the System.
A	Equipment Required/Consumable Items.
B	Preventive Maintenance Parts Lists.

Scheduling Preventive Maintenance

Regular preventive maintenance will ensure that your system operates reliably and accurately. Refer to the schedule shown below to plan your maintenance.

Maintenance Schedule

Table 1-1. Preventive Maintenance Schedule

Maintenance Procedures	Daily	Weekly	Monthly	Three Monthly	Six Monthly	Yearly	Two Yearly
Clean Terminal		X	X	X	X	X	X
Check Printer Paper/Ink		X	X	X	X	X	X
Check Condition of Airfilter		X	X	X	X	X	X
Exchange Airfilter					X	X	X
Exchange Fan Tray						X	X
Exchange Tangential Fan							X
Check RFI Strips					X	X	X
General Cleaning						X	X
Check Cables & Connectors							X
Run Diagnostics	X	X	X	X	X	X	X
Run Base Calibration					X	X	X
Run DC/AC Calibration				X	X	X	X

Periodic Hardware Maintenance

An important part of preventive maintenance is adequate and thorough cleaning of the system.

Warning **Switch the system OFF before cleaning it.**

System Shutdown

The HP 82000 system uses the HP-UX, operating system, and you should follow a recognized procedure to shut the system down. This is necessary, to maintain the integrity of the file-system.

A knowledge of HP-UX and a privileged login is required, so the system administrator should perform this procedure.

1. Before switching the test system off, exit all HP-UX files. Use the *shutdown* command to shutdown HP-UX. This command is described in the *HP-UX System Administrator Manual*.
2. Switch-off all peripherals.
3. Switch-off the circuit-breaker(s) on the rear-panel of the Power Control Module (PCM).

Warning **Failure to switch the system OFF may result in injury or death.**

4. Switch-off the **mains** power.
5. Disconnect the system from the mains.

Cables and Connectors

When you are cleaning the system you should:

- check for loose cables and connectors.
- check that all boards are correctly seated.
- check that cables are tied correctly (for example, away from fan blades).
- check cables for signs of overheating and burning.
- check power-connector contacts for blackening or oxidization of the connector surfaces.

Preventive Maintenance Procedures for Peripherals

For preventive maintenance of peripherals, refer to the operating manuals supplied with the equipment.

Air Filters - Standardframe and Maxiframe

Caution

To prevent damage to the test system or storage media by dust and dirt, move the air-filter well away from all other equipment **before** cleaning it with a vacuum cleaner.

Inspect the filter for signs of clogging and dust build-up. Small amounts of dust can be removed using a vacuum cleaner. If there is a significant amount of clogging, replace the filter.

The locations of the air-filters are shown in Figure 2-1 and Figure 2-2.

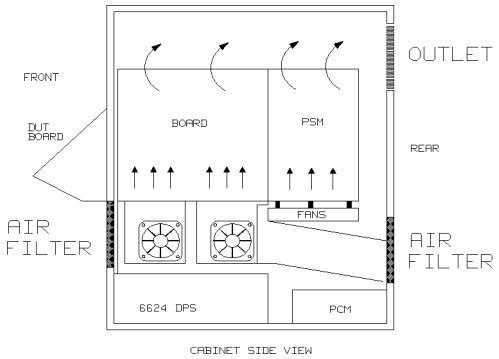

Figure 2-1. Standardframe - Location of Air Filters

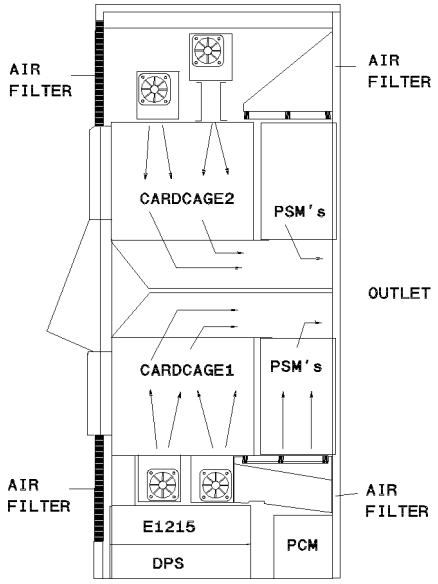

Figure 2-2. Maxiframe - Location of Air Filters

The next procedure tells you how to install and remove air-filters.

Warning **Failure to switch the system OFF may result in injury or death.**

1. Switch-off the circuit-breaker on the PCM rear panel.
2. For access to rear air-filters, open the rear-door of the mainframe. For access to front air-filters, remove the front air-grilles.
3. To remove an air-filter, remove the two screws holding the air-filter fixing-clamp in position, and remove the clamp.
4. Carefully remove the air-filter.
5. Installing an air-filter is the reverse of this procedure.

Miniframe Fans

To remove or install fans in a Miniframe complete the next procedure.

Warning **Failure to switch the system OFF may result in injury or death.**

1. Switch-off the circuit-breaker on the rear-panel of the Miniframe.
2. Remove the Miniframe top-cover (8 screws).

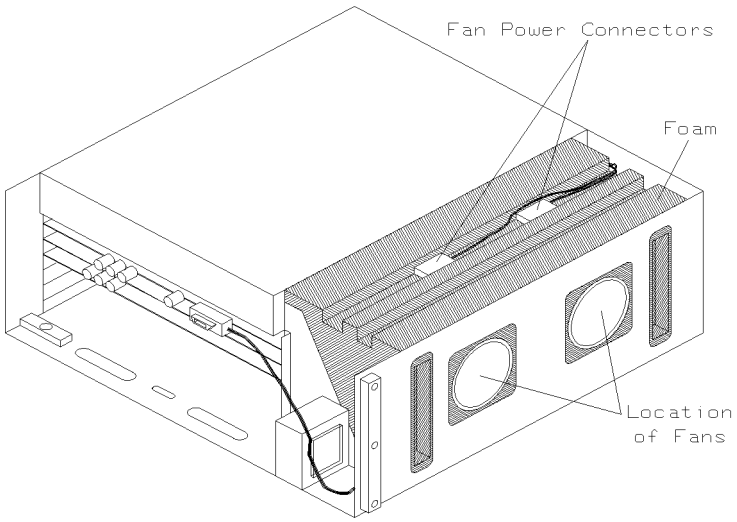

Figure 2-3. Miniframe Fan Positions

3. Unplug the power-connectors for the fan (see Figure 2-3).
4. Remove the top section of the foam fan-housing.
5. Remove the defective fan.
6. Fit the new fan in position.

Note

The new fan must be positioned with the power-connector at the top and the power-connector pins facing towards the rear.

7. Carefully replace the top-section of the fan-housing.
8. Reconnect the power-connectors.
9. Replace the top-cover of the Miniframe.

Standardframe Fans

Two tangential fans are located at the bottom of the Standardframe cabinet.

A tray containing six radial fans is located immediately below the system Power Supply Modules (PSMs).

You must replace faulty fans, because the Standardframe depends on these fans for cooling.

Tangential Fans

Warning **Failure to switch the system OFF may result in injury or death.**

1. Switch-off the circuit-breaker on the rear-panel of the PCM.
2. Remove the air-grille from the front of the Standardframe. The grille is a press-on fitting.

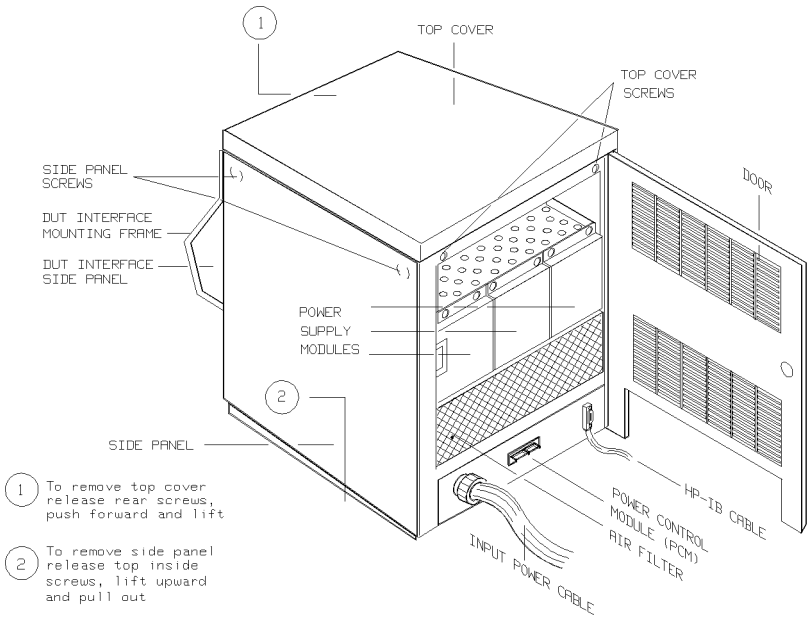

Figure 2-4. Standardframe

3. Remove the top-cover of the Standardframe. This is done by opening the rear-door and releasing the two top-cover screws (refer to Figure 2-4). Remove the top-cover by pushing it forward (viewed from the rear) and lifting it off its hook-fasteners.

4. Remove both Standardframe side-covers. This is done by releasing the two screws located at the top inside of the side-panel (viewed from the top of the Standardframe). Remove the side-cover by lifting it upwards and releasing it from the bottom hook-fasteners.

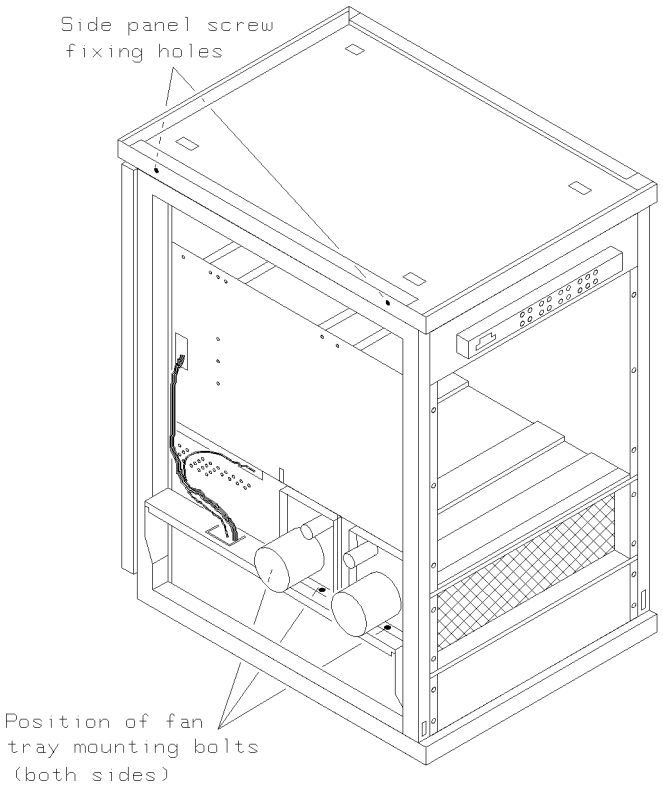

Figure 2-5. Tangential Fans - Standardframe

5. The tangential fans are mounted on anti-vibration mounts. Remove the six bolts securing the fan assembly (3 on each side).
6. Disconnect the power supply cables, identify the cables before disconnecting them.
7. Remove the tangential fan assembly from the cabinet.

   Installing fans is the reverse of this procedure.

Radial Fans

Warning **Failure to switch the system OFF may result in injury or death.**

1. Switch-off the circuit-breaker on the PCM rear-panel.
2. Open the Standardframe rear-door.
3. Remove the rear air-filter.
4. Remove the four screws holding the air-duct in position.
5. Carefully remove the fan-tray air-duct.
6. Disconnect the fan power-supply cable from the back-panel of the PCM.

Maxiframe Fans

Maxiframes with one card-cage are fitted with two tangential fans (directly above the two instrument-slots at the bottom of the card-cage) and six radial fans mounted under the Power Supply Modules (PSM). The tangential fans cool the boards and the radial fans cool the PSMs.

Maxiframes with two card-cages have, in addition, the same arrangement for the upper card-cage, except the tangential fans are above the card-cage and the radial fans are above the PSMs.

Tangential Fans

Warning **Failure to switch the system OFF may result in injury or death.**

1. Switch-off the circuit-breaker(s) on the PCM rear-panel.
2. Remove the air-grilles from the front of the mainframe. The grilles are press-on fittings.

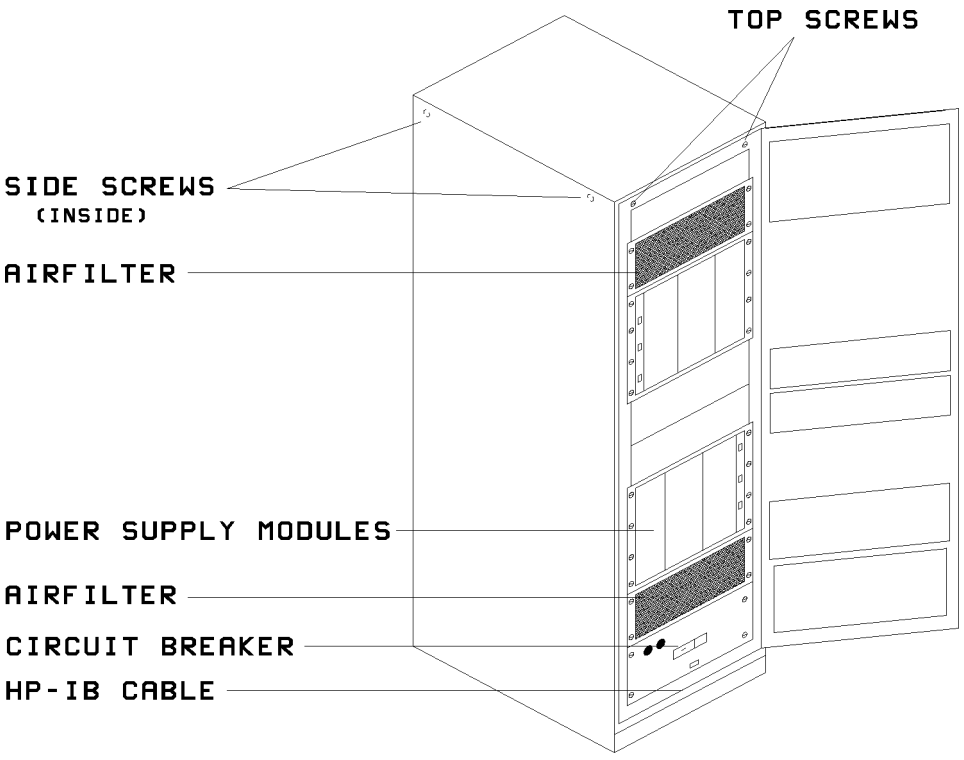

Figure 2-6. Rear View of Maxiframe

3. Remove the top-cover of the Maxiframe. This is done by opening the rear-door and releasing the two top-cover screws (refer to Figure 2-4). Remove the top-cover by pushing it forward (viewed from the rear) and lifting it off its hook-fasteners.
4. Remove both Maxiframe side-covers. This is done by releasing the two screws located at the top inside of the side-panel (viewed from the top of the Standardframe). Remove the side-cover by lifting it upwards and releasing it from the bottom hook-fasteners.

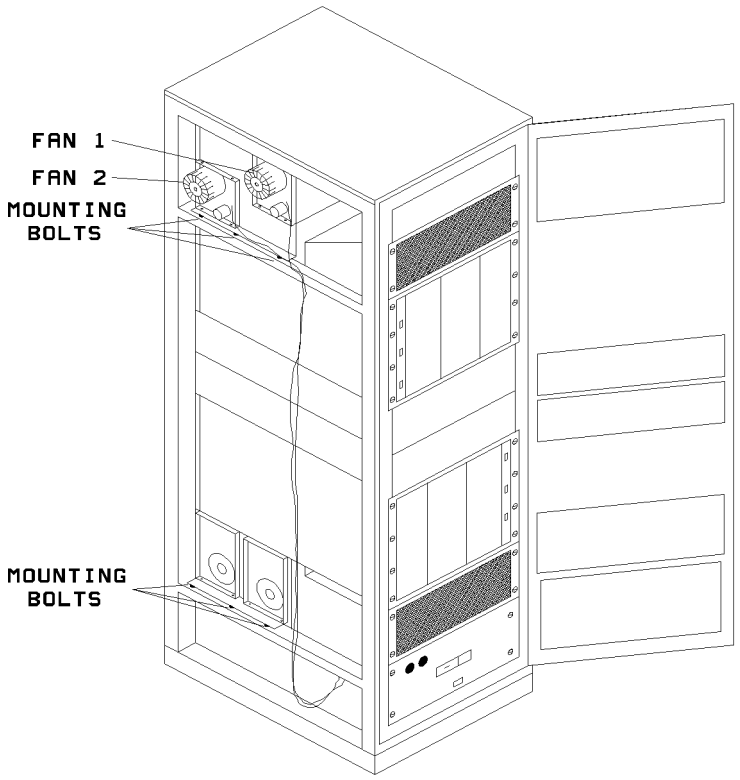

Figure 2-7. Tangential Fans - Maxiframe

5. The tangential fans are mounted on anti-vibration mounts. Remove the six bolts securing the fan assembly (3 on each side).
6. Carefully disconnect the power-supply cables, identify the cables before disconnecting them.
7. Carefully remove the tangential fan assembly from the cabinet.

   Installing fans is the reverse of this procedure.

Radial Fans

Warning **Failure to switch the system OFF may result in injury or death.**

1. Switch-off the circuit-breaker on the PCM rear panel.
2. Open the Standardframe rear-door.
3. Remove the rear air-filter behind the fan.
4. Remove the four screws fixing the air-duct in position.
5. Carefully remove the fan-tray air-duct.
6. Disconnect the fan power-supply cable from the PCM back panel.

RFI Strips

The RFI strips (P/N 0363-0170) are the metal spring-contacts which run around the edges of the rear-door, and along some edges which might otherwise be electrically isolated from each other. The purpose of these strips is to keep all of the cabinet at the same potential so that it acts as an RF shield. If the strips are broken or damaged, the cabinet will not adequately shield the system. It is also essential to maintain this shield, to prevent the system from interfering with other electrical or communication systems.

Inspecting RFI Strips

- Check each strip for signs of burning from electrostatic discharge.
- Ensure that all strips are making proper contact and not preventing the door from closing properly.
- Replace any faulty strips.

Replacing RFI Strips

To replace an RFI strip:

1. remove the old strip (taped in position - the tape is supplied with the strip).
2. clean off any old tape remaining in the area.
3. ensure that the new strip is correctly oriented and fix it into position.
4. check that the door or panel still fits correctly with the new strip in position.

Handling the DUT Board

Take precautions against electrostatic discharge when installing or removing the DUT board.

To maintain your system's measurement capabilities note the following:

- Keep the DUT Board as clean as possible
- Handle the DUT board with care, especially when installing it.

Cleaning the DUT Interface

Take precautions against electrostatic discharge when cleaning the DUT interface.

If you need to clean your DUT Board or pogo-pin connectors, note the following:

- Use a lint-free cloth, lightly moistened with de-ionized water or isopropyl alcohol.

- When cleaning pogo-pins, do not allow any cleaning-fluid to run down the pogo pins into the body of the pogo-pin block. This may cause corrosion and eventual failure of the pogo pins.
- When installing a new DUT Board, clean the pogo pins and DUT Board pads.

General Cleaning

HP 82000 Mainframes are painted with a durable, long lasting, nontoxic paint. It will preserve the appearance of the system for many years.

Caution

Chemical spray-on cleaners used for appliances and other household applications may damage the finish. These and other chemical cleaners should not be used.

Warning

Failure to switch the system OFF may result in injury or death.

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1. Switch-off the circuit-breaker(s) on the mainframe.
2. Dampen a clean, lint-free cloth with a solution of clean water and mild soap.

Note

If you are cleaning heavily soiled areas, use a solution of 50% clean water and 50% isopropyl alcohol.

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3. Wipe the soiled areas of the mainframe. Take care not to allow any cleaning-fluid to get inside the mainframe.
4. Dry the mainframe with a clean, lint-free cloth.

Periodic Software Maintenance

Reasons for Software Maintenance

Your file system represents a valuable investment and it is in your interest to keep it at peak efficiency. Software maintenance includes basic tasks such as regular backups, restores, removing unwanted files, and so on.

Purging Unecessary Files

As your file system grows, you will begin to see files you no longer have any use for. If you decide they **will not be used again**, you should delete them.

If you are running out of disc space it may be possible to make backup copies of device files that are not used often and remove them from the system.

Removing Temporary Files

During day-to-day operation, the HP 82000 software creates several temporary work-files. Some of these temporary files remain on your disk, and you can clean up your system by periodically deleting these work-files:

`/tmp/ol_vec_file` *This is a temporary file used to store expected data in the Data Acquisition (DA) mode.*

`/tmp/DiTmpFilxxxxx` *This is a diagnostic report file. (xxxxx is the HP-UX process id number).*

`/usr/tmp/cae_vs_axxxx`
`/usr/tmp/dia_a_xxxx`
`/usr/tmp/s_err`
`/usr/tmp/s_out`
`/usr/tmp/sv_err`
`/usr/tmp/sv_out`
`/usr/tmp/tc_err`
`/usr/tmp/tc_out`

These are temporary work-files which are recreated by the HP 82000 software as necessary.

Compressing Files to Save Space

You can save additional space by compressing files which you do not immediately need, but which you wish to keep on the system. To compress a file, use the HP-UX command `compress` *filename*. To uncomress a file, type in `uncompress` *filename*.

Removing Log Files

Locate the log files by typing in:

```
cd /
```

```
find . -name *log -print
```

This will give you all super-user and networking log files. Refer to HP-UX and networking manuals supplied with the system for a description of their purpose.

If required you can remove these files using the `rm` command.

Removing Core Dumps

To remove core dumps that could have been generated by the system, input the following commands:

```
cd /
```

```
find . -name core -print -exec rm {} \;
```

If you require more information on files, refer to the HP 9000 Series 300, Application Execution Environment P/N 98515-90001.

Backing Up the System

Performing archive (full) and incremental backups is one of the most important software maintenance tasks and it is important that you or your system administrator does this on a regular basis.

The various backup strategies are discussed under "Backing Up and Restoring the File System" in Volume 1 of the *HP-UX System Administrator Manual*.

Example

To backup everything in `/users/demo` to a tape cartridge at `/dev/update.src`, proceed as follows:

1. Put a tape cartridge into your tape drive and wait until the *Busy* light extinquishes.
2. Get into the backup directory by typing in:
   `cd /users/demo`
3. Start the backup by typing in:
   `find . -print | cpio -ocvx | tcio -odv /dev/update.src`

To restore the tape back to `/users/demo`, proceed as follows:

1. Put the tape cartridge into your tape drive and wait until the *Busy* light extinquishes.
2. Get into the restore directory by typing in:
   `cd /users/demo`
3. Start the restore by typing in:
   `tcio -i /dev/update.src | cpio -ictv`

Creating Directories

If you require information on creating new directories, refer to the HP 9000 Series 300, Application Execution Environment P/N 98515-90001.

Disc Checks

If you require information on disc checking, refer to the HP 9000 Series 300, Application Execution Environment P/N 98515-90001.

Diagnostic Overview

The diagnostic software tests the operation of system functional blocks. When a faulty block has been identified the software issues recommendations to remedy the problem. Due to the complexity of the HP 82000 system the corrective action will most often be a board swap. An exception to this is the case of a faulty I/O channel which can be replaced by a functional one if the system resources will allow it.

You should run system Diagnostics to confirm that your system is operating correctly.

Diagnostic tests are made on the following system components:

- Clock Board.
- HP-IB interface.
- Processor Board.
- Sequencer Board.
- One or more I/O boards.
- PMU Board.

1. Login to the system.
2. To start the HP82000 System Software type in: `hp82000`

Figure 4-1 shows the Welcome Window which will be displayed while the software is loading..

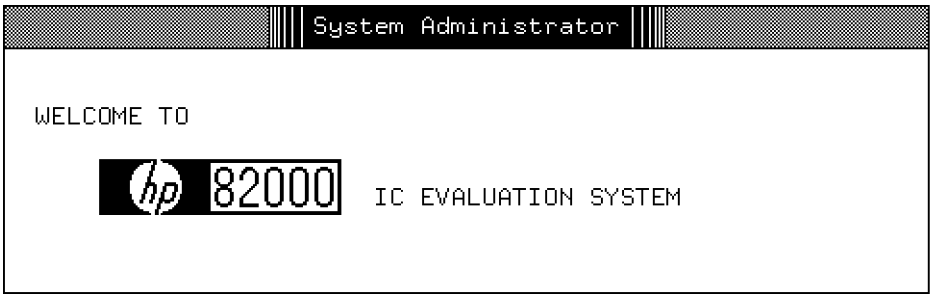

Figure 4-1. Welcome Window.

To run system Diagnostics follow the next procedure.

1. Check the Report Area and confirm that no errors have been reported.
2. Start Diagnostics by selecting (Aux) and then (Diagnostics) in the Main Menu.

   Figure 4-2 shows the Diagnostic Window. In this example the position and number of black dots indicate that card-cage 1 is configured with 1 module board (I/O or PMU). The number of black dots indicates that I/O or PMU Boards are installed in these slots. Check that the number of dots corresponds to the total number of I/O and PMU Boards fitted in each card-cage.

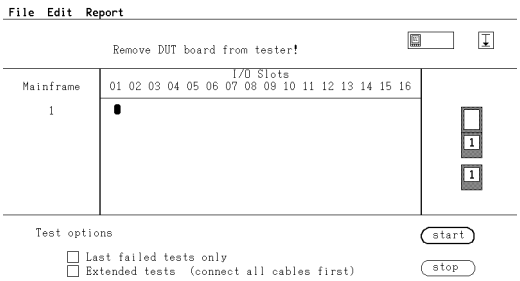

Figure 4-2. Diagnostic Window.

3. Remove the DUT Board.
4. If you intend to run extended Diagnostics (only required if you intend to use the external sequencer inputs) follow the next procedure.
   a. Fit BNC "T" piece P/N 1250-0781 to the "Trigger Out" socket on the Sequencer Board.
   b. Connect a BNC cable P/N HP10502A between one end of the "T" piece and the socket "External Input A".
   c. Connect a BNC cable P/N HP10502A between the other end of the "T" piece and the socket "External Input B".

   Figure 4-3 shows the connections you must make to run extended Diagnostics.

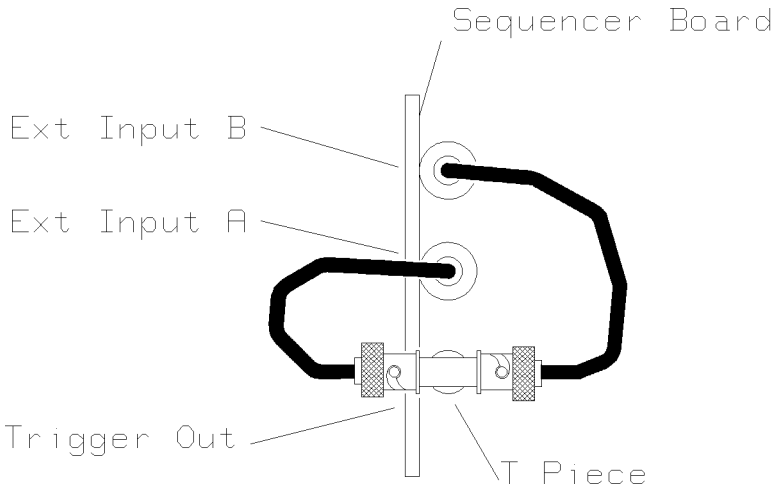

Figure 4-3. Extended Diagnostics - Connections Required.

5. Above the **Extended Diagnostics** checkbox, is another checkbox marked **Failed Tests Only.** If you click this box, the diagnostics will run only the tests which failed in the *previous diagnostic run*. This is designed to save time when troubleshooting problems.

6. Start Diagnostics by pressing exec or start extended Diagnostics by clicking the extended test box and then exec.

   The result of each diagnostic test (passed/failed) is shown in the Report Window.

7. When you see the message:

   `Diagnostics finished with no errors`

   close the Diagnostics Window by clicking the X in the top left hand corner. If errors are reported refer to *Servicing the HP 82000*. Repeat Diagnostics and calibration after any repairs.

Important

Please read this chapter before using any of the calibration procedures.

In addition to the calibration routines, there are two other system features that may have an effect on system accuracy. These are the:

- Pin attribute files
- `LAST_SETTING` files

It is very important that you are fully acquainted with the effects these files have on system accuracy, as well as the inter-dependencies between the various calibration files, **before** you embark on system calibration.

Notation

In the following sections, filenames such as `bc_cal_dxxx`, `dc_cal_dxxx` and `ac_cal_dxxx` assume the names:

`bc_cal_d50`, `dc_cal_d50`, and `ac_cal_d50` for 50 MHz systems,

`bc_cal_d100`, `dc_cal_d100`, and `ac_cal_d100` for 100 MHz systems (includes D100X),

`bc_cal_d200`, `dc_cal_d200`, and `ac_cal_d200` for 200 MHz systems.

`bc_cal_d400`, `dc_cal_d400`, and `ac_cal_d400` for 400 MHz systems.

Overview

The calibration processes of the HP 82000 form a hierarchy of four stages:

- Base Calibration
- DC Calibration
- Standard AC Calibration
- User AC Calibration

Base Calibration; The Foundation for Tester Accuracy

Base Calibration ensures the accuracy of the internal timing and level standards against external measurement equipment. A trained service technician must perform this procedure twice a year. Base Calibration data is stored global to the system, in the file `/hp82000/fw/data/bc_cal_dxxx`.

DC Calibration; Providing the Reference Levels

The second calibration stage is DC Calibration. This maintains adjustment data for each channel's level references and for the level references of the PMU. You can execute this calibration routine from the `CALIBRATION` window selected in the main menu of the system software.

You must carry out the DC Calibration routine quarterly. The adjustment data is stored in the global file `/hp82000/fw/data/dc_cal_dxxx`.

Standard AC Calibration; Setting the System's Timing Reference

The third calibration stage, Standard AC Calibration, adjusts the skew and positional accuracy of the timing edges. No signal has a rise- or fall-time equal to zero, so it is important to measure edge-timing against accurate reference levels. So AC Calibration depends on the accuracy of the level references established by DC Calibration.

Standard AC Calibration does not assume a given set of period, edge delay or mode settings, but takes an average of the adjustment parameters, so that they meet the accuracy specifications for any given setting.

Standard AC Calibration is the default selection in the `CALIBRATION` window. When you execute AC Calibration on a channel, you place the tip of the calibration probe on a selected calibration point (usually the DUT pin). Your AC Calibration is then valid at this particular reference point.

The length of the electrical interconnection to the DUT pins is different for each DUT board. To compensate for this, you can maintain the AC Calibration data separately within the directory structure of each DUT. This is called a *local* calibration strategy.

If no DUT specific calibration data is available, calibration data is taken from files in the global device technology directories `/hp82000/dev_tech/ecl` or `/hp82000/dev_tech/cmos`, where factory supplied calibration data, specific to your particular system, is stored. These files calibrate the system for use by a complete family of devices. This is called a *global* calibration strategy.

Standard AC Calibration data, just like DC Calibration data, is valid for three months after shipment, providing that the ambient temperature stays within ±5 °C of the temperature at calibration time.

User AC Calibration; Optimum Timing Correction for Functional Testing

This final calibration stage provides optimized AC Calibration at user settings. User AC Calibration adds adjustment data on top of the Standard AC Calibration data, to compensate for inaccuracies at a given period, edge setting and mode. It therefore relies upon the integrity of calibration data from all previous stages.

Note that most test functions vary the settings when taking measurements. Only test functions which maintain fixed parameter settings (such as a Functional Test) can take advantage of the improved accuracy of User AC Calibration.

User AC Calibration data must not be loaded in the hardware while you are executing test functions that sweep edges (such as `prop_delay`, `setup_time` tests, or Shmoo Plots).

As with Standard Calibration, you make User AC Calibration measurements by placing the tip of the calibration probe on the point where the channel is to be calibrated. The adjustment data is always stored in the directory structure of the current device. This data is specific to the particular DUT board, and to

the settings of period, edge delays, modes and calibration data present in the system at time of executing the User AC Calibration process.

Global versus Local Calibration Strategy

Depending on the measurement accuracy you require, you can use different strategies to maintain the system's calibration. Global and Local calibration files are discussed in detail later in this chapter.

If the electrical wiring on some or all of your DUT boards is of a similar length, a global calibration strategy may give you sufficient accuracy. Then you would only have to maintain a single Standard AC Calibration file in the directory structure of each device technology that you use.

If, however, the various devices that you test require a different measurement accuracy, we recommend that you use a local calibration strategy for the critical devices. This would give you full control to make accurate adjustments for each specific device.

Calibration with a Reference Calibration Board

When implementing a global calibration strategy, you must choose one reference DUT board for calibrating the system. You can store the differences in signal delay between the calibration reference points of this calibration reference board, and the device pins on any specific DUT board, in *pin attribute* files. These correction values (called *delta delays*) may be considered fixed, since they are only dependent on the dielectric behavior of the boards. In this sense they are also independent of test frequency. The total measurement uncertainty is determined by the accuracy of the Standard AC Calibration, in addition to the accuracy with which the delta delays are determined.

You can setup delta delays in pin attribute files. When you download these files into the test system they are superimposed on the global calibration data. (See "Using Pin Attribute Files").

Base Calibration

The procedure for determining the accuracy of the internal references is called "Base Calibration".

The Base Calibration Routine requires external traceable measurement equipment and needs to be performed manually. The routine relates to two types of internal references built into the system:

- Timing reference on the Clock Board.
- Level references on the Clock Board and the PMU Board.

Timing Reference

The timing reference element of the system is a crystal oscillator used to drive the HP 82000 timing system. There is no adjustment possible, the timing reference can only be checked for accuracy.

Note

In a multi card-cage system, the timing reference of the mastercard-cage (card-cage 1) determines system timing. Therefore only the Clock Board of the master card-cage gets checked for accuracy.

Level Reference

The level reference elements consist of rudimentary DVMs. These are A to D converters (ADCs) on the Clock and PMU Boards.

The key parameters of the reference ADCs are their gain factor and offset value. While the gain factor needs to be measured using external traceable equipment, the system itself measures the offset value.

The gain factors for all reference ADCs installed in the test system are stored in the **Base Calibration File**. This is the file

`/hp82000/fw/data/bc_cal_dxxx`.

The offset values of all reference ADCs are stored along with other parameters in the DC Calibration File.

The Base Calibration File is a **global** calibration file and is supplied from the factory as part of the E1200CAL fileset. It is valid for six months after shipment (refer to "When to Perform Calibration").

DC Calibration

The next step is to ensure that all DC outputs and inputs (levels and currents) are within specifications. This is done by the "DC Calibration Routine". This routine runs without user interaction and determines the relevant parameters for each part of the level and current generating circuitry throughout the system.

Description of the DC Calibration Concept

All levels used in the system are generated by D to A converters (DACs). If the real transfer function of a DAC is known, it is possible to calculate the bit pattern which must be input in order to generate a particular output voltage. The task of the DC Calibration Routine is to determine the actual transfer function for each of the level generating circuits.

The transfer function of a DAC is determined by using a two-point measurement with linear approximation between the two measurement points. The firmware checks the calculated values against limits during download. If the determined gain factors and offset values exceed allowed tolerances, errors are reported in the Report Window. The tolerances are given in the *HP-IB Command Reference*.

The gain factors and offset values for all DACs installed in the test system are stored in the **DC Calibration File**. The file also contains the offset values for all reference ADCs (refer to the previous section). This is the file

`/hp82000/fw/data/dc_cal_dxxx`.

The DC Calibration File is a **global** calibration file and is supplied from the factory as part of the E1200CAL fileset. It is valid for three months after shipment (refer to "When to Perform Calibration").

Standard AC Calibration

When the level generators have been verified, the HP 82000 timing system can be adjusted to meet specifications. This is done by running the *Standard AC Calibration Routine*. While the DC Calibration Routine runs without any human interactions, the Standard AC Calibration Routine requires manual probing at the end of the transmission line on the DUT Board or at the DUT socket.

Because the correction factors determined by the Standard AC Calibration Routine are determined at the end of the transmission line (which can be of different lengths) these correction factors are only valid for this particular test setup. If you have to test several devices mounted on different DUT Boards, you need to create additional standard AC Calibration files for each of the different DUT Board/test setups.

Standard AC Calibration Settings

The Standard AC Calibration Routine runs at fixed levels and at a default system period. The settings are listed below:

System period 100/200/400 MHz system:	30 ns
System period 50 MHz system:	150 ns
100/200/400 MHz systems:	
HIL:	+0.4 V
LOL:	−0.4 V
50 MHz system:	
HIL:	+5 V
LOL:	0 V
ihs pins:	
HIL:	+0.8 V
LOL:	−0.8 V
Termination 100/200/400 MHz system:	active terminated to ground
Termination 50 MHz system:	active terminated to ground

Note

Providing you run the Standard AC Calibration Routine at the default system period and make subsequent test measurements

at the 50% point of level transitions, the system will operate in a specification window of:

D50	±800 ps
D100	±600 ps
D100X	±500 ps
D200	±500 ps
D400	±400 ps

for all timing setups (including all system periods), data formats and system modes.

Level dependencies are automatically compensated for by the system software, at the 50% point of level transition. Automatic level compensation is based on a fixed slew rate of 2 V/ns and on timing measurements made at the 50% point of level transition. Selecting the `freeze` function in the Level Setup Window disables level compensation. Refer to *Using the HP 82000* for the description of the `freeze` function.

Description of the Standard AC Calibration Concept

The Standard AC Calibration Routine adjusts the timing system to meet specifications by de-skewing all edge generators on the driver as well as the receiver side. Additionally, it determines the system round trip delay.

The routine covers all circuitry that contributes to the timing accuracy of the system. It determines edge-related delays for the leading and trailing edges for all HP 82000 operating modes. Non-linearities in the fine timing circuits are also determined. An edge-related delay is the time by which an edge generator of a "faster" channel must be delayed to compensate for the delay of the slowest channel. Both driver and receiver circuitries are taken into consideration by this routine. Standard AC Calibration has to be performed at DUT pins to achieve the specified system accuracy at DUT pins.

You can store Standard AC Calibration data either within a device's own directory (*local calibration files*) or within the directory used by all the devices in one technology family (*global calibration files*)

"Raw" Calibration Data

When you perform a Standard AC Calibration, the system measures the *absolute* delay from the pin driver/receiver circuitry to the tip of the calibration probe. The absolute values for each channel included in your calibration are stored as files in the `calib_raw` directory.

Once you have made absolute measurements on all the channels, the system calculates the difference between the value of the slowest channel and all the other values. The resulting values are now *relative* to the slowest channel, and are stored in the `calibration` directory.

Raw calibration data is needed by the system either when you are recalibrating a subset of the pins, or when you are you are performing a User AC Calibration.

When you use the `upload` or `download` testfunctions to transfer data to the tester hardware, the data you are sending is in the form of *relative* values from the `calibration` directory. To use `calib_raw` data (for example, when calibrating a subset of pins, or for User AC Calibration), you must load the calibration file from the `CALIBRATION` window.

Global Files

Global calibration files hold the default correction values for all installed machine channels regardless of user logon and device under test, and are used by an entire device technology family.

You must store global files within the device technology directory, under the filename `ac_cal_dxx`. If you use any other name, the system will not find these files in its startup search-path.

For example, the Standard AC Calibration data for the ECL family of devices is stored in the file:

```
/hp82000/dev_tech/ecl/calibration/ac_cal_dxxx
```

The corresponding *raw* data file is stored as:

```
/hp82000/dev_tech/ecl/calib_raw/ac_cal_dxxx
```

The global files are automatically downloaded into the hardware when the system is started up, if no `LAST_SETTING` file is present. The global AC

Calibration Files will also be downloaded when you use the Change Device window to define a new device.

The directories `/hp82000/dev_tech/cmos` and `/hp82000/dev_tech/ecl` hold other directories which hold global files for calibration and test function purposes. These files will be loaded by the system as defaults if the relevant local files are missing. The contents of these directories are listed in Chapter 8 of *Advanced Testing with the HP 82000*.

Note

After system installation you must perform Standard AC Calibration on all channels and store the resulting calibration files in the global directories for the relevant device technology. This procedure is described in in the next chapter.

Calibration File Search Path

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When you start up the HP 82000 System Software, calibration files are searched for and loaded in the following sequence:

1. The global Base Calibration and DC Calibration files are loaded. The Report screen prints the message:

   `downloading calibration data ...`

2. The system searches for a file `calibration/LAST_SETTING` in the directory of the device. The Report screen prints the message:

   `downloading LAST_SETTING ...`

3. If the system does not find a `LAST_SETTING` file, the system searches the selected device technology directory (`dev_tech`) for `calibration/ac_cal_dxxx`. If this is found, the Report screen prints:

   `Standard AC cal file in use.`

4. If the system does not find either

   `LAST_SETTING` in the device directory,

   OR
   `ac_cal_dxxx` in the device technology directory,

   then the Report window displays:

```
WARNING:
No AC calibration file found
Tester will operate out of spec
Perform calibration please.
```

Local Files

You can perform a Standard AC Calibration specifically for one device, and save it in the directory structure of the selected device type. This type of local file (like other setup files—e.g. for pin configuration, timing, levels, etc..) will not be loaded by default; you must load it yourself using the `download` test function.

For example, if your login name is "demo", your device is "mc10136" and you save your calibration file as `cal_10136`, the Standard AC Calibration routine will produce the following files:

`/users/demo/mc10136/calib.raw/cal_10136` and
`/users/demo/mc10136/calibration/cal_10136`

Standard AC Calibration in Single Mainframe Systems

If you are calibrating all installed channels there are no restrictions to consider. If you are calibrating only a subset of installed channels, note that the remaining channels will still have their previous, possibly obsolete, calibration values.

Standard AC Calibration in Multi-Mainframe Systems

As long as all system channels are being calibrated there are no differences to the calibration process whether you run Standard AC Calibration on a single card-cage or a multi card-cage test system.

If you are calibrating only some of the installed system channels, note the following rules:

- For a two card-cage configuration, use the following procedure:
  - Include channel 10107 in the calibration (channel 7 on the first I/O Board in the master.

- Include channel 2 of the highest numbered extender I/O Board in the calibration.

- For a three card-cage configuration, use the following procedure:
  - Include channel 10107 in the calibration (channel 7 on the first I/O Board in the master.
  - Locate the extender with the higher number of installed channels. Include channel 2 of the highest numbered I/O Board in the calibration.

  You have to calibrate these channels even if you do not intend to use them for tests. This is necessary in order to calculate the correct system round trip delay.

Standard AC Calibration with Fixed System Period

From the `CALIBRATION` Window, you can set the calibration system clock period to the specific clock period at which you are testing.

The system default calibration period sets up the system for general testing. By confining your testing to a fixed period, and by calibrating at that period, you can improve the system accuracy to a value somewhere between the accuracy of User AC Calibration and Standard AC Calibration.

Caution

If you change the calibration period from its default setting, and you perform tests at a *different* period to your calibration period, **the system accuracy may fall below Standard AC Calibration accuracy.**

Standard AC Calibration with Calibration MUX Probe

The HP 82000 test system is supplied with the Single Channel Calibration Probe as standard.

In order to speed up the calibration process, E1262A (E1263A) Calibration Matrix products are available consisting of a Multiplexed Calibration Probe and a Calibration Board. With these products you can calibrate 16 channels at a time with no user interactions on a system consisting of one or more standardframes. The part numbers of these products are:

D50	- E1263B
D100/D100X/D200	- E1262B
D400 (no HSWG)	- E1262B
D400 with HSWG	- E1262C

Multiplexing 16 channels during Standard AC Calibration causes an additional measurement uncertainty of ±150 ps. The differences in wiring between this Calibration Board and a pre-wired DUT board can cause an inaccuracy of up to ±350 ps on top of this. However, you can compensate for differences in wiring by using Pin Attribute files, discussed later in this chapter.

User AC Calibration

User AC Calibration routine allows you to finely tune the test system to the test characteristics of one particular device, for performing high accuracy functional tests.

Functional tests with User AC Calibration can be made with an accuracy improved to:

D50	±500 ps
D100	±350 ps
D100X	±250 ps
D200	±250 ps
D400	±200 ps

The User Calibration routine achieves this higher accuracy by taking into account the test frequency as well as the timing edges and formats being used. The calibration is only valid if *all the test parameters used in the test run are the same as those used during calibration.* This means that you must not calibrate your system with this routine if you are using shmoo plots, or any tests that use an edge search routine.

User AC Calibration builds on the accuracy of the Standard AC Calibration data. Therefore, you must not perform the User AC Calibration routine if the Standard AC Calibration of the system was performed using the MUX calibration probe.

You perform the User AC Calibration procedure using the Single Channel Calibration Probe previously used to perform Standard AC Calibration.

Description of User AC Calibration

The User AC Calibration routine requires a pre-calibrated test system (Standard AC Calibration performed and calibration files loaded into the hardware). The routine compares the programmed values of the edge-timing and the actual position of the edges. It then creates its own files, containing corrections to the Standard AC Calibration values, to bring the edges to the accuracies given above.

The User AC Calibration files are located in the `user_cal` sub-directory of the device type in use. Note that these files only contain the delta values generated by User AC Calibration Routine and can only be used in conjunction with a *valid* Standard AC Calibration File for the current device.

A valid Standard AC Calibration file

- is one that contains correction values for either
  - all installed channels or
  - a subset of channels to be calibrated with User AC Calibration
- is related to the test environment for which User AC Calibration will be performed (DUT Board and user wiring on the DUT Board)
- is performed using the single channel calibration probe.

When you perform User AC Calibration you will be logged on under your login name and will be working in the directory structure of the selected device type. Assuming your login name is “demo”, your device is “mc10136” and you save your calibration file under `cal_10136`, the User AC Calibration Routine will produce the following file:

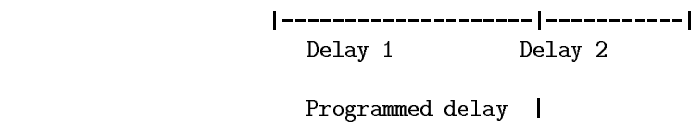
```
/users/demo/mc10136/user_cal/cal_10136
```

As mentioned above, the User AC Calibration Routine determines the time differences between the programmed edge settings and the actual placement of a timing edge for one particular timing and format setup. Therefore, all test parameters which influence system timing must be decided *before* a User AC Calibration can be started.

Actual edge placement consists of the following delays:

Delay 1 Calibration correction values from Standard AC Calibration.

Delay 2 Edge placement programmed by the user in the Timing Setup.



An additional important prerequisite is that the `calib_raw` file is loaded in controller RAM. To ensure this, you must load the Standard AC Calibration file from the `Calibration` window. (See ""Raw" Calibration Data").

Device Filenames

You should make sure that only those device files that are to be used for tests with tighter timing specifications are downloaded to the hardware prior to User AC Calibration.

The easiest way to ensure this is to give matching files similar or identical names, if possible, with some sort of device name coding.

For example:

```
/users/demo/CD4031B/calibration/device_xx_p150
    /device_xx_p500
        .
        .

/users/demo/CD4031B/timing/device_xx_p150
      /device_xx_p200
      /device_xx_p300
      /device_xx_p500
      /device_xx_p600
        .
        .
```

```
/users/demo/CD4031B/pin_attributes/device_xx_p150
        .
        .
```

The time differences determined by the User AC Calibration are stored in the `user_cal` subdirectory of the device type. You should use the same naming convention as shown above.

For example:

```
/users/demo/CD4031B/user_cal/device_xx_p150
        /device_xx_p200
        /device_xx_p300
        /device_xx_p500
        /device_xx_p600
```


The file
`/users/demo/CD4031B/calibration/device_xx_p150`
is the "parent" Standard AC Calibration File for the file
`/users/demo/CD4031B/user_cal/device_xx_p150`

Note

If you "user calibrate" only a subset of already calibrated channels, then only the "user calibrated" channels will be set to the tighter timing specification.

Using Edge Search Test Functions

If you have set up the system with User AC Calibration, and you then want to use an edge search test, you must first ensure that no User AC Calibration data is loaded in the hardware for the pins that you wish to test.

One way of doing this is to download a file containing zeros for the pins you wish to test, to mask out the values of the User AC Calibration.

To do this, you must:

- first use `upload` to store the actual values from the hardware in the `user_cal` file;
- then use the HP-UX shell window and the vi editor to enter zeros for the pins to be tested;

- save this with a different filename;
- and finally use `download` to enter these values into the hardware.

Last Setting

The system software allows you to store settings currently in the hardware to a file when you quit your session. This also includes current calibration data. You can enable or disable this feature by clicking the `Store Last Setting` checkbox at the end of a session.

When you exit a session with `Last Setting` enabled, the system creates a `LAST_SETTING` file in the `calibration` directory of your current device. Assuming your login name is "demo" and your device is "mc10136", the system produces the following file:

```
/users/demo/mc10136/calibration/LAST_SETTING
```

You should bear in mind that an existing `LAST_SETTING` file may or may not result from the last session. The HP-UX date stamp will give you some guidance in this respect. Because the system software will always try to load the `LAST_SETTING` timing calibration file first at the start of a session, you should take this file into account when considering a calibration strategy. This subject is discussed in greater detail in "Calibration File Dependencies". You should nevertheless note the following points:

1. The calibration data contained in a `LAST_SETTING` file may be different from that required for your tests.
2. Existing Standard AC and User AC Calibration files may not be up to date and thus cause system inaccuracies if you download them into the hardware. If you then also quit with `Last Setting` enabled, these false settings will be automatically downloaded into the hardware at the start of the next session.
3. It is not possible to run User AC Calibration if the calibration files have been downloaded into the hardware via the test function or `Last_Settings` processes. This is because no files in the `calib.raw` directories get loaded via these processes, but the files are required during User AC Calibration (refer back to "Prerequisites for Running User AC Calibration").

Using Pin Attribute Files

The Pin Attribute files allow you to store device-specific data for special applications. Additional delays introduced by small wiring changes on otherwise identical DUT Boards, or from the addition of a wafer prober, can be entered in a Pin Attribute file.

Rather than perform a Standard AC Calibration for each DUT Board, which is time consuming, you could do it for just one board and set up Pin Attribute Files to hold the small timing differences for the other boards.

The Pin Attribute files are stored in a sub-directory of each device, under the name `pin_attributes`. You can edit/view the files using the HP-UX vi editor, and download them into the tester hardware using the `download` test function.

There also exists a Pin Attribute screen. Refer to the manual *Advanced Testing with the HP 82000* for information on how to use this screen.

5

Pin Attribute File Parameters

Each pin attribute file comprises HP-IB commands for setting system attributes (SATR) and pin attributes (PATR). This is what a typical pin attribute file looks like:

```
hp82000,pin_attribute,0.1
SATR 7
PATR 120,0,0,3,5,(PIN_1)
PATR 120,0,0,3,5,(PIN_2)
:
:
PATR 120,0,0,3,5,(PIN_16)
```

The syntax of the SATR and PATR commands is given in the *HP-IB Command Reference Manual*.

Caution

If you edit a pin attribute file, do not modify the file header (the first line of the file):

`hp82000,pin_attribute,0.1`

There are certain occasions when you will need to clear pin attribute data that had previously been downloaded to hardware. For instance, you may wish to change the DUT Board, but still use the existing setup files. You may then want to use the `LAST_SETTING` feature to download a set of setup and/or calibration files, but not the pin attribute file.

To generate an empty Pin Attributes File, perform the following procedure:

1. Create a new device by clicking the mouse on the (Change Dev) key in the main menu bar.
2. In the System Administration Window enter a device name (any name) and click (create device). Disable `store LAST_SETTING` and click (continue).
3. The HP 82000 system software reboots. The Report Window informs you that the Standard AC Calibration File is in use. (This is the Global AC Calibration File.)
4. In the Test Control Window select `new` in the (file) pull down menu. From the `AC Tests` pull down menu select the `Download/Upload` test functions.
5. Select `upload` and click (new). Type a name of your choice into the `pin_attributes` entry field and click (exec). Make sure the file name is unique.

This has created a Pin Attributes File *containing zeros* for the system round trip time (SATR) and all t_{driver} and $t_{receiver}$ delays (PATR) for all *defined pins* (pins defined in the Pin Configuration Window and the Pin Configuration File downloaded to hardware). The file resides in the `pin_attribute` subdirectory of the new device type.

To download the "empty" file to the hardware take the following steps:

1. Call up the HP-UX Window. Using the shell, copy the empty file you've just created into the `pin_attribute` subdirectory of the old device type.
2. Use (Change Dev) to get back to the directory structure of the old device.

Once the empty file exists in the `pin_attribute` subdirectory of each of your devices, you only need to download it to the hardware whenever you wish to clear the pin attribute data from the hardware. To download the file use the `download` test function.

Each calibration routine stores its correction values in a file. The files are located in different parts of the HP-UX file system.

After system software installation factory supplied global calibration files are located in the following directories:

```
/hp82000/fw/data/bc_cal_dxxx
/hp82000/fw/data/dc_cal_dxxx
```

These are global files for base and dc calibration.

```
/hp82000/dev_tech/ecl/calibration/ac_cal_dxxx
/hp82000/dev_tech/ecl/calib.raw/ac_cal_dxxx

/hp82000/dev_tech/cmos/calibration/ac_cal_dxxx
/hp82000/dev_tech/cmos/calib.raw/ac_cal_dxxx
```


These are global files for ac calibration.

As delivered from the factory, the calibration files in the `calibration` directories of device families `ecl` and `cmos` are identical. Similarly, the files in the `calib.raw` directories of device families `ecl` and `cmos` are also identical. The files have been produced with the Multiplexed Calibration Probe and Calibration DUT Board.

When you make use of the `Create New Device` feature in the Welcome Window or click the Change Device pushbutton, the system creates the necessary subdirectories for the new device. These are discussed in the chapter "HP 82000 Software Structure" of the manual *Advanced Testing with the HP 82000*.

Assuming that your login name is `verify` and you have just created a new device CY7C168, then for the purposes of calibration the system creates the following local AC Calibration directories.

```
/users/verify/CY7C168/calibration
/users/verify/CY7C168/calib.raw
/users/verify/CY7C168/user.cal
/users/verify/CY7C168/pin_attributes
```

The directories are empty.

A similar arrangement exists for the global AC Calibration directories:

```
/hp82000/dev_tech/ecl/calibration
/hp82000/dev_tech/ecl/calib.raw
/hp82000/dev_tech/ecl/user.cal
/hp82000/dev_tech/ecl/pin_attributes

/hp82000/dev_tech/cmos/calibration
/hp82000/dev_tech/cmos/calib.raw
/hp82000/dev_tech/cmos/user.cal
/hp82000/dev_tech/cmos/pin_attributes
```

The `calibration` and `calib.raw` directories contain factory supplied files as outlined above. The other directories are empty.

AC Calibration Files can also be related to an application or device and become thus dependent on a particular test setup. Therefore, AC Calibration Files can also be local AC Calibration Files. They are stored in the `calibration` subdirectory of the device-type directory in use. You supply their names, but it makes sense to make the name device related. For example:

```
/users/demo/mc10136/calibration/cal_10136
```

The file of *absolute* measurements will be stored under the same name in the `calib.raw` directory.

```
/users/demo/mc10136/calib.raw/cal_10136
```

If you quit your session with `Last Settings` enabled, the current tester setup including the AC calibration data will be stored in the `LAST_SETTINGS` files in the subdirectories of the device-type in use. This includes the calibration `LAST_SETTINGS` file. For example:

```
/users/demo/mc10136/calibration/LAST_SETTINGS
```

There are several methods you can use to move calibration data between the HP-UX file system and tester hardware. Which method you select depends on your requirements.

Test Function Download

This test function is described in the chapter on Transferring Setup Files in *Using the HP 82000*. With the `download` test function you can load setup files into the hardware. This includes Standard AC Calibration, User AC Calibration and Pin Attribute Files. *It does not include the* `calib.raw` *file.*

Test Function Upload

This test function is described in the chapter on Transferring Setup Files in *Using the HP 82000*. With the `upload` test function you write the current hardware settings to relevant files on the system. Again, it includes all the above.

Store Last Settings

When you quit your session with `LAST_SETTINGS` enabled, the system performs an upload as if it had been done with the `upload` test function.

Calibration Window Load Menu

You can download a calibration file into the hardware via the File pull down menu in the Calibration Window. Select function `load` and type the path to the calibration file into the entry field. From the file browser select the calibration file you wish to download.

Note

The `load` function also loads the `calib.raw` file of the same name into the RAM of the PWS. You must load the `calib.raw` file into RAM before running User AC Calibration.

Because of the hierarchical structure of the calibration system, and the aim of providing independence between different applications running on the same hardware resources, there are some interdependencies between calibration and setup files.

Here it must be differentiated between global files which are valid for all of the hardware and for all users and calibration files which are only relevant for one particular test setup or device type. These dependencies and their effects are described below.

Base Calibration File — Because base calibration is the lowest level of calibration, no dependencies exist to other calibration routines.

DC Calibration File — To achieve correct correction factors, a valid `bc_cal_dxxx` file is a pre-condition for running the DC Calibration Routine.

Standard AC Calibration File — The precondition for standard AC Calibration Routine is a valid `dc_cal_dxxx` file.

User AC Calibration File — The pre-requisites for user calibration file are:

- Valid raw calibration data loaded into the controller memory stemming from an AC Calibration performed for a combination of user, DUT Board and device. This can be achieved by using the Calibration Window File `load` function.
- Pin configuration and timing setup loaded into the hardware.

When to Perform Calibration

Because all the other calibration routines rely on the accuracy of the system internal references, these references should be checked at regular intervals. An interval of 6 months is recommended for base calibration. All other calibration files should be updated at intervals of at least 3 months.

The following diagram shows the six monthly base calibration cycle and the two associated three monthly cycles for DC, Standard AC and User AC calibration.

```
|----------6 months----------|          Base Calibration Cycle

|---3 months---|                        DC Calibration Cycle
|--------------|                        Std. AC Calibration Cycle
|--------------|                        User Calibration Cycle

               |---3 months---|         DC Calibration Cycle
               |--------------|         Std. AC Calibration Cycle
               |--------------|         User Calibration Cycle
```


Calibration of New Installations

As part of the HP 82000 System Software you get the E1200CAL System Calibration Tape. The tape contains calibration files for

- Base Calibration
- DC Calibration
- Standard AC Calibration

The files have been generated at the factory and relate specifically to your tester. The Base Calibration files are valid for six months after shipment and the DC Calibration files are valid for three months.

The Standard AC Calibration file has been generated with the help of the Multiplexed Calibration Probe. This guarantees a calibration accuracy of approximately ±1 ns, providing you use one of the Hewlett-Packard pre-wired DUT Boards. If you require a higher level of accuracy, you will, after system installation, have to perform Standard AC Calibration again using the Single Channel Calibration Probe supplied with the tester.

The setting up procedure for a new system is as follows:

1. Install the test system.
2. Boot the HP 82000 System Software. The Global DC and AC Calibration Files will automatically be downloaded.
3. Perform Standard AC Calibration with the demo DUT Board.
4. Run a functional test on the demo device to check out the tester.
5. Wire up your new DUT Board to suit your testing requirements.
6. Perform Standard AC Calibration with the new DUT Board.
7. If required perform AC Calibration at User Settings.
8. Test your DUT.

Calibration After Repair

It is obvious that the correction factors determined by the calibration routines can only be related to the hardware with which the correction factors were determined. As soon as the hardware is modified, the correction factors in the calibration files are no longer valid.

The following calibration routines should be performed if one of the listed hardware modules is replaced:

Power supply:	BC/DC/AC/UC
Clock Board:	BC/DC/AC/UC
IO Board:	DC/AC/UC
PMU Board:	BC/DC
Sequencer Board:	No re-calibration required

Before a calibration routine is started, the temperature inside the closed system cabinet should be stable. A 30 minute warm-up period is required to achieve stable temperature conditions.

Calibration After Reconfiguration

If you have modified the system configuration by adding an I/O Board, there will be no calibration data available for the new hardware. In this case, you must perform BC, DC, AC, and User Calibration. If you add a PMU Board you must perform BC and DC Calibration.

If the system has had boards removed as part of a reconfiguration, the effect on the accuracy of the system will be as follows:

- Removing I/O Boards from the "end" will result in the software trying to load calibration data for non-existent hardware causing error messages to appear in the Report Area. These values will be ignored by the hardware so re-calibration is not necessary.
- Removing I/O Boards from the "middle" will cause the remaining boards to be moved up as no gaps between boards are allowed. This will render DC, Standard AC and User AC Calibration data invalid. Recalibration is necessary.

If you swap a board with another one in the same card-cage (for instance to substitute an unused board for a faulty one), then you must recalibrate.

If a single card-cage system has been upgraded to a two or three card-cage system, all the calibration files must be generated again. The same is true when changing from a multi card-cage to a single card-cage configuration.

Temperature Range Restrictions

The system will operate in specification as long as the internal system temperature does not change by more than ±5°C (±9°F) from the temperature measured at calibration time. If this temperature restriction is not met, you must recalibrate. This means, you must perform Base, DC, Standard AC and if required, User AC Calibration.

The temperature at calibration time is logged in the "raw" calibration file and stored in the `calib.raw` subdirectory of the device type. The temperature is given in degrees Kelvin.

The software automatically checks the internal temperature of the system when it tries to download global AC calibration files. It generates a warning if the current temperature differs from the calibration temperature by more than ±5°.

The system temperature can be checked using the `Read temperature` test function.

Maintaining Calibration Files

All calibration files can be accessed just like all other files in the HP-UX file system. The calibration files can be viewed, edited, deleted or overwritten.

Caution

There is no default protection mechanism built into the system software to protect calibration files.

It is your responsibility to maintain the calibration files.

Note

If you need to fulfill the requirements of MIL STD 45662A, **do not** modify the base calibration file `bc_cal_dxxx` unless you carry out full system performance verification. Performance verification for such systems is recommended at six monthly intervals.

Calibration Files in a Single-User Environment

The standard calibration procedure consists of:

1. Ensuring that the `bc_cal_dxxx` data is valid.
2. Performing a DC calibration.
3. Performing an AC calibration.
4. Performing a User AC calibration (optional).

Note that you will have to run through steps 3 and 4 also when modifying your DUT Board wiring or changing to a different DUT Board type.

When a number of users have access to the system, you can make calibration file maintenance easier by following the procedure below. The procedure consists of two parts:

- Maintenance of global calibration files. In this part, global `bc_`, `dc_`, and `ac_` calibration files are generated that are suitable for all users.
- Maintenance of device-specific calibration files. In this part, each user generates a pin attribute file for all his devices.

If this method is used, only the global calibration files need to be modified and the system can be calibrated periodically without affecting the accuracy of individual users' tests.

Note

The following tasks should be done by the user responsible for updating *global* calibration files.

1. Schedule and perform base calibration at regular intervals.
2. Ensure regular updates of the DC calibration file.
3. Ensure regular updates of the global AC calibration files used for new devices. These are the files:

   ```
   /hp82000/dev_tech/ecl/calibration/ac_cal_dxxx
   /hp82000/dev_tech/cmos/calibration/ac_cal_dxxx
   ```

   and files for any other device families you may have created in the `dev_tech` directory.

Note

Standard AC Calibration should be performed for all installed pins, even though they may not be used by all users.

4. Ensure that Standard AC Calibration is performed using a DUT Board that is similar with respect to delays to the DUT Boards used by other users. Standard AC Calibration should always be carried out using the same (reference) DUT Board.
5. Protect global calibration files so that they cannot be overwritten by other users. Global calibration files are listed earlier in this chapter under "Calibration File System Overview". Use the `chmod` command to ensure that only one user can modify these files, for example, by making the `calibration` and `calib.raw` subdirectories non executable (`chmod 766 calibration`). Protect the files in these directories by making them non writable (for example `chmod 644 ac_cal_dxxx`).
6. Inform other users when global calibration files have been updated, for example with the HP-UX `wall` or `mail` command.

Device Specific Files for ±500/600/800 ps Accuracy

Note

The following is a concept for providing file maintenance of device specific calibration files to achieve ±500/600/800 ps accuracy. The procedures described should be performed by individual users. It is assumed that all DUT Boards used will be of the **same type** (same product number).

You will most likely have several DUT Boards in order to test your various devices. All these boards will exhibit different delays dependent on how the boards have been wired. If each user were to keep separate calibration files for each of his DUT Boards, there would soon be dozens of calibration files on the system.

You can cut this down to just one calibration file in each of the global AC Calibration directories. Since the boards differ from each other only in user wiring, you designate one of the boards a Reference DUT Board.

This presupposes that delay deviations to the other boards will be less than ±1 ns (see also the section on Pin Attribute files in the *HP-IB Command Reference*). To find out the delays introduced by a DUT Board, look them up in the relevant `calib.raw` file or measure them with an oscilloscope.

With the Reference DUT Board mounted on the tester you will:

1. Perform Standard AC Calibration in order to generate a Global AC Calibration File.
2. Save the calibration file under the file name `ac_cal_dxxx`, using the `save_as` option from the File pull down menu.

   Every time a Standard AC Calibration is run, a file with an identical name is produced which holds the absolute correction values for driver and receiver. This file is automatically stored in the `calib.raw` subdirectory when you use the `save_as` option.

With the user-wired DUT Board mounted on the tester:

1. Perform Standard AC Calibration in order to generate a Local AC Calibration File.
2. Save the calibration file under a user defined name, using the `save_as` option from the File pull down menu.

From the correction values in the user-wired DUT Board `calib_raw`, file the offsets to the Reference DUT Board values need to be calculated (see "Calibration File Maintenance Procedure"). This is based on the fact that delays caused by user-wiring are relatively stable over time, temperature and frequency.

As soon as the delays caused by user-wiring are known and entered in the `pin attributes` file for each device, only one Standard AC Calibration File needs to be maintained in the calibration directory of the relevant device technology. This Global AC Calibration File is then the only file that needs to be updated at regular intervals for each `dev_tech` in use.

This strategy makes the maintenance of the calibration files easier if the following conditions are met:

- AC calibration files in

  `../dev_tech/ecl/calibration` and
  `../dev_tech/cmos/calibration`

  directories are based on the reference DUT Board.
- No users exit the HP 82000 system software with `store LAST_SETTING` enabled.

- The development/evaluation cycle of a DUT is longer than the calibration interval (3 months).

To calculate the *average of the differences in delays* between the Reference DUT Board and a user-wired DUT Board:

1. Generate a global `calib_raw` file based on a Standard AC Calibration with the Reference DUT Board fitted.
2. Generate a local `calib_raw` file based on a Standard AC Calibration with the user wired DUT Board fitted.
3. Calculate the differences between the delays in these two files for all edges and pins.
4. The average of the differences represents the offset for the user-wired DUT Board from the Reference DUT Board.

Note

For the system software to be able to compensate for the offset, this value should not exceed 1ns.

The next time the tester is due for calibration you only have to run Standard AC Calibration with the Reference DUT Board for the current device family.

Note that when all calibration files have been downloaded at the start of the session, you also have to download the *pin attributes file* for the current DUT Board in order for the calculated offset to be included.

Calibration File Maintenance Procedure

This procedure applies in detail the concepts of file maintenance outlined above. It closes with an example on calibration file maintenance.

1. Mount the Reference DUT Board on the tester. Perform Standard AC Calibration and update the `ac_cal_dxxx` files in

   `/hp82000/dev_tech/ecl/calibration`
   `/hp82000/dev_tech/ecl/calib.raw` and
   `/hp82000/dev_tech/cmos/calibration`
   `/hp82000/dev_tech/cmos/calib.raw`

Calibrate at the end of the Transmission Lines (at DUT socket) on the reference DUT Board.

There are several methods of updating the files. For instance, you can copy existing (local) Standard AC Calibration files from current device type `calibration` and `calib.raw` directories to the above directories. Alternatively you can generate new Global AC Calibration Files (refer to "Generating Global AC Calibration Files" in the next chapter).

2. Mount your user-wired DUT Board on the tester. Perform Standard AC Calibration (refer to "Generating Local AC Calibration Files" in the next chapter). Calibrate at the DUT pins with no DUT installed. Save the local Standard AC Calibration File in the calibration subdirectory of the device type with a user-defined name.
3. Compare the delays stored in the calibration files in the `calib.raw` directory and calculate the average of the time differences for all edges of one driver channel as follows. Do not include the tristate edge.

   The calculated averaged delay is $\mathbf{t_{driver}}$ which must be entered in the pin attributes file for the device type with a negative sign if the delays on the user wired DUT Board are greater than those on the reference DUT Board, and vice versa. Repeat the calculation for all driver channels and write the delays into the pin attributes file.

   Repeat the calculation also for all edges of one receiver channel. The calculated average delay is $\mathbf{t_{receiver}}$ which must be entered in the pin attributes file for the device type with a positive sign if the delays on the user wired DUT Board are greater than those on the reference DUT Board, and vice versa. Repeat the calculation for all receiver channels and write the delays into the pin attributes file.
4. Save the pin attributes file.
5. Use the "Download" Test Function to download the pin attributes file into the hardware.

Example of Calibration File Maintenance

A user wants to generate an `ecl` global AC calibration file and a `pin_attributes` file in the DUT device-specific directory. These will later be

used to download calibration data relevant to his device-specific (user-wired) DUT Board to the tester.

The user performs a Standard AC Calibration with the Reference DUT Board and saves the file in the `/hp82000/dev_tech/ecl` directory. A Standard AC calibration with the user-wired DUT Board is then performed and the calibration file saved with a `user-defined-name` in the DUT device-specific directory. The following procedure is then performed:

1. The global AC calibration file `ac_cal_dxxx` in

   `/hp82000/dev_tech/ecl/calib.raw`

   is printed-out.

   The following listing shows a part of this file. For a description of the HP-IB commands see the *HP-IB Command Reference*.

```
hp82000,calibration,0.1
ITMC 0,1,30,24.11,400,769,1123,1475,1821 ...
CALP 30,7.5
TEMP 1,295
RTMC 0,10101,1,30,18.16,17.238,17.309,16.389,20.25,41.62,83,103.75
     ,124,143.5,162.25,180.75,199,17.774,17.135,16.977,19.75,40.25
     ,60.5,81.25,102,121,139.5,158.75,177.75,196
DTMC 0,10101, ...
⋮
RTMC 1,10308, ...
DTMC 1,10308,1,30,21.211,22.231,21.5,42.5,63.5,83.75,102.75,121.5,
     141,161,180.75,200,21.137,23.208,22.731,22.25,43.25,63.75,84.
     25,105.25,126.25,146,165.25,184.5,203
DRMA 25.555
DRMI 19.548
RCMA 21.778
RCMI 15.501
RDTP 16.946
```

2. The device-specific calibration file

   `/users/tested_device/calib.raw/user_defined_name`

   is printed-out.

   The following listing shows a part of this file.

```
hp82000,calibration,0.1
ITMC 0,1,30,24.099,397, ...
```

```
CALP 30,7.5
TEMP 1,296
RTMC 0,10101,1,30,18.68,17.787,17.869,16.898,21,42,62.75,83,103,
     122.75,142.25,161.5,180.25,199,18.177,17.631,17.451,20.5,
     40.75,62,83.5,103.75,123.25,142.75,161.75,180.25,199
DTMC 0,10101,1,30, ...
:
RTMC 0,10308,1,30, ...
DTMC 0,10308,1,30,21.464,22.497,21,42.25,63.5,83.5,102.25,121.25
     ,141,161,180.75,200,21.435,23.661,22.956,22,43.5,64.25,85.25,
     106.5,127,147,166.5,185.25,204
DRMA 25.940
DRMI 19.808
RCMA 22.307
RCMI 16.015
RDTP 17.856
```

In each RTMC (Receiver Timing Calibration) and DTMC (Driver Timing Calibration) line there are a number of values that need to be extracted to calculate the relative delays for $t_{receiver}$ and t_{driver} respectively, which are introduced by differences in user wiring on a DUT Board. The leading numbers in the following lists give the positions of the values of interest in the RTMC and DTMC lines.

For the purposes of AC Calibration the test system selects the 50/100/200/400(receiver only) MHz MUX mode. The values are extracted from Master and MUX channels which always form channel pairs. The first channel in a pair is always an odd numbered channel, the second channel in the pair is always a neighboring even numbered channel. The calibration routine treats the channel currently being calibrated as the Master channel and the other channel in the pair as the MUX channel.

Receiver Delay. For the RTMC lines, the values of interest are:

5 - Leading edge window compare delay - Master channel
6 - Leading edge window compare delay - MUX channel
7 - Leading edge edge compare delay - Master channel
8 - Leading edge edge compare delay - MUX channel
19 - Trailing edge window compare delay - Master channel
20 - Trailing edge window compare delay - MUX channel
21 - Trailing edge edge compare delay - Master channel

The remaining parameters consist of channel and base point information that is not required for this procedure.

The corresponding values should be extracted from the relevant lines in each file and the average of the delta values calculated as shown below for receiver channel 10101.

Table 5-1. Receive Delay Calculation

Data	Pa r. 5	Par. 6	Par. 7	Par. 8	Par. 19	Par. 20	Par. 21
Reference DUT Bd.	18.16	17.238	17.309	16.889	17.774	17.135	16.977
User Wired DUT Bd.	18.68	17.787	17.869	16.898	18.177	17.631	17.451
Delta Value	0.52	0.549	0.56	0.509	0.403	0.496	0.474

The average of the delta values for the channel 10101 receiver is 0.502. This value should be entered in the pin attribute file as the $t_{receiver}$ parameter for the pin name using the channel 10101.

Repeat this procedure for every output channel and enter the values for $t_{receiver}$ in the pin attributes file.

Driver Delay. For the DTMC lines, the values of interest are:

5 Leading edge delay - Master channel
6 Leading edge delay - MUX channel
17 Trailing edge delay - Master channel
19 Trailing edge delay - MUX channel

The remaining parameters consist of channel and base point information that is not required for this procedure.

The corresponding values should be extracted from the relevant lines in each file and the average delta values calculated as shown below for driver channel 10308.

Table 5-2. Drive Delay Calculation

Data	Par. 5	Par. 6	Par. 17	Par. 19
Ref. DUT Bd.	21.211	22.231	21.137	22.731
User wired DUT Bd.	21.464	22.497	21.435	22.956
Delta value	0.253	0.266	0.298	0.225

The average of the delta values for the channel 10308 driver is 0.2605. This value must be entered in the pin attribute file as the t_{driver} parameter for the pin name using the channel 10308.

Repeat this procedure for every input channel and enter the values for t_{driver} in the pin attributes file.

Remove the standard AC calibration file from the device type `calibration` and `calib.raw` sub-directories. Make sure that no new `LAST_SETTING` calibration files are created by leaving the system software with `store LAST_SETTING` disabled.

With the procedure shown above, an accuracy of ±500/600ps/800ps) is maintained as long as no changes are made to DUT Board wiring.

Calibrating the System

Caution

Do not perform any of the procedures described in this chapter before you have read Chapter 5. Failure to comply could lead to inaccurate test results.

Allow a 30 minute warm-up period before performing any of the procedures described in this chapter.

Calibration Overview

Two types of calibration procedure are used to calibrate the HP 82000 IC Evaluation System:

- **Base Calibration** - to manually update/check internal references.
- **Auto Calibration** - system software-driven routines to calculate correction factors for levels and timing.

Connecting the Calibration Probe

Check that the calibration probe has been fitted.

The single channel calibration probe is used in conjunction with the standard DUT Boards to perform an AC Calibration on one channel at a time.

The Single Channel Calibration Probe is shown in Figure 6-1.

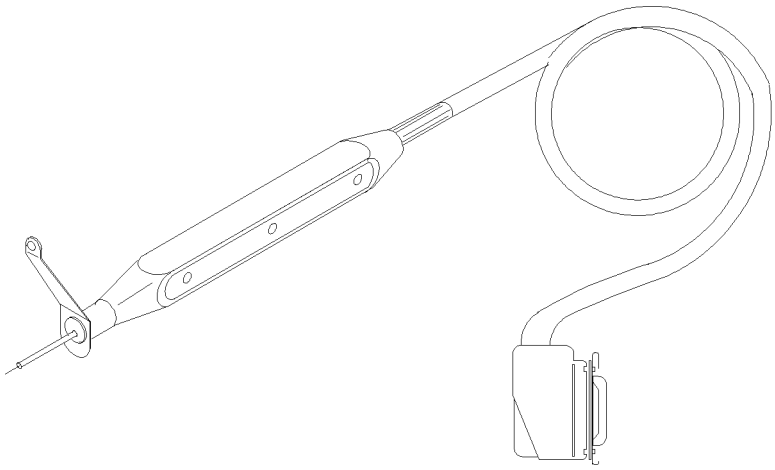


Figure 6-1. Single Channel Calibration Probe

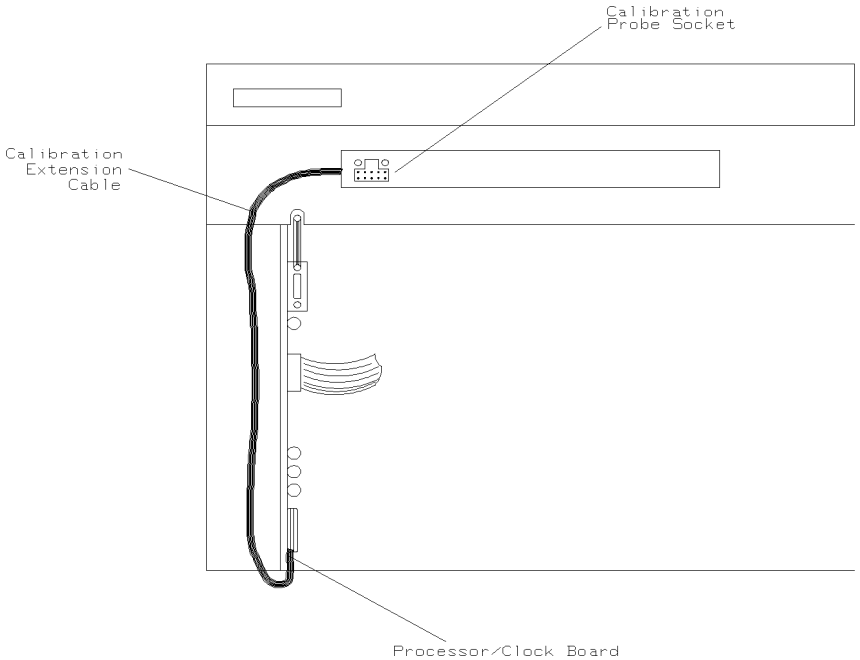


Figure 6-2. Fitting the Calibration Extender Cable

6-2 Calibrating the System

Multiplexed Calibration Probe

The E1262A and E1263A Calibration Matrix products consist of a Calibration Board, a 16 channel Multiplexed Calibration Probe and a Calibration Extender Cable. Plug the cable into the calibration socket on the Clock Board and fit the cable as shown in Figure 6-2. Install the MUX Calibration Probe as described above. The Calibration Board's sole purpose is to interface with the MUX Calibration Probe. With these products you can calibrate the system to an accuracy of ±1 ns.

If you require greater accuracy use the Single Channel Calibration Probe.

Base Calibration

This consists of checking the accuracy of the system timing reference and measuring the gain of the ADCs on the Clock Board and any PMU Boards that may be installed.

Equipment Required

- Power supply with a voltage output range of -20V to +20V
- DVM - HP3456A
- Counter - HP5370B
- BNC cables
- BNC TEE connector - 1250-0781
- BNC to dual banana plug - 1251-2277

Figure 6-3 shows the measurement set up.

Picture 1
Measurement set; Base Calibration

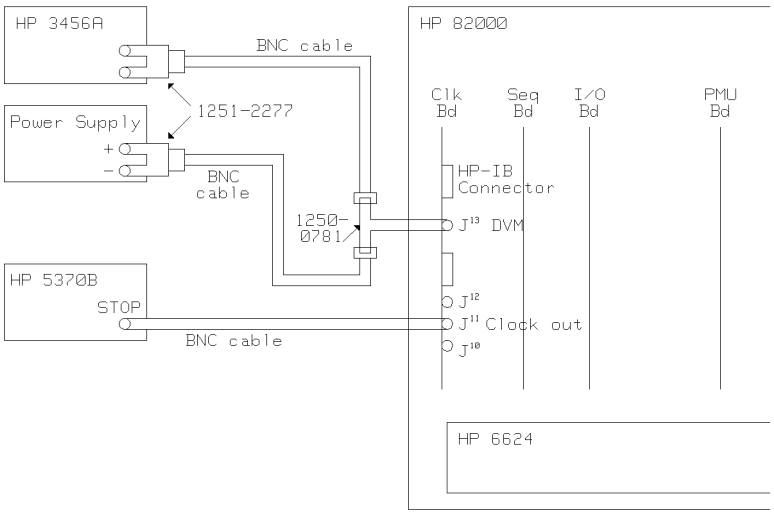


Figure 6-3. Base Calibration - Measurement Set Up

Caution

Before connecting the power supply, check that the output voltage does not exceed the limits −20V and +20V.

Note

Allow a warm-up period of 30 minutes for all equipment.

Measuring the Accuracy of the Timing Reference

Set up the measurement setup as shown in Figure 6-3.

1. Download the firmware by starting the system software. Type in:

   `hp82000`

2. Wait until the HP 82000 software has finished loading.

Start an HP-UX shell by pressing the `HP-UX Shell` softkey in the (AUX) Menu.

3. Load the HP-IB driver by typing in:

   ```
   /hp82000/pws/bin/hpt
   ```

   and enter the commands:

   ```
   *rst
   sqst off
   ```

   to ensure that the system is reset and the sequencer is switched off.

4. Set the operating frequency to 10 MHz by typing in the HP-IB commands:

   ```
   sclk int,100,
   sqst run
   ```

5. Set the counter:

   Gate Time = 0.1 Second.
   Statistics = Mean.
   Input Amp = 50Ω.
   Level = Preset.
   Start Com/Separate = Separate
   AC/DC = AC

6. Read the counter display. The counter should display 10 MHz ±10 kHz.

Note

There is no adjustment procedure for the timing reference channel. Only the accuracy can be checked. If the timing reference channel fails the accuracy test, the Clock Board must be replaced and the Base Calibration procedure repeated.

In systems using more than one card-cage, only the **master card-cage** is to be checked for timing accuracy.

Calculating the Gain of Clock Board ADC

1. Connect the measuring equipment as shown in Figure 6-3. Use a BNC TEE piece to connect to the DVM BNC connector located on the Clock Board. See Figure 6-3.

2. Type in the commands:

   ```
   *rst
   sqst off
   ```

   to ensure that the system is reset and the sequencer is not running.

3. Set the power supply output to approximately 7 Volts. Note the exact reading on the DVM. This reading is *V1*.

4. Read the ADC bit pattern by typing in the HP-IB query:

   ```
   adcm? 1
   ```

   or 2/3/4 depending on the number of the card-cage you are calibrating.

   The system will respond by returning the ADC bit pattern (close to 4000). The value returned is *adc_value_1*. Note the value.

5. Set the power supply output to approximately −3 Volts. Note the exact reading from the DVM. This reading is *V2*.

6. Read the ADC bit pattern by typing in the HP-IB query:

   `adcm? 1`

   The system will respond by returning the second ADC bit pattern (close to 500). The value returned is *adc_value_2*. Note the value.

7. Calculate the gain using the following formula:

$$adc\_gain = \frac{(V1 - V2)}{(adc\_value\_1 - adc\_value\_2)}$$

Note

The values of *V1* and *V2* should be in **microvolts.**

---

8. Enter the *adc_gain* value into the file `/hp82000/fw/data/bc_cal_dxxx` under variable name "MLCD 1", where 1 is the id number of the card-cage.

   If your system has more than one card-cage, steps 3 to 8 should be repeated adding the card-cage id to the HP-IB command (`adcm? 2`, `adcm? 3` and `adcm? 4` respectively) respectively.

9. Type in CTRL D to stop the HP-IB driver.

Example:

Power Supply Reading	DVM Reading	ADC Reading
7.0000V	V1 = 6.9998V	3620
-3.0000V	V2 = -3.0002V	510

Gain Calculation:

$$adc\_gain = \frac{(6999800 + 3000200)}{(3620 - 510)} = 3215.44\ \mu\ \text{V/bit}$$

Note

The Clock Board must be replaced if:
ADC gain $\leq$ 2500 μV/bit or
ADC gain $\geq$ 4000 μV/bit.

Using the HP-UX `vi` editor, edit the file `/hp82000/fw/data/bc_cal_dxxx`.

Type in:

```
MLCD 1, 3215.44,,,,,,,,
```

Note

Be sure that you have entered exactly 8 commas following the gain value.

Ensure that **no** changes are made to the file header:
`hp82000,calibration,0.1`

Calculating the Gain of PMU ADC

You have to carry out this procedure after you have installed the optional PMU Board in the card-cage. If you already have a PMU Board installed, perform the procedure at six monthly intervals.

The equipment required and measurement setup are the same as in the previous procedure.

Caution

Before connecting the power supply, check that the output voltage does not exceed the limits −20V and +20V.

1. Connect the power supply and the HP3456A. Use a BNC TEE piece to connect to the DVM BNC connector located on the Clock Board. See Figure 6-3.
2. Download the firmware by starting the system software. Type in:

   `hp82000`

   and wait until the HP 82000 software has finished loading.
3. Start an HP-UX shell by pressing the [HP-UX] softkey in the AUX Menu.

4. In the HP-UX window, load the HP-IB driver by typing in:

   ```
   /hp82000/pws/bin/hpt
   ```

   Type in the commands:

   ```
   *rst
   sqst off
   ```

   to make sure that the system is reset and the sequencer is not running.

5. Set the power supply output to approximately +12 Volts. Note the exact DVM reading. This reading is *V1*.

6. Read back the bit pattern from the ADC by typing in the HP-IB query:

   ```
   pmbc? p11
   ```

   where p11 is the pmu_id - card-cage 1 pmu 1.

   The system responds by returning the ADC bit pattern (close to 200).

   Example

   ```
   PMBC P11,247,2669.6,2172,2109,0,2046.7....
   ```

   The value you require is the first value in the string (247). Note this value as *adc_value_1*.

7. Set the external power supply to approximately -12 Volts. Note the exact reading taken from the DVM as *V2*.

8. Read the ADC bit pattern by typing in the HP-IB query:

   ```
   pmbc? p11
   ```

   The system responds by returning the second ADC bit pattern (close to 4000). Note this value as *adc_value_2*.

9. Calculate the gain using the following formula:

$$adc\_gain = \frac{(V1 - V2)}{(adc\_value\_2 - adc\_value\_1)}$$

Note

The values *V1* and *V2* must be in **microvolts**.

10. Repeat steps 5 to 9 for each PMU installed in the system while changing the PMU id in the HP-IB query. For example:

    ```
    pmbc? p12
    pmbc? p21
    pmbc? p22  and so on.
    ```

11. Type in CTRL D to stop the HP-IB driver.

12. Enter the adc_gain values into the file `/hp82000/fw/data/bc_cal_dxxx` by typing in the line `PBCD P11,XXXX,,,,,,,,,,,` where 11 stands for the PMU identifier (11 means card-cage 1, PMU 1).

    Example

    For a full configuration containing 3 PMU Boards you would type in:

    ```
    PBCD P11, 10001,,,,,,,,,,
    PBCD P12, 10025,,,,,,,,,,
    PBCD P21, 10005,,,,,,,,,,
    PBCD P22, 10010,,,,,,,,,,
    PBCD P31, 10024,,,,,,,,,,
    PBCD P32, 10017,,,,,,,,,,
    ```


Note

Be sure that you have entered exactly 11 commas following the gain value.

Ensure that **no** changes are made to the file header: `hp82000,calibration,0.1`

13. To download the new Base Calibration values into the hardware:
    - exit the HP 82000 system software by clicking the QUIT softkey in the main menu;
    - then restart the system software by typing

      `hp82000`

at the HP-UX command line prompt.

Using the Calibration Window

The calibration routines can be accessed from the Calibration Window. This is done by pressing the Calibration softkey in the AUX Menu.

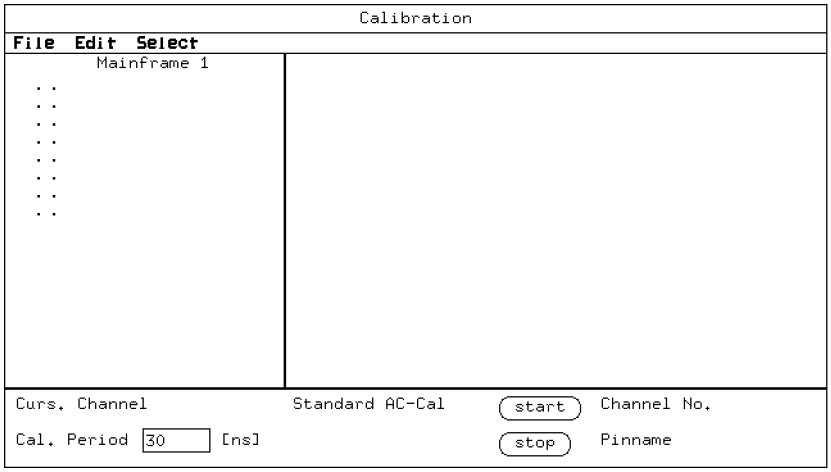


Figure 6-4. Calibration Window

Calibration Window Description

The Calibration Window is divided into three parts:

Menu Bar At the top of the Calibration Window there are three keywords used to access the `File`, `Edit`, and `Select` pull down menus.

- `File` allows you to access the file operation functions.
- `Edit` allows you to use the `cut` and `paste` functions.
- `Select` allows you to select which of the calibration routines is to be executed.

Middle Part The center of the calibration window is divided into sections, each representing one card-cage. The number of sections

depends on the number of card-cages connected. The dots that are displayed indicate the number of IO channels installed in the system. The number of columns indicates the number of IO Boards installed in each card-cage. The number of dots in a column will be either 8 or 16 to indicate 200 MHz or 50 MHz IO Boards respectively. In the above example, the system consists of one card-cage with two 200 MHz IO Boards installed. (PMU Boards are not displayed in this window.)

Lower Part The lower part of the screen indicates:

- The type of calibration that is to be performed, this can be either:
  - Standard AC-Cal
  - User AC-Cal
  - DC-Cal
- `Cal. Period` (30) `[ns]` -
  The value inside the field is the period at which the system will be calibrated. The default value (D100/D100X/200/400 : 30 ns, D50 : 150 ns) is the system period for Standard AC Calibration. If you want to calibrate the system at a different period, enter the required period value in this field. In this case refer to "Standard AC Calibration with Fixed System Period" in Chapter 5 in the previous chapter.
- `Channel No.` and `Pinname` -
  indicates the channel number currently connected to the Calibration Probe. If a pin configuration is loaded, the pin name will also be displayed.

  The channel number has 5 digits and has the same format as the display in the Pin Configuration window.
- (Start), (Stop), and (exec) -
  these pushbuttons are used to start and stop the calibration routines. (The latter is used to execute the DC Calibration Routine.)

Note

Before starting the DC Calibration Routine, make sure that the Calibration Probe is connected to the system. This can be either a single channel probe or the Multiplexed Probe.

Also ensure that the DUT Board has been removed from the DUT Interface.

DC Calibration Procedure

Call up the DC Calibration Routine from the calibration window by selecting `DC-Cal` in the Select pull down menu. The DC Calibration screen will be displayed as shown in the figure below.

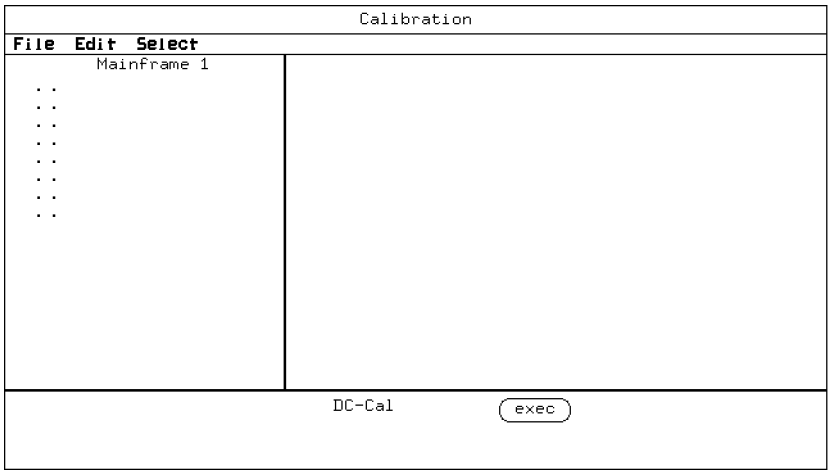


Figure 6-5. DC Calibration Window

Start the DC Calibration routine by pressing the exec pushbutton.

You will hear relays clicking as the routine executes.

As soon as the DC calibration has determined the gain and offset values for all installed level generators (D to A converters) the exec button will reappear.

If any errors are detected during DC Calibration they will be listed in the Report Window after the DC Calibration has finished. (Any error messages will be generated during the download of new correction values into the hardware.)

If any errors are reported, the system needs to be repaired. Refer to the hardware troubleshooting chapter of *Servicing the HP 82000*.

If no errors were reported, make the new correction values available to other users by saving them (see "Saving DC Calibration Values" below).

Running DC Calibration in a Multi Card-Cage System

The procedure is the same whether you run the DC Calibration Routine on a single or a multi card-cage configuration. You should, however, note that in a multi card cage system, the gain and offset values for the DACs on the IO Boards are determined by the ADC on the Clock Board located in the card-cage where the IO Boards are installed. There is no DC link from card-cage 1 to card-cages 2, 3 or 4.

Saving DC Calibration Values

To enable the system to access the DC Calibration data, the new gain and offset values are stored in the global calibration file `dc_cal_dxxx` in the `/hp82000/fw/data` directory. When you select the `File` pull down menu the functions available are:

- `hardcopy` - prints out a copy of the calibration screen
- `catalog print` - prints out a listing of the `/hp82000/fw/data` directory so you can see the modification dates of all the global calibration files
- `save` - overwrites the old copy of `dc_cal_dxxx` with the newly generated values.

Select `save` to store the new correction values.

Generating Global AC Calibration Files

Before you start working with Global AC Calibration Files make sure you have released the relevant directory and file protections. Refer to "Maintaining Global Calibration Files" in Chapter 5 in Chapter 5.

- In the system main menu click the (Change Dev) key.
- In the System Administration Window click (enter).
- In the path name entry field enter `/hp82000/dev_tech`.
- From the device browser select `ecl` or `cmos` and click (enter dev). The tester hardware reboots.
- Call up the Calibration Window and perform Standard AC Calibration for all installed channels. Use the (save_as) option to store the calibration results into the file `ac_cal_dxxx`. This overwrites the existing `ac_cal_dxxx` file.

Generating Local AC Calibration Files

Call up the Calibration Window and perform Standard AC Calibration for all installed channels. Use the (save_as) option to store the calibration results. Supply a file name of your choice.

Guidelines for Running Standard AC Calibration

- Before starting the Standard AC Calibration routine install the DUT Board you want to use for testing your DUT. **Do not insert a DUT.**
- Connect the Calibration Probe to the system. Do not connect the Calibration Probe to the system channels until you are told to do so.
- Ensure there are no loads connected to the DUT Board.
- The total electrical length of wiring to the DUT must not exceed 10 ns (40 ns). This includes I/O Board to DUT Interface wiring, DUT Board track

and user wiring on the DUT Board. The delta delay on user wiring (the difference between the fastest and the slowest channel) must be $\leq$ 1 ns.

- Any serial resistors on the DUT Board should be $\leq$500 Ω.
- Make sure there are no dual TMLs (two drivers connected to one DUT pin) on the DUT Board.
- Calibrate at the end of the TMLs.

Standard AC Calibration Procedure

Select `Standard AC_Cal` in the `Select` pull down menu. The Standard AC Calibration screen will be displayed as shown below.

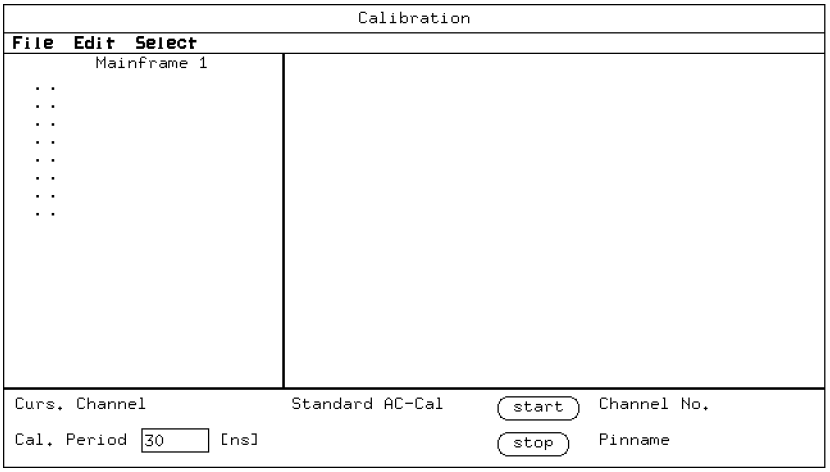


Figure 6-6. Standard AC Calibration Window

The system offers the default calibration period of 30 ns (D50 : 150 ns). You can choose one of two options:

1. Use the default calibration period. With this value the system will be calibrated to an accuracy of $\pm$500 ps ($\pm$600 ps) ($\pm$800 ps) for all settings of the system clock period, levels and operating modes.
2. Enter your own calibration period. As long as you do not change the system clock period during DUT testing or use frequency sweep tests, the system

will have an accuracy between that of user calibration and standard AC calibration, for all settings of levels and operating modes.

Start the Standard AC Calibration routine by clicking the (start) pushbutton.

A message will appear telling you to not to connect the Calibration Probe yet. Press (start) again and wait for the Calibration Probe measurements to finish. When the LED on the Calibration Probe goes off and the message

`cal probe measurement is finished`

appears, you can start to calibrate the system channels.

- Always connect the earth contact to the DUT Board cover first.
- Connect the tip of the Calibration Probe to the end of a TML on the DUT Board. Contact the probe to a point as close as possible to the end of the TML or at the DUT socket. Hold the probe on the pin until the LED on the probe switches on and off twice.
- If an error message appears such as,

  `cannot perform driver timing` or
  `cannot perform receiver timing`

  followed by a six-digit error number, the probe tip or ground may no longer be in contact with the system. Re-probe the channel. If the error persists, there could be excessive loads, connected dual TMLs or a faulty channel. Check the DUT Board loading and whether channels are connected together. If you suspect a faulty channel refer to *Servicing the HP 82000*.

  As each system channel is identified, the `Channel No.` and `Pinname` fields will display the system channel number and pin name (pin name will only be displayed if a pin configuration has been downloaded into the system hardware). When the channel has been calibrated the small dot for each channel will change to a large filled dot to show that the calibration data has been received for that channel. (This tells you that the Standard AC Calibration routine has gathered all correction values for the driver and receiver channel and the calibration was successful.)
- When all the required channels have been calibrated, press (stop) to complete the calibration routine. The calibrated channels will now be displayed as large empty dots as shown below.

- Click the file pull down menu. Select the `save_as` function and type a file name of your choice into the entry field of the `save` sub-window. Click the save_as push button.

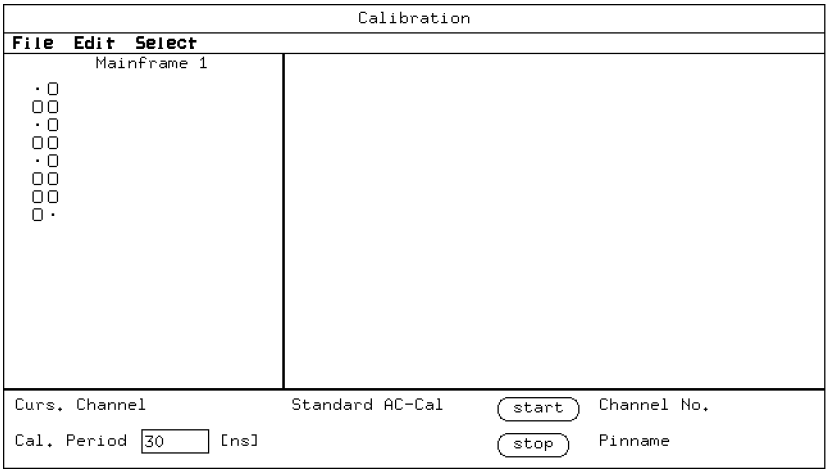


Figure 6-7. Standard AC Calibration Window after Calibration

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While the Standard AC Calibration is active, the gathered data is kept in a database (raw data). When all the required channels have been calibrated and you have clicked stop, the calibration routine calculates the final correction factors for each edge generator from the raw database and downloads them to the system hardware.

Saving Standard AC Calibration Values

When the Standard AC Calibration is terminated by pressing the stop pushbutton, save the correction by selecting the `save` or `save_as` function in the File pull down menu.

On selecting `save` or `save_as` you will be prompted for a new or an existing filename. The calibration file will be saved in the `calibration` directory and the database file in the `calib.raw` directory under the device family directory that you have selected. Both the calibration file and the data base file will have identical file names.

Running User AC Calibration

Use this procedure to improve the system timing accuracy for specific system settings.

Note

Before starting this procedure:

- The global base and DC calibration files `bc_cal_dxxx` and `dc_cal_dxxx` files must contain valid calibration data.
- The requirements of the Standard AC Calibration must be fulfilled.
- A valid Standard AC Calibration File must be loaded in the hardware and data base (`calib.raw`) file loaded in the RAM of the PWS.

User AC Calibration Procedure

You can provide User AC Calibration data to the hardware by performing User AC Calibration. You provide the Standard AC Calibration data by loading the "parent" Standard AC Calibration File. (A definition of a parent file is given in Chapter 5 under "Description of User AC Calibration" in Chapter 5.)

1. Mount the required DUT Board on the DUT Interface. The DUT Board used for calibration has to be the one used for actual testing.
2. Make sure no DUT is installed on the DUT Board. Make sure that restrictions concerning the total electrical length of wiring as outlined in "Guidelines for Running Standard AC Calibration" are met.
3. Load the "parent" Standard AC Calibration File using the Calibration Window File `load` function.

   To load the file, proceed as follows. From the Calibration Window click on the File menu and select the `load` function. The file browser displays all files contained in the `calibration` directory of your device. Select the file you need and click load.
4. Download the following files using the `download` function in the Test Control Window.

a. Pin Configuration File
b. Timing Setup File
c. Pin attributes File (if required)

5. In the Calibration Window pick (Select) and pick `user_cal`.
6. Connect the Calibration Probe to all pins that should be calibrated to the tighter timing accuracy. Hold the probe in place until the pins have been marked with a dot in the Calibration Window.
7. Click (stop) when you are done with the last pin.
8. Save the User AC Calibration File under a user defined name with the `save_as` option of the (File) pull down menu.

   This generates a User Calibration File in the `user_cal` subdirectory of the device type in use.
9. All user calibrated pins are set to the tighter timing accuracy.

The alternative method of providing User AC Calibration data to the hardware is by generating the necessary "parent" Standard AC Calibration File.

1. Mount the required DUT Board on the DUT Interface. The DUT Board used for calibration has to be the one used for actual testing.
2. Make sure no DUT is installed on the DUT Board. Make sure that restrictions concerning the total electrical length of wiring as outlined in "Guidelines for Running Standard AC Calibration" are met.
3. Run Standard AC Calibration for all pins that will be calibrated to user settings. Save the Calibration data to a file.
4. Download the following files using the `download` function in the Test Control Window.

   a. Pin Configuration File
   b. Timing setup File
   c. Pin Attributes File
5. Click the (Select) option in the Calibration Window and pick `user_cal`.
6. Connect the Calibration Probe to all pins that should be calibrated to the tighter timing accuracy. Hold the probe in place until the pins have been marked with a dot in the Calibration Window.

7. Click (stop) when you are done with the last pin.
8. Save the User AC Calibration File under a user defined name with the `save_as` option of the (File) pull down menu.

   This generates a User Calibration File in the `user_cal` subdirectory of the device type in use.
9. All user calibrated pins are set to the tighter timing accuracy.

To enable quick and efficient preventive maintenance we recommend that you stock the following parts:

Table A-1. List of Replaceable Parts.

Product Number	Part Number	Description	Quantity
E1222M	3150-0562	AIRFILTER-FRNT	1
E1222M	3150-0563	AIRFILTER-REAR	1
E1222M	3160-68501	FAN-AXIAL	2
E1222M	E1222-88501	FAN-RAD,CCW	2
E1222M	E1222-88502	FAN-RAD,CW	2
E1222M	2110-0303	FUSE 2 AMP	2
E1222M	2110-0304	FUSE 1.5 AMP	2
E1222M	0363-0170	RFI STRIPS	4

You will require the following tools/consumables when carrying out preventive maintenance.

- Selection of Cross-head Screwdrivers.
- Selection of Flat-head Screwdrivers.
- Isopropyl Alcohol.
- Lint-free Cloth.
- Screen Cleaner Spray.
- Tape Head Cleaner plus Cleaning Pads.

A

B

C

D

E

F

G

T

U

V