

# F6080 Field Calibration

## User's Guide



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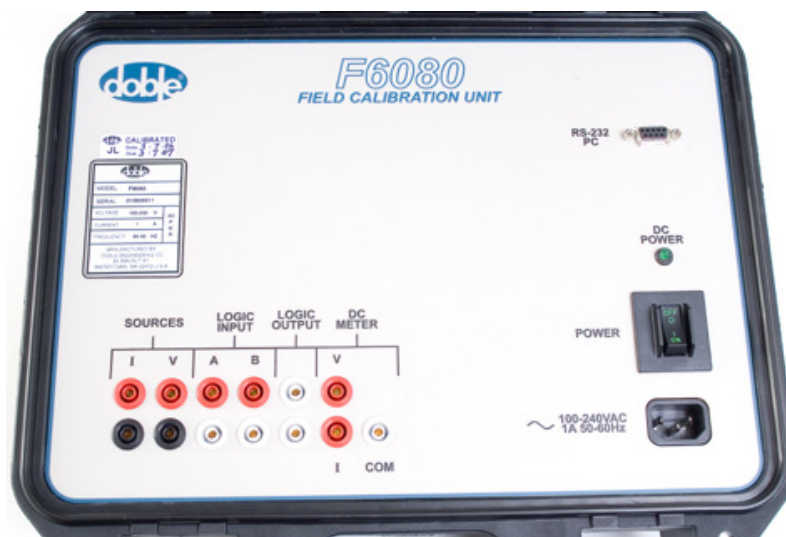






# 1. Introduction

The F6080 Field Calibration Unit (Figure 1-1) enables you to calibrate and verify the performance of F6150 and F2250 instruments. Depending on the instrument, you can calibrate amplifiers, a DC meter, the frequency, or an optional AIM PC board. You can also perform voltage, current, resistance and frequency measurements.



*Figure 1-1 F6080 Instrument Front Panel*

F6080 software, run on your PC, performs the checks and calibrations, exports test data to an Excel file, and enables you to edit other Excel files and print test results.



Unless otherwise noted, references to the F6150 also apply to the F6150A.

## Set-up

Set up the F6080, F6150 or F2250, and your PC as follows:

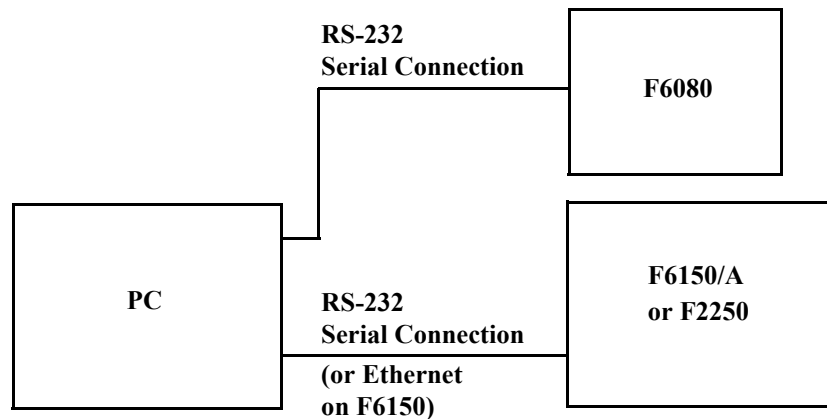
1. Make sure Microsoft® Excel® is installed on your PC.
2. Install the F6080 software supplied with the F6080 on your PC.
3. Connect a serial cable between the RS-232 connector on the F6080 and a serial port on your PC.
4. For F6150 instruments, connect a serial, USB, or Ethernet cable between the F6150 and a second serial port on your PC.

For F2250 instruments, connect a serial cable between the F2250 and a second serial port on your PC.

5. Power up the F6080 and the F6150 or F2250 instrument.
6. Allow a 20-minute warmup before calibrating.
7. Refer to [Chapter 2, “F6000 Calibration”](#), for F6150 test and calibration procedures and [Chapter 4, “F215x and F225x Specific Calibration”](#), for F2250 procedures.

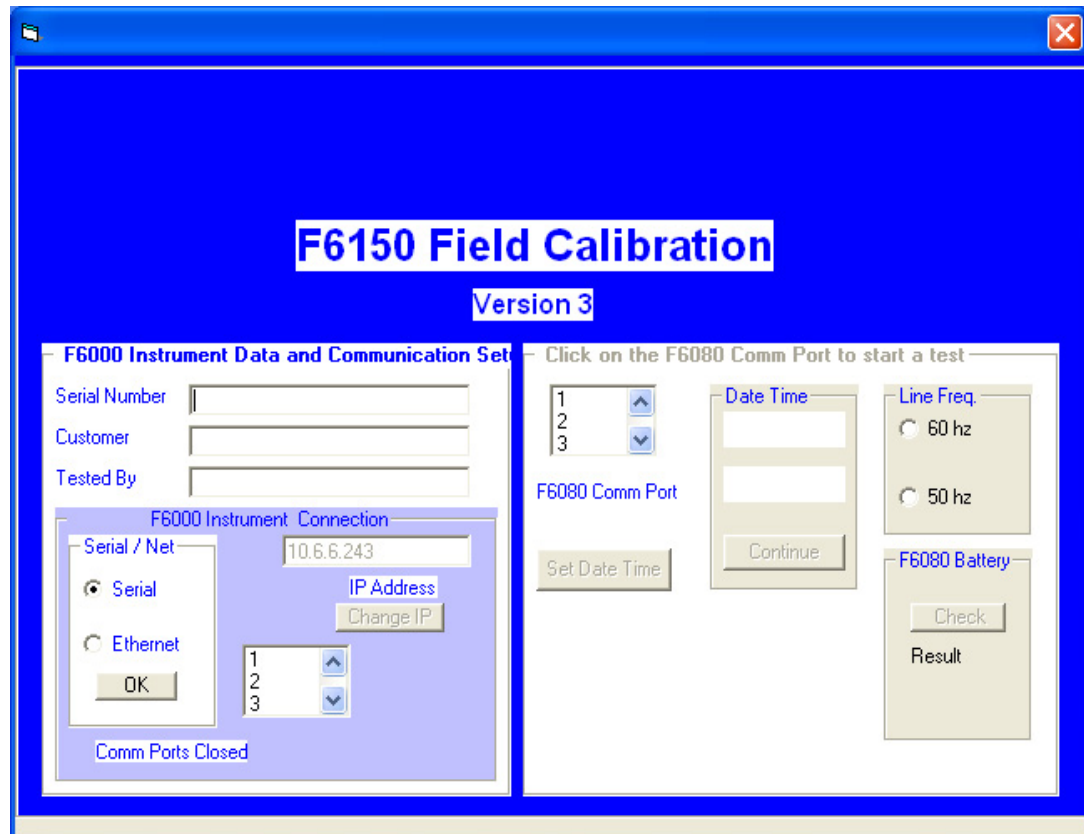


**You must power up the F6080 and the F6150 or F2250 for at least 20 minutes before attempting performance or calibration tests.**



**Figure 1-2 F6080 Connection Diagram**

## 2. F6000 Calibration



*Figure 2-1 F6080 Main Screen*



The F6080 is designed for F6000 instruments with firmware build numbers of 830 or higher. If you have an earlier firmware version, you can download the latest version from the Doble website ([www.doble.com](http://www.doble.com)), to ensure proper functioning of the F6080.

## Operation

The F6000 user interface displays a field calibration screen that enables you to enter F6000 instrument data and activate the F6080 to start a test. The screen has two sections:

- an F6000 section on the left
- an F6080 section on the right

The cursor rests in the Serial Number field.



**You must power up the F6000 and the F6080 for at least 20 minutes before you can execute instrument performance or calibration tests.**

### F6000 Data and Communications Set-up

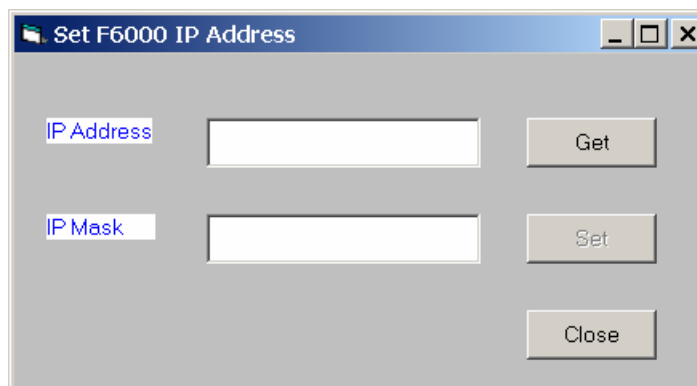
Enter the following data in the three fields in the F6000 Instrument Data and Communications Setup section of the F6000 Field Calibration Screen (Figure 2-1).

1. Enter the instrument serial number for the F6000 instrument you want to test.
2. Enter the customer name.
3. Enter the name of the tester.

The following section enables you to choose either a serial port or an Ethernet connection. In the serial mode, you can review the IP Address and the Mask. In the Ethernet mode, you can change the IP address.

### F6000 Instrument Connection

1. To select the instrument connection, select either the **Serial Comm Port** or **Ethernet** radio button.
2. If you select **Serial Comm Port**, select an F6000 COM port number from the list.  
If the message `The COM port is not available` appears, make another selection.
3. If you select **Ethernet**, the F6080 connects to the instrument using the IP address displayed in the data field.
4. To change the IP address, click **Change IP**. The Set F6000 IP Address dialog box appears (Figure 2-2).



**Figure 2-2 Set F6000 IP Address Dialog Box**

5. Click **Get** to retrieve the instrument's IP address and IP mask of the instrument under task.
6. Enter the new IP address and IP mask for the test instrument.
7. If uncertain of the correct IP address and mask, ask your IT department.
8. Click **Set**. The new IP address and Mask appear.
9. Click **Close**.
10. Click **OK**.

After you execute the F6000 data options, you can activate the F6080 communication options. These options enable you to select the communications port, current date and time, and line frequency.

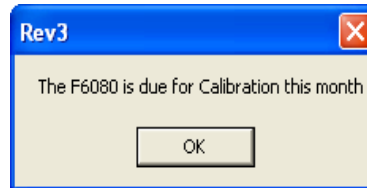
## F6080 Instrument Connection

In the F6080 list box, use the Up and Down arrow keys to scroll through a list of available communication ports.

1. In the F6080 Comm Port section, select a COM port number from the list.  
If you used serial communication for the F6150 in step 6, select a different COM port number here.

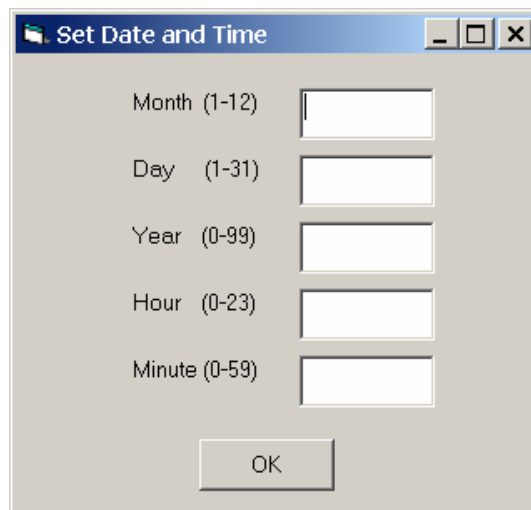
After you click a COM port number, the current date and time appear in the Date Time fields; the buttons in the right-hand pane — Set Date Time, Continue, and Battery Check — become enabled. The F6080 calibration due date appears below the Continue button.

When the F6080 calibration is due in the current month, the following prompt appears (Figure 2-3).



**Figure 2-3 Calibration Due Prompt**

2. To set a new date and time, click **Set Date Time**. The Set Date And Time dialog box appears (Figure 2-4).



**Figure 2-4 Set Date and Time Dialog Box**

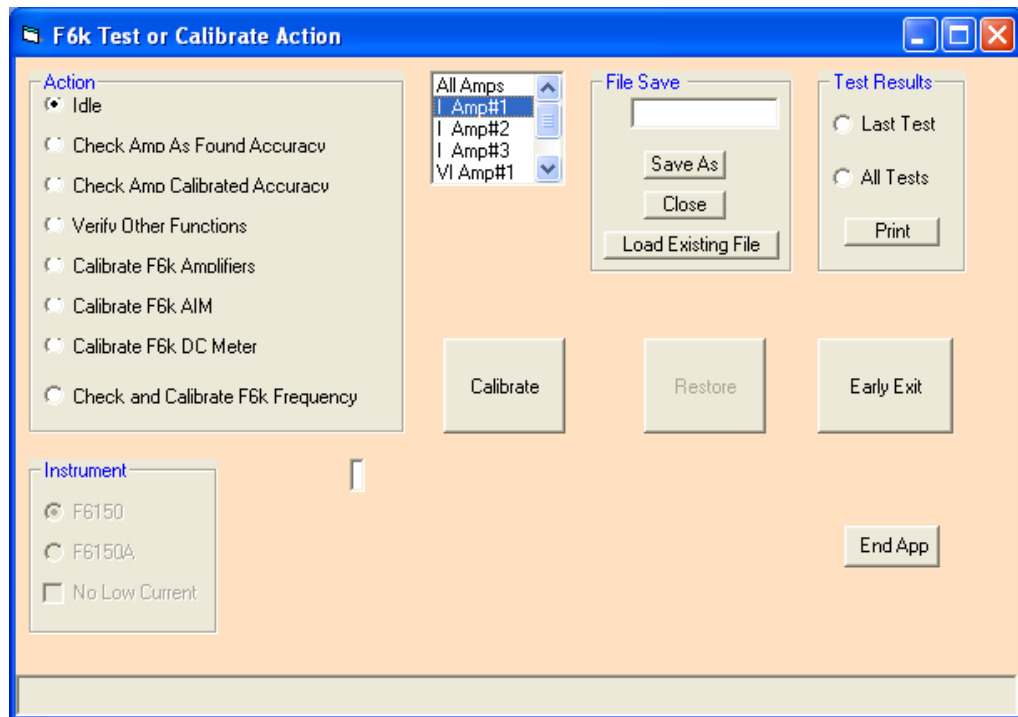
3. Enter the appropriate values for month, day, year, hour, and minute.
4. Click **OK**.
5. In the Line Freq. section, click the **50** or **60 hz** option button.
6. To check the condition of the F6080 battery, click **Check**.
7. In the Date Time section, click Continue.

An Excel template is loaded and all entered data appears on the first Excel worksheet.

The screen shown in [Figure 1-1 on page 1-1](#) appears, enabling you to perform advanced test functions.

### 3. F6000 Test and Calibration Options

The F6k Test or Calibrate Action screen (Figure 3-1) enables you to perform advanced test functions, such as loading and editing existing Excel files, calibrating amplifiers, performing various measurements, and printing current and previous tests.



*Figure 3-1 F6k Test or Calibrate Action Screen*

The parts of this screen include:

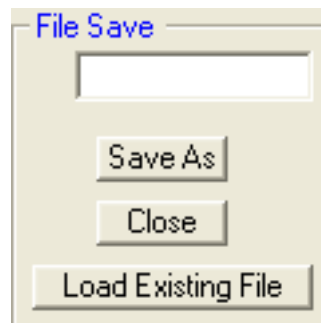
- **Action** — enables you to select a test or calibration to perform (see “Action Options” on page 3-3).
- **Amplifiers** — enables you to select one or all amplifiers for calibration.
- **File Save** — enables you to save, load, and edit existing Excel files. (see “Action Options” on page 3-3).
- **Test Results** — enables you to print the last test or all tests.

- **Instrument** — indicates the instrument under test. The No Low Current option is set if that option is not available. All options are set by the program during a hardware read. The blank slot to the right of this section displays user prompts and test status.
- **Calibrate** — begins the calibration process.
- **Restore** — restores all calibrated coefficients to their initial values prior to the start of the calibration process.
- **Early Exit** — terminates the calibration/verification process before completion.
- **End App** — enables you to exit the application. A prompt appears asking you to save changes to the file or close the program without saving your changes

## Editing Excel Files

To load and edit an existing Excel file:

1. In the File Save section of the F6k Test or Calibrate Action screen ([“File Save Section of the F6k Test or Calibrate Action Screen”](#) on page 3-2), **click Load Existing File**.



*Figure 3-2 File Save Section of the F6k Test or Calibrate Action Screen*

The Open dialog box appears.

2. Select the Excel file you want to edit.
3. Click **Open**.  
The file opens in Excel and the template is closed.
4. When done, click **Close** to save your changes.
5. If you did not load an existing file, enter a file name in the File Save field.
6. Click **Save As**. The file is saved in the application path and a blank Excel template is loaded.





If you click the End App button, a prompt appears asking you to save changes to the file or close the program without saving your changes.

## Action Options

### Idle

Enables you to not perform any further actions. When this option is selected, the dialog box displays the message `Choose a test`.

### Check Amp As Found Accuracy

Determines whether you need to calibrate the amplifiers. You can test any or all of them. The test result contains the DC amplitude accuracy for all amplitude ranges in the 75, 150, 300, and 450 VA configurations.

During this test, no changes occur to the calibration coefficients. The Excel test file displays Pass or Fail. The measured value and percent deviation from Nominal appear at the top of the test sheet where the definition for Nominal appears.

### Check Amp Calibrated Accuracy

Runs after amplifier calibration and is similar to the latter, except that the amplifier EEPROM gain and offset coefficients are optimized.

### Verify Other Functions

Opens the Verify Performance dialog box (see [“Verify Performance” on page 3-8](#)).

### Calibrate F6k Amplifiers

The Calibrate F6k Amplifiers option enables you to calibrate all or selected amplifiers

1. From the scroll-down menu, select **All Amps** to calibrate all six amplifiers that appear on the menu.
2. To calibrate an individual amplifier, use the scroll-down menu to select one of the six amplifiers: I Amp#1, I Amp#2, I Amp#3, VI Amp#1, VI Amp#2, and VI Amp#3.
3. Click the **Calibrate** button. The calibration coefficients adjust to the nominal value for each amplifier.

4. Click the **Restore** button to restore all calibrated coefficients to their initial values prior to the start of the calibration process. This option is useful if you want to recover these coefficients due to an unanticipated error.
5. Click the **Early Exit** button to exit the calibration/verification process before you complete the selected event.
6. Click the **Calibrate** button to start the process again.

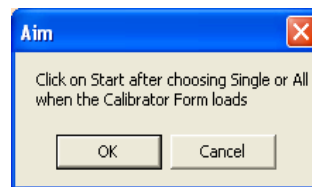
### Calibrate F6k AIM

Enables you to calibrate the optional AIM board.



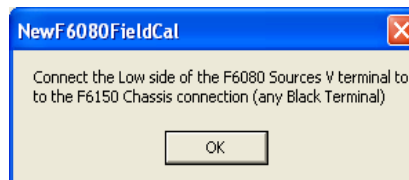
If you did not install the AIM board, this option will not work.

When you select this option, the following prompt appears.



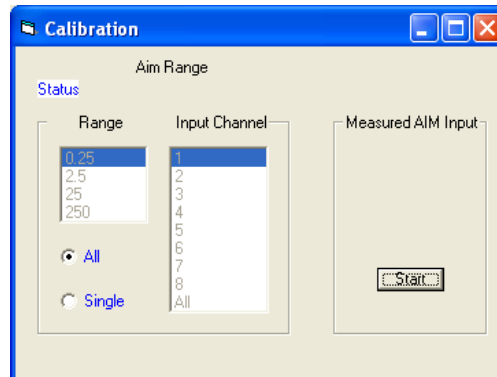
*Figure 3-3 Calibrate F6k AIM Option — 1*

1. Click **OK**. The following prompt appears.

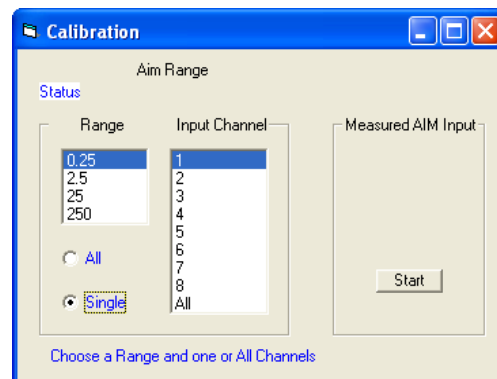


*Figure 3-4 Calibrate F6k AIM Option — 2*

2. Click **OK**. The following dialog box appears with an option to calibrate all ranges ([Figure 3-5](#)) or a single range with one or all channels ([Figure 3-6](#)).



**Figure 3-5 Calibration Dialog Box — All Ranges**



**Figure 3-6 Calibration Dialog Box — Single Range**

**3. Click the **Start** button.**

- If the range is 0.25 or 2.5 volts, a prompt appears requesting you to connect the DC meter V on the F6080 to the logic input.
- If the range is 25 or 250 volts, a prompt appears requesting you to connect the F6k voltage output to the logic input and to the high-voltage input on the F6080.

On each voltage range, the AIM source voltage and measurement sequence occurs as follows:

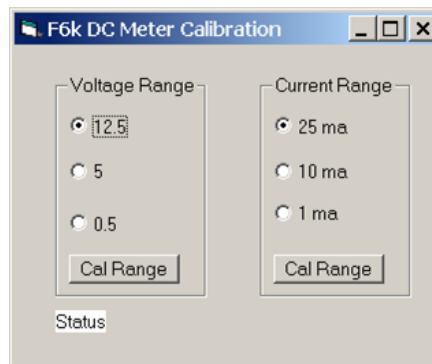
- Apply  $-0.8 * \text{full scale}$  (where full scale =  $\text{range} * \sqrt{2}$ )
- Apply zero volts for offset
- Apply  $0.8 * \text{full scale}$

The software checks the applied voltage and the AIM raw data for expected values before writing new coefficients to the EEPROM. If an error occurs, the coefficients do not change, and the calibration routine stops.

4. Run the AIM test as indicated in “AIM” on page 3-15 to check the result of this calibration.

### Calibrate F6k DC Meter

The Calibrate F6k DC Meter option enables you to calibrate the DC meter (Figure 3-7). Refer to Step 1 in “DC Meter  $\pm$  10 Volts” on page 3-12 and “DC Meter  $\pm$  20 mA” on page 3-13 for instructions on making test connections.

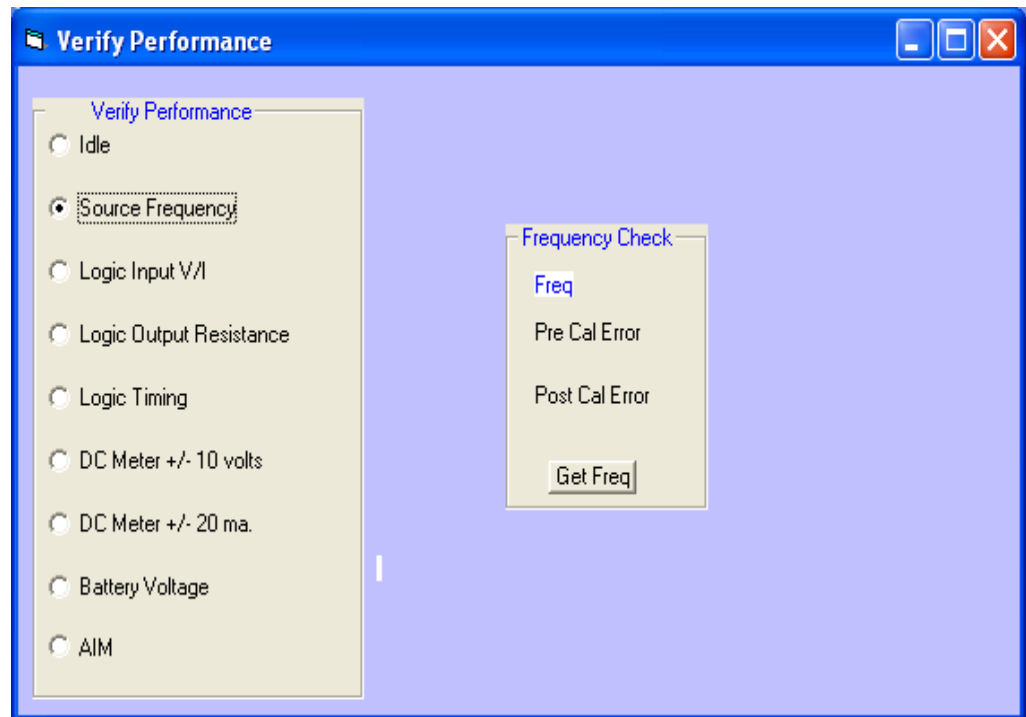


**Figure 3-7 F6k DC Meter Calibration Screen**

1. Click the appropriate **Cal Range** button. You must calibrate each voltmeter and current range separately.
  - The software calibrates the F6k voltmeter on the 12.5, 5, and 0.5 volt ranges for offset and gain. During offset calibration, the source applies zero volts. The software applies amplitudes of 10, 4.5 and 0.45 volts and measures them for the 12.5, 5, and 0.5 volt ranges, respectively.
  - The software calibrates the F6k ammeter on the 25, 10, and 1 milliamp ranges. During offset calibration, the source applies zero amps. The software applies amplitudes of 12, 9, and 0.9 milliamps and measures them for the 25, 10, and 1 milliamp ranges, respectively.
2. To check the results of the calibration process, run the DC meter tests indicated in “DC Meter  $\pm$  10 Volts” on page 3-12 and “DC Meter  $\pm$  20 mA” on page 3-13.

### Check and Calibrate F6k Frequency

Enables you to calibrate the F6000 source frequency (Figure 3-8).



*Figure 3-8 Frequency Calculation Screen*

**1. Select Check And Calibrate F6k Frequency.**

A prompt appears asking you to connect the 10 kHz notch filter to the F6080 Sources V input.

**2. Click OK.**

The Verify screen appears, prompting you to connect source VA to the input of the 10 kHz filter and click the Get Frequency button.

If the source frequency is within the  $\pm 0.5$  ppm tolerance, a message appears telling you that the frequency is within specification, otherwise the frequency will be automatically adjusted to within  $\pm 0.5$  ppm.

The pre cal and post cal errors are displayed on the screen and imported to Excel.

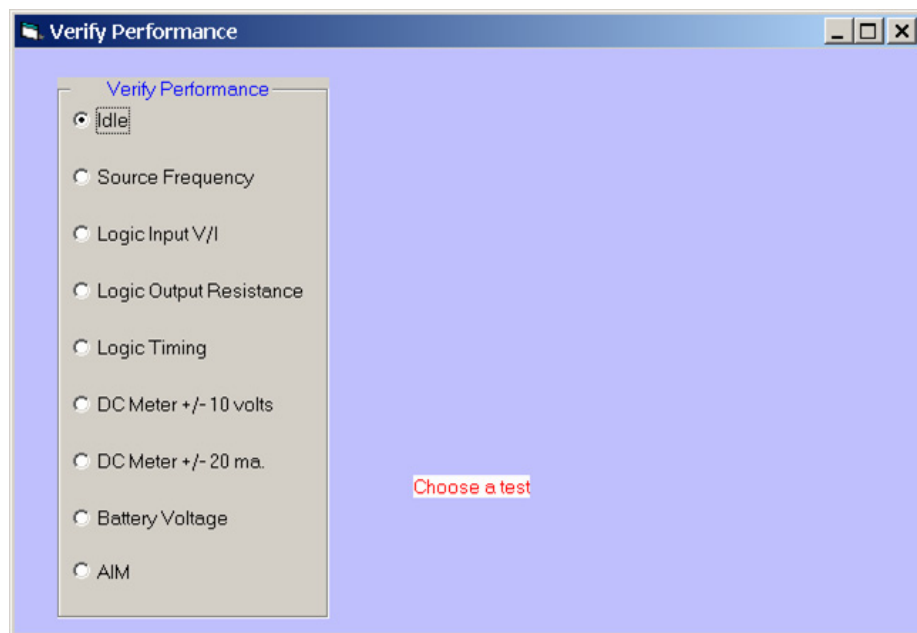
**3. Disconnect the 10 kHz notch filter. This filter should be used only for this test; otherwise it introduces an error in amplitude measurements.**



The frequency calibration will be performed correctly even if the 10 kHz filter is not used; however the measurement accuracy is improved with its use. The filter suppresses any remnant of the F6150s 10 KHz sampling frequency from erroneously tripping the F6080s zero crossing detector.

## Verify Performance

The Verify Other Function option launches the Verify Performance screen, which contains the following options (Figure 3-9).



*Figure 3-9 Verify Performance – Idle*

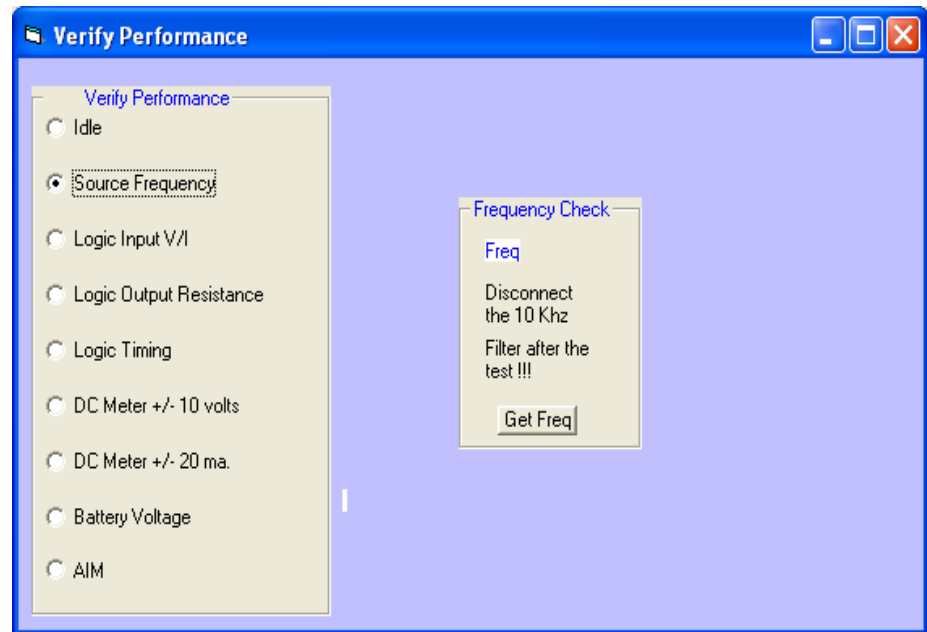
### Idle

Enables you to choose not to perform any further actions. Since no further action is required, the screen displays the prompt `Choose a test`.

### Source Frequency

Enables you to measure the F6k source frequency (Figure 3-10). When you select Source Frequency, a prompt appears asking you to connect the 10 KHz filter. If the filter is not available, continue without it.

1. Connect the field calibrator voltage input to the F6150/A VA voltage source.
2. Click the **Get Freq** button. The voltage source is turned on. After a gated time interval, the results of the frequency measurement appear on an Excel spreadsheet. To pass, the error of measurement should be less than  $\pm 1.5$  ppm.



*Figure 3-10 Verify Performance – Source*



The frequency test will be performed correctly even if the 10 kHz filter is not used; however the measurement accuracy is improved with its use. The filter suppresses any remnant of the F6150s 10 KHz sampling frequency from erroneously tripping the F6080s zero crossing detector.

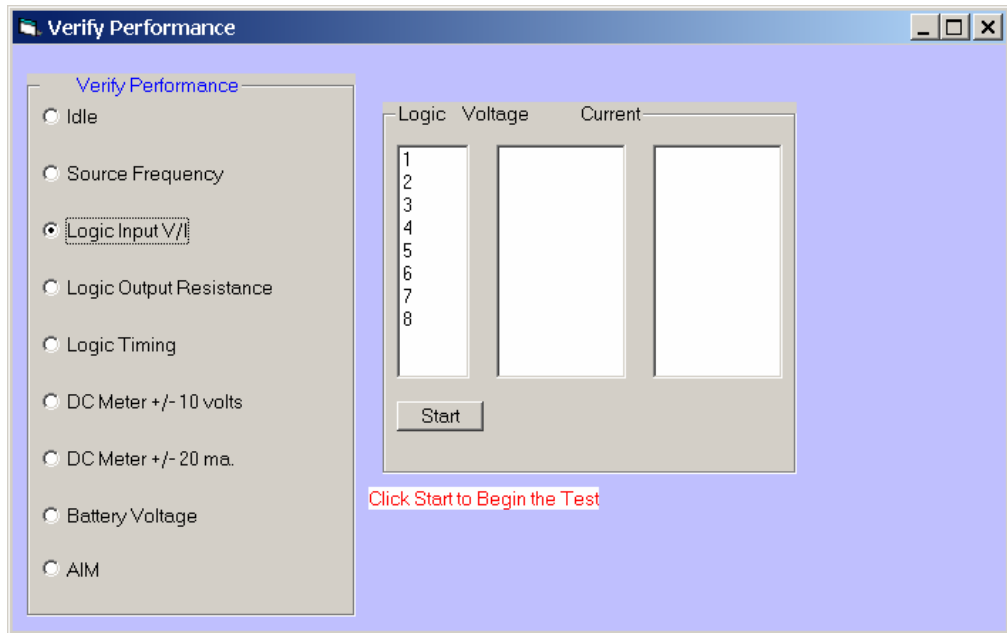
### Logic Input V/I

Measures the input open circuit voltage and short circuit current of logic inputs (Figure 3-11).

1. Connect the logic input A of the F6080 to the F6150/A logic input.
2. Click the **Start** button. The program measures open circuit voltage and short circuit current of the logic input. The results appear on an Excel spreadsheet.

The measurement process repeats itself for all eight logic inputs. The test criteria vary with the type of logic I/O board inserted in the F6150/A and whether an AIM board is present.

The program automatically determines the board variations and the test result criteria change accordingly.



**Figure 3-11 Verify Performance – Logic Input V/I**

### Logic Output Resistance

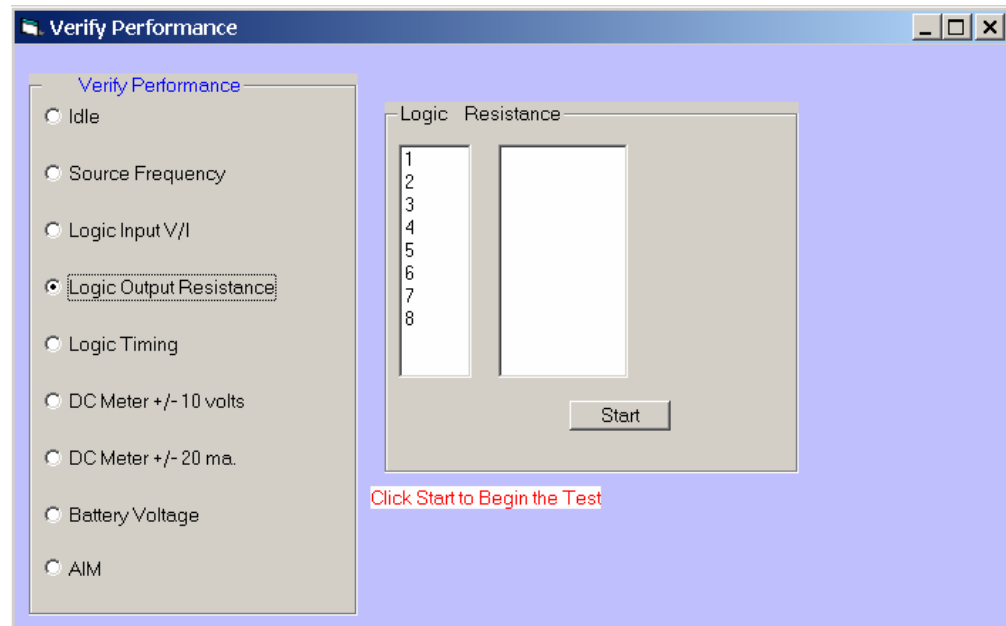
Measures the resistance of the logic outputs (Figure 3-12).

1. Connect the logic output of the F6080 to the F6150/A logic output.
2. Click the **Start** button. The program measures the resistance of the logic output. The results appear on an Excel spreadsheet.

The measurement process repeats itself for all eight logic inputs. The test criteria vary with the type of logic I/O board inserted in the F6150/A.

For older I/O boards, all eight logic outputs have a resistance tolerance of 4 to 10 ohms. New logic I/O boards have a tolerance of 0.5 ohms for logic outputs 1 to 4 and a tolerance of 4 to 10 ohms for logic outputs 5 through 8.



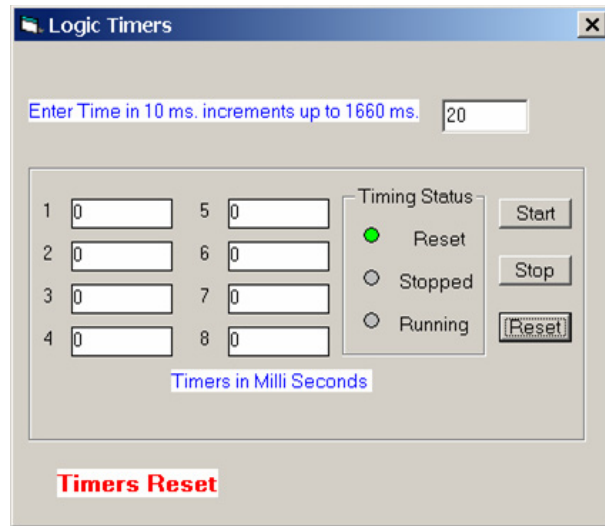


**Figure 3-12** *Verify Performance – Logic Output Resistance*

### Logic Timing

Measures logic timing from 10 to 1660 milliseconds ([Figure 3-13](#)).

1. Connect logic input A of the F6080 to logic input 1 of the F6150/A.
2. Connect logic input B of the F6080 to logic input 8 of the F6150/A. A screen appears that displays the results of the eight timers, as well as controls for starting, stopping, and resetting the timers. The program automatically resets all timers after the screen is loaded.



**Figure 3-13 Logic Timers Dialog Box**

3. Enter the time in 10-millisecond increments, from a minimum of 10 to a maximum of 1660 milliseconds. The default is 20 milliseconds.
4. Click Start to execute the timers for the given input.
5. Click Reset to start another test.

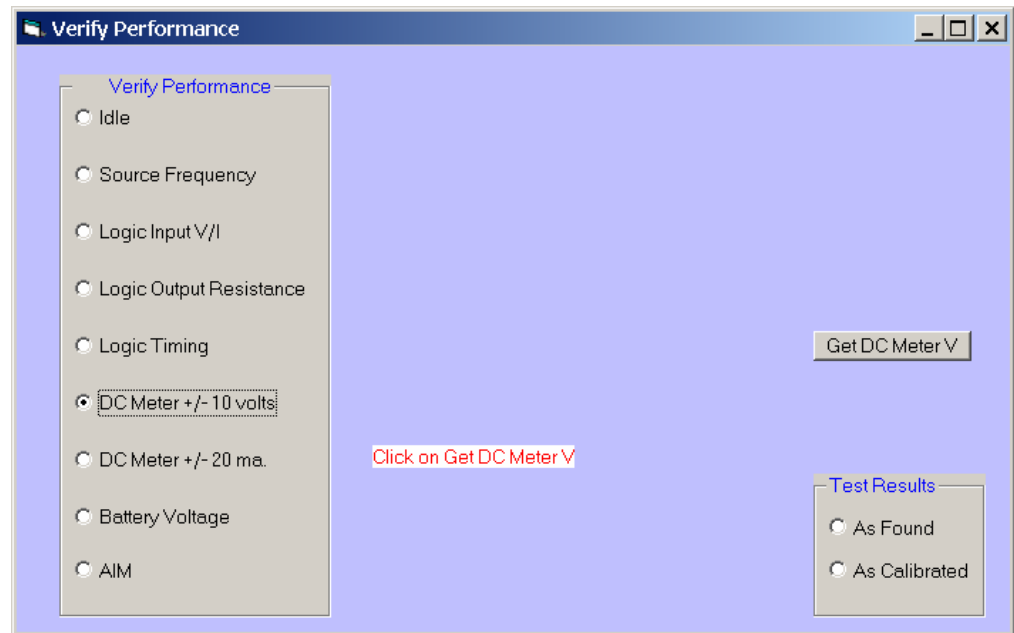
All timers start by a transition from logic input A of the F6080 and stop when they transition to logic input B. The program can detect whether the start or stop transition is missing. This would occur due to an error in connections from the field calibrator to the F6150/A.

Test results should indicate that all eight timers equal the interval entered  $\pm 100$  microseconds.

### DC Meter $\pm 10$ Volts

Measures the DC voltmeter on all ranges (Figure 3-14).

1. Connect DC meter V of the field calibrator to the F6150/A DC voltmeter.
2. Under Test Results, select either **As Found** or **As Calibrated**.
3. Click the **Get DC Meter V** button. This action sets the F6150/A meter range to 12.5 volts. The field calibrator then sources 10 volts and measures the F6150/A meter output.



**Figure 3-14 DC Meter  $\pm 10$  Volts Dialog Box**

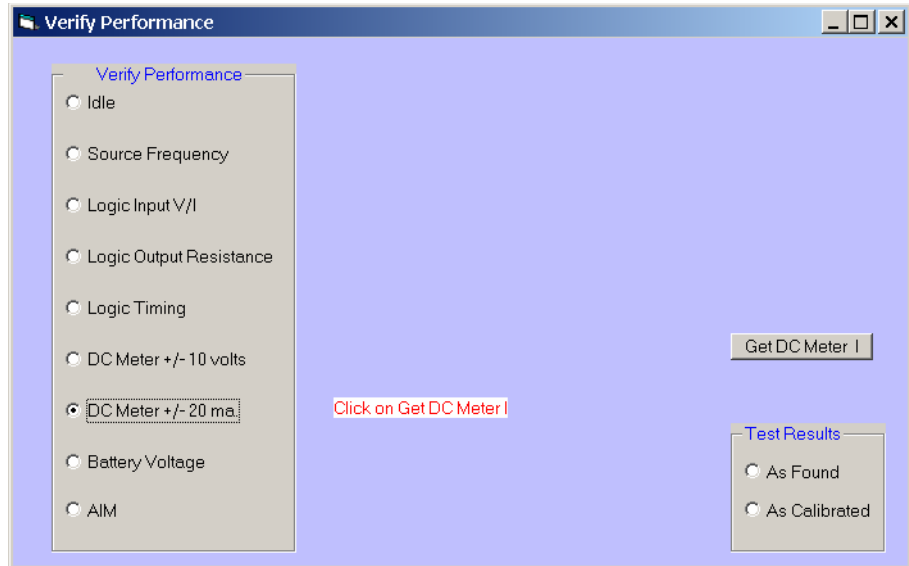
The measuring sequence continues on the 5 and 0.5 volt ranges of the instrument with an applied voltage of 4.5 and 0.45 volts, respectively.

Test results should indicate a difference between the applied voltage and the measured voltage of less than or equal to  $\pm 0.0005$  volts.

### DC Meter $\pm 20$ mA

Measures the DC ammeter on all ranges (Figure 3-15).

1. Connect DC meter I of the F6080 to the F6150/A DC ammeter.
2. Under Test Results, select either **As Found** or **As Calibrated**.
3. Click the **Get DC Meter I** button to set the F6150/A meter range to 20 milliamps. The field calibrator then sources 12 milliamps and measures the F6150/A output.



**Figure 3-15 DC Meter  $\pm$  20 Milliamp Dialog Box**

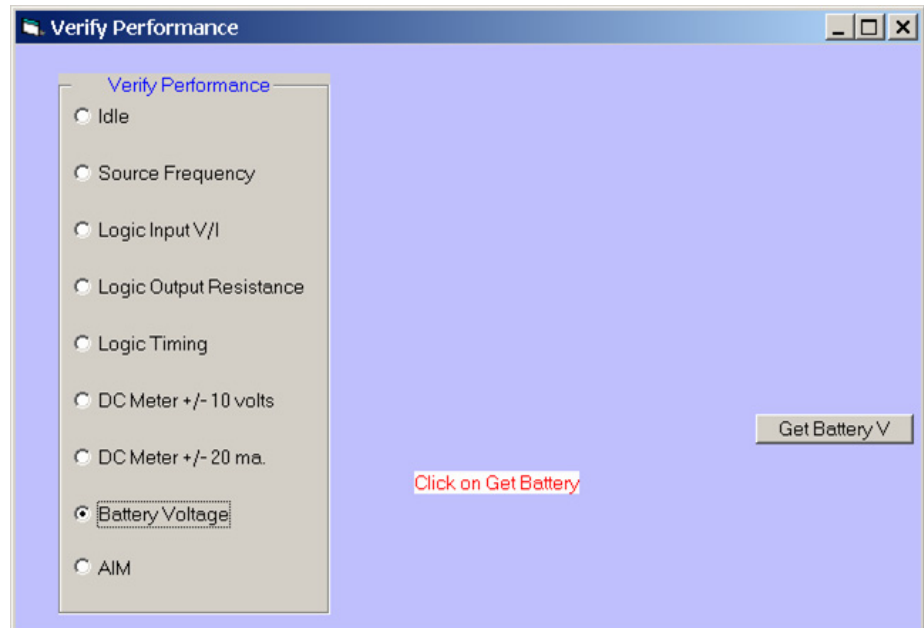
The measuring sequence continues on the 10 and 1 milliamp ranges of the instrument with an applied current of 9 and 0.9 milliamps, respectively.

Test results should indicate a difference between the applied current and the measured current of less than or equal to  $\pm 0.0005$  milliamps.

### **Battery Voltage**

Measures the battery simulator voltage on all ranges (Figure 3-16).

1. Connect the high voltage input of the F6080 to the F6k battery simulator.
2. Click the **Get Battery V** button. The F6080 measures the battery simulator voltage on the 48, 125, and 250 volt ranges.



**Figure 3-16 Battery Voltage Dialog Box**

If you install the variable battery simulator, you can make a 300-volt measurement.

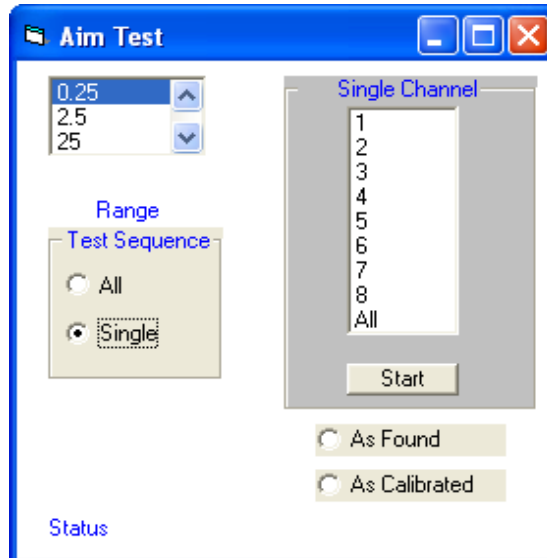
Test results should indicate a measured value equal to the set value with a difference of  $\pm 5\%$ .

### AIM

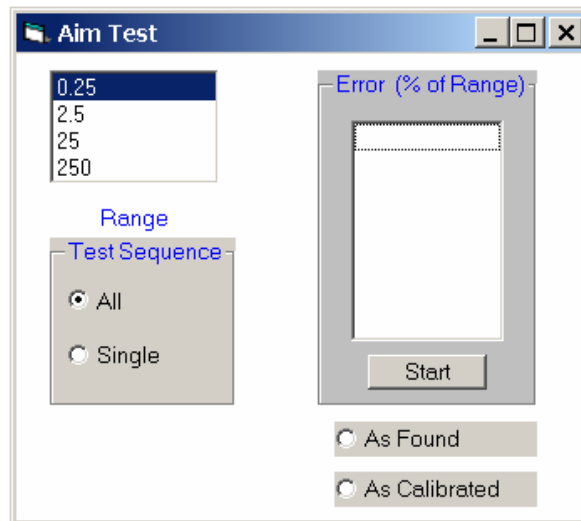
Measures the AIM output voltage on all ranges (Figure 3-18). To run this test, the AIM board must be installed.

1. Install the AIM board.

A dialog box appears with an option to test a single range and one or all channels (Figure 3-17) or all ranges and channels (Figure 3-18). These ranges are 0.25, 2.5, 25, and 250 volts.



*Figure 3-17 AIM Test Dialog Box — Single Range*



*Figure 3-18 AIM Test Dialog Box — All*

2. Choose either **As Found** or **As Calibrated**.
3. Click the **Start** button.

If the range is 0.25 or 2.5 volts, a prompt appears asking you to connect the DC meter V on the F6080 to the logic input.

If the range is 25 or 250 volts, a prompt appears asking you to connect the F6k VA voltage output to the logic input and to the high voltage input on the field calibrator.

Depending on the selected option, the F6080 measures a single range and one or all channels or all ranges and channels.

**Table 3-1 Ranges and Applied Voltages per Source**

<b>Range</b>	<b>Applied Voltage</b>	<b>Source</b>
0.25	0.2	F6080
2.5	2.0	F6080
25	22.5	F6k VA
250	225	F6k VA

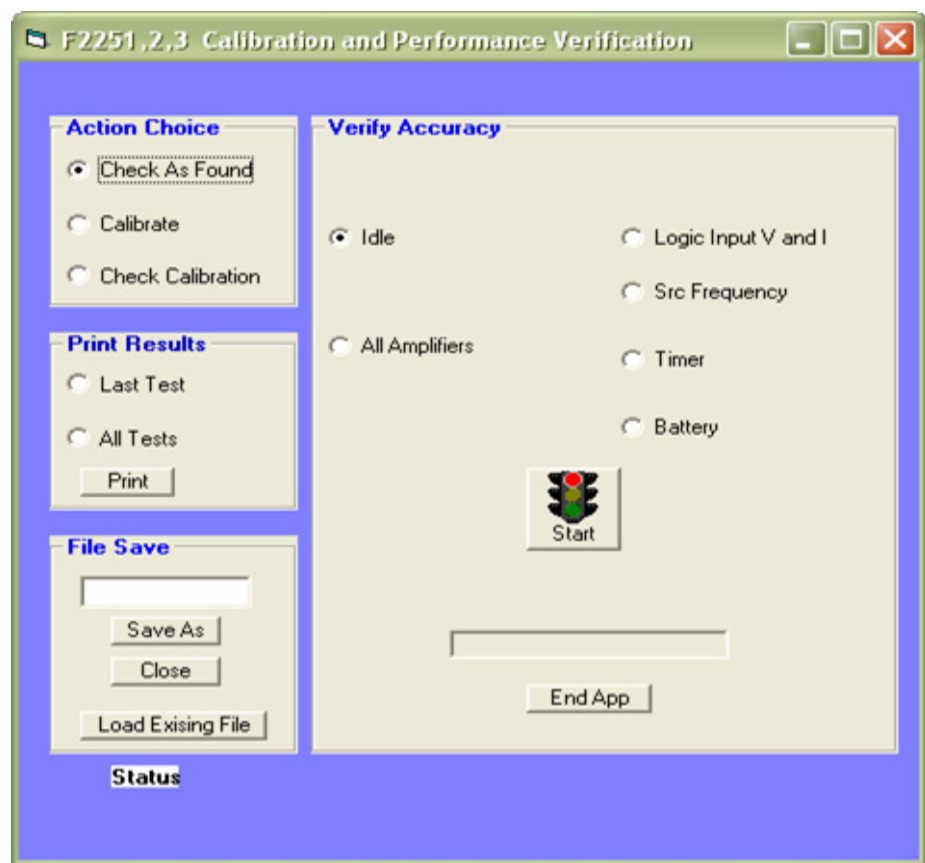
The 0.25-volt range averages the AIM output. The software then deducts the applied voltage from the AIM output voltage, with this difference reflecting the error. The test criteria dictate an ABS (error) of  $0.0006 * \text{SQRT}(2) * \text{Range}$ .





## 4. F215x and F225x Specific Calibration

The F2K Test or Calibrate Action screen enables you to load and edit existing Excel files, calibrate amplifiers or perform various measurements, and print current and former tests.



*Figure 4-1 F2251,2,3 Calibration and Performance Verification Screen*

### Editing Excel Files

On the F2251,2,3 Calibration and Performance Verification screen, the File Save section enables you to load and edit an existing Excel file. This enables you to finish an incomplete file.

1. In the File Save section, click **Load Existing File**. A Microsoft dialog box appears.
2. Select the Excel file you want to edit.
3. Use Microsoft Excel to edit the selected file.
4. Click **Save As** to save your changes. A prompt appears asking you to enter a file name. (If a file name already appears in the box, this prompt does not appear.)
5. Enter a file name in the File Save dialog box. The software adds an .xls extension to the end of the file name.



**If you click the End App button, a prompt appears that asks you to save changes to the file or to close the program without saving your changes.**

## Action Choice

The F2251,2,3 Calibration and Performance Verification screen has an Action section that enables you to:

- Check As Found accuracy
- Calibrate amplifiers gain
- Check Calibration accuracy

Select the radio button for the action you want to perform.

## Idle

Enables you to choose not to perform any further actions. Since no further action is required, the screen displays the prompt *Choose a test*.

## Check Amplifier Accuracy

The Check As Found option determines whether you need to calibrate the amplifiers ([Figure 4-1](#)). You can choose to test all of the amplifiers. The test result contains the DC amplitude accuracy for all amplitude ranges in the 75 and 300 VA configurations.

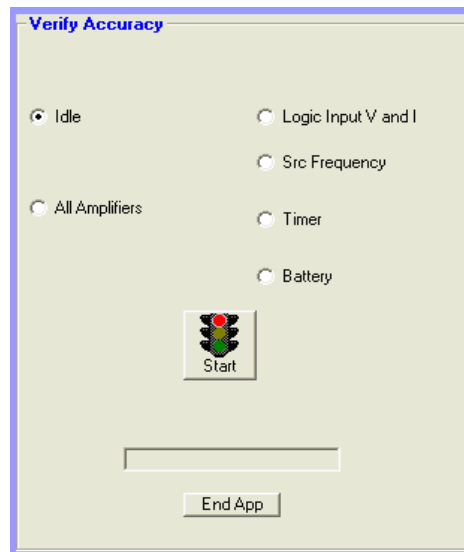
During this test, no changes occur to the calibration coefficients. The Excel test file displays the term Pass if the criteria occur within the test specification. If the criteria occur outside the specification, the file displays the term Fail.

The measured value and percent deviation from Nominal appear at the top of the test sheet where the definition for Nominal appears.

The Check Calibration accuracy option is run after Amplifier Calibration. It is similar to Check As Found, except that the amplifier EEPROM gain and offset coefficients are optimized.

## Verifying Other Functions

The Verify Accuracy section enables you to verify other functions. The choices are made via radio buttons on the right hand side of the screen (Figure 4-2).



*Figure 4-2 Verify Performance Screen*

- **Idle** — enables you to choose not to perform any further actions. When you select this option, the screen displays the prompt Choose a test.
- **Logic Input V and I (F225x only)** — measures the input open circuit voltage and short circuit current of logic inputs. After you select this option:
  1. Respond to the F2251, 2, 3 CalVerify box by selecting **OK** to perform the test or **Cancel** to abort the test.
  2. Connect the F6080 Sources V to the F2250 START Contact input. Click the **OK** button on the F2251, 2, 3 CalVerify box.
  3. Connect the F6080 Sources I to the F2250 START Contact input. Click the **OK** button on the F2251, 2, 3 CalVerify box.
  4. Connect the F6080 Sources V to the F2250 STOP Contact input. Click the **OK** button on the F2251, 2, 3 CalVerify box.

5. Connect the F6080 Sources V to the F2250 STOP Contact input. Click the **OK** button on the F2251, 2, 3 CalVerify box.
6. Click the **Start** button. The program measures open circuit voltage and short circuit current of the logic input. The results appear on an Excel spreadsheet.

The measurement process repeats itself for START and STOP logic inputs.

The program automatically determines the test result criteria.

- **Logic Input V and I (F215x only)** — measures the input open circuit voltage and short circuit current of logic inputs.
  1. Select the **Logic Input V and I** radio button.
  2. Respond to the F2251, 2, 3 CalVerify box by selecting **OK** to perform the test or **Cancel** to abort the test.
  3. Connect the F6080 Sources V to the F2150 blue terminals. Click the **OK** button on the F2251, 2, 3 CalVerify box.

The program automatically determines the test result criteria.

- **Source Frequency (F225x and F215x)** — enables you to measure the F2k source frequency.
  1. Connect the field calibrator voltage input to the F2K VA voltage source.
  2. Select the **Src Frequency** radio button on the F2251, 2, 3 Calibration and Performance Verification screen.
  3. Respond to the F2251, 2, 3 CalVerify box by selecting **OK** to perform the test or **Cancel** to abort the test.

The program automatically determines the test result criteria.

- **Timer (F225x only)** — measures logic timing of 1230 milliseconds. Carefully make the following connections between the F6080 and the F2350 under test.
  1. Connect the F6080 Logic Input A red terminal to the F2250 Logic input contact START yellow terminal.
  2. Connect the F6080 Logic Input A white terminal to the F2250 Logic input contact START middle terminal. (**NOTE:** In some cases this terminal may be black; in other cases it is white.)
  3. Connect the F6080 Logic Input B red terminal to the F2250 Logic input contact STOP yellow terminal.

4. Connect the F6080 Logic Input B white terminal to the F2250 Logic input contact START middle terminal. (**NOTE:** In some cases this terminal may be black; in other cases it is white.)
5. Select the **Timer** radio button on the F2251, 2, 3 Calibration and Performance Verification screen.
6. Click the **OK** button on the F2251, 2, 3 CalVerify box. The test starts automatically.

The program automatically determines the test results.

- **Battery (F225x only)** — checks the Battery Voltage Accuracy on the 48, 124, and 250 volt ranges.
  1. Set the battery voltage to 48 volts and turn on the batter simulator.
  2. Select **Battery** on the F2251, 2, 3 Calibration and Performance Verification screen
  3. When prompted, turn off the battery simulator, set the battery voltage to 250 volts, and turn on the battery simulator.
  4. When prompted, turn off the battery simulator.

The program automatically exports the test results to Excel.

