2.7.2 IEEE-488 bus error reporting

You can detect errors over the bus by testing the state of EAV (Error Available) bit (bit 2) in the status byte. (Use the *STB? query or serial polling to request the status byte.) If you wish to generate an SRQ (Service Request) on errors, send "*SRE 4" to the instrument to enable SRQ on errors.

You can query the instrument for the type of error by using the ":SYSTem:ERRor?" query. The Model 2001 will respond with the error number and a text message describing the nature of the error.

See paragraph 3.5 in Section 3 for more information on bus error reporting.

2.8 Comprehensive calibration

The comprehensive calibration procedure calibrates DCV, DCI (except for the 2A range), ¾2, and ¾4 functions. At the end of the DC calibration procedure, AC self-calibration is performed to complete the calibration process.

Comprehensive calibration should be performed at least once a year, or every 90 days to ensure the unit meets the corresponding specifications.

The comprehensive calibration procedure covered in this paragraph is normally the only calibration required in the field. However, if the unit has been repaired, you should perform the low-level calibration procedure explained in paragraph 2.10.

2.8.1 Recommended equipment for comprehensive calibration

Table 2-3 lists all test equipment recommended for comprehensive calibration. Alternate equipment (such as a DC transfer standard and characterized resistors) may be used as long as that equipment has specifications at least as good as those listed in the table. See Appendix D for a list of alternate calibration sources.

NOTE

Do not connect test equipment to the Model 2001 through a scanner.

2.8.2 Front panel comprehensive calibration

Follow the steps below to calibrate the Model 2001 from the front panel. Refer to paragraph 2.8.3 below for the procedure to calibrate the unit over the IEEE-488 bus. Table 2-4 summarizes the front panel calibration procedure.

Table 2-4
Front panel comprehensive calibration summary

Step	Description	Equipment/ connections
1	Warm-up, unlock calibration	None
2	DC zero calibration	Low-thermal short
3	+2VDC calibration	DC calibrator
4	+20VDC calibration	DC calibrator
5	20k¾ calibration	Ohms calibrator
6	1M¾ calibration	Ohms calibrator
7	Open-circuit calibration	Disconnect leads
8	AC self-calibration	Disconnect leads
9	Enter calibration dates	None
10	Save calibration constants	None

Table 2-3
Recommended equipment for comprehensive calibration

Mfg.	Model	Description	Specifications*
Fluke	5700A	Calibrator	±5ppm basic uncertainty. DC voltage: 2V: ±5ppm 20V: ±5ppm Resistance: 19k¾: ±11ppm 1M¾: ±18ppm
Keithley	8610	Low-thermal shorting plug	

* 90-day calibrator specifications shown include total uncertainty at specified output. The 2V output includes 0.5ppm transfer uncertainty. Use 20k¾ instead of 19k¾ if available with alternate resistance standard. See Appendix D for a list of alternate calibration sources.

Procedure

Step 1: Prepare the Model 2001 for calibration

1. Turn on the power, and allow the Model 2001 to warm up for at least one hour before performing calibration.
2. Unlock comprehensive calibration by briefly pressing in on the recessed front panel CAL switch, and verify that the following message is displayed:

   CALIBRATION UNLOCKED
   Comprehensive calibration can now be run

3. Enter the front panel calibration menu as follows:
   A. From normal display, press MENU.
   B. Select CALIBRATION, and press ENTER.
   C. Select COMPREHENSIVE, then press ENTER.
4. At this point, the instrument will display the following message:

   DC CALIBRATION PHASE

Step 2: DC zero calibration

1. Press ENTER. The instrument will display the following prompt.

   SHORT-CIRCUIT INPUTS

2. Connect the Model 8610 low-thermal short to the instrument INPUT and SENSE terminals, as shown in Figure 2-1. Wait at least three minutes before proceeding to allow for thermal equilibrium.

   NOTE

   Be sure to connect the low-thermal short properly to the HI, LO, and SENSE terminals. Keep drafts away from low-thermal connections to avoid thermal drift, which could affect calibration accuracy.

3. Press ENTER. The instrument will then begin DC zero calibration. While calibration is in progress, the following will be displayed:

   Performing Short-Ckt Calibration

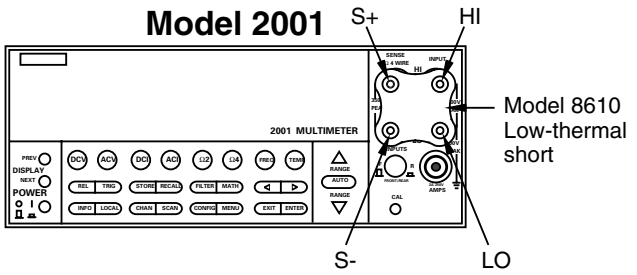

Figure 2-1
Low-thermal short connections

Step 3: +2V DC calibration

1. When the DC zero calibration step is completed, the following message will be displayed:

   CONNECT 2 VDC CAL

2. Disconnect the low-thermal short, and connect the DC calibrator to the INPUT jacks, as shown in Figure 2-2.

   NOTE

   Although 4-wire connections are shown, the sense leads are connected and disconnected at various points in the procedure by turning calibrator external sense on or off as appropriate. If your calibrator does not have provisions for turning external sense on and off, disconnect the sense leads when external sensing is to be turned off, and connect the sense leads when external sensing is to be turned on.

3. Set the calibrator output to +2.0000000V, and turn external sense off.
4. Press ENTER, and note that the Model 2001 displays the presently selected calibration voltage:

   VOLTAGE = 2.0000000

   (At this point, you can use the cursor and range keys to set the calibration voltage to a value from 0.98 to 2.1V if your calibrator cannot source 2V).

   NOTE

   For best results, it is recommended that you use the displayed calibration values throughout the procedure whenever possible.

5. Press ENTER. The instrument will display the following during calibration:

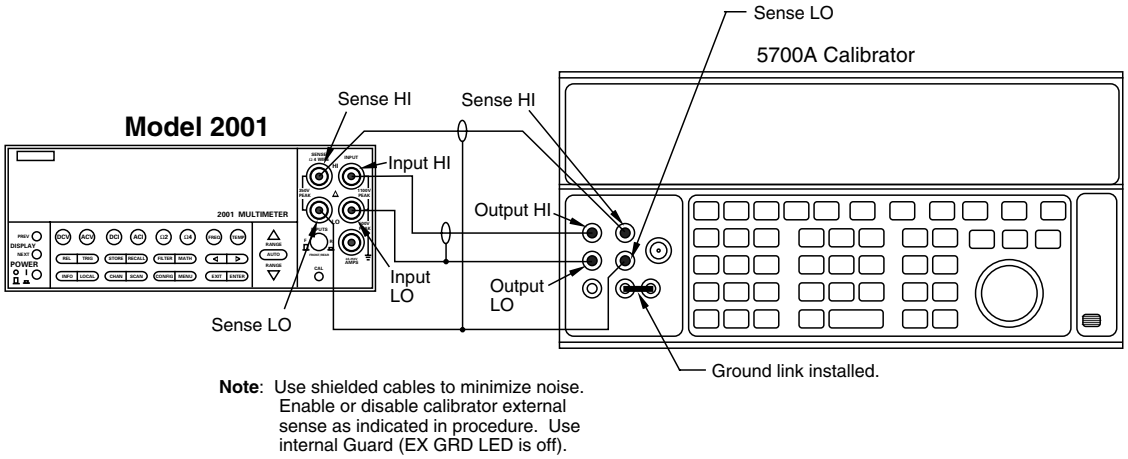

Figure 2-2
Connections for comprehensive calibration

Performing 2 VDC Calibration

Step 4: +20V DC calibration

1. After completing 2VDC calibration, the instrument will display the following:

   CONNECT 20 VDC CAL

2. Set the DC calibrator output to +20.000000V.
3. Press ENTER, and note that the instrument displays the calibration voltage:

   VOLTAGE = 20.0000000

   (At this point, you can use the cursor and range keys to set the calibration voltage to a value from 9.8 to 21V if your calibrator cannot source 20V).

4. Press ENTER. The instrument will display the following message to indicate it is performing 20V DC calibration:

   Performing 20 VDC Calibration

Step 5: 20k¾ calibration

1. After completing 20VDC calibration, the instrument will display the following:

   CONNECT 20kOHM RES

2. Set the calibrator output to 19.0000k¾, and turn external sense on.
3. Press ENTER, and note that the Model 2001 displays the resistance calibration value:

   OHMS = 20000.000

4. Using the cursor and range keys, set the resistance value displayed by the Model 2001 to the exact resistance value displayed by the calibrator. (The allowable range is from 9k¾ to 21k¾.)
5. Press ENTER, and note that the instrument displays the following during 20k¾ calibration:

   Performing 20 kOHM Calibration

Step 6: 1M¾ calibration

1. After completing 20k¾ calibration, the instrument will display the following:

   CONNECT 1.0 MOHM RES

2. Set the calibrator output to 1.00000M¾, and turn external sense off.
3. Press ENTER, and note that the Model 2001 displays the resistance calibration value:

   OHMS = 1000000.000

4. Using the cursor and range keys, set the resistance value displayed by the Model 2001 to the exact resistance value displayed by the calibrator. (The allowable range for this parameter is from 800k¾ to 2M¾.)
5. Press ENTER, and note that the instrument displays the following during 1M¾ calibration:

   Performing 1.0 MOHM Calibration

Step 7: Open-circuit calibration

1. At this point, the instrument will display the following message advising you to disconnect test leads:

   OPEN CIRCUIT INPUTS

2. Disconnect all test leads from the INPUT and SENSE jacks, then press ENTER. During this calibration phase, the instrument will display the following:

   Performing Open-Ckt Calibration

Step 8: AC self-calibration

1. After open circuit calibration, the instrument will display the following message:

   AC CALIBRATION PHASE

2. Make sure all test leads are still disconnected from the Model 2001 INPUT and SENSE jacks.
3. Press ENTER to perform AC calibration, which will take about six minutes to complete. During AC calibration, the instrument will display the following:

   Calibrating AC: Please wait

4. When AC calibration is finished, the instrument will display the following:

   AC CAL COMPLETE

Step 9: Enter calibration dates

1. Press ENTER, and note that the instrument prompts you to enter the present calibration date:

   CAL DATE: 01/01/92

2. Use the cursor and range keys to enter the current date as the calibration date, then press ENTER. Press ENTER again to confirm the date as being correct.
3. The instrument will then prompt you to enter the due date for next calibration:

   NEXT CAL: 01/01/93

4. Use the cursor and range keys to set the date as desired, then press ENTER. Press ENTER a second time to confirm your selection.

Step 10: Save calibration constants

1. At the end of a successful calibration cycle, the instrument will display the following:

   CALIBRATION SUCCESS

2. If you wish to save calibration constants from the procedure just completed, press ENTER.
3. If you do not want to save calibration constants from the procedure just completed and wish instead to restore previous constants, press EXIT.
4. Press EXIT to return to normal display after calibration.

NOTE

Comprehensive calibration will be automatically locked out after the calibration procedure has been completed.

2.8.3 IEEE-488 bus comprehensive calibration

Follow the procedure outlined below to perform comprehensive calibration over the IEEE-488 bus. Use the program listed in paragraph 2.6.3 or other similar program to send commands to the instrument. Table 2-5 summarizes the calibration procedure and bus commands.

Procedure

Step 1: Prepare the Model 2001 for calibration

1. Connect the Model 2001 to the IEEE-488 bus of the computer using a shielded IEEE-488 cable such as the Keithley Model 7007.
2. Turn on the power, and allow the Model 2001 to warm up for at least one hour before performing calibration.
3. Unlock calibration by briefly pressing in on the recessed front panel CAL switch, and verify that the following message is displayed:

   CALIBRATION UNLOCKED
   Comprehensive calibration can now be run

NOTE

You can query the instrument for the state of the comprehensive CAL switch by using the following query:

:CAL:PROT:SWIT?

A returned value of 1 indicates that calibration is locked, while a returned value of 0 shows that calibration is unlocked.

4. Make sure the primary address of the Model 2001 is the same as the address specified in the program you will be using to send commands (see paragraph 2.6.3).