CALIBRATION PROCEDURE

General

The instrument should be calibrated following a warm-up period of at least 30 minutes in an ambient termperature of 18°C to 22°C. If the AC compensation is to be adjusted this must be done with the case open, once this is completed the instrument must be re-cased and allowed to stabilise for 30 minutes before further calibration is attempted.

Equipment requirements

1. In order to perform closed case calibration you will need either a GPIB computer or RS232 equipped computer operating at 9600 baud.

2. Calibration sources of accuracy at least 5 times better than the instrument specification.

Procedure

If the AC compensation requires adjustment, dismantle the instrument, being careful not to disturb the screens or the input wiring, and ensure that the main p.c.b. position is not changed relative to the lower screen (this would adversely affect the high frequency accuracy).

The following assumes that the instrument is correctly calibrated at 50Hz. If it is not then the calibration figures at 50Hz should be noted for each range, and these figures used instead of those given below; e.g. if you apply 1V at 50Hz on the 4V range and the reading is 1.0200V then when you apply 1V at 10kHz adjust for a reading of 1.0200V not 1.0000V.

To adjust the high frequency response proceed as follows:

Select the 400V AC range, apply 100V 10KHz and adjust VC1 using an insulated trimming tool until the display reads 100.00 ± 1%.

(a) Select the 4000V AC range, apply 750V 400Hz and check that the reading is between 742.5 and 757.5, if it is not then adjust the values of the select-on-test capacitors C24 and/or C37. Disconnect the input signal.

(b) Select the 4V AC range, apply 1V 10KHz and adjust VC2 for a reading of 1.0000 ± 1%.

(c) Select the 40V AC range, apply 10V 10KHz and adjust VC3 for a reading of 10.000 ± 1%.

Re-case the multimeter and leave for 30 minutes before performing further calibration.

Closed case calibration

The instrument may be calibrated either completely or on individual ranges only. Calibration may be carried via the front panel controls, the GPIB or the RS232 computer interfaces. To enable calibration and allow writing to the calibration memory, a shorted 3.5mm jack plug must be inserted into the rear panel calibration socket. When the plug is inserted the front panel CAL lamp will flash. When the plug is in position the power must NOT be removed otherwise the calibration memory may be corrupted. If the CAL function is selected the lamp will stop flashing and remain on, the calibration function is then enabled. To disable the calibration function (and before removing the power), remove the jack plug, the CAL lamp will then go out and normal operation will resume.

The ranges are then calibrated by applying two input levels on each range, one close to full scale and one at or close to zero.

Front panel calibration

With the CAL lamp flashing, press the SHIFT key, causing the SHIFT lamp to flash, then press the CAL key (the 4000 range key), the CAL lamp will light continuously and the message 'CAL' will appear on the display.

To calibrate the 4VDC range, for example, proceed as follows:

1. Select the 4VDC range.

2. Apply a precisely known reference voltage e.g. 4.0000V.

3. Press the SHIFT key followed by the RECALL key. The current measurement value will be displayed with the first digit flashing. The value displayed may now be edited to agree with the reference voltage, e.g. 4.0000V. Once you have entered the correct reading press the ENTER key; the instrument will measure the reference voltage and when completed it will display the message 'DONE'.

4. Short the inputs together.

5. Press the SHIFT then RECALL keys.

6. Edit the display using the numeric keys and if necessary the ± key until the display reads 0.0000, then press the ENTER key. The instrument will measure the input voltage and when complete will display 'DONE' followed by either 'GOOD' or 'BAD'. At this point the instrument calculates its calibration constants and stores them in the calibration memory. If the calculated constants are within limits the 'GOOD' message is displayed, otherwise the 'BAD' message is displayed. If the 'BAD' message is displayed you may have made an error, either entered an incorrect value or applied the wrong voltage, so repeat the high and low calibration points.

The above procedure should be repeated for each range that you wish to calibrate.

NOTE!

If you wish to calibrate the high AC and DC voltage ranges ensure that these ranges are done after the other voltage and resistance ranges. The multimeter main p.c.b. (in common with all multimeters) will suffer from a certain amount of dielectric absorption, this will cause an apparent leakage current to flow and small offsets to appear. The dielectric absorption effect will continue for a short time after the high voltage has been removed and the accuracy will be impaired, so it is important to perform all low voltage and resistance calibration before a high voltage is applied.

The current ranges should be calibrated after the voltage and resistance ranges. The 10A AC and DC ranges should be calibrated after the others in order to prevent problems caused by self-heating when 10A is flowing.

The preferred order of calibration is:

400Ω, 4KΩ, 40KΩ, 400KΩ, 4000KΩ, 40MΩ, .4V DC, 4V DC, 40V DC, 400V DC, .4V AC, 4V AC, 40V AC, 400V AC, 750V AC, 1000V DC, 4mA DC, 400mA DC, 4mA AC, 400mA AC, 10A AC, 10A DC.

On all functions the calibration high point should be close to full scale (subject to not exceeding the maximum input levels). On DCV, DCmA and Ohms a low point of 0 may be used, but on ACV and ACmA a low point of 10% of full-scale should be used, do NOT use zero. With zero input a small reading will be seen on the AC functions. This is normal and may be ignored.

RS232 CALIBRATION

General

The basic procedure is the same as front panel calibration, i.e. the calibration jack plug is inserted into the CAL socket causing the CAL lamp to flash. The command 'C1' is then sent, causing the CAL lamp to stay on continuously. Each range must then be calibrated at two points, the high point (close to full scale) and the low point (close to 0). The high and low calibration commands begin with the letters 'H' and 'L' respectively. To send a calibration high point of 4.000V send the command 'H4.0000' or 'H4'. To send a low point of 0V, send the command 'L0'. The instrument measures the input voltage each time and when it has finished the message 'DONE' appears on the display and the string 'DONE 〈term〉' is sent to the computer via the RS232 port. 〈term〉 is the currently selected terminator (〈CR〉, 〈LF〉, 〈CRLF〉 or none).

Example: to calibrate the 4V DC range do the following:

1. Send the command string 'F1R1' (select the 4V DC range).
2. Apply 4.0000V to the multimeter point.
3. Send the command 'H4'.
4. Wait until the message 'DONE' is returned.
5. Apply 0.0000V to the multimeter input.
6. Send the command 'L0'.
7. Wait until the messages 'DONE' followed by 'GOOD' or 'BAD' are returned. If the message 'GOOD' appears then calibration of this range is finished. If the message 'BAD' appears, a mistake has probably been made so repeat the high and low calibration steps.

GPIB CALIBRATION

General

The basic procedure is the same as RS232 calibration, i.e. the calibration jack plug is inserted, causing the 'CAL' lamp to flash. Then the command C1' is sent causing the 'CAL' lamp to come on continuously. The high and low commands begin with the letters 'H' and 'L' respectively. To send a calibration high point of 4.0000V send the command 'H4.0000' or 'H4'. To send a calibration low point of 0V send the command 'L0'. The instrument measures the input voltage each time and displays the message 'DONE', it then informs the controller by sending a service request if the service request is enabled. See the Operating Manual for more information on the SRQ function. Assuming that SRQ is enabled and that you send the high command before the low command, then after the high command the instrument measures the input and when it has finished (approximately 3 seconds) it will request service, and the SRQ response byte returned will be 42 HEX, i.e. calibration completed. After the low command it will measure the input then request service and return either 44 HEX (range calibration OK) or 48 HEX (calibration error constants out of range). If you do not use SRQ to detect completion you may instead read back a response string the same as RS232 except the response string is treated by the instrument as an error string and must therefore be read using the '!' command. For example, send the high or low cal value, e.g. 'H4.012' then wait 3 seconds, send the command '!' and the instrument will send back the command 'DONE' if the point was the first of the pair and if it was finished. If it was the second of the pair, 'DONE' is not returned (as it is with RS232) but either 'GOOD' or 'BAD'. If the cal point was not complete the message 'ERROR 00' will be returned.

Example: calibrate the 4V DC range using service request.

1. Send the command 'P15' (enable all service requests).
2. Send the command string 'F1R2' (select the 4V DC range).
3. Apply 4.0000V DC to the input.