## 1.4 PRECALIBRATION

For all normal purposes, the routine procedures detailed in Section 1.2 (and repeated in User's Handbook Section 8) are sufficient to maintain 4000 calibration.

In an initial internal calibration process at manufacture, certain 'pre-cal' parameters are established in a special calibration memory to define the overall linearity of the 4000, and to allow maximum routine calibration memory span for adjustments. Thus all routine calibrations may be performed from the front panel or over the IEEE Interface without removing any covers.

The stored parameters are invalidated by replacement of certain critical parts of the instrument:

1) The Lithium battery which powers the whole calibration memory when the instrument supply is switched off. This should be replaced at five-year intervals (refer to Section 5.3).
2) The Digital Assembly
3) The Reference Divider Assembly
4) Critical components in the Digital or Reference Divider assemblies

} Normally replaced only on failure. A full list is given in Section 1.1 Table 1.1

After replacement of any of these parts, new parameters are generated and stored in the "pre-cal" memory by the procedures detailed in this section.

Pre-calibration must be followed by a full Routine Calibration of the whole instrument (Section 1.2).

### 1.4.1 Pre-calibration Procedure

#### 1.4.1.1 Validity

The adjustments detailed in the following sequences include intentionally clearing the instrument's calibration memory, which loses all previous calibration information. Therefore, before proceeding make certain that the reasons for carrying out a complete recalibration are valid. (If in any doubt, consult your Datron Service Centre)

#### 1.4.1.2 Calibration Standards Equipment Required

1. A DC Voltage Calibration source of 10V ±20ppm
2. A ÷2 precision divider, capable of dividing 20.000,000V to 10.000,000V ± 0.1ppm, D.C.
3. A battery-operated null detector with variable sensitivity.

Example: Keithley Instruments Model 155
Read the "Notes on the Use of the Null Detector" at Section 1.2.3.1.

#### 1.4.1.3 Identification of Access Holes (Fig. 1.5)

a) Release 6 screws retaining the top cover

b) Lift the top cover at the front of the instrument and locate two holes giving access to the two-position "pre-cal Enable" switch and the press-button "Clear Calibration Memory" switch.

DO NOT OPERATE EITHER SWITCH YET

c) Replace the top cover, do not secure

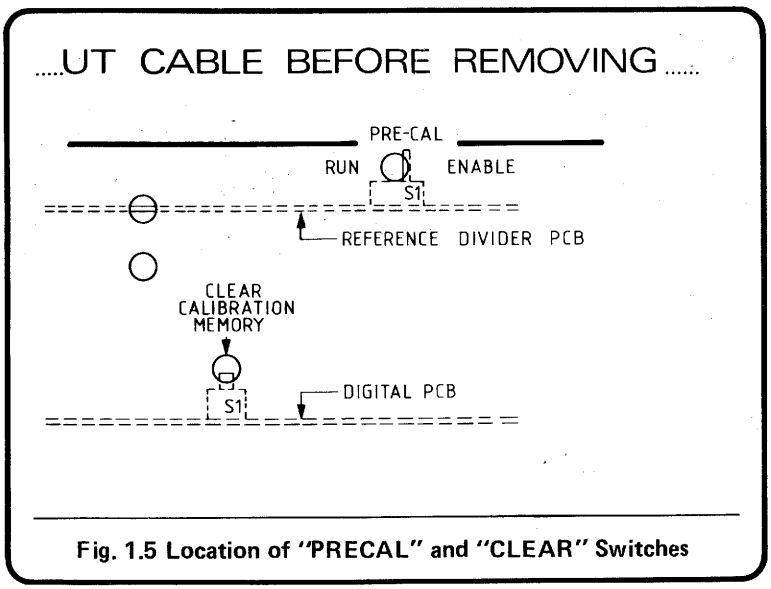


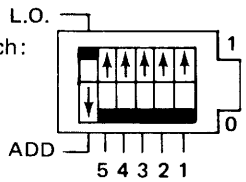

**Fig. 1.5 Location of "PRECAL" and "CLEAR" Switches**

### 1.4.1.4 Preparation

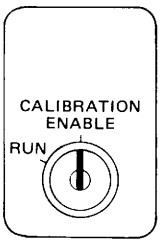
Before any calibration is carried out, prepare the 4000 as follows:

1. Turn on the instrument to be checked and allow minimum of 4 hours to warm-up in the specified environment

2. IEEE 488 Address switch: Set to ADD 11111 as shown (Address 31)




3. CALIBRATION ENABLE key switch: Insert Calibration Key and turn to ENABLE.




### 1.4.1.5 Interconnections

**CAUTION:** First read the Notes on the use of the Null Detector in Section 1.2.3.1.

(a) Ensure that the 4000 OUTPUT OFF LED is lit.

(b) Select DC and connect the DC Voltage Calibration source, Precision Divider and Null Detector to the 4000 terminals as shown. Use short leads.

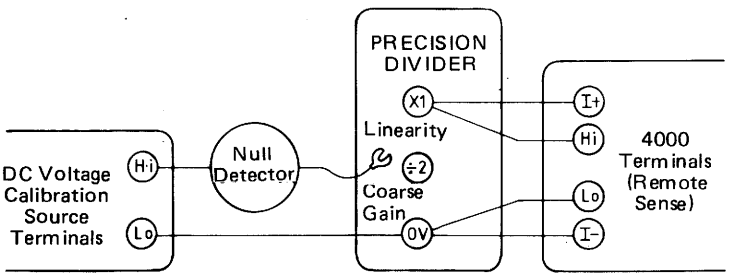



**Fig. 1.6 Interconnections for Pre-calibration (Coarse Gain and Linearity)**

(c) Ensure that the calibration source voltage is set to zero and that the interconnecting circuit has thermally stabilized. Do not connect the Null Detector yet.

### 1.4.1.6 "Pre-cal Enable" and Calibration Memory "Clear" Switches

| | |
|---|---|
| (a) 4000 | Lift the top cover at the front. Locate the hole which gives access to the pre-cal enable switch. |
| (b) "Enable" | Insert an insulated tool in the hole and move the pre-cal switch to the right (Enable). |
| | The legend Cal appears on the OUTPUT display also. |
| (c) | Locate the hole which gives access to the Calibration Memory "Clear" push button. |
| (d) "Clear" | Insert an insulated tool in the hole and press the button to clear the calibration memory. Refit the top cover but do not secure. |

### 1.4.1.7 ±0

| | |
|---|---|
| (a) Null Detector | Set to Low sensitivity. |
| (b) 4000 | Ensure OUTPUT OFF in 10V DC range. Ensure Remote Sense LED is unlit. |
| (c) 4000 | Press OUTPUT Zero Key Connect the Null Detector between Hi and Lo terminals Press ON+ Key |
| | Press ±0 Key: ±0 LED lights, OUTPUT display at zero. |
| (d) Null Detector | Increase sensitivity to give an off-null reading (approx. -20mV) and use 4000 OUTPUT ↑/↓ keys to back-off to null. Repeat until null lies between two values of the output display least-significant digit. |
| (e) 4000 | Press CAL key:<br>CAL LED lights<br>No change to OUTPUT display |
| (f) 4000 | Press ON- key |
| (g) Null Detector | Obtain accurate null as in (d) above. |
| (h) 4000 | Press CAL key:<br>CAL LED goes OFF<br>±0 LED goes OFF<br>OUTPUT display falls to zero |
| (j) Null Detector | Set to Low sensitivity |

The 4000 positive and negative zeros are now both aligned to zero.

| | |
|---|---|
| (k) 4000 | Disconnect the Null Detector |

### 1.4.1.8 Coarse Gain

(a) Null Detector — Set to Low sensitivity

(b) 4000 — Ensure OUTPUT OFF

(c) 4000 — Select Remote Sense and ensure LED is lit

(d) 4000 — Press the SET Key:
SET LED lights green
OUTPUT display reading goes to zero.

(e) 4000 — Use OUTPUT ↑/↓ keys to set the OUTPUT display to +19.999,999V

(f) 4000 — Press the ON+ Key

(g) Null Detector — Connect between Calibration Source Hi and Precision Divider ÷2 terminal (Fig. 1.6)

(h) Null Detector — Increase sensitivity to give an off-null reading and use 4000 ↑/↓ keys to back-off to null. Repeat until null lies between two values of the OUTPUT display least-significant digit.

(j) 4000 — Press CAL Key:
CAL LED flashes once.
OUTPUT display changes to +19.999,999V.
SET LED goes OFF

(k) Null Detector — Set to Low Sensitivity.

(l) 4000 — Set OUTPUT OFF

### 1.4.1.9 Linearity

(a) Null Detector — Disconnect from Precision Divider

(b) 4000 — Ensure set to OUTPUT OFF
Select Remote Sense and ensure LED is lit.

(c) 4000 — Press the STD Key:
STD LED lights green
OUTPUT display reading goes to zero.

(d) 4000 — Use OUTPUT ↑/↓ keys to set the OUTPUT display to +10.000,000V

(e) 4000 — Press the ON+ Key

(f) Null Detector — Connect between Calibration Source Hi and Precision Divider X1 terminal.

(g) Null Detector — Increase sensitivity to give an off-null reading and use 4000 ↑/↓ keys to back-off to null. Repeat until null lies between two values of the OUTPUT display least-significant digit.

(h) 4000 — Press CAL Key:
CAL LED flashes once
OUTPUT display changes to +10.000,000V
STD LED goes OFF.

(j) Null Detector — Set to Low sensitivity.
Disconnect.

(k) 4000 — Set OUTPUT OFF.

### 1.4.1.10 Pre-cal Enable Switch (See CAUTION below)

(a) 4000 — Lift the top cover at the front.

Locate the hole which gives access to the pre-cal Enable switch.

Insert an insulated tool in the hole and move the pre-cal switch to the left (RUN).

The legend "cal" on the OUTPUT display disappears, but the same legend remains on the MODE display.

CAUTION: DO NOT re-press the calibration memory "clear" button. If this is done, the micro-zero, coarse gain and linearity adjustments will have to be repeated.

(b) 4000 — Refit and secure the top cover.

### 1.4.1.11 Routine Calibration

The 4000 is now ready for full Routine Calibration as detailed in Section 1.2.

## 1.5 Ω OPTION INTERNAL ADJUSTMENT (Refer to Section 5.4)

The Autocal procedure for routine calibration of the 4000 Resistance Function is described in Section 1.2.10.

The method of calibration is to measure the value of each standard resistor, and store the measured value in non-volatile calibration memory. Subsequently, each time a resistance RANGE is selected, the previously calibrated value is displayed.

If a standard resistor has been subjected to undue stress, its value may have moved outside its tolerance (signalled by an Error 6 message during Routine Autocalibration). If the value is less than approx. 50ppm outside tolerance, it can be adjusted internally using a variable trimmer. For values out of tolerance in excess of 50ppm it is likely that the resistor has been over-stressed – consult your Datron Service Centre.

### 1.5.1 Manual Trimming Procedure

The following procedure is a supplement to Routine Autocalibration. It is necessary only when the 4-wire calibration of Section 1.2.10 has resulted in an "Error 6" message.

It can also be used when, for operational reasons, it is necessary to calibrate a resistor at its nominal value. For this purpose a continuously-reading method of measurement is convenient.

(a) Release eight screws retaining the top cover.

(b) Lift the top cover at the front of the instrument and locate the 8 holes giving access for "Ω OPTION ADJUSTMENT"

(c) Insert an insulated screw driver tool in the hole for the range selected, and adjust the preset resistor (rotating clockwise increases the resistance value)

(d) Re-measure the 4-wire value and repeat operation (c) until the desired value is obtained

(e) Re-calibrate the range for 4-wire and 2-wire connections as detailed in section 1.2.10.

(f) Repeat the manual trimming procedure above for all ranges as required.

(g) Finally refit and secure the top cover using the eight screws removed in (a), above.