3. The zero-based linearity line extends in both directions from the point where $i_N = 0$ mA and $R_s = 120\ \Omega$. The line is positioned such that it is an equal distance from $i_N$ at each extremity. We will use $L_N$ for the $y$-coordinate of the zero-based line. The magnitude of $L_N$ at each extremity is determined by averaging the magnitude of $i_N$ at each extremity.

When $R_s = 140$, $L_N = (17.544 + 18.182)/2 = 17.863$ mA
When $R_s = 100$, $L_N = -17.863$ mA

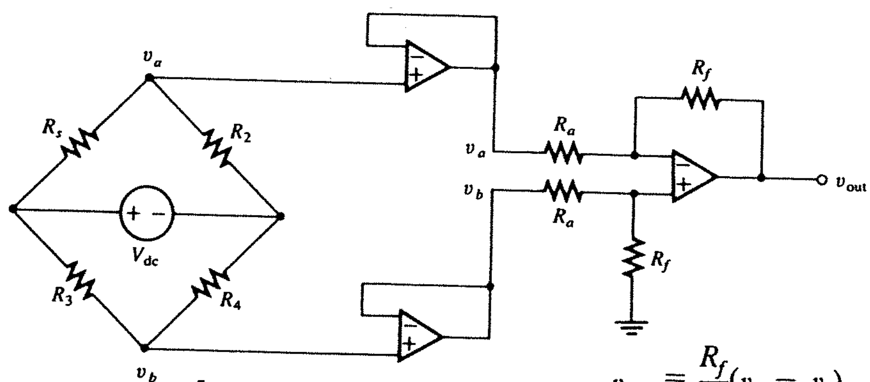
The equation of the zero-based linearity line is determined by the following two points:

$$R_s = 120\ \Omega \qquad L_N = 0.0\text{ mA}$$
$$R_s = 140\ \Omega \qquad L_N = 17.863\text{ mA}$$

Zero-based linearity line $L_N = 0.89315R_s - 107.178$
The values of $L_N$, $L_N - i_N$, and the percentage of difference are in the last three columns of the table below.

| T (°C) | $R_s$ (Ω) | $i_N$ (mA) | $L_N$ (mA) | $L_N - i_N$ | % Diff. |
|---|---|---|---|---|---|
| 0 | 100 | −18.182 | −17.863 | 0.319 | 0.89 |
| 25 | 110 | −9.009 | −8.931 | 0.078 | 0.22 |
| 50 | 120 | 0.000 | 0.000 | 0.000 | 0.00 |
| 75 | 130 | 8.850 | 8.931 | 0.081 | 0.23 |
| 100 | 140 | 17.544 | 17.863 | 0.319 | 0.89 |

◆




$$v_b - v_a = \left[\frac{\alpha(1-\alpha)\epsilon}{1+\alpha\epsilon}\right]V_{dc}$$

$$v_{out} = \frac{R_f}{R_a}(v_b - v_a)$$

$$v_{out} = \frac{R_f}{R_a}\left[\frac{\alpha(1-\alpha)\epsilon}{1+\alpha\epsilon}\right]V_{dc}$$

◆ **Figure 6.17** Unbalanced Wheatstone bridge and instrumentation amplifier circuit. The purpose of the circuit is to produce an output voltage that is proportional to the difference between $R_3$ and $R_{bal}$.