

Anderson Loop Equations

Dual-differential subtractor:

$$v_{out} = A_1 V_g - A_2 V_{ref}$$

Current regulator:

When current regulation feedback is obtained from v_{ref}

$$i = v_{ref} / R_{ref}$$

Overall circuit:

$$v_{out} = i(A_1 R_g - A_2 R_{ref})$$
$$v_{out} = i[A_1 (R + \Delta R) - A_2 R_{ref}]$$

(Note that wire resistance is irrelevant when v_g and v_{ref} are observed with Kelvin connections having insignificant energy transfer.)

When $A_1 = A_2 = 1$ and $R_{ref} = R$ then

$$\Delta R = R_g - R_{ref}$$
$$v_{out} = i \Delta R$$
$$v_{out} = (v_{ref} / R_{ref}) \Delta R$$
$$\Delta R = (v_{out} / v_{ref}) R_{ref}$$

For ratiometric observations

$$\Delta R/R = (R_{ref} / R) (v_{out} / v_{ref})$$

When $R_{ref} = R$

$$\Delta R/R = (v_{out} / v_{ref})$$

For an electrical resistance strain gage:

$$\Delta R/R = (GF) \Delta l/l$$

where GF is the gage factor and $\Delta l/l$ is the definition of mechanical strain.

$$\text{strain} = \Delta l/l = \Delta R / (R GF)$$

From an electrical measurement using Anderson loop signal conditioning:

$$\mu\text{strain} = v_{out} 10^6 / (v_{ref} GF)$$

If v_{out} is amplified by A

$$\mu\text{strain} = v_{out} 10^6 / (v_{ref} A GF)$$