Wheatstone Bridge: Unknown Resistance and Output Voltage

Unknown resistance at balance of a Wheatstone bridge from the three known arms, and the bridge output voltage for any fourth arm and supply.

Method: Wheatstone bridge balance $R_1/R_2 = R_3/R_x$

Input parameters

Unit system: SI

Parameter	Value	Unit
Arm R_1 (top left)	1,000.0	Ω
Arm R_2 (bottom left)	2,000.0	Ω
Arm R_3 (top right)	500.00	Ω
Fourth arm, actual value (bottom right)	1,010.0	Ω
Supply voltage	10.000	V

Calculated results

Parameter	Value	Unit
Fourth arm at balance $R_2 R_3 / R_1$	1,000.0	Ω
Bridge output voltage	22.075	mV
Deviation of R_x from balance	1.0000	%

Formula and method

$$R_{x,bal} = \frac{R_2 R_3}{R_1}, \quad V_o = V_s \left(\frac{R_x}{R_3 + R_x} - \frac{R_2}{R_1 + R_2} \right)$$

Variables

R_1	Arm R_1 (top left)	Ω
R_2	Arm R_2 (bottom left)	Ω
R_3	Arm R_3 (top right)	Ω
R_x	Fourth arm, actual value (bottom right)	Ω
V_s	Supply voltage	V
$R_{x,bal}$	Fourth arm at balance $R_2 R_3 / R_1$	Ω
V_o	Bridge output voltage	V
δ	Deviation of R_x from balance	-

Method and standards

Two voltage dividers compared.

Assumptions and limits

- High-impedance detector.

References

- Wheatstone bridge balance $R_1/R_2 = R_3/R_x$

Report details

Report reference	FCC-SRXY-RR4V (the same inputs always give the same reference)
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Release checks	3 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/electrical/circuits/wheatstone-bridge

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.