Total Measurement Uncertainty (Root Sum Square)

Total probable error of a measuring loop from up to five independent error sources by root-sum-square, with the worst case, in span units and per cent of reading.

Method: Root-sum-square combination of independent errors

Input parameters

Unit system: SI

Parameter	Value	Unit
Span of the loop, in its own units	100.00	
Reading, in the same units	60.000	
Transmitter reference accuracy (share of span)	0.075000	%
Ambient temperature effect (share of span)	0.050000	%
Static pressure or other process effect (share of span)	0.050000	%
Input card or indicator (share of span)	0.10000	%
Other (calibrator, drift) (share of span)	0.050000	%

Calculated results

Parameter	Value	Unit
Total probable error, root-sum-square (share of span)	0.15207	%
Worst-case error, straight sum (share of span)	0.32500	%
Total probable error, in span units	0.15207	
Total probable error as a share of reading	0.25345	%

Notes for this case

- Root-sum-square assumes the sources are independent and stated at the same confidence; convert per-cent-of-reading terms to span first.

Formula and method

$$u = \sqrt{\sum e_i^2}, \quad u_{wc} = \sum e_i$$

$$uS, \quad uS/x$$

Variables

S	span	units
x	reading	units
e_1	transmitter accuracy	-
e_2	ambient effect	-
e_3	static pressure or process effect	-
e_4	input card	-
e_5	other	-
e_i	error term i (share of span)	-
u	root-sum-square error	-
u_{wc}	worst-case error	-
uS	error in span units	units
uS/x	error as a share of reading	-

Method and standards

Independent random errors combine by root-sum-square; the straight sum is the worst case.

Assumptions and limits

- Independent errors at the same confidence level. Makers' accuracy figures are often limits (rectangular) or 2σ values: convert them to one basis (as in the GUM, with a coverage factor) before combining; this tool does not.

References

- Root-sum-square combination of independent errors

Report details

Report reference	FCC-1BGW-P471 (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/instrumentation/control-loops/measurement-uncertainty-rss

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.