Comparator with Hysteresis (Schmitt Trigger) Thresholds

Upper and lower switching thresholds and hysteresis of an inverting comparator with positive feedback, from the resistors, reference and output levels.

Method: Comparator with positive feedback (Schmitt trigger)

Input parameters

Unit system: SI

Parameter	Value	Unit
Resistor from the reference to the + input	10.000	kΩ
Feedback resistor from the output to the + input	100.00	kΩ
Reference voltage	2.5000	V
Output high level	5.0000	V
Output low level	0	V

Calculated results

Parameter	Value	Unit
Upper threshold (input rising, output goes low)	2.7273	V
Lower threshold (input falling, output goes high)	2.2727	V
Hysteresis	454.55	mV
Centre of the hysteresis band	2.5000	V

Notes for this case

• The + input sits between the reference and the output, weighted by the resistors: $V_+ = (V_ref\ R_2 + V_out\ R_1)/(R_1 + R_2)$. With the output high, the input must rise to the upper threshold to switch it; once low, it must fall to the lower threshold. The hysteresis $(V_OH - V_OL)\ R_1/(R_1 + R_2)$ stops a slow or noisy signal from chattering. With an open-collector output include the pull-up resistor in R_2's path.

Formula and method

$$V_{TH} = \frac{V_{ref} R_2 + V_{OH} R_1}{R_1 + R_2}, \quad V_{TL} = \frac{V_{ref} R_2 + V_{OL} R_1}{R_1 + R_2}, \quad V_H = \frac{(V_{OH} - V_{OL}) R_1}{R_1 + R_2}$$

Variables

R_1	Resistor from the reference to the + input	Ω
R_2	Feedback resistor from the output to the + input	Ω
V_{ref}	Reference voltage	V
V_{OH}	Output high level	V
V_{OL}	Output low level	V
V_{TH}	Upper threshold (input rising, output goes low)	V
V_{TL}	Lower threshold (input falling, output goes high)	V
V_H	Hysteresis	V
V_c	Centre of the hysteresis band	V

Method and standards

Schmitt trigger.

Assumptions and limits

- Ideal comparator; no input current.

References

Comparator with positive feedback (Schmitt trigger)

Report details

Report reference	FCC-9BSP-4WZ7 (the same inputs always give the same reference)
Generated	23 November 2026, 17:34 UTC
Calculator	Comparator with Hysteresis (Schmitt Trigger) Thresholds
Method last reviewed	17 November 2026
Software release	FireCAD Calc, release of 22 November 2026
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/electronics/schmitt-trigger-thresholds

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.