Doppler Shift for Sound or Radio Waves

Observed frequency and Doppler shift for a moving source or observer, for sound with the classical formula or radio and light with the relativistic radial formula.

Method: Classical acoustic Doppler and relativistic radial Doppler

Input parameters

Unit system: SI

Parameter	Value	Unit
Wave type	Radio or light (relativistic, radial)	
Emitted frequency	437.00	MHz
Source speed towards the observer	7,000.0	m/s
Observer speed towards the source	0	m/s
Speed of sound in the medium (sound only)	343.00	m/s

Calculated results

Parameter	Value	Unit
Observed frequency	437.01	MHz
Doppler shift f − f_0	10.204	kHz
Frequency ratio	1.0000	
Relative shift (ppm)	23.350	

Notes for this case

- Sound: f = f_0(c + v_o)/(c − v_s), speeds positive when approaching. Radio and light: relativistic radial Doppler with the closing speed v_s + v_o (small speeds: f ≈ f_0(1 + v/c)).

Formula and method

$$\text{sound}: \; f = f_0 \frac{c + v_o}{c - v_s}, \quad \text{radio and light}: \; f = f_0 \sqrt{\frac{1+\beta}{1-\beta}}, \; \beta = \frac{v_s + v_o}{c}$$

Variables

wave	Wave type	-
f_0	Emitted frequency	1/s
v_s	Source speed towards the observer	m/s
v_o	Observer speed towards the source	m/s
c_s	Speed of sound in the medium (sound only)	m/s
f	Observed frequency	1/s
Δf	Doppler shift f − f_0	1/s
f/f_0	Frequency ratio	-
$\Delta f/f_0$	Relative shift (ppm)	-

Method and standards

Doppler effect.

Assumptions and limits

- Motion along the line of sight; uniform medium for sound.

References

Classical acoustic Doppler and relativistic radial Doppler

Report details

Report reference	FCC-9BEE-WC9D (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/electronics/doppler-shift

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.