EKG TECH BASICS · ONE-PAGER

Paper, Settings and Measurement

The grid, paper speed, gain and the calibration pulse, filters, heart rate methods, PR, QRS and QT in adults and children, QTc formulas and U waves

21 sources + more detail

ekgtechbasics.com/sheets/ekg-paper-measurement.html

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1 The grid at standard settings

Horizontal is time, vertical is voltage. A standard 10-second strip at 25 mm/s holds 50 large boxes; at 50 mm/s the same paper holds 5 seconds.

BOX	TIME AT 25 MM/S	TIME AT 50 MM/S	VOLTAGE AT 10 MM/MV
Small (1 mm)	0.04 s (40 ms)	0.02 s (20 ms)	0.1 mV
Large (5 mm)	0.20 s (200 ms)	0.10 s (100 ms)	0.5 mV
5 large boxes	1 second	0.5 second	2.5 mV

2 Speed, gain and the calibration pulse

SETTING	WHAT IT CHANGES	CHECK
Speed 25 mm/s (standard)	Width only	Printed in the header
Speed 50 mm/s	Everything twice as wide; intervals look twice as long	Halve box times: small 0.02 s. Rate constants become 600 and 3,000
Gain 10 mm/mV (standard)	Height only	1 mV calibration pulse is 10 mm tall
Gain 5 mm/mV (half standard)	Complexes half as tall	Pulse 5 mm tall; double every amplitude you measure
Gain 20 mm/mV (double standard)	Complexes twice as tall	Pulse 20 mm tall; halve every amplitude you measure

EXAM TIP The calibration pulse is the ruler for height. Read its height before any amplitude: a 10 mm R wave is 1 mV at standard gain, 2 mV at half standard and 0.5 mV at double standard. Paper speed never changes height, and gain never changes width.

3 Filters

MODE	BAND	USE	COST
Diagnostic, adult	0.05–150 Hz	Every resting 12-lead	Shows noise if the prep is poor
Diagnostic, child	0.05–250 Hz	Pediatric 12-lead	As above
Monitoring (telemetry, bedside)	Narrower, about 0.5–40 Hz	Rate and rhythm	ST level unreliable; smaller QRS, lost notches and pacing spikes

SAFETY A 0.5 Hz low-frequency cutoff, used in real time on monitors, can create false ST elevation or depression of several millimeters. Do not judge ST changes on a monitoring-mode strip; record a 12-lead at diagnostic settings and report to the nurse or provider. Fix noise at its source (skin prep, electrode contact, cables, power cords), not with a filter.

4 Heart rate

METHOD	HOW (25 MM/S)	BEST FOR	FAILS WHEN
300 method	300 ÷ large boxes R to R (300, 150, 100, 75, 60, 50)	Quick check, regular rhythm	Irregular rhythm; R waves between lines (round with care)
1,500 method	1,500 ÷ small boxes R to R	Regular rhythm, especially fast	Irregular rhythm
6-second method	QRS complexes in 6 s × 10 (or in 10 s × 6)	Irregular or slow rhythms	Imprecise: each complex is worth 10/min (6/min on a 10 s strip)

EXAM TIP Count atrial and ventricular rates separately when they differ. The machine's rate can be wrong: it may count tall T waves as QRS complexes (doubling the rate) or miss small complexes. At 50 mm/s use 600 ÷ large boxes or 3,000 ÷ small boxes.

5 Intervals: normal values

MEASURE	FROM → TO	ADULT NORMAL	CHILDREN
Heart rate	R to R	60–100/min (exam convention)	Newborn 110–150, age 2: 85–125, age 4: 75–115, 6 and over: 60–100
PR interval	Start of P → start of QRS	0.12–0.20 s (3–5 small boxes)	Shorter: about 0.07–0.15 s in infants, rising with age
QRS duration	First to last QRS deflection	0.07–0.10 s; 0.12 s or more is wide	Narrower: about 0.08 s or less in infants; over 0.09 s may be wide
QT interval	Start of QRS → end of T	Under half the R-R at normal rates	Rate-dependent; use QTc
QTc	QT corrected for rate	Long: over 450 ms (men), over 460 ms (women); over 500 ms high risk	Up to 440 normal; 440–460 borderline; over 460 prolonged

6 Measuring the QT and QTc

1. Use lead II or V5–V6, whichever shows the longest QT; measure several beats.
2. End of T: draw a line down the steepest part of the T downslope; where it meets the baseline is the end.
3. Leave out a U wave that is separate from the T; if T and U merge, use the tangent.
4. Bazett: QTc = QT ÷ $\sqrt{RR}$ (seconds). Adequate at 60–100/min; it overcorrects above 100 and undercorrects below 60.
5. Outside 60–100/min, Fridericia (QT ÷ $\sqrt[3]{RR}$) or Framingham (QT + 0.154 × (1 − RR)) is preferred; Hodges (QT + 0.00175 × (HR − 60)) is another linear option.

EXAM TIP Worked example at 120/min (RR 0.50 s), QT 0.32 s: Bazett 453 ms looks long, but Fridericia gives 403 ms and Framingham 397 ms. A long Bazett QTc at a fast rate may be the formula, not the patient. Report the QT, the rate and the formula used.

7 U waves

A small wave after the T, same direction as the T, usually about 0.5 mm and under a quarter of the T's height, best seen in V2–V3 and at slow rates. Prominent U waves (over 1–2 mm): bradycardia and low potassium most often; also low magnesium or calcium, and drugs such as digoxin, sotalol and amiodarone. An inverted U wave where the T is upright is abnormal: report it.

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