ARN Metro-Tuner — User Manual

Overview

ARN Metro-Tuner is an Apple Watch app combining a **haptic metronome** and a **chromatic tuner** in a single, minimal interface. Everything runs directly on the Watch — no iPhone interaction is needed during use.

The app is organized into three screens, navigated by **horizontal swipe**:

SCREEN	FUNCTION
Metronome	Haptic beat, tap tempo, beats per measure
Tuner	Chromatic pitch detection, cents deviation
Settings	A4 reference, mic sensitivity, accent toggle

1. Metronome

Starting and stopping

Tap the **green Play button** to start the metronome. The button turns red and shows a stop icon. Tap again to stop.

Reading the display

- The large number at the top is the current **BPM** (beats per minute).
- The row of dots below represents the **beats of the measure**. The active beat lights up — orange for beat 1 (downbeat), white for all others.
- The lock icon next to the BPM indicates whether the **Digital Crown** is locked or unlocked for tempo control.

Changing the tempo

Digital Crown (recommended for fine adjustment):
Tap the BPM display to unlock the Crown (the lock icon opens and the number turns orange). Rotate the Crown to increase or decrease the BPM in steps of 1. Tap the BPM again to lock it and prevent accidental changes.

Tap Tempo:
Tap the **TAP button** (left circle) repeatedly in time with your desired tempo. The BPM is calculated from the average of the last 8 taps. If you stop tapping for more than 2.5 seconds, the sequence resets automatically. A minimum of 2 taps is required before a BPM is displayed.

Valid range: 20 – 220 BPM.

Changing beats per measure

Use the **up (∧) and down (∨) chevron buttons** on the right to set the number of beats per measure. The range is 1/4 to 7/4. The beat indicator dots update instantly.

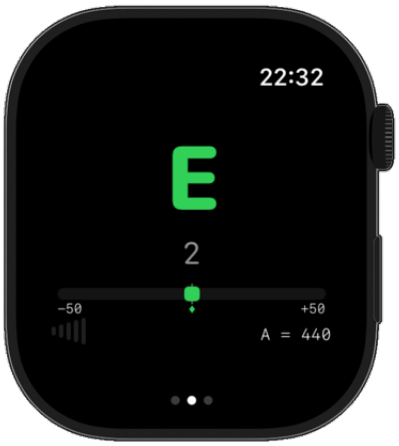
Accent on beat 1

When the accent is enabled (toggle in Settings), beat 1 produces a stronger, more distinct haptic pulse than the other beats. This helps you feel the downbeat clearly, especially at fast tempos.

Phase-preserving tempo changes

When you change the BPM while the metronome is running — via Crown or TAP — the engine calculates the time remaining until the next scheduled beat and adjusts from that point forward. The beat sequence never resets to zero, so the rhythmic phase is preserved even mid-measure.

2. Tuner



How it works

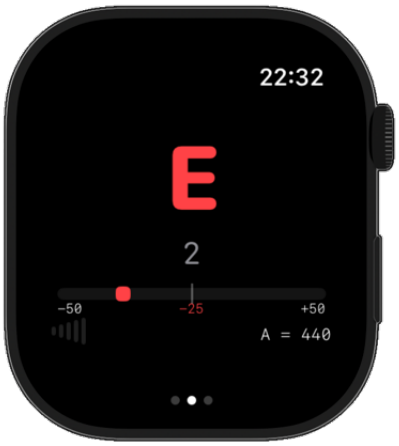
The tuner listens continuously through the Watch microphone and uses the **YIN pitch detection algorithm** to identify the fundamental frequency of the sound. The detected pitch is mapped to the nearest chromatic note relative to your configured A4 reference.

Reading the display

Note name and octave: The large letter(s) in the center show the detected note (e.g. "A", "C#") with the octave number below (e.g. 4 for A4). The display fades out smoothly when no pitch is detected and reappears when a new pitch is found.

Cents indicator: The horizontal bar below the note shows how far the detected pitch deviates from the exact target frequency, in cents (1 cent = 1/100 of a semitone):

- The marker moves **left** if you are flat (too low)



- The marker moves **right** if you are sharp (too high)

- Range: −50 to +50 cents

Color coding:

COLOR	MEANING
Green	In tune (within ±5 cents)
Yellow	Slightly off (within ±20 cents)
Red	Out of tune (more than ±20 cents)

Haptic feedback: When the note enters the in-tune zone (±5 cents), the Watch produces a single click haptic. This lets you tune by feel without looking at the screen.

Signal level: Five small bars in the bottom-left corner indicate the microphone input level. Green bars = good signal, yellow/red = very loud input.

A4 reference: The current A4 frequency is shown in the bottom-right corner (e.g. "A = 440"). Change it in Settings.

Idle state

When no pitch has been detected for 3 continuous seconds, the tuner enters idle state and shows a muted waveform icon. It resumes automatically as soon as a signal is detected.

Tips for accurate tuning

- Play or sing a sustained, steady note — the YIN algorithm works best with a stable pitch.
- Keep the Watch reasonably close to the sound source (30–60 cm).
- Avoid loud background noise; use a quieter environment or increase mic sensitivity in Settings.
- If the display flickers between two notes, you may be very close to the boundary between semitones — keep adjusting until the indicator stabilizes in the green zone.

3. Settings

Access Settings by swiping right twice from the Metronome, or once from the Tuner.

Pitch Reference (A4)

Sets the reference frequency for A4, which shifts all note targets proportionally. The default is **440 Hz**.

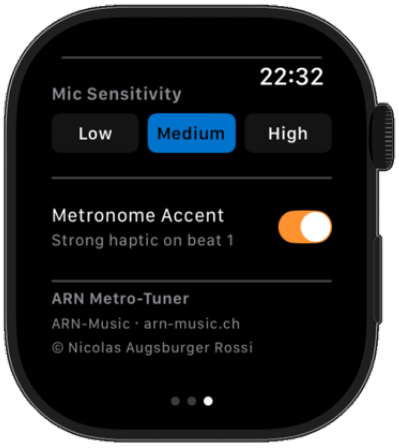
Preset buttons: Tap any of the preset values (415, 432, 435, 440, 442, 443, 444, 446) to set A4 instantly.

Fine adjustment with the Digital Crown:

Tap the **crown icon** next to the A4 display to enter edit mode. The Crown is now dedicated to A4 adjustment — rotate to change the value by 1 Hz per step. The valid range is **415 – 446 Hz**. Tap the crown icon again (now shown in orange) to exit edit mode and return to the scrollable settings list.

> *The edit overlay removes the ScrollView entirely so the Crown has no conflict — it is fully dedicated to A4 tuning while in this mode.*

Mic Sensitivity



Controls the minimum signal level the tuner requires before attempting pitch detection.

SETTING	USE CASE
Low	Quiet environments, close miking, studio use
Medium	General use (default)
High	Noisy environments, distant source, outdoor use

Increase sensitivity if the tuner is slow to respond or misses quiet notes. Decrease it if you get spurious readings from background noise.

Metronome Accent

When enabled, beat 1 of each measure uses a stronger haptic type (`directionUp`) instead of the standard beat haptic (`start`). This makes the downbeat clearly distinguishable by feel.

Toggle this off if you prefer a uniform pulse across all beats.

4. Watch System Settings that affect the app

These settings are found in the **Watch Settings app** (directly on the Watch) or in the **Watch app on iPhone** under your Watch's settings.

Sound & Haptics

Path: Watch Settings → Sound & Haptics

SETTING	EFFECT ON ARN METRO-TUNER
Haptic Strength	Directly affects the intensity of all metronome beats and UI feedback. Set to maximum for the clearest beat perception.
Prominent Haptic	Adds a subtle pre-tap before scheduled haptics (system feature). Has a minor effect on perceived beat timing at high BPM — leave off for precision use.
Crown Haptics	Controls the click feedback when rotating the Crown to adjust BPM or A4. Personal preference; does not affect metronome timing.
Mute (Silent Mode)	Select this option if you want haptic-only feedback.

Wrist Detection

Path: Watch Settings → General → Wrist Detection (or Watch app on iPhone → General → Wrist Detection)

When Wrist Detection is **enabled** (default), the Watch automatically locks the screen and reduces power when it detects the Watch has been removed from the wrist.

Effect on ARN Metro-Tuner:

- **Metronome:** The extended runtime session keeps the haptic engine running even when the wrist is lowered (screen dims). However, if Wrist Detection is on and the Watch is physically removed, the session will eventually be suspended.
- **Tuner:** The microphone session is paused when the app goes to background (wrist lowered). It resumes automatically when you raise your wrist and the screen reactivates.

> ⚠️ ***Safety note:*** *Disabling Wrist Detection allows the app to run continuously without the Watch being worn — useful for testing on a desk or using the metronome in a fixed position. However, disabling Wrist Detection also* ***disables the automatic lock screen****, which means anyone could access your Watch without your passcode. Only disable this setting if you understand and accept the security implications.*

To disable Wrist Detection: Watch app on iPhone → Passcode → Wrist Detection → Off. You will be asked to confirm, as your passcode will be required manually.

Display & Brightness

Path: Watch Settings → Display & Brightness

SETTING	EFFECT ON ARN METRO-TUNER
Always On Display (Series 5+)	Keeps a dim version of the screen visible when the wrist is lowered. The metronome continues running. The tuner pauses the microphone in background but resumes on wrist raise.
Wake Duration	Controls how long the screen stays on after a wrist raise. Set to 70 seconds for longer visibility during tuning sessions.
Return to Clock	If set to a short interval, the Watch may navigate away from the app to the clock face. Set to **After 1 hour** or disable it to keep the app in the foreground.

Path (iPhone Watch app): My Watch → General → Return to Clock → After 1 hour

5. Tips & Best Practices

Metronome

- Lock the BPM (tap the number to toggle the lock) before starting a session to avoid accidentally changing the tempo with the Crown while playing.
- Use TAP to set the tempo by feel from an existing recording, then fine-tune with the Crown.
- At very high BPM (above ~200), the difference between accent and normal beat haptics may be harder to perceive — try reducing the BPM range or disabling accent for a cleaner pulse.
- The metronome uses an extended runtime session that auto-renews every 10 minutes, so it can run for extended practice sessions without interruption.

Tuner

- The tuner detects pitches in the range **25 Hz – 2000 Hz** (@A4 = 440 Hz, approx. A0 to B6), covering the full range of guitar, bass, violin, cello, and voice. Very high harmonics above 2 kHz are filtered out.
- For bass instruments (electric bass, double bass), ensure Mic Sensitivity is set to Medium or High, as low-frequency fundamentals can be quieter relative to harmonics.
- If you see the note flickering rapidly, the signal may be too weak — move closer to the Watch or increase Mic Sensitivity.
- The A4 reference affects **all** note targets proportionally. If you're tuning an instrument to a non-standard pitch (e.g. baroque tuning at A=415 or orchestral at A=443), simply set the correct A4 in Settings before tuning.

Battery

- The metronome's haptic engine and extended runtime session consume more battery than idle Watch use. For long rehearsals, ensure the Watch is sufficiently charged beforehand.
- The tuner's continuous microphone use also draws power. If battery life is a concern, stop the tuner when not actively tuning.
- Keeping the screen brightness lower (Watch Settings → Display & Brightness) helps extend battery during long sessions.

On Apple Watch SE

Due to hardware characteristics of the Apple Watch SE, there is a known behavior: when the wrist is lowered and the screen turns off, the metronome may lose its phase reference. Upon raising the wrist again, the metronome resynchronizes automatically, but there may be a brief moment of realignment. This does not affect Apple Watch Series 4 and later.

6. Platform Limitations

ARN Metro-Tuner is built entirely on Apple Watch. This choice offers genuine advantages — the Watch is always on your wrist, its Taptic Engine is ideal for rhythmic feedback, and the microphone is close to your instrument. However, the Apple Watch platform has inherent constraints that are worth understanding.

Metronome timing accuracy

The metronome uses a `DispatchSourceTimer` running on a high-priority queue, which is the most precise timing mechanism available on watchOS. In practice, timing jitter is in the range of a few milliseconds — imperceptible at normal musical tempos and well within the tolerance of human rhythm perception.

That said, watchOS is not a real-time operating system. Under heavy system load (e.g. an incoming notification, a health sensor burst, or a background sync), the system scheduler may briefly delay a timer event by a few extra milliseconds. This is rare and short-lived, but it means ARN Metro-Tuner cannot provide the sub-millisecond accuracy of a dedicated hardware metronome or a desktop DAW. For studio recording with click track synchronization, a dedicated device is preferable.

Haptic feedback

- The sensation varies depending on how tightly the Watch is worn and individual skin sensitivity.
- At very fast tempos (above ~200 BPM), the haptic pulses may merge perceptually into a continuous buzz rather than distinct beats.

Microphone quality and placement

The Apple Watch microphone is optimized for voice calls and Siri — not for musical instrument pickup. Compared to a dedicated clip-on microphone or a smartphone held near the instrument, it has:

- **Limited low-frequency sensitivity**, which can make the fundamental of bass instruments harder to detect reliably. The app compensates with adjustable mic sensitivity, but results at the extreme low end (below ~80 Hz) may be less stable.
- **Fixed placement on the wrist**, which means the distance and angle to the sound source varies with arm position. For best results, position your wrist 20–50 cm from the instrument's sound hole or pickup area.
- **No noise cancellation for musical use**: the Watch's noise suppression is designed for speech, not pitched sounds. In loud environments, the tuner may struggle to isolate the fundamental from background noise.

Session and background limits

watchOS imposes strict limits on background execution. ARN Metro-Tuner uses a `WKExtendedRuntimeSession` (mind & body / self-care type) to keep the haptic engine and microphone alive beyond the standard foreground window. This session:

- Lasts up to **10 minutes per grant**, then auto-renews silently as long as the app is in use.
- Is **suspended if the Watch is removed from the wrist** (with Wrist Detection enabled) or if the system needs to reclaim resources for a higher-priority task (e.g. an incoming call or an emergency alert).
- Does **not** survive a Watch restart or an explicit app termination from the app switcher.

In practice, these limits are rarely encountered during a normal practice session, but they are worth knowing for edge cases such as very long rehearsals or recitals.

No subdivision or polyrhythm

The current version supports beats per measure (1/4 – 7/4) with optional downbeat accent, but does not offer subdivisions (8th notes, triplets), polyrhythms, or programmable rhythm patterns. These features would require a more complex interface that does not fit well within the constraints of the Watch screen and single-tap interaction model.
