Ham Learning

User Manual

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1. Getting Started

Ham Learning is a comprehensive learning and reference tool for the amateur radio community. It is designed for every skill level — from first-time operators preparing for their license exam all the way to experienced hams who want deeper references and interactive simulators on demand.

The app is organised into seven main tabs accessed through the bottom navigation bar. Each main tab opens on its own page that contains several inner sub-tabs for related features. Everything is theme aware — the whole app switches between dark and light mode instantly when you toggle the setting. Every panel that shows reference data has a Share button so you can export it as a clean image with the app watermark centered at the bottom.

1.1 Tab map at a glance

Tab	What it does
Learn	Curriculum (600+ topic lessons), Q-codes, phonetics, electronics (660+), glossary (360+)
Practice	Mock exam from 1,431 real questions + per-subelement progress
Tools	Calculators with rotating compass, references with all-region band chart, antenna & circuit labs with shareable images
Morse	Koch trainer (4-step guided), drills, mic decoder, paddle, text-to-Morse sender, reference
WebSDR	Curated public SDR receivers in-app + SWL logbook (log heard QSOs, export CSV)
Settings	Default values (callsign, grid, email, dark mode, font scale), target license, Morse defaults, master reset
About	App info, features list, credits, User Manual + Support links

1.2 Internet is optional

Every essential feature works entirely offline. The only online feature is the optional question pool refresh, which degrades gracefully — the app falls back to the bundled data when no network is available.

2. Learn Tab

The Learn tab is your curriculum hub. Five inner sub-tabs give you a curriculum tree, a full Q-code reference, the NATO phonetic alphabet, a layered electronics course and a searchable amateur-radio glossary.

2.1 Topics

Browse the curriculum tree by category (License, Bands, Modes, Antennas, Activities, Satellites, Station). Tap any topic to expand its list of lessons, then tap a lesson to open the reader. Use the search box at the top to find any lesson by keyword across every category.

Inside the lesson reader you can read the lesson body (with bold accents), tap the speaker icon to have the lesson read aloud via text-to-speech (the icon turns into a stop button while audio is playing — tap again to stop), and

tap the share icon to export the lesson as a clean image. The shared image strips the speaker and share controls so it looks like the lesson content itself, with the standard Ham Learning watermark centered at the bottom.

2.2 Q-Codes

A complete searchable list of every amateur-related Q-code. Each entry shows the meaning (as a statement), the meaning as a question, and the context in which it is used. Tap any entry to hear it read aloud (a stop button appears in the search row while TTS is speaking), copy it, or share the whole filtered view as an image. Full list appears in Section 9 of this manual.

2.3 Phonetics

The NATO / ITU International Radiotelephony Spelling Alphabet. Every letter and digit has an associated word (Alfa, Bravo, Charlie...) and a pronunciation hint. The Spell My Callsign helper at the top accepts any callsign or phrase and spells it out phonetically — the speaker button toggles play/stop. The Letters and Digits panels each have their own share icon in the panel header that exports just that panel as an image, and a full-width "Share both panels in one image" button at the bottom of the page captures Spell + Letters + Digits stacked into a single shared image.

2.4 Electronics

An 11-category electronics course (DC Fundamentals, AC & Reactance, RF Circuits, Semiconductors, Power Supplies, Digital Logic, RF Components, Test Equipment, Filters & Resonance, SDR & DSP, Troubleshooting & Repair) with 660+ lessons. Each lesson links to related interactive simulators in the Tools tab where applicable.

2.5 Glossary

360+ amateur-radio terms, each with a concise definition and subject tags. The search field filters across terms, definitions and tags in real time. A per-entry share-as-image button on each card exports that single entry as a compact themed snapshot including its tags.

3. Practice Tab

The Practice tab is a complete US FCC license-exam preparation engine. Two inner sub-tabs let you run a timed mock exam and review your progress over time. The target license is set in Settings → Target License (Technician, General, or Amateur Extra) and the Mock Exam pulls from the matching official NCVEC question pool.

1,431 real questions are bundled with the app from first install: Technician 2026-2030 (409), General 2023-2027 (423), and Amateur Extra 2024-2028 (599). The pools come from the russolsen/ham_radio_question_pool GitHub project (Apache-2.0) which mirrors the official NCVEC public-domain pools. The app checks for updates silently once a month and you can manually refresh from Settings → Target License → refresh icon.

3.1 Mock Exam

Generates a randomised, exam-length test from the selected pool. Pick an answer, move on, then submit when you are done. The scored results screen highlights every wrong answer with the correct choice and a short explanation. The first card on the screen shows the pool overview with the current license-level badge and question count.

An "About these pools" panel sits below the Start button to explain where the questions come from and how the offline fallback works.

3.2 Progress

A dashboard showing your study streak, the number of mock exams attempted, your overall pass rate, and per-subelement mastery bars for the currently selected pool. Recent mock exam attempts appear at the bottom. Mock Exam answers feed into the SM-2 spaced-repetition tracker so the dashboard always reflects your true mastery.

4. Tools Tab

The Tools tab collects everything calculator-, reference- or simulator-shaped into one place. Four inner sub-tabs cover 11 calculators, static reference tables, an interactive antenna simulator and an electronics lab.

4.1 Calculators

Eleven calculators, each in its own themed panel with formula reminder below:

- Wavelength ↔ Frequency (λ = 300 / f)
- Half-wave dipole length, each leg and total
- Quarter-wave vertical element length
- Ohm's Law solver — enter any two, solve the rest
- Decibel converter (power ratio ↔ dB)
- SWR from forward / reflected power, plus return loss
- LC resonant frequency
- Coax loss for common cable types, scaled by frequency
- RF exposure estimator (far-field, isotropic model)
- Maidenhead grid ↔ latitude / longitude
- Great-circle beam heading and distance between grids

4.2 References

Static lookup data: the amateur band chart showing all three IARU regions side-by-side in one table, resistor colour codes, RST signal scale, CW prosigns, ITU emission designators, ADIF modes, contest exchanges, ITU prefixes, propagation modes, and a directory of useful online references rendered as tappable hyperlinks (each link opens in your system browser). Every reference panel has a Share button in its header that exports the panel as a clean image.

4.3 Antenna Lab

Pick an antenna type from the dropdown (½-wave dipole, ¼-wave vertical, ⅝-wave vertical, end-fed half-wave, full-wave loop, J-pole, or Yagi-Uda with adjustable element count). Two compact sliders sit below the dropdown: Height (in wavelengths, 0.05–2.00 λ) and Frequency (1.8–450 MHz, shown to 3-decimal precision so you can dial in band-edge exact values like 144.250 MHz). The whole tab is sized to fit one phone viewport with no scrolling so you can watch the Live Values numbers update as you slide.

Defaults are 145.000 MHz and 0.25 λ — a sensible 2-m band anchor. A circular reset arrow at the right of the Antenna & Parameters panel header reloads the entire tab back to defaults in one tap.

Important: the Frequency slider deliberately does NOT move the elevation pattern picture. Frequency only drives the derived numbers in the Live Values panel (wavelength, physical length in metres, feedpoint impedance, gain). The pattern is driven by the antenna type plus the Height (λ) slider, so you can change frequency without seeing the picture jump around.

The elevation pattern is drawn with a per-type analytical model: cos^N E-plane × ground array factor for the verticals (¼ wave, ⅝ wave, J-pole), height-dependent ground-reflection lobes for horizontal antennas (dipole, EFHW, loop), and an asymmetric forward+back lobe for the Yagi whose front-to-back ratio improves with element count. A small silhouette of the actual antenna sits to the left of the polar plot so you can tell types apart at a glance, with an H/V/Mix polarity tag.

The peak indicator (orange line + label) points straight up at the zenith for every type EXCEPT the Yagi — all other types are omnidirectional in azimuth so the peak marker just shows ↑. The Yagi is the only directional type and shows its peak at the actual takeoff angle.

The share button at the top of the elevation pattern panel exports the pattern + silhouette + live values together in one image.

4.4 Circuit Lab

Four interactive experiments with live diagrams: the voltage divider, series / parallel resistor combinations, the RC time constant on a log time axis (so the curve actually slides as R or C changes), and the low-pass RC filter rendered as a proper Bode magnitude plot in dB with the textbook -20 dB/decade slope above the cutoff frequency. Both the RC and Low-Pass panels have share buttons in the header.

5. Morse Tab

Everything Morse. Five sub-tabs cover learning, practice, real-time decoding of audio, text-to-Morse playback and a tap-to-play full reference chart.

5.1 Learn

Guided 4-step Koch-method trainer. Step 1 picks the lesson level (2 trains K and M; each level adds one new character from the Koch order, up to 40 characters). Step 2 plays random groups of the trained characters through the speaker at your configured WPM with Farnsworth spacing. Step 3 lets you type your copy and tap Reveal — only after you reveal does Step 4 show the side-by-side accuracy review with color-coded hits and misses. The Reveal gateway prevents accidentally seeing the answer before you've made an honest attempt. The Clear button resets the drill state.

When you reach 90% accuracy on a lesson, the review card tells you to bump the lesson up. The Koch method explanation lives behind the (i) icon in Step 1 if you want a refresher.

5.2 Practice

Drill categories: random words, random US callsigns, and common QSO phrases — switched via the dropdown in the panel header. Plays the selected target, lets you type the answer and shows the original with its Morse

pattern on reveal. The Send-It-Yourself paddle below uses raw pointer events and a 4-second safety timer so the keying tone never gets stuck, and its sidetone deliberately bypasses the global key-stream so the Send tab's keying LED doesn't blink in sympathy when you tap the paddle.

5.3 Decode

Listen to Morse through the device microphone. The decoder uses a Goertzel tone filter at your configured target tone frequency with an adaptive noise-floor threshold. The mic permission flow probes via the native record package on every platform (iOS, Android, macOS, Windows, Linux) and falls back to the OS settings page with a one-tap "Open Settings" button if the user permanently denied access.

Best results with a clean tone (radio speaker, practice oscillator, key + buzzer) and low background noise. The tone indicator bar above the Start button shows the current detected signal magnitude so you can position the phone correctly.

5.4 Send

Type any text and tap Play — the app synthesises a sine-wave sidetone, plays the resulting Morse audio through the speaker and shows a small pulsing indicator above the playback controls (no full-screen flash). You can also adjust the character speed, effective Farnsworth speed and tone on the same screen.

5.5 Reference

A complete reference chart: letters, digits, punctuation and prosigns. Tap any entry to hear it played at your configured speed and tone. See Section 10 for the full list.

6. WebSDR & SWL Log

The WebSDR tab brings live shortwave listening into the app. It embeds a curated set of public Software-Defined Radio receivers from around the world inside a theme-aware in-app browser, so you can tune real signals, hear live QSOs and log what you hear without leaving Ham Learning. The receiver keeps playing in the background when you switch to other tabs.

6.1 Choosing a receiver

Pick a receiver from the dropdown at the top of the page. The list spans well-known stations (University of Twente, Northern Utah, KiwiSDR and WebSDR directories, and several regional HF receivers). A short description line under the dropdown gives each receiver's band coverage and location. The toolbar buttons let you go Back inside the receiver page, Reload it, and Open it in your system browser. By default the first receiver pre-loads when you open the tab; you can turn that off in Settings if you prefer to tap to load.

6.2 SWL Log

The SWL Log button — between the receiver dropdown and the Back arrow — opens a short-wave-listener logbook over the live receiver. Use it to record the QSOs you hear: both callsigns, the signal reports the two stations exchange on air (CS1 RST and CS2 RST), and your own reports of how you hear each station (My RST 1 and My RST 2), plus the frequency and mode. All eight fields are required; the four RST fields start at 59, and the

frequency and mode are auto-filled from the receiver you are tuned to (you can correct them). Any missing field is outlined in red when you try to save.

The date, time and receiver name are captured automatically when you save — you never type them. Save stores the QSO and clears the form for the next one (Clear empties the callsigns and resets the RST fields to 59 but keeps the frequency and mode). Cancel closes the dialog without saving the entry on screen. Tap Check My List to expand your saved log below the form: a scrollable list, newest first, where each QSO can be edited or deleted (deletion asks for confirmation). Above the list, Collapse hides it again, Export CSV shares your whole logbook as a CSV file to any app you choose, and Clear List empties the log after a confirmation prompt. Your log is saved on the device and survives closing the app.

7. Settings Tab

The Settings tab drives every personalization in the app. Changes take effect immediately on Save — you do not need to restart the app. All other tabs refresh automatically. After tapping Save, the keyboard automatically dismisses and any focused text field loses focus.

7.1 Default Values

Single panel for all your day-to-day defaults — replaces the old Personal + Appearance split.

- Callsign (UPPERCASE, used in Morse drills + Support page)
- Maidenhead grid (8-char positional formatter — UPPER, digit, lower, digit pattern auto-applied as you type)
- Email address (prefilled into the Support page)
- Dark mode toggle — flips the whole app instantly
- Font scale slider — applied at the root via MediaQuery.textScaler so it scales every text widget app-wide for accessibility
- Show Tips & Tricks toggle — opt in or out of the rotating contextual hints (100 of them, shuffle-deck delivery, at most twice a week). Turning it off stops all tips; turning it back on resets the deck.

7.2 Target License

Pick your study target (Technician, General, or Amateur Extra). The Practice tab uses this to load the matching NCVEC pool. Tap the refresh icon next to the dropdown to manually pull the latest pool from the maintained source. The reload toast only says "Question pool updated" when the upstream content actually changed (hash-based comparison) — repeated taps on identical data show "Already up to date".

7.3 Morse Defaults

- Character speed (5–40 wpm)
- Effective Farnsworth speed (5–40 wpm)
- Tone (400–1000 Hz)

These defaults propagate to every Morse panel in the Morse tab on next visit.

7.4 Reset

A single destructive button at the bottom resets all settings, study progress, exam attempts and accordion state to a fresh-install state after a confirmation dialog. Cannot be undone.

8. About Tab

The About tab shows the app icon, version, credits and a compact key-features list on a single phone screen. The User Manual and Support links at the top open the in-app manual viewer and the email-composed support page respectively.

Support emails are prefilled with your callsign, email, and the current UTC timestamp. The recipient is A46UNX@GMAIL.COM. When you tap Send, the app opens your default email client with the subject and body ready.

9. Q-Code Full Reference

The full amateur-subset Q-code list. Each entry shows the code and its statement meaning.

QRA	Name of my station is	**QRX**	I will call you again at	**QSY**	Change frequency to __ kHz
QRB	Distance between stations (km)	**QRZ**	You are being called by	**QSZ**	Send each word twice
QRG	Your exact frequency is	**QSA**	Strength of your signals (1–5)	**QTA**	Cancel message number
QRH	Your frequency varies	**QSB**	Your signals are fading	**QTB**	I do not agree with your counting
QRI	Tone of your transmission (1–3)	**QSD**	Your keying is defective	**QTC**	I have __ messages for you
QRJ	I cannot receive you, signals too weak	**QSK**	I can hear you between my signals	**QTE**	Your true bearing from me is
QRK	Readability of your signals (1–5)	**QSL**	I acknowledge receipt	**QTG**	I will send two 10-second dashes
QRL	I am busy, please do not interfere	**QSM**	Repeat the last message	**QTH**	My location is
QRM	I have man-made interference	**QSN**	I heard you on __ kHz	**QTI**	My true course is
QRN	I am troubled by static / atmospheric noise	**QSO**	I can communicate with __ directly	**QTR**	The exact time is

QRO	Increase transmitter power	**QSP**	I will relay to	**QTV**	Stand guard for me on __ kHz
QRP	Decrease transmitter power	**QSR**	Repeat the call on the calling frequency?	**QTX**	I will keep my station open
QRQ	Send faster	**QSS**	Working frequency is	**QUA**	I have news of
QRS	Send more slowly	**QST**	General call to all amateurs	**QUC**	The last message I received was
QRT	Stop sending / closing station	**QSU**	Send on this frequency	**QUD**	I have received the urgency signal
QRU	I have nothing for you	**QSV**	Send a series of V's	**QUM**	Distress traffic has ended
QRV	I am ready	**QSW**	I am going to send on __ kHz		
QRW	Please inform __ I am calling	**QSX**	I am listening on __ kHz		

10. Amateur Band Chart

Amateur frequency allocations for IARU Regions 1, 2 and 3 on the HF and main VHF / UHF bands — all three regions shown side-by-side in one table. The same table is also available in-app at Tools → References → Amateur Band Chart, with a Share button to export it as an image.

Band	Region 1 (MHz)	Region 2 (MHz)	Region 3 (MHz)
160M	1.810–2.000	1.800–2.000	1.800–2.000
80M	3.500–3.800	3.500–4.000	3.500–3.900
60M	5.3515–5.3665	5.330–5.405	5.330–5.405
40M	7.000–7.200	7.000–7.300	7.000–7.200
30M	10.100–10.150	10.100–10.150	10.100–10.150
20M	14.000–14.350	14.000–14.350	14.000–14.350
17M	18.068–18.168	18.068–18.168	18.068–18.168
15M	21.000–21.450	21.000–21.450	21.000–21.450
12M	24.890–24.990	24.890–24.990	24.890–24.990
10M	28.000–29.700	28.000–29.700	28.000–29.700
6M	50.000–52.000	50.000–54.000	50.000–54.000
2M	144.000–146.000	144.000–148.000	144.000–148.000

70CM	430.000–440.000	420.000–450.000	430.000–440.000

11. How to Use

A quick walk-through for common workflows. Each row below names a task and the shortest path to complete it inside the app.

Task	Shortest path
Study for my Technician exam	Settings → Target License → Technician → Practice → Mock Exam → Start
Switch between Tech, General, Extra	Settings → Target License → pick the level → Save
Look up a Q-code quickly	Learn → Q-Codes → search box. Tap a code to hear it spoken.
Spell my callsign phonetically	Learn → Phonetics → enter callsign → tap the speaker
Calculate a dipole length	Tools → Calculators → Half-wave Dipole Length
See where a beam should point	Tools → Calculators → Beam Heading → enter From/To grid (the share icon appears once both grids are valid)
Practice Morse at 18 wpm	Morse → Learn → pick lesson → Play → type → Reveal
Send Morse with the paddle	Morse → Practice → Send-It-Yourself → tap key
Decode Morse from my radio	Morse → Decode → set tone → Start (mic permission requested first run)
Share an antenna pattern + values as image	Tools → Antenna Lab → tap share icon on the elevation pattern panel
Reset Antenna Lab to defaults	Tools → Antenna Lab → tap the circular arrow on the Antenna & Parameters panel header
Share a reference table as image	Tools → References → tap share icon on any panel
Turn on dark mode	Settings → Default Values → Dark Mode toggle
Scale the font size for accessibility	Settings → Default Values → Font Scale slider
Refresh question pools manually	Settings → Target License → tap the refresh icon
Reset everything to a fresh install	Settings → Reset All App Settings to Fresh Defaults
Send a support request	About → Support → type message → Send

12. Troubleshooting

12.1 The Morse decoder is not recognising anything

Make sure the target tone (Decode sub-tab) matches the tone of the signal you are listening to — the Goertzel filter only sees the configured frequency. Start with a clean tone from a practice oscillator or a radio speaker. Background noise above the adaptive threshold causes false positives.

12.2 Microphone permission is permanently denied

If you previously denied microphone access, the OS will not show the permission dialog again. The Decode tab shows an "Open Settings" button — tap it to jump directly to the app's permissions screen, enable the microphone, then come back. The permission flow probes via the native record package first (works on iOS, Android, macOS, Windows, Linux) before falling back to permission_handler for iOS / Android permanent-denial detection.

12.3 Question pools look outdated

Open Settings → Target License → tap the refresh icon next to the license dropdown. The toast tells you whether the upstream content changed or whether you were already up to date. The app also refreshes silently once a month in the background when you have network access.

12.4 The keying tone got stuck on the Practice paddle

If the paddle button on Morse → Practice ever leaves a tone playing after you lift your finger, it will auto-stop within 4 seconds via a built-in safety timer. Tapping the paddle again also forces a stop. The underlying gesture handler uses raw pointer events so this is rare in practice.

12.5 I want to reset everything

Settings → Reset All App Settings to Fresh Defaults. This wipes all settings, study progress, exam history and the in-memory accordion state. A themed confirmation dialog asks before deleting. Cannot be undone.

13. Credits

Developed by Yousuf AL Balushi (A46UNX) with Flutter and Dart for smooth cross-platform performance. Built for the amateur radio community to make learning, practicing and exploring the hobby easier for everyone.

Thanks to HamStudy.org for the open question-pool data and every amateur who contributed to the open curriculum material this app references.

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