
lonaut

Handbook

Amateur radio for iPhone and iPad

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Preface

There are plenty of amateur radio apps. Most of them show numbers. Ionaut tries to explain them.

The difference sounds small and is the entire point. A sunspot number of 142 is no use to anyone who does not know whether that is a lot. A prediction that reads 90 per cent reliability is worthless if you do not know that the figure refers to the *undisturbed* days of a month. And a D-STAR repeater that stays silent has four possible causes — not one of which appears on screen unless somebody writes it down.

So every module in this app says where its data comes from, what it means, and where it stops being true. This handbook does the same, at greater length.

How to read it

Skipping is allowed. Each part stands on its own, and the contents page takes you straight to a module.

If you are new to the hobby, read **Part 2** from the beginning anyway. Its first chapter explains how HF propagation actually works — no app, no screen. Everything after that makes sense by itself.

Every module follows the same shape: **What it is about** (the background), **What the app shows**, **How to use it**, and **Limits**.

That last section is the unusual one. It says what a module *cannot* do. That is not an admission but the reason you can believe the rest — a tool that names its limits has no hidden ones.

The app stays free

No paid tier, no advertising, no account. This is not an introductory offer but a decision: Ionaut is a contribution to a community I have benefited from for years.

For the same reason the app sends nothing about you. It reads public sources and computes on the device. Your callsign goes only where you ask for it yourself.

A note on where this was written

Ionaut is written in the Gulf, and it shows in the examples: paths to Japan, the grey line over the Indian Ocean, a repeater in Ajman. The physics is the same everywhere, and every module works from your own locator — but where an example would otherwise be abstract, it is a real one from a real station. That seemed better than inventing a neutral one.

The band plans, licence classes and repeater data cover more than seventy countries. Where a rule is national, the text says so.

Thanks

Almost everything this app shows was built by other people and is given away for free: NOAA with its space weather data, the GIRO network with its ionosondes, PSK Reporter, the Reverse Beacon Network, the DX clusters, ircDDB, AMSAT, Celestrak, the IARU with its band plans, and a good many individuals who maintain databases nobody pays them for.

Without them this app would be an empty shell. The sources are named in each module, and again in full in the appendix.

Reiner Klohn, A65RW

Part 1 — Getting started

The first launch

Ionaut needs no account, no sign-in and no registration. On first launch it asks for two things, and they matter more than they look.

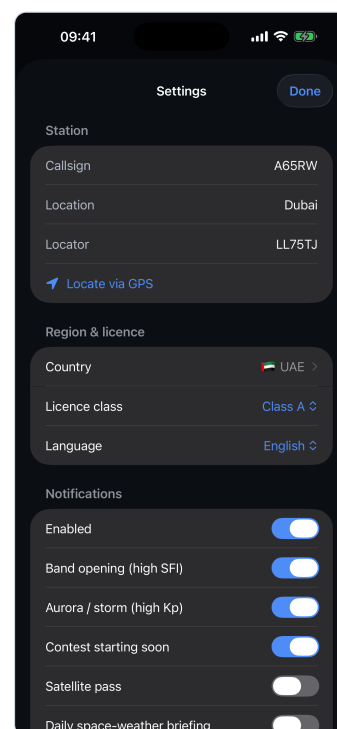
Callsign and locator

Almost everything hangs on the locator. It is the answer to “where are you”, and without that answer the app cannot do most of its arithmetic: no distance, no bearing, no sun and moon times, no propagation prediction, no satellite passes.

The **Maidenhead locator** is a grid laid over the Earth. `LL75TJ`, for example, breaks down like this: the first two letters divide the Earth into 324 large fields, the two digits narrow that to roughly 110 by 70 kilometres, the last two letters to about 5 by 4 kilometres. Six characters are therefore enough to place a station to within a few kilometres — more precise than radio ever needs, and vague enough not to give away your street address.

If you do not know your locator, fetch it from GPS in the **My location** module. Once, and it stays.

The callsign is needed by fewer modules, but the important ones: Live spots, the Watcher and D-STAR live all look for it. If you only listen, you can leave the field empty or enter something made up — the app transmits nothing and reports nothing about you, it only uses the callsign to query public databases.



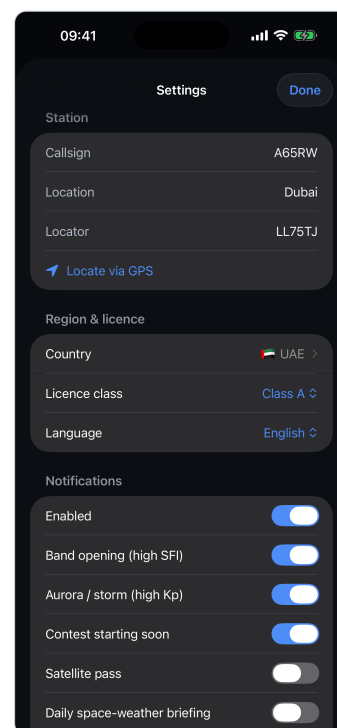
Settings: this is where the callsign and locator live.

Country and licence class

These two settings change **what the app shows you**, not merely how it labels things.

Band plans differ by country. Frequency ranges, permitted power and modes depend on where you are and which examination you passed. What a German Class A holder may do looks different in the Emirates, and some bands are not released to an entry-level class at all.

Enter both, and the app shows **your** band plan instead of a generic one. That is the difference between a table and an answer.



Language, country and licence class.

Language

Ionaut speaks 46 languages. The setting changes everything — labels, explanatory text, learning chapters. The default follows the device.

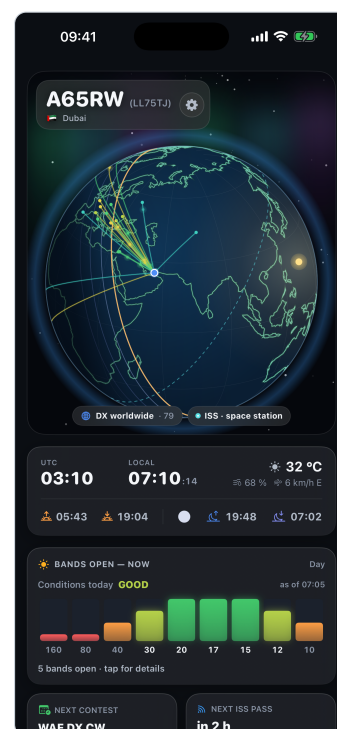
Reading the home screen

From top to bottom:

The header with callsign, locator, national flag and place name. The gear icon beside it leads to the settings.

The globe. It shows your location and the contacts being made right now, somewhere — each line a real spot from the last few minutes. The bright edge is the day-night terminator, the grey zone along which the low bands open up wide for a short while. Below the globe you switch what it displays: DX worldwide, the ISS, and more.

The time row with UTC and local time, weather, sunrise and sunset, moon phase, moonrise and moonset. UTC comes first on purpose: amateur radio thinks in UTC, worldwide, so that nobody has to negotiate time zones.

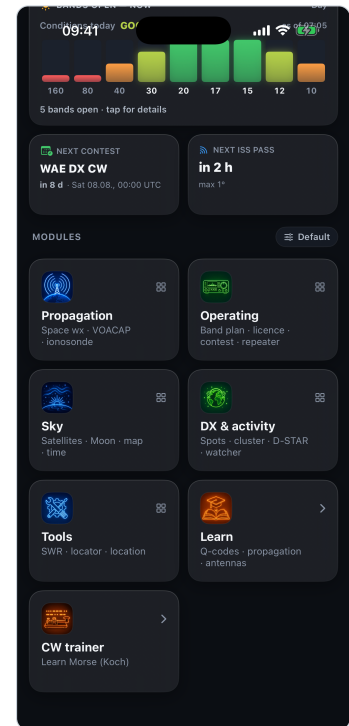


Bands open — now. The bars show how conditions stand on each band. Red is closed, green is open. Tapping leads to the detail.

Two cards with the next contest and the next pass of the space station.

And below that the modules, gathered into seven groups: Propagation, Operating, Sky, DX & activity, Tools, Learn, CW trainer. One tap opens a group; a tap on the small grid symbol in the top right of a tile lists the individual modules inside it.

The home screen, upper part.

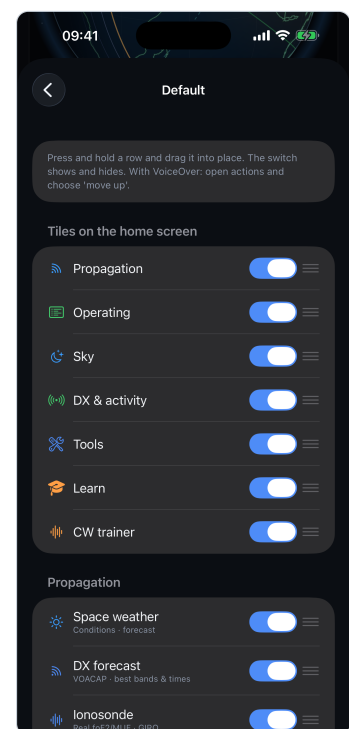


Further down: the seven groups.

Rearranging the home screen

Nobody uses every module. Anyone working only HF has no need for the satellites; anyone working only digital modes has no need for the CW trainer.

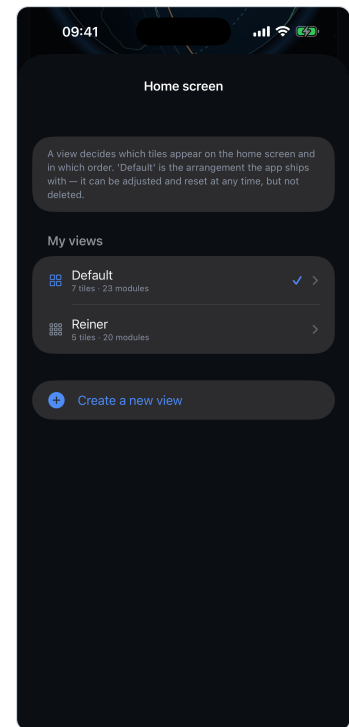
The button beside “MODULES” takes you into edit mode. There you can **move** and **hide** tiles. Hidden does not mean deleted — the modules stay reachable, they just stop being in the way.



Edit mode: tiles can be moved and hidden.

You can also keep **several home screens** and name them. One for HF, one for contesting, one for satellites — each with its own order and its own tiles. You switch with the picker at the top. Four templates ship with the app so that you do not start from nothing.

“Reset” brings back the default order at any time.



The view picker: several saved home screens.

On the iPad



The same home screen on the iPad: more columns, larger cards.

The app runs on iPhone and iPad from the same programme. On the iPad there is more room — tiles sit in more columns, cards and diagrams grow, and the learning chapters'

figures can be read without zooming. Operation is identical; this handbook therefore shows mostly the iPhone.

What you should know before reading on

The app transmits nothing. It reads public data sources and computes. Your callsign goes only where you ask for it yourself — for instance when you look in Live spots to see who heard you.

Much of it needs the internet. Propagation data, spots, satellite orbits and repeater data come from the network. Without a connection the app shows the last state it had and says that it is old — it does not pretend everything is fresh.

And the app explains itself. In nearly every module you will find a card at the bottom describing where the data comes from and what it cannot do. If you do not have this handbook to hand, the essentials are still in the device.

Part 2 — Propagation

Six modules in this group answer variations of the same question: *will this get me anywhere?* Before the modules, a chapter about the thing itself. Anyone who understands what is going on overhead reads the displays differently afterwards — and is less often annoyed by a prediction that turned out to be right.

How HF really works

Why a signal gets anywhere at all

Radio waves travel in straight lines. The Earth is round. Two sentences, and the puzzle is already on the table: why can you hear an Australian on 20 m when there are 12,000 kilometres of planet in the way?

The answer sits 60 to 400 kilometres above the ground. Up there the air is so thin that solar radiation knocks electrons off the atoms. What remains is an electrically conductive layer — the **ionosphere**. To HF it behaves like a mirror hanging over half a continent.

Strictly it does not reflect, it **refracts**. The wave enters the ionised layer at a shallow angle, is bent piece by piece, and comes out again — like a spoon in a glass of water, only over hundreds of kilometres. For practical purposes the distinction does not matter; for understanding it does. A reflection would be a fixed property. Refraction depends on how strongly the layer happens to be ionised at that moment, and that changes by the hour.

The wave returns to the ground a few thousand kilometres away, bounces, and goes up a second time. That is how signals of a few watts get halfway round the planet. It is called **hops**, and each one costs signal.

The four layers

The ionosphere is not one thing but a stack. From the bottom up:

The D layer, 60 to 90 km. It exists only in daylight and disappears within an hour of sunset. It does not reflect — it **absorbs**, and the lower the frequency the harder. It is the reason 160 and 80 m are dead at midday and wake up in the evening. No other process in the ionosphere is quite so brutal and quite so punctual.

The E layer, around 110 km. Also daylight-dependent, reflecting the middle bands over shorter distances. It also produces sporadic E — sudden, very dense patches that open 6 m and 10 m over a thousand kilometres for hours in summer and vanish just as suddenly. Exactly why they form is still not settled; wind shear at that altitude is the leading suspect.

The F1 layer, 150 to 200 km. Daytime only, and usually the least important of them all.

The F2 layer, 250 to 400 km. The real DX layer. It survives the night because the air up there is thin enough that electrons and ions rarely find each other again. Everything beyond 3,000 kilometres goes via F2.

At night F1 and F2 merge into a single F layer, the D layer disappears and the E layer weakens. Night on HF is therefore not simply “less” but something else entirely: the low bands open wide, the high bands close.

MUF and LUF: the window

Two numbers bound what is possible on a path.

The **MUF** — maximum usable frequency — is the ceiling. Above it the wave is no longer bent enough and disappears into space. It depends on how strongly F2 is ionised, and it is not a property of the ionosphere alone: the shallower the angle, the higher the MUF. A long path therefore tolerates a higher frequency than a short one.

The **LUF** — lowest usable frequency — is the floor. Below it the D layer eats the signal before it gets up there.

Between them lies the window. When it is wide open you have a choice. When it closes — the LUF rises by day, the MUF falls by night — sometimes only one band is left. And it happens that the LUF rises above the MUF. Then nothing works on that path, whatever power you use.

The rule of thumb that follows: the best frequency sits just below the MUF, usually at 80 to 90 per cent of it. Not so high that you transmit into space, but high enough that the D layer gets little of it. That is exactly what the DX forecast works out for you.

Why everything turns with the Sun

The ionosphere exists only because the Sun creates it. So everything depends on the Sun — daily, annually, and on an eleven-year cycle.

Across the day the window travels with the Sun's elevation. The high bands open in the morning, stand wide open at midday while the low bands are shut, and the pattern reverses in the evening. The hours around sunrise and sunset are special: along the day-night terminator, the **grey line**, the D layer has gone and F2 is still there. For an hour or two, 40 and 80 m do remarkable things.

Across the year the balance shifts: the low bands are better in winter because the nights are longer, the high bands in summer.

Across eleven years runs the sunspot cycle. More spots means more radiation means a denser F2 layer means a higher MUF. At maximum, 10 m and 12 m are open regularly and you work the world with five watts. At minimum the same bands are dead for months, while 40 m runs more dependably.

Where in the cycle we currently are is shown by the **History** module. Putting a figure in this handbook would be dishonest — it would be wrong within a year.

When the Sun gets in the way

So far the Sun has been the friend. It has another side, and it comes in two forms.

The solar flare. A burst of brightness sends X-rays that arrive **eight minutes** later. They ionise the D layer instantly and it then swallows everything low. Across the entire daylight side of the Earth, 80 m goes quiet within minutes, then 40, and in strong events 20 m as well. It is called the Mögel-Dellinger effect, or simply a blackout. After one or two hours it is over. There is no warning — the light travels exactly as fast as the news about it.

The geomagnetic storm. One to three days after an eruption the particle cloud arrives. It deforms the Earth's magnetic field, compresses the F2 layer — the MUF falls — and lights up the aurora in polar regions. Paths across the Arctic, so Europe to Japan or North America, become attenuated or unusable. It is measured by the **Kp index** from 0 to 9. Up to 3 is quiet; from 5 one speaks of a storm.

Of all things, these two events are what the classical prediction model VOACAP does not know about — more on that in the DX forecast section. They are the reason the app shows the current situation alongside the prediction.

Space weather

What it is about

Space weather is the weather map of the ionosphere: a handful of numbers describing how the Sun is currently acting on the Earth. They do not tell you whether a particular contact will work — that is the DX forecast's job — but they tell you what kind of day it is.

Three numbers carry most of the weight:

SFI, the solar flux. What is measured is the Sun's radio emission at 10.7 cm wavelength, daily at Penticton in Canada. It is a good proxy for the ionisation of the F2 layer. Below 70 there is little going on; from 150 it gets interesting; above 200 the high bands are open.

SSN, the sunspot number. The same statement, older and more tangible — you count spots. It swings more from day to day than the flux does.

Kp, the geomagnetic index. Renewed every three hours, 0 to 9. It says how quiet the Earth's magnetic field is. High Kp means aurora and disturbed northern paths.



Space weather: the key figures with a rating, the bands below.

What the app shows

At the top the figures with a traffic-light colour, so that you need not remember whether 142 is a lot. Below that a rating per band, and further down a path prediction to selectable target regions.

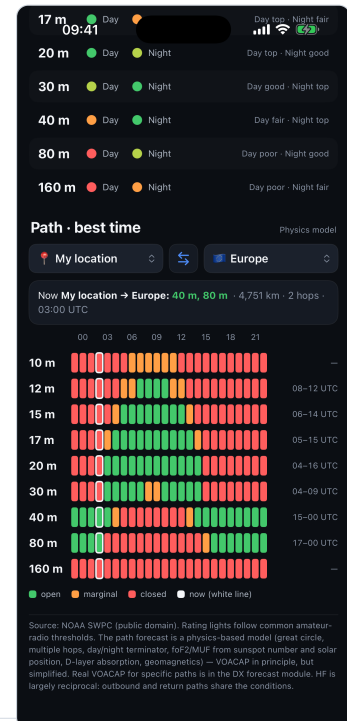
How to use it

First thing in the morning. One glance tells you whether it is worth switching the rig on at all, and where to start. For a specific contact you then move on to the DX forecast.

Limits

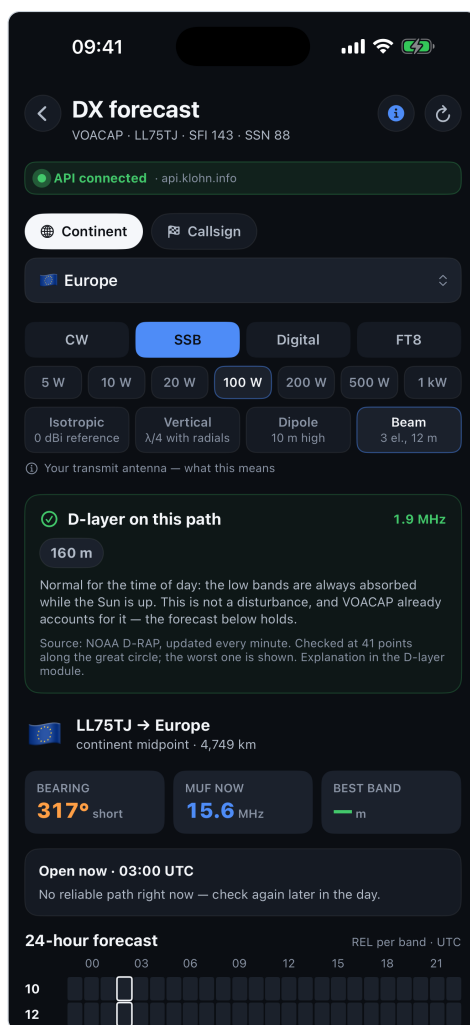
The path prediction in this module is a simplified model of our own, built on the VOACAP principle: great circle, multiple hops, terminator, D layer, geomagnetics. It is fast and good enough for an overview. Real VOACAP for a specific path lives in the next module.

All the figures come from NOAA and are in the public domain. They describe the state of the Sun, not the state of your antenna.



The path prediction, further down the same view.

DX forecast



DX forecast with a target selected. At the top, the D-layer check for this path.

What it is about

This is real **VOACAP** — the same model broadcasters have used since the eighties to plan their schedules and contest operators use to set their strategy. It comes from the US telecommunications institute ITS, is written in Fortran, and runs on our server in Germany rather than on your phone: a computation of that kind is too heavy for a mobile device.

VOACAP takes location, target, month, sunspot number, mode, power and antenna, and from those works out the expected reception quality **for every hour and every band**. What comes out is not a yes-or-no answer but a probability.

What the app shows

At the top you choose the target — a world region, or a callsign whose country the app works out itself. Along with mode and power.

Below that, when needed, the **D-layer check for this particular path**. It warns only when there is more than the ordinary daytime absorption — more on that below.

Then the now-view for the current hour, and the **24-hour matrix**: bands vertically, hours horizontally, colour equals reliability. Every cell can be tapped and gives the signal-to-noise figure in plain numbers.

How to use it

1. Choose a target — a region for the overview, a callsign for the specific case.
2. Set the mode. It changes the result considerably, because FT8 gets by on far less signal than SSB.
3. Enter power and antenna honestly. Anyone with 100 watts to a dipole who enters a kilowatt to a Yagi is only lying to themselves.
4. In the 24-hour matrix look for the time windows, not the bands. The question is rarely “which band” but “when”.

Limits

An honest word belongs here, of the kind you will not find in another handbook.

VOACAP works with monthly medians, not with today.

The ionospheric maps it rests on were fitted from measurements taken between **1954 and 1958**. They describe what an average July looks like at this level of solar activity.

It knows nothing of solar storms or flares. There is no input for them anywhere in the model. Worse: the strongly disturbed days were deliberately removed from the database it was calibrated against. The reliability figure therefore means precisely this: *the proportion of the undisturbed days of this month on which it works*.

What it does know about is the ordinary daytime absorption of the D layer. That is why the app warns about it only when the absorption exceeds the normal level — usually during a flare. A warning that lit up every lunchtime would have been ignored within a week.

And the prediction knows nothing about your surroundings. Noise in a built-up area, a poor site, an antenna in the loft — none of that is in there.



The 24-hour matrix. Green means dependable, red means very unlikely.

Ionosonde

What it is about

Where VOACAP computes, this **measures**. An ionosonde is a radar that transmits straight up and sweeps in frequency. From the echo delay it derives the height at which the reflection happened and the frequency up to which the layer returns anything at all.

Two values matter. **foF2** is the highest frequency that still comes back vertically — the direct measure of F2 density. **MUF(3000)** is the maximum usable frequency derived from it for a path of 3,000 kilometres.

There are around eighty such instruments worldwide, measuring every few minutes. This is the most dependable statement about the ionosphere that exists — and at the same time the one with the biggest catch.

What the app shows

A selection of stations with their current values and the time of measurement.

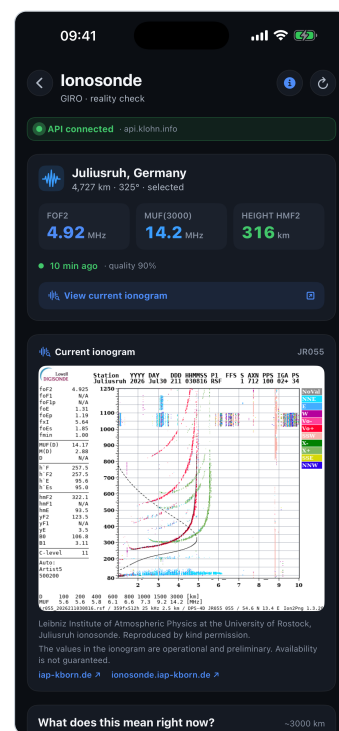
How to use it

As a reality check. If the DX forecast says 15 m is open and the nearest ionosonde reports an foF2 of 4 MHz, believe the ionosonde. It looked ten minutes ago; the model is working with an average.

Limits

The catch is the distribution. Eighty stations sounds like a lot but they are scattered across the globe, concentrated in Europe and North America. Over the Pacific, the Atlantic, large parts of Africa and Asia there is not a single one. For a path to Japan the reflection points lie exactly where nobody measures.

An ionosonde also measures **straight above itself**. For oblique paths the value holds only approximately, and the further away the station, the less.



Ionosonde: measured values from one station.

D-layer

What it is about

This module shows a single quantity, but shows it properly: **how hard the D layer is absorbing right now**. NOAA re-computes it every minute, worldwide, from the measured solar X-ray flux and the proton flux. The result is called the *highest affected frequency* — up to that frequency the absorption is noticeable.

The great advantage over everything else in this group: it is **now**. No monthly medians, no model based on climatology. Whatever the Sun is doing this minute is here within a minute.

What the app shows

The value at your own location, large and rated. Below it the bands currently affected — orange means attenuated, grey means clear. And a card on the solar situation: whether NOAA is reporting a flare, and if so how long the recovery is estimated to take.

How to use it

When suddenly nothing works. One glance says whether it is you or the Sun. If the value is high and the solar card says a flare is in progress, then it is neither the antenna nor the rig, and in one or two hours it will be over.

Limits

The value applies to **your location**, not to the path. On a contact from Europe to Japan it can be night here and broad daylight there — the absorption then happens at the far end. For the path, look at the DX forecast, which checks the whole way.

And it is an instantaneous value, not a history. How it looked an hour ago is not in there.



D-layer: highest affected frequency at the QTH, affected bands, solar situation.

History graphs

What it is about

A single number says little. Whether an SFI of 130 is good depends on whether it stood at 90 or at 180 last week. This module shows thirty days.

The value is in the trend. The Sun rotates once in about 27 days — active regions therefore come back into view after roughly four weeks. Anyone who knows the history sees that coming.

What the app shows

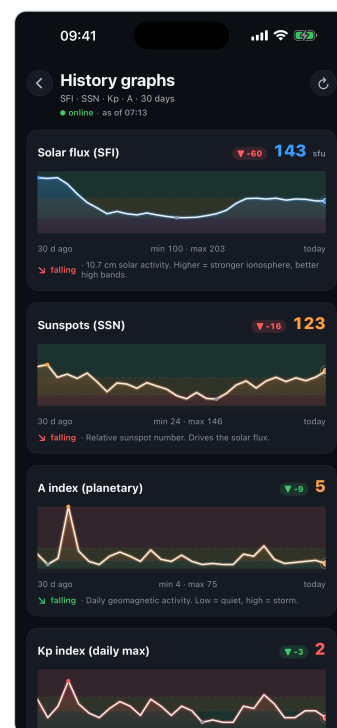
Four graphs: solar flux, sunspot number, Kp, and the A index, a daily mean of geomagnetic activity.

How to use it

Before a contest or a planned activity. A flux rising over a week is good news; a Kp that keeps jumping to 5 is bad news.

Limits

A look back, not a forecast. And thirty days is too short to see the cycle — that takes years.



History: thirty days of SFI, SSN, Kp and the A index.

Solar images

What it is about

Everything so far has been numbers. Here you see the cause: the Sun itself, at several wavelengths, from the SDO and SOHO spacecraft.

Different wavelengths show different heights of the solar atmosphere. In the extreme ultraviolet the active regions appear as bright patches — precisely the ones responsible for flux and flares. And SOHO's coronagraphs mask the Sun so that the corona becomes visible, and with it **coronal mass ejections**: the particle clouds that trigger the geomagnetic storm one to three days later.

What the app shows

The current images with an explanation of what is visible in each.

How to use it

When you want to know why. A Kp of 6 is a number; an ejection that two days earlier came out of the corona as a glowing cloud is an explanation.

And when you look at a large active region on the solar limb, you know: in a few days it will be facing Earth. Then it gets interesting, in both directions.

Limits

Pictures, not measurements. They help with understanding, not with computing.

In summary

The six modules build on one another, and you use them in this order:

- **Space weather** — what kind of day is today?
- **DX forecast** — can I reach this target, and when?
- **Ionosonde** — does the measurement agree?
- **D-layer** — why is nothing working right now?
- **History** — is it getting better or worse?
- **Solar images** — what is actually behind it?

And if a prediction ever contradicts what you can actually hear: the ionosphere is always right. The model only computes the average of many days, and your evening is not one of them.

Part 3 — DX and activity

Part 2 was about predictions. This part is about observations: not what the ionosphere *ought* to be doing, but what was actually heard, moments ago, by real stations. That is the second half of the truth, and often the more interesting one.

Who reports what, exactly?

What a spot is

A **spot** is a report of the form: *station X was heard at 14:32 on 14.074 MHz by station Y*. Nothing more. Four facts, distributed worldwide, millions of times a day.

That sounds trivial and is not. A spot is the only proof that a radio path really worked at that moment. No model, no arithmetic, no statistics — somebody heard somebody.

The four networks

Ionaut taps four of them. They differ more than one would think.

The DX cluster is the oldest, and the only one where humans do the reporting. Anyone who hears an interesting station types it in. That makes it valuable and unreliable at the same time: what gets reported is what interested somebody. A rare island appears within seconds; an entirely ordinary contact never does.

PSK Reporter collects automatically whatever the digital modes decode — mostly FT8. Around 26 million reports a day. Nobody decides what gets reported; the software reports everything it understands. That makes it the most honest source for the question *is the band open*, and the only one in which boring contacts also show up.

The Reverse Beacon Network does the same for CW and RTTY: receivers listen automatically and report every callsign somebody calls in CW.

ircDDB is the address book behind D-STAR and not a spotting network as such — but because every D-STAR transmission leaves an entry there, one arises as a by-product. There is a chapter of its own on that below.

The most important mistake

An empty band is not the same as a closed band.

If there are no spots on 17 m, that can mean two things: the band is shut, or nobody tried. Sunday afternoon is full, Tuesday at four in the morning is empty — and the ionosphere has nothing to do with it.

So every look at these modules belongs together with a second look at the prediction. The spots tell you what **happened**. The prediction tells you what would be **possible**. Only together do they make a picture.

And there is something else a spot does not tell you: **how well** it went. A station with a kilowatt into a beam will be heard everywhere. If you have 100 watts into a wire, their spot does not mean you can walk the same path.

Live spots

What it is about

This module inverts the usual question. Not “who can I hear”, but “**who hears me**”.

The data comes from PSK Reporter. Anyone using FT8, FT4 or another digital mode is reported there automatically as soon as somebody, somewhere in the world, decodes them. The result is an honest account of your own station, of a kind you would otherwise only get from other people's reports.

What the app shows

A band overview with the number of receptions and the most recent time, and below it the individual reports with distance and bearing. Switchable between “heard by” and “hearing” — that is, between your transmissions and your receptions.

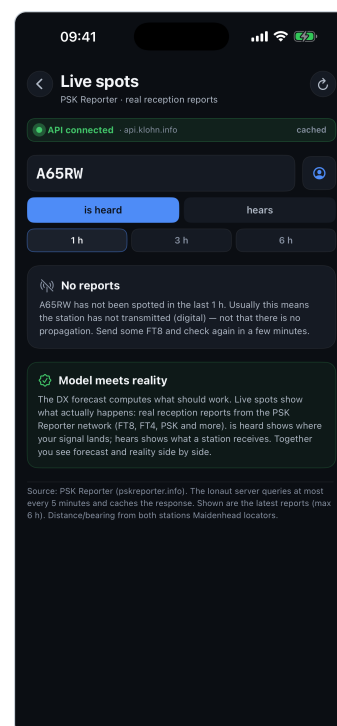
How to use it

After changing an antenna. Two rounds of FT8 on 20 m, then look here: range, directions, count. That is a measurement, not a feeling.

Limits

It works only for digital modes. Anyone running SSB does not appear. And anyone who is not transmitting sees nothing — that is not a fault but an absence of data.

The server queries PSK Reporter at most every five minutes, as their rules require. The display can therefore lag by a few minutes.



Live spots: where your own callsign was heard.

DX cluster

What it is about

The classic hunting ground. Radio amateurs worldwide report which interesting stations they are hearing right now. Anyone looking for a rare island or an expedition looks here first.

What the app shows

The most recent reports with frequency, mode and time. The app derives country, flag and distance from the prefix, and the bearing from your locator — so you can see at once where the antenna would have to point. Filters for bands and modes.

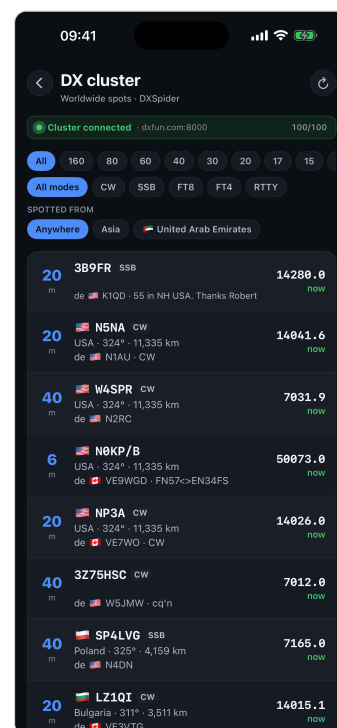
How to use it

As a search aid, not as truth. A spot says somebody heard somebody — not that you can. They may have been 3,000 km closer.

What is useful is the link to the prediction: if there is a spot from a region you want, it is worth checking whether the band is open at your end too.

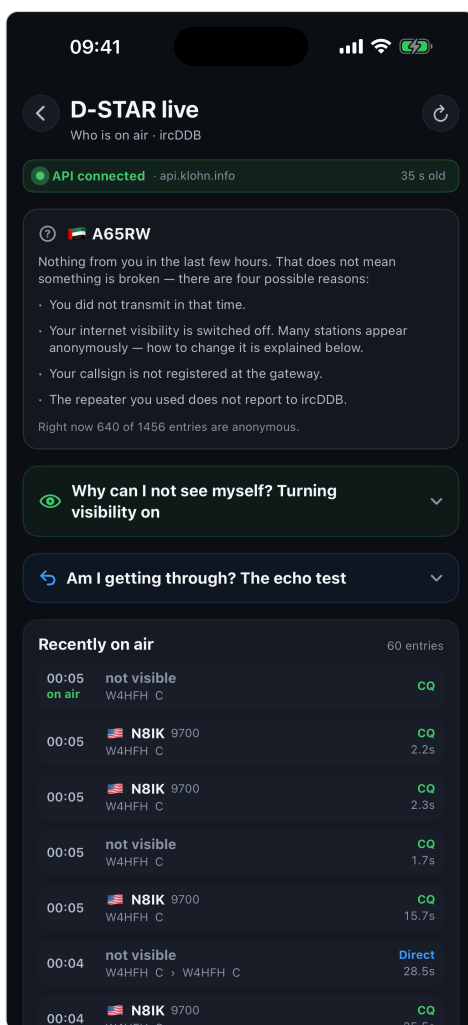
Limits

People report what interests them. The cluster is therefore skewed towards the rare and the spectacular, and it contains mistakes — wrong frequencies, typing errors, occasional nonsense. A noticeable share of the reports corresponds to no contact that actually took place.



DX cluster: reported stations with country, flag and bearing.

D-STAR live



D-STAR live: status line, your own record, the expandable help.

What it is about

D-STAR is the oldest digital voice mode in amateur radio. It can do something analogue radio cannot: **call a person instead of a frequency**. You enter a callsign, and the network works out for itself at which repeater that person was last heard, and puts the connection through to there.

What makes that possible is **ircDDB** — an address book that has been run by volunteers since 2010 and remembers where everyone was last. This module shows the by-product: because every transmission creates an entry in the address book, a list falls out of it showing who is speaking on D-STAR anywhere in the world right now.

D-STAR's real problem

D-STAR has no technical defect. It has a **feedback problem**.

The whole of its operation runs through one eight-character field called **URCALL**, which means three completely different things: the destination, the route, and commands to the

repeater. Put something wrong in there and **nothing** happens. No error message, no tone, only silence.

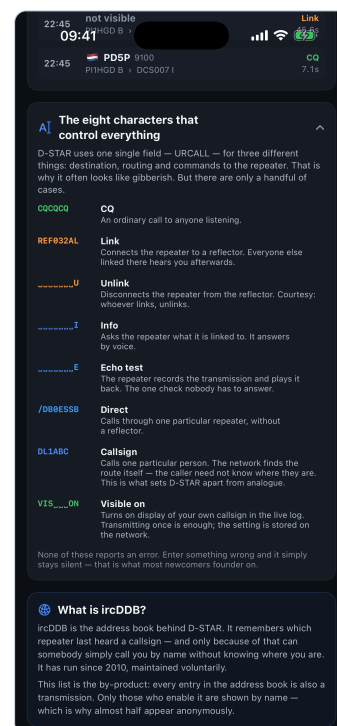
And silence does not tell you which of four causes applies:

1. The callsign is not registered at the gateway.
2. Your own visibility in the network is switched off.
3. The repeater you are using does not report to ircDDB at all.
4. Nobody happens to be listening.

Four causes, one symptom. This is exactly where most newcomers come unstuck, and exactly why this module exists: the live log is the one place where D-STAR talks back.

The eight characters

What goes in URCALL is often not a callsign at all:



The legend in the app, expanded.

Entry	Meaning
CQCQCQ	Ordinary call to anyone
REF032AL	Link to reflector REF032, module A (the L at the end stands for Link)
UUUUUUUU	Unlink from the reflector
IUUUUUUU	Info — the repeater announces by voice what it is linked to
EEEEUUUU	Echo test — the repeater plays your own transmission back
/DB0ESSB	Direct call via one particular repeater
DL1ABC	Call to a person . The network finds the route

The stands for a space. Seven of them and a letter.

A **reflector** is a meeting point on the internet that many repeaters can link to at the same time. Whoever links hears everyone else — and the other way round. Point of courtesy: whoever links also unlinks again.

Why you may not see yourself

Since 2011 **everybody decides for themselves** whether their callsign appears in the ircDDB live log. Many have never switched it on — which is why a substantial share of entries carries no name, only “not visible”. How many that is right now, the app shows below your own record.

First, the reassurance: this affects the internet display only. Callsign routing works independently of it. Anyone invisible can still do everything — they simply are not listed publicly.

Switching it on takes one transmission:

1. In the radio, set UR (YOURCALL) to exactly `VIS     ON` — three spaces between VIS and ON, eight characters in all.
2. Press PTT briefly once, at a repeater connected to the ircDDB network.
3. Set UR back to `CQCQCQ`.

The setting is stored permanently in the network. Once is enough, for good. The reverse is `VIS     OFF`, with two spaces.

The echo test

The second question nobody answers: *am I getting through at all?* You could call — but then you may end up in a conversation you have no time for just now.

The echo test solves that. The repeater records your transmission and plays it straight back. You hear yourself as others hear you, and nobody has to answer.

1. Set UR to `E` — seven spaces, then an E.
2. Press briefly, say a few words, release.
3. The repeater plays it back. If it stays silent, you are not reaching it.
4. Then look at your own record here: the duration and packet loss of your transmission are shown.

Not every repeater offers echo. And set UR back to `CQCQCQ` afterwards, or next time you will be calling into the void.

What the app shows

The status line at the top — green when the server answers, amber for cached data, red with no connection. On the right, the age of the data.

Your own record for your callsign. If you were heard, it says when, via which repeater, for how long and with how much packet loss. If ircDDB reports your callsign as faulty, the card turns red and explains what that means. And when there is nothing, it lists the four possible reasons instead of an empty space.

The list of recent transmissions with time, callsign and flag, repeater and destination, the kind of transmission, and — once it has ended — duration and packet loss.

And the detail sheet, when you tap an entry: every field in plain language, plus an explanation of what this kind of transmission actually is.

How to use it

To check yourself. After setting up a new radio, or when something does not work: send an echo test, then look here. The answer is in one line.

To see where something is going on. Which reflectors are in use, which repeaters have traffic.

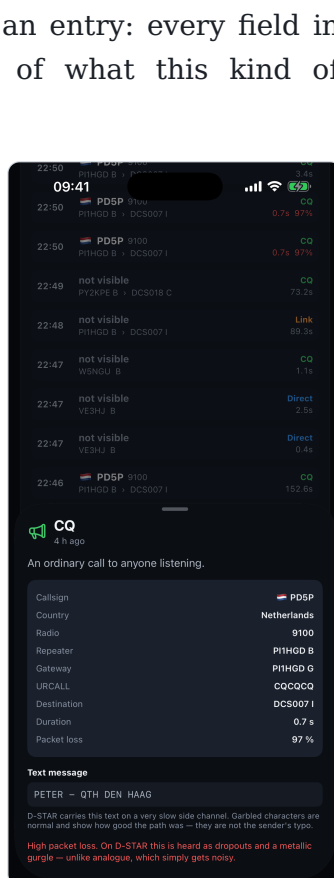
To learn. The list is a textbook that writes itself. What was a link, an unlink, a direct call is right there in the line — with real examples instead of invented ones.

Limits

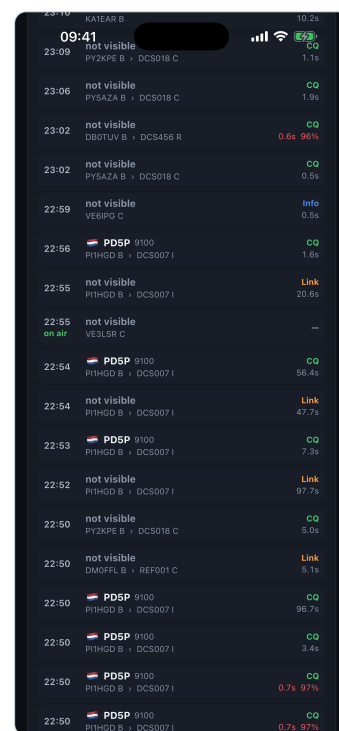
Only the visible show up. A substantial share of entries carries no callsign. If you cannot find someone you know, ask them for `VIS_####ON`.

The text message gets damaged over the air. D-STAR carries it on a very slow side channel; garbled characters are normal and not the sender's typing. They even tell you how good the path was.

The live log is run by a single radio amateur and is occasionally unreachable. That says nothing about D-STAR itself — your repeater carries on working.



Detail sheet for one entry.



The list. “live” means: this transmission has not ended yet.

The Watcher

What it is about

Every module so far has to be opened. The Watcher turns that round: it gets in touch by itself when a callsign you care about appears.

The server watches the reporting networks around the clock. When a report matches your list, a notification arrives on your phone — even with the app closed.

What the app shows

Your list of callsigns, the filters for bands and modes, and a test button so you can check that notifications arrive at all.

How to use it

For the callsigns you are waiting for. A missing country, an announced expedition, a friend with whom you have failed to arrange a time for weeks.

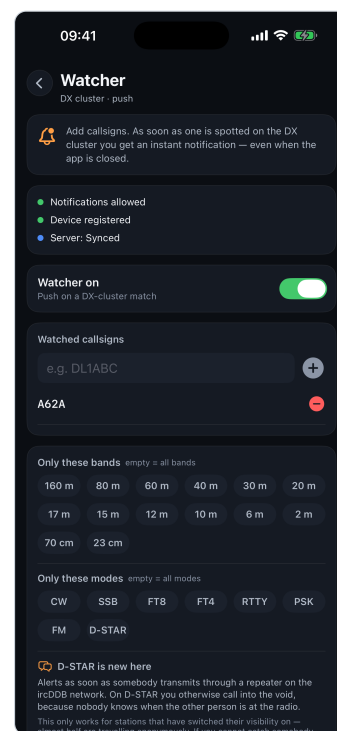
A **prefix is enough**: enter `A65` and you get everything from the Emirates.

The filters are the difference between useful and a nuisance. Without filters you get every report; with band and mode filters, only what you can actually work.

D-STAR in the Watcher

Since version 1.3, D-STAR is selectable as a mode. This is the case where a notification pays off most: on HF you can hear whether somebody is there — on D-STAR you call into the void, because nobody knows when the other person is sitting at the radio.

Two things about it. It only works for stations that have switched their visibility on. And the notification can currently take one to two minutes — the source is queried deliberately sparingly as long as written permission for it is not in hand.



The Watcher: monitored callsigns and the filters.

Conditions instead of callsigns

Below the filters there is a second kind of watcher. Instead of “tell me when DL1ABC shows up”, it says **“tell me when 20 m opens to Japan”**.

Eight destinations are there to tap — Europe, North America east and west, Japan, Australia, South America, South Africa, India. For each path you pick a band or leave it open, plus the sensitivity: **early** or **reliable**. Five paths is the maximum; more becomes noise anyway.

Behind those two levels there is no fixed percentage but a **share of the best value of the day on that path** — a third and two thirds respectively. That sounds like a detail and is in fact the difference between usable and useless: prediction figures are not comparable between a short hop to Europe and a long haul to Australia. A fixed threshold would fire constantly on one path and never on the other. A share of the day's best means what you actually want to know: **now is the best time on this path**.

The arithmetic runs on the server, with the same VOACAP calculation as the DX prediction — once a day per path, because one run delivers all 24 hours at once.

Three rules keep the service from becoming a nuisance. The notification comes **only on a change** from closed to open, never as a reminder. Between 22:00 and 07:00 it stays quiet, but the state is still tracked — so you miss the message, not the next opening. And there is a cap per day.

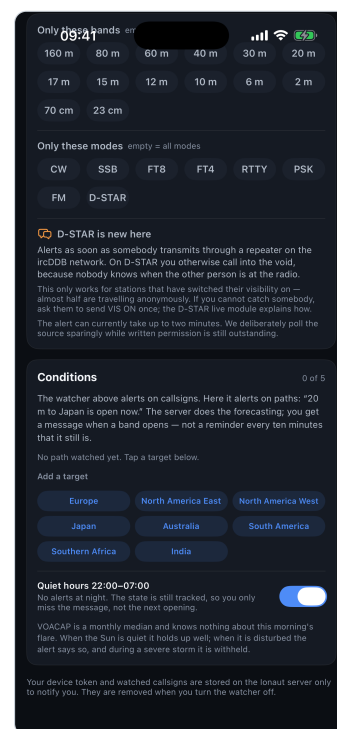
When you set it up it stays quiet at first: the first pass only takes note of what is currently open. Otherwise you would get five notifications the moment you set it up, for openings that have long been running.

Limits

The Watcher can only report what gets reported. Anyone not spotted does not appear — and anyone who is rarely on the air is rarely spotted.

For conditions the limit is a different one, and it is stated in the app too: **VOACAP is a monthly median**. It does not know about this lunchtime's solar flare. With a quiet sun it is a good match; when things are unsettled, the caveat appears in the notification, and in a severe storm the notification stays away altogether. A push service does not survive three false alarms in a row.

And a second, less comfortable limit worth knowing. The reliability VOACAP gives is for **a single pair of stations with 100 watts into dipoles** on an average day. FT8, however, works far below what such a pair achieves on such a day — and when thousands of sta-



The Conditions card: paths, band and level selection, with the grid of destinations below.

tions are active at both ends, plenty get through even at a low individual probability. So there are bands on which contacts really are being made although the model considers them closed.

Whether there is a pattern in that, the app now measures for itself: since 29.07.2026 the server records daily what was predicted and what, according to the reporting networks, actually arrived. What comes out of it will become visible in a later version.

To stop your phone ringing continuously there are limits: the same callsign is not reported repeatedly in a row, and there is a ceiling per hour.

Callsigns

What it is about

A reference work. Enter a callsign, and the app says which country, which continent, which CQ and ITU zone, how far away and in which direction.

That works via the **prefix** — the first characters of a callsign are allocated internationally. **DL** is Germany, **A6** the Emirates, **VK** Australia. The app knows the allocation and computes distance and bearing from your location.

How to use it

When a callsign appears in the cluster that you cannot place. Or before a call, to know where the antenna has to point.

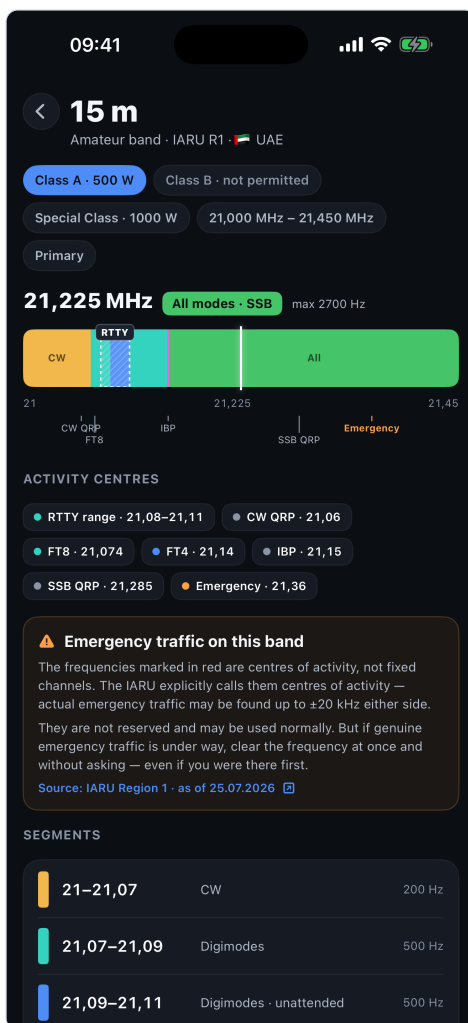
Limits

The prefix gives the country, not the place. A **DL** callsign may sit in Flensburg or in Munich — the bearing is therefore an approximation to the centre of the country. And a portable suffix can throw everything out: anyone operating as **DL1ABC/VK2** is in Australia.

Part 4 — Operating

Four reference works for the questions that come before you press the key: where am I allowed? What am I allowed? When is something going on? And who will pick me up?

Band plan



One band on one page: classes, segments, activity centres, notes.

What it is about

A band plan is an agreement, not a regulation — with one important exception.

The band edges and the power limits are in law. Anyone transmitting beyond them is operating outside their licence, and that is not a matter of taste.

Everything inside the edges is an agreement among radio amateurs, drawn up by the IARU and arranged differently in three regions: Region 1 is Europe, Africa and the Middle East, Region 2 the Americas, Region 3 Asia and Oceania. It settles where CW lives, where

the digital modes are, where voice starts. Anyone not keeping to it is doing nothing forbidden, but they are causing interference — and the reason it works anyway is that almost everybody does keep to it.

What the app shows

No scrolling sideways, no hunting in a table. **One band, one page:**

At the top the band name, IARU region and country. Below it the **licence classes** of your country with the power each is allowed — and, where it applies, the note “not permitted”. Along with the frequency range, whether the band is allocated primary or secondary, and particulars such as “WARC · no contests”.

In the middle the **frequency slider**. You pick a frequency and the app tells you what is permitted there: mode and maximum bandwidth. The coloured bar below shows the segments in context — CW, digital, beacon range, voice — and the small marks under that show the **activity centres**: FT8, IBP, QRP frequencies, emergency traffic.

At the very bottom, the segments once more as a list, with frequency range, mode and permitted bandwidth.

How to use it

Before transmitting on a band you rarely use. Set the frequency, look, done — the question “may I do FT8 here” is answered in five seconds.

And on holiday. Change the country, and the app shows that country's plan with that country's classes.



Band plan on the iPad: segments and activity centres side by side.

Limits

The app reflects the **IARU band plan** and the national allocations as well as it can. It does not replace a look at your regulator's own document when things get tight — and for regions where rules have changed recently it may lag behind.

For every band the source is named, with its date. If an old date appears there, you know how far to rely on it.

One point that is often misunderstood: **emergency frequencies are not blocked channels**. The IARU explicitly calls them activity centres. They may be used normally — but if real emergency traffic is running there, you clear immediately and without discussion, even if you were there first.

Licence classes

What it is about

Every country divides its radio amateurs into classes, and each class may do something different: different bands, different power, sometimes different modes. The names are inconsistent — what Germany calls “Klasse N” is called “Foundation”, “Technician” or “Novice” elsewhere, and the rights behind them are not the same.

For two situations this is more than curiosity: when planning an examination, and when operating on a foreign licence in your own country or the other way round.

What the app shows

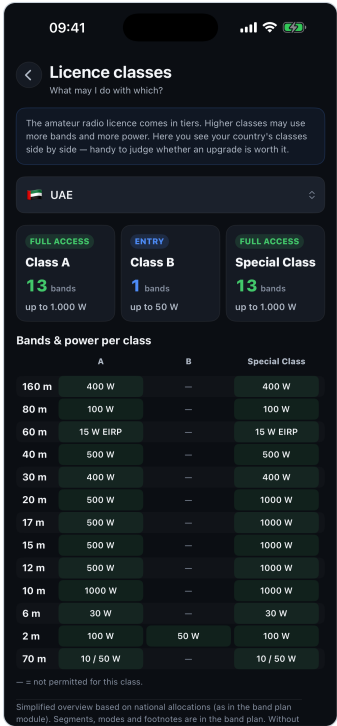
The classes of the chosen country side by side, with bands, power and restrictions. What your own class may do is highlighted.

How to use it

Before an examination, to see what the next step brings. Or before a trip, to know what your own licence is worth there.

Limits

The data is researched and carries its sources, but it does not replace a ruling from the competent authority. Reciprocal recognition between countries is a topic of its own, which the app does not cover.



Licence classes compared.

Contests

What it is about

A contest is a competition: as many contacts as possible in a set time, under fixed rules. For some, the point of the hobby; for others, the reason not to go on 20 m this weekend.

Both groups need the same information: **when is what**.

What the app shows

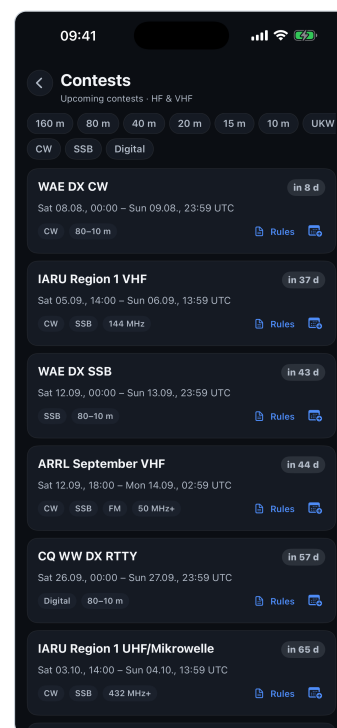
A calendar of forthcoming contests with period, bands and mode. Every entry can be added to your own calendar.

How to use it

Anyone taking part plans with it. Anyone not taking part knows why the band is full — and can go elsewhere, for instance to the WARC bands 30, 17 and 12 m, on which contests do not take place as a matter of principle.

Limits

The calendar is as complete as its source. Small regional contests may be missing. And the rules are not in it — that is the organiser's own announcement.



Contest calendar.

Repeaters

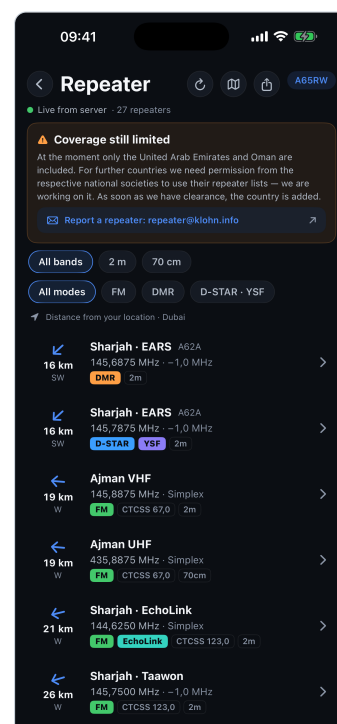
What it is about

A repeater sits high up, listens on one frequency and transmits simultaneously on another. That way a handheld with five watts suddenly reaches a hundred kilometres instead of five.

To use one you need to know three things: the **output frequency**, the **shift** (by how much, and in which direction, the input is offset) and the **access tone**, usually a CTCSS tone that stops every burst of interference from waking the repeater up. Digital repeaters add other details.

What the app shows

The repeaters around you, **sorted by distance** — with distance and bearing from your location. The detail view shows frequencies, shift, tone, mode and operator.



How to use it

While travelling. New city, hand-held in your pocket: open the module, the nearest repeater is at the top, copy the frequencies across.

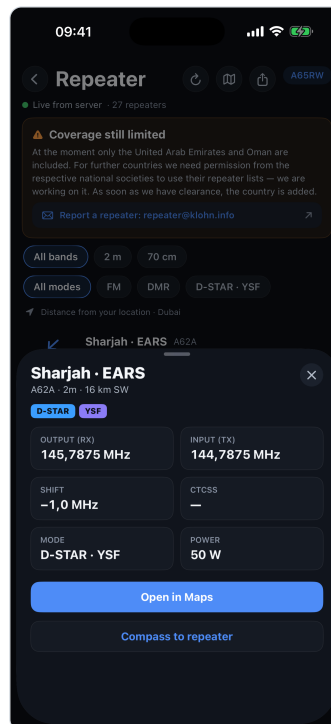
Limits

The repeater data comes from **curated lists held by the national amateur radio societies**, live from the Ionaut server, falling back to the version stored in the app when there is no network. Completeness varies by country, and locations are at town level — not to the metre. For some countries the data is missing entirely because its release has not been granted; that is stated explicitly, so that nobody thinks there is nothing there.

If a repeater is missing or a detail is wrong: **repeater@klohn.info**.

And: a repeater being in the list does not mean you can reach it. Distance says nothing about the mountains in between.

Repeaters by distance.



Detail of one repeater.

Part 5 — Sky

Four modules that all solve the same problem: **where is something right now, and when can it be reached from here**. Once for satellites, once for the moon, once for the Earth itself, and once for the clock.

Background: orbits in two paragraphs

A satellite is falling. It falls towards the Earth the whole time and misses, because at the same time it is travelling sideways fast enough. How fast sideways it has to be depends on altitude alone — and everything else follows from that.

Low orbit (LEO), 300 to 800 km. One revolution in about 90 minutes. The satellite crosses the sky, is above the horizon for four to fifteen minutes, and disappears again. Everything of interest to radio amateurs — the ISS, SO-50, RS-44, the FUNcube series — flies here. Because it is moving, its frequency shifts: **Doppler**. On the way up it is coming towards you and the signal sits too high; on the way down it is moving away and the signal slides lower. Across one pass that is around ± 10 kHz on 70 cm — so you have to follow it.

Geostationary orbit, 35,786 km. At that height one revolution takes exactly one day. The satellite therefore stays over the same point of the equator and **does not move as seen from the ground**. QO-100 is one of those. Point the antenna once, bolt it down, done — no Doppler, no pass times. The price: you can only see it if you are inside its footprint. From Dubai QO-100 sits high in the sky, from New Zealand not at all, and no antenna changes that.

And the moon? It is 384,400 km away and a miserable but reliable reflector. Anyone sending a signal there and catching it again — **EME, Earth-Moon-Earth** — loses 250 to 270 dB on the way. Hence the need for beams, power and low-noise preamplifiers. The advantage: the moon is visible from half the Earth at once. Whoever sees it, and whoever it sees, can be reached — regardless of what the ionosphere happens to be doing.

Satellites

What it is about

A few dozen satellites with amateur radio payloads fly over us. To use one you need to know three things: **when it comes**, **where in the sky it is** and **on which frequency** — the last of those including the Doppler correction.

The orbital data for that is called **TLE** (Two-Line Elements) and is republished continuously. From it a method called **SGP4** computes the position at any moment. That is not a formula you do in your head.

What the app shows

At the top the **groups**: amateur radio, QO-100, all GNSS, weather — and the star for your **favourites**. Plus a search field that looks through names and NORAD numbers.

The status line below it says whether the Ionaut server is reachable and whether the answer came from the cache. The orbit arithmetic runs there, not in the phone.

In the **detail view**, from top to bottom:

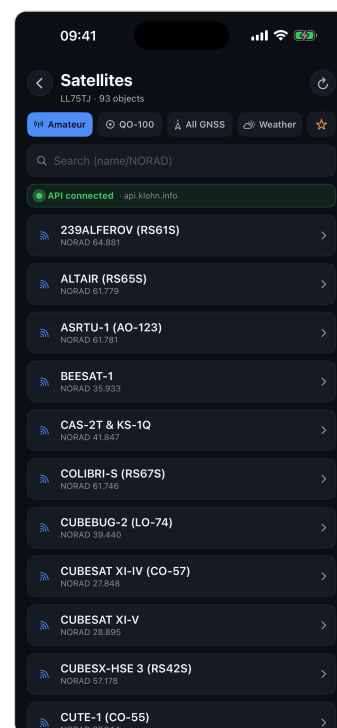
The status line — above or below the horizon, and how long until the next pass.

The AMSAT line, when reports exist: “heard”, “beacon / telemetry only”, “reports contradictory” or “reported: not heard”, plus how often in the last 24 hours. That is not a measurement but what other radio amateurs have reported — and it answers the question no orbit calculator can answer: **is the thing still alive at all?**

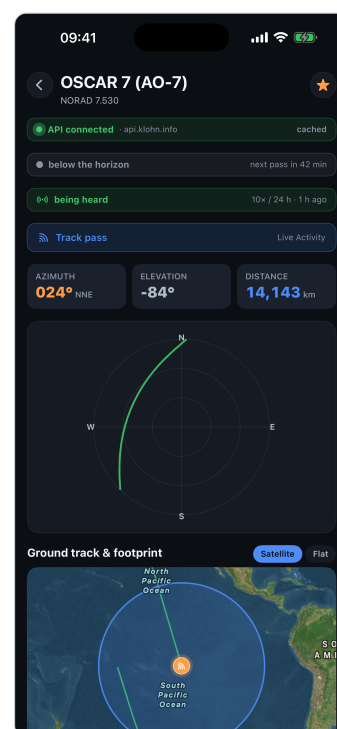
Azimuth, elevation, range as three tiles, live.

The polar plot — the sky seen from above. The rim is the horizon, the centre is straight up, the rings lie at 30° and 60° elevation. The green curve is the satellite's track across the sky, the red dot its current position. Anyone turning a beam by hand reads off where to point.

Ground track and footprint, either on a satellite map or on a flat world map. The circle is the area from which the satellite is currently visible. If your QTH is inside it, you are in business; if it is outside, no antenna helps.



The list: choose a group, tap a satellite.



Detail: azimuth, elevation, polar plot, passes, frequencies.

The next passes — rise, highest point, set. The maximum elevation is the figure that matters: **from 40° up it is a good pass** (green), from 15° usable (amber), below that it only scrapes along the horizon.

Frequencies and Doppler for the common satellites — ISS, SO-50, RS-44, QO-100, AO-7, AO-73, PO-101. **RX** ↓ is your receive frequency, **TX** ↑ your transmit frequency, with the Doppler correction already applied. If the satellite is above the horizon the app computes live; otherwise it shows the nominal value.

How to use it

Once: open Satellites, mark the interesting ones with the star. The favourites list then shows the next pass for each — and the app reminds you ten minutes beforehand.

Before the pass: open the detail view, look at the polar plot, turn the antenna to the rise point, copy the frequencies down.

For QO-100 none of that applies. The app names azimuth and elevation once, the dish is aimed accordingly and stays there.

Limits

The orbit arithmetic runs **on the Ionaut server** from Celestrak data. With no internet the module shows nothing.

The live position is interpolated between reference points — accurate to a few tenths of a degree, more than enough for turning an antenna, but not a precision instrument.

Passes are computed 48 hours ahead, up to twelve are displayed. Favourites are limited to twelve.

And the AMSAT line is only as good as people's willingness to report: if nobody reports, that does not mean nothing is working. That is why, in the absence of reports, the app deliberately shows nothing at all rather than writing “not heard”.

Moon

What it is about

For EME four numbers count: **azimuth and elevation** (where to point), **range** (how much loss) and **the angle between moon and sun** (how much noise).

The moon's orbit is an ellipse. At **perigee** it is around 356,000 km away, at **apogee** around 407,000 km. Because the path is travelled twice, the difference enters with the fourth power: **about 2 dB** between the best and worst day. That sounds small, but in EME it is the difference between readable and not.

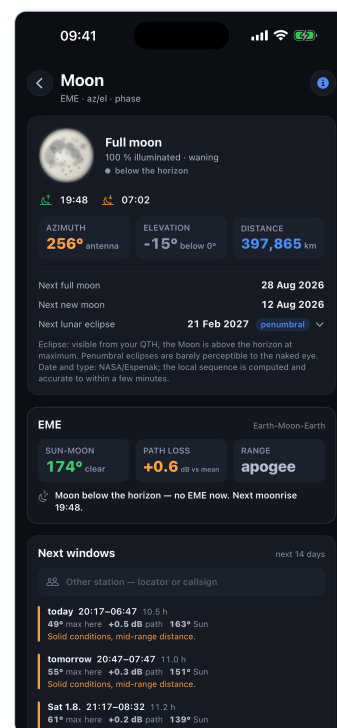
When the moon sits close to the sun, the sun's noise comes into the antenna lobe. On 70 cm and above in particular that raises the noise floor noticeably.

What the app shows

At the top the **drawn lunar disc** with the actual illumination, beside it the phase name and the percentage. Then the status line — above or below the horizon — moonrise and moonset, and the three tiles **azimuth, elevation, range**.

Below that the **dates**: next full moon, next new moon, next lunar eclipse with its type (total, partial, penumbral). The eclipse line can be tapped and expands into the full sequence — penumbral entry through to exit, each with altitude and direction at **your** location.

The **EME card** sums it up: sun-moon angle, path loss relative to the average, perigee or apogee. And below it a sentence in plain language, such as “Near perigee and clear of the sun — good EME conditions, signals a little stronger” or “Moon close to the sun — solar noise degrades reception”.



Position, phase, dates — and the EME assessment.

The next windows

The EME card assesses the moment. But EME is arranged days ahead — and for that, below it, there is a list of the **next five windows**, with date, period, duration, highest elevation, path loss and sun separation. For each window a sentence in plain language, such as “Near perigee and the sun well away — the best the month has to offer”. At the end, the date of the next perigee, because over several weeks that is the only figure that really counts.

The most interesting part is the **partner station** field. Enter a locator there — or a callsign, which the app looks up in the callbook — and only the time when the moon is above the horizon for **both** of you still counts. In EME that is the actual arrangement.

Two decisions you will notice. A window begins at **5° elevation**, not at 0°: at the horizon the antenna sits in ground noise, hangs in trees and houses and looks through the thickest layer of air — a window starting at 0° promises time nobody can use. And windows shorter than half an hour are dropped.

If the callbook holds no locator, the app computes with the centre of the country and says so. Unlike an antenna bearing, that is harmless here: the moon is 384,000 km away, and two stations 300 km apart see it within a few degrees of the same place.

How to use it

Antenna to azimuth and elevation. Both stations must have the moon above the horizon — that is the actual arrangement in EME, not the frequency.

And for planning: full moon is irrelevant, perigee is not.

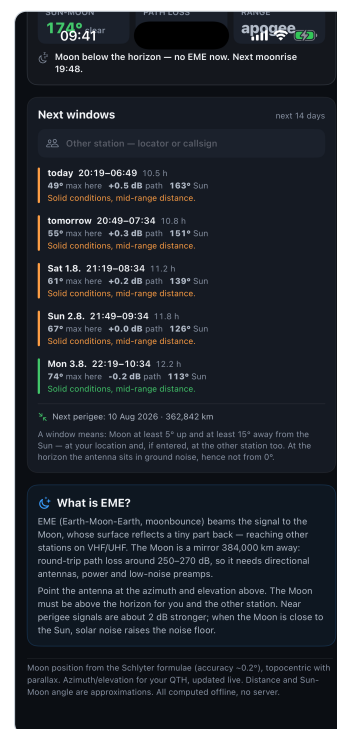
Limits

Everything is computed **offline**, with no server. The moon's position follows Schlyter's formulae and is accurate to around 0.2° — for a Yagi with a 15° beamwidth that is ample.

Range and sun-moon angle are approximations. Path loss is given only **relative** to the mean, not in absolute terms.

The eclipse sequence is accurate to a few minutes — which is why the app deliberately shows no seconds, because that would be a sharpness that is not there.

At very high latitudes it can happen that the moon neither rises nor sets within 48 hours. The times then show a dash.



The next windows, with a partner locator entered: only the shared part counts.

Map

What it is about

An ordinary world map is useless for radio. It shows Greenland as large as Africa, and above all: **the shortest connection between two points is not a straight line on it**. Anyone taking a bearing from a world map turns the antenna to the wrong place.

The **azimuthal equidistant projection** solves that for exactly one point — yours. From the centre outwards, every direction is right and every distance is right. If Japan lies at 060° on the map, turn the antenna to 060°. The rim of the disc is the antipode.

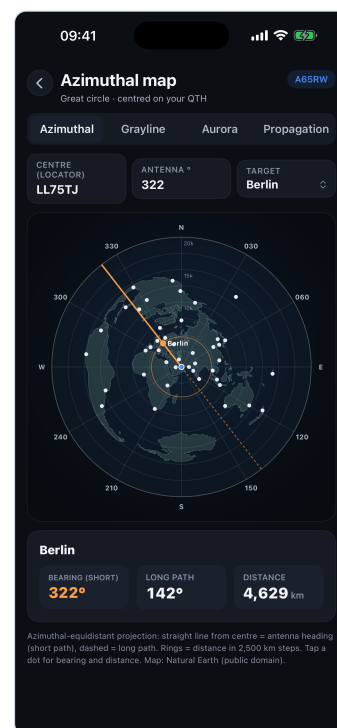
The module holds four views under one roof.

What the app shows

Azimuthal — the disc, centred on your locator. Distance rings every 2,500 km, radial lines every 30°, cities as dots. The solid line is your antenna heading (short path), the dashed one the long path. Choose a city under “target” and the app shows **short-path bearing, long path and distance** below it as figures — and you can simply tap the map as well.

Grayline — the day/night boundary on a real world map you can pan and zoom freely. The orange line is the terminator, the dark areas are night and the three twilight stages. Plus sunrise and sunset, day length, the grey-line window, and a note about which bands are due now.

Below those figures sits the **grey-zone planner**. Enter a target — locator or callsign — and the app works out four lines for the next 48 hours: grey zone at your end, grey zone at the target, **darkness over both ends** and **grey zone at both ends**.



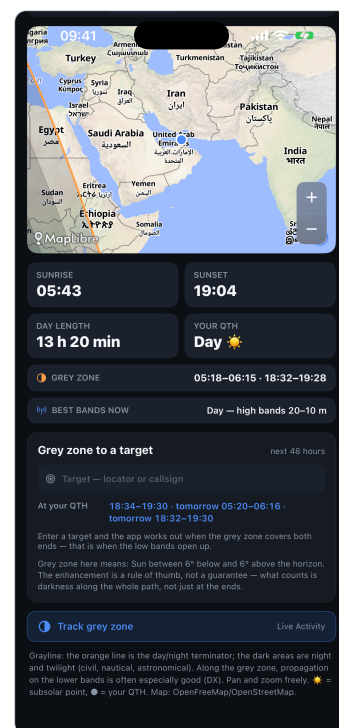
Azimuthal map: everything on one line really is on one line.

The third line is the most important in practice. It is not the grey zone that opens the low bands but **darkness over the whole path**: then the absorbing D layer is gone and the reflecting F layer is still there. The grey zone is only the moment when one end has just got there.

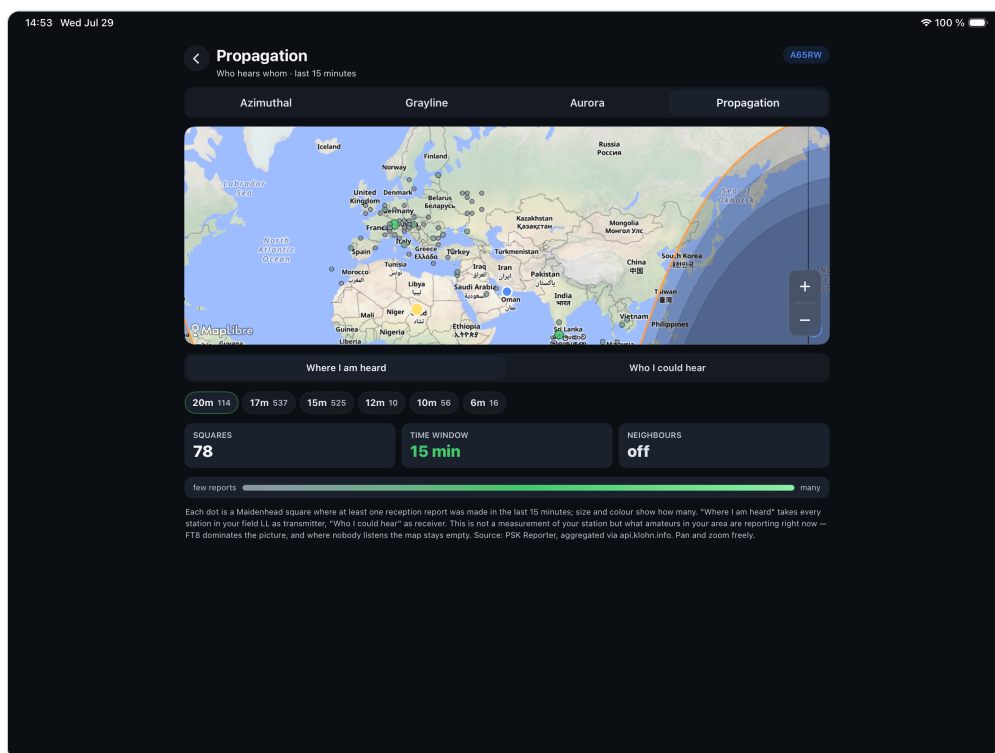
The fourth line — both ends in twilight at the same time — is the rare case low-band DXers wait for. From Dubai it does not occur at all to most targets, because the solar times lie too far apart; the app then says so, rather than showing an empty dash.

Aurora — the NOAA OVATION forecast as a coloured area over the same map, plus the probability at your QTH and the Kp value. For radio, a lot of aurora means two things: **HF disturbed on northern paths**, but **VHF aurora on 144 MHz possible**.

Propagation — who hears whom, over the last 15 minutes. Each dot is a Maidenhead square from which a reception report came; size and colour show how many. Switchable between “**where I am heard**” and “**who I could hear**”, with band selection and a switch for the neighbouring fields.



The grey-zone planner: four lines for the next 48 hours.



The same map on the iPad.

How to use it

Azimuthal before turning the antenna. Grayline for planning: anyone wanting 80 m DX looks at when the grey zone stands over the target. Propagation when you want to know whether a band is open — and where to.

Limits

The map tiles come from the network (OpenFreeMap/OpenStreetMap); for the grayline the app downloads a coarse world overview once, for offline use.

The aurora forecast is fetched **once when the view opens** and does not update by itself.

The propagation map is **not a measurement of your station**. It shows what radio amateurs in your area are reporting. FT8 dominates the picture, and where nobody is listening the map stays empty — which is something quite different from the band being shut. After a server restart the 15-minute window needs a quarter of an hour once to fill up; the app says so when that happens.

World time

What it is about

Amateur radio thinks in **UTC**. But as soon as there is a person at the other end it gets concrete again: is it night there? When does the sun rise there? Is it worth calling now?

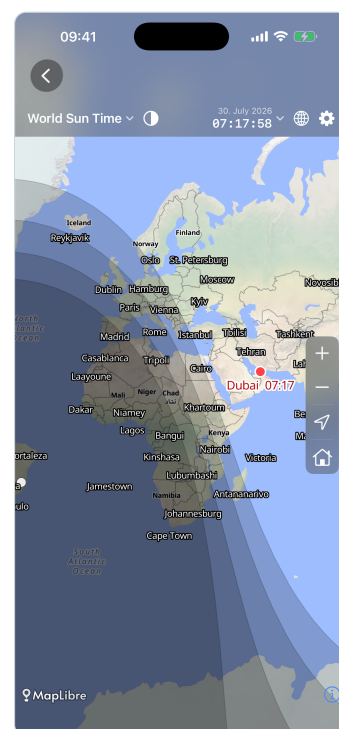
What the app shows

A world map with the actual solar shadow, free to pan and zoom. The clock at the top shows date and time to the second.

Tap a city and a sheet opens with **local time, day or night, weather, sunrise and sunset, day length and solar elevation**, plus a countdown to the next sunrise or sunset. Below that, cards for the **course of the day's light** (twilight stages, golden hour, solar noon), the **sun's path** as a curve, the **moon** with phase and rise/set, the **next eclipses** and the **next solstice or equinox**.

Cities can be made **favourites** with the star; the title menu then jumps straight to them.

The most remarkable part is **time travel**: the clock opens a slider with which you shift the moment — by hours, by days, or by picking a date up to three years in either direction. The shadow moves with it. That way you can see how the grey zone will lie over Japan in four weeks' time, instead of working it out.



The Earth with the shadow of the real sun.

How to use it

Before arranging a sked: tap the city, read the local time, and use time travel to see when sunrise or sunset is there. For the low bands that is precisely the interesting time.

Limits

The solar arithmetic is accurate to about 0.1° — far more than radio needs.

The weather is fetched once when a city opens and is not refreshed.

Time travel goes ± 96 hours by slider and around three years by date picker.

Part 6 — Tools

Two modules with no data source: they compute, and nothing else. Which is exactly why they also work in a cellar with no reception.

Toolbox

What it is about

There is a handful of calculations you need again and again when building things, and for which you otherwise hunt for a sheet of paper every time. The app has put them together.

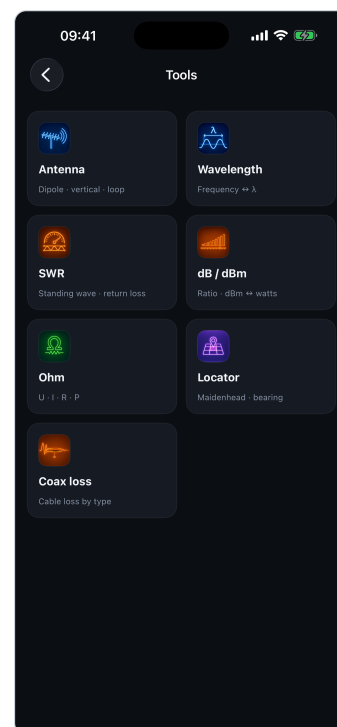
What the app shows

Seven tiles:

Antenna — enter a frequency, read off the lengths: free-space wavelength, dipole overall and per leg, quarter-wave vertical, full-wave loop. The app computes with $143 / f$ rather than $150 / f$, that is with the usual **end effect of around 5 %**; a wire in the air is electrically a little longer than it measures.

Wavelength — frequency to λ , $\frac{1}{2} \lambda$, $\frac{1}{4} \lambda$, $\frac{5}{8} \lambda$, and back from wavelength to frequency.

SWR — either from the SWR value or from forward and reflected power. Result: SWR, reflection coefficient, return loss, mismatch loss and the share of reflected power as a percentage. Below it five deeper views from the learning chapter: impedance calculator, power budget as far as the antenna, tuner in the shack or at the feed point, a matching helper, and a view in which you watch a standing wave forming.



Seven calculators that actually get used in the shack.

dB / dBm — three directions: compare two powers, ratio to decibels and back, dBm to watts and back. With the anchors below: 3 dB double, 6 dB one S-unit, 10 dB tenfold, 0 dBm = 1 mW, 30 dBm = 1 W.

Ohm — U, I, R, P. Enter two, the other two appear. The fields currently being computed lock themselves, so that you cannot overwrite yourself.

Locator — locator to locator: short-path bearing, long path, distance, plus both coordinate pairs. Four-, six- and eight-character locators are read.

Coax loss — enter cable type, length, frequency and SWR. Result: loss in dB, transmitted and lost share as a percentage, and with an SWR above 1 additionally the **extra loss caused by the mismatch** as well as the SWR the radio at the other end of the cable gets to see. 21 cable types are stored, from RG-58 to Ultraflex 13.



SWR: five figures out of one.

How to use it

When building antennas: Antenna for the length, Coax loss for the question of whether the thin cable is still worth it.

After putting it up: SWR, to turn the meter's reading into a statement.

Before a QSO: Locator, when somebody passes their location and you want to know where the antenna has to point.

Limits

Antenna lengths are **starting values, not final dimensions**. Height above ground, surroundings, insulators and feed shift the resonance. Always start a little long and measure.

The coax calculator interpolates from two data-sheet points per cable. For the question “is RG-58 good enough on 2 m?” that is exactly right; for a precision measurement it is not.

The SWR at the radio is always better than the SWR at the antenna — that is not a trick of the app but the cable damping the reflection. A very good SWR in the shack with a long, thin cable is therefore more of a warning sign than a success.

My location

What it is about

The locator is the app's most important setting (see Part 1). This module fetches it by GPS so that you do not have to look it up.

What the app shows

The **Maidenhead locator**, eight characters — that is around 900×460 metres. The first six characters are the usual measure in a QSO; the last two you only need for EME and microwaves.

Below it the coordinates in degrees/minutes/seconds **and** decimal, plus the altitude if the device supplies it. A link leads to a world map with the Maidenhead grid — fields, squares, subsquares to look at.

The button **“Use in settings”** writes locator and place name to where the rest of the app reads them.

How to use it

Once when setting up. And again when you operate portable or on holiday — after that bearings, grayline, propagation prediction and satellite passes are right again.

Limits

It does not work without location permission; the app then says so and carries on showing the stored locator.

And the locator is deliberately coarse. It gives away the area, not the address — that is a feature, not a shortcoming.

Part 7 — Learn

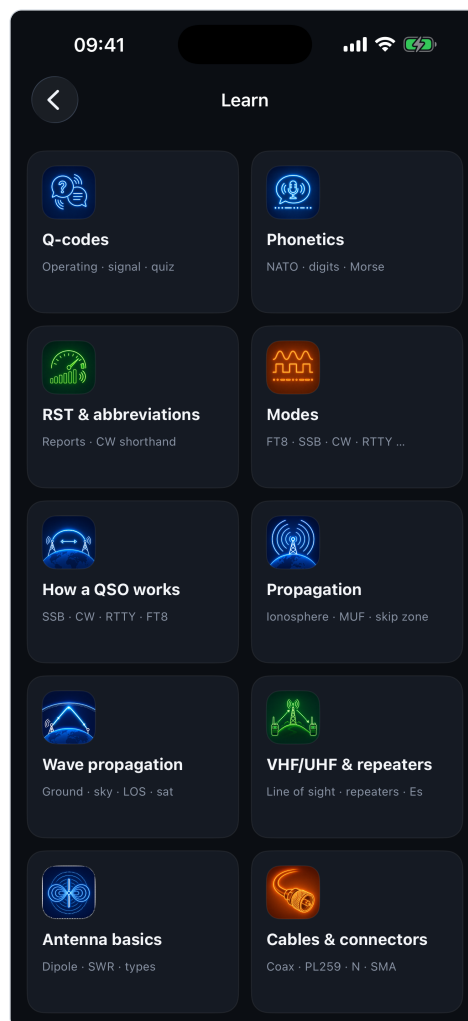
The learning section is the part of the app that works without an antenna. It is entirely offline, asks no server, and does not change with the sunspot cycle.

What it is about

Amateur radio has a barrier to entry that has less to do with technology than with language. What is QSB? Why does somebody say “599”? Why is a cable called a “feed line”? And what on earth is a skip zone?

None of it is hard. It is just rarely written down in one place.

What the app shows



Thirteen chapters, from the Q code to the arithmetic part of the examination.

Thirteen tiles:

Chapter	Content
Q codes	24 codes in two groups — operating and signal — with a quiz
Phonetic alphabet	NATO alphabet and numerals, German and English, each audible in Morse
RST & abbreviations	the report scale and 26 common abbreviations from CQ to 73
Transmission modes	10 modes with bandwidth, band position and beginner rating
QSO procedure	a complete contact in SSB, CW, RTTY and FT8, line by line
Propagation	the ionosphere you can touch — see below
Wave propagation	ground, sky and line-of-sight waves, satellite
VHF/UHF & repeaters	line of sight, repeaters, sporadic E
Antenna basics	dipole, SWR, the common designs
Cables & connectors	coax, PL259, N, SMA — what fits what
D-STAR	digital operating, reflectors, setting the UR/RPT fields
CW trainer	Part 8 of this handbook
Arithmetic	Part 9 of this handbook

How a chapter is built

The longer chapters are made of named building blocks that always look the same: **running text**, **lists**, **tables**, **formulae** in monospace with an explanation below, **graphics** you can tap and zoom — and coloured **memory boxes** in five sorts: key idea (blue), mnemonic (green), warning (red), practice (amber) and analogy (violet).

The graphics are stored **without text** in the device; the labels are laid over them. That is why they are readable in every language without a picture having to be redrawn — and why there is also a separate version of them for dark mode.

At the end of every chapter there is a **set of questions**, and across all chapters a **knowledge test**. Both work the same way: question, four answers, one choice. Then comes the explanation — **even when you were right**. That is deliberate: the wrong answers are the real misconceptions, and the reason is worth as much as the result.



A chapter: text, graphic, memory box, formula.

The flashcard quizzes (Q codes, phonetic alphabet, abbreviations) remember what has stuck and what has not. A character you have got wrong three times comes round more often; one that stuck five times comes round rarely. Progress survives app restarts and can be reset per quiz.

Example: the propagation chapter

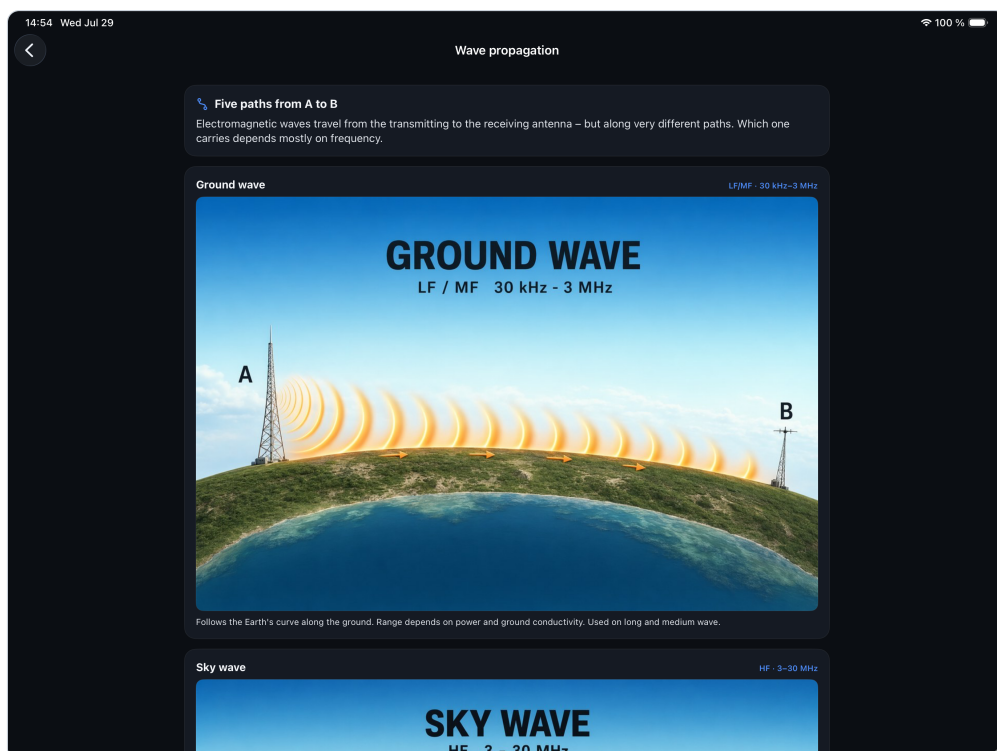
Because it is the centrepiece, here it is in detail. At the top a picture of the Earth with the D, E, F1 and F2 layers glowing — in two versions, which cross-fade into each other as soon as you shift the time of day.

Below it a **diagram with two sliders**: time of day from 0 to 24 hours, frequency from 1.8 to 30 MHz. And then you watch:

- Frequency too high → the ray goes **red, into space**.
- Frequency too low, sun up → the ray ends **dashed orange in the D layer**, absorbed.
- In between → the ray makes a **green arc** and arrives at the second mast.

Plus three figures: MUF, LUF, foF2. And a sentence saying what is happening — such as “In the evening the D layer disappears, then 80 and 40 m open”.

After that the explanatory texts on the layers, on MUF and LUF, and on the **skip zone**: from Dubai, India is crystal clear, but nearer Muscat is not, because it lies exactly in the skip zone. At the end, three cross-references into the live modules — Space weather, D layer, DX prediction — so that you get from the model to reality.



A learning chapter on the iPad: more room for the graphics.

How to use it

Before the examination: Q codes, RST, modes, propagation.

Before your first QSO: QSO procedure. The chapter runs through a complete contact, in four modes, with notes on why what is said at which point.

And when building: Antenna basics and Cables & connectors.

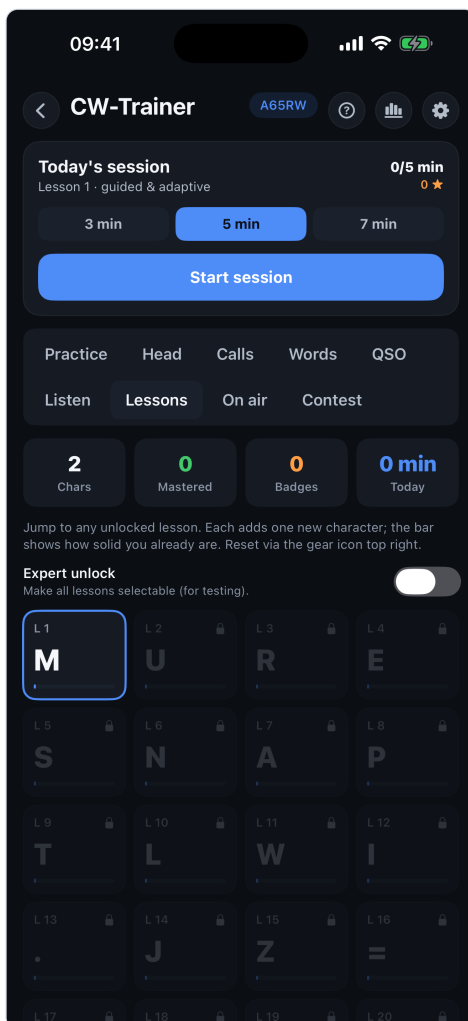
Limits

The learning section is deliberately **not** tied to the country setting. Q codes and RST apply the same everywhere; where national rules apply, the text says so.

The propagation diagram is **not a propagation calculator**. It uses a deliberately coarse model so that the relationship becomes visible. For real predictions, Space weather, D layer and DX prediction are responsible — and the chapter says so at the end.

The quizzes are for practising, not for examining. There is no mark and no certificate.

Part 8 — CW trainer



Lesson 1: two characters unlocked, the rest closed. At the top, the guided training.

What it is about

Learning Morse almost always comes unstuck in the same place: people learn it as a table. A is dot-dash, B is dash-dot-dot-dot — and then you sit in front of the receiver translating in your head, element by element, while the sender is already two characters further on. At 8 words a minute that just about works. At 20 it does not, and the only way out of that trap is to forget what you learnt.

The **Koch method** avoids the detour. Its core is uncomfortable and seems wrong at first:

Full speed from the first minute. Not 8 wpm but 20 or more. At that speed you *cannot* count any more — and that is the whole point. The brain learns each character as a **sound**, the way it recognises a spoken word as a whole and not letter by letter.

So that you can keep up anyway, it is not the characters that are slowed down but **the gaps between them that are lengthened**. That is called **Farnsworth**. The sound stays right, there is simply more time to answer.

And you start with **two characters**. K and M. Only when those have stuck does the third join, then the fourth. Always one. That is slow and feels silly — and it is the reason the method works where tables fail.

What the app shows

At the top a card **“Today's training”** with your lesson, the progress in minutes and the number of badges. Below it a bar with nine modes:

Practice — the main mode. A character sounds, you type it. The on-screen keyboard shows only the characters belonging to your lesson — so you cannot reach for the wrong one. A bar counts the last 30 answers; from **90 % correct** the button appears that unlocks the next character. Switchable to **weak spots**: then only the characters you are worst at come up.

Head — head copying. A group of three to five characters sounds, you type *nothing* but reveal afterwards and mark yourself: had it, or missed it. That is the skill you need in a real QSO.

Call — callsigns. Random international callsigns, checked character by character.

Words — common words and ham abbreviations as a whole. Recognising word shapes instead of spelling them out.

QSO — a complete simulated contact in four lines, from CQ to SK, with your own callsign in it. Hidden first, then revealed; individual lines can be repeated.

Listen — no test, just reference. Tap a character, see the sound and the dit/dah.

Lessons — the overview: how many characters, how many mastered, how many minutes today. Plus the **needs practice** section with the weakest characters as tappable chips.

Radio — prosigns, Q codes and abbreviations, each to learn and to practise.

Contest — contest simulation: 10, 20 or 30 QSOs, typing callsign and serial number each time, with a clock and a hit counter.

Settings

Via the gear: **character speed** 15–40 wpm, **effective speed** (Farnsworth) 5–40 wpm, **pitch** 450–850 Hz, character groups on or off, and a spoken announcement after the tone — phonetic (“Alfa”) or as a letter.

The sensible starting setting is the default: **20 wpm character speed, 12 wpm effective**. Anyone who lowers the character speed to make it easier in fact makes it harder — because then the counting starts again.

Assessment

Via the chart symbol: a **heatmap over all 41 characters** — green, amber, red, grey for “never seen”. Every cell is tappable and plays the character again. Plus a streak in days, total minutes and a bar row for the last 21 days.

How to use it

Five minutes a day beat two hours on Sunday. That is not an admonition but a property of memory. Which is why the guided daily training is limited to 3, 5 or 7 minutes, and why at the end of a completed session it says, in as many words: *daily goal reached — further sessions are pure repetition. No grind, no burnout.*

The route: start the guided training, see it through, done. Anyone wanting more takes the **Practice** mode and unlocks as soon as the bar stands above 90 %.

If a character simply will not stick: **weak spots**. Not the whole lesson again.

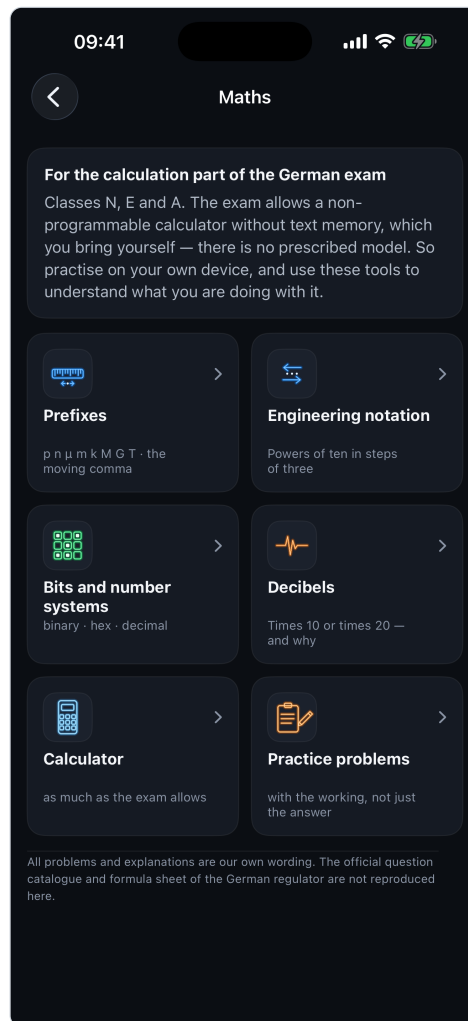
Limits

The trainer is a **listening trainer**. It practises receiving, not sending — a sending and keying trainer is not in it yet.

Unlocking follows a fixed criterion (90 % over 30 answers). Anyone preferring to decide for themselves switches on **expert unlocking** and selects any lesson freely — intended for testing, not for learning.

The contest mode always sends 599. That is not the app simplifying but ordinary contest practice.

Part 9 — Arithmetic



Six tools for the arithmetic part of the examination.

What it is about

The arithmetic part of the German amateur radio examination — classes N, E and A — is technically undemanding. Ohm's law, power, wavelength, decibels, standing waves, resonant circuit. Once understood, it is two lines of working.

And still the commonest cause of mistakes is not a formula but **a decimal point that has slipped**. 2700 Hz, 2.7 kHz and 0.0015 MHz — as soon as prefixes come into play, losing marks becomes alarmingly easy.

So the tools in this part are not built as converters that spit out an answer, but as views in which you **see what is happening**.

What the app shows

Prefixes

No “from” field and no “to” field. Instead a **number line** on which all the prefixes from pico to tera lie side by side, and below it a table in which the same value appears in **every** notation at once.

Two markers: the blue one shows the prefix you chose, the green one the engineering notation. And the decisive point: changing the prefix does not change **the quantity**, only the way it is written. You watch the decimal point travel instead of getting an answer.

Nine units: Hz, W, V, A, Ω , F, H, m, s.

Engineering notation

The number line shows which prefixes exist. This is about the **rule** behind them: exponent in steps of three, mantissa between 1 and 1000 — which is why exactly one prefix fits every result.

At the top, the same number in three notations, one below the other: as entered, scientific, engineering. Below it a slider that shifts the decimal point in steps of three. Only one position is green — and a “**usual**” button takes you back there at any time.

Bits and number systems

Eight toggle switches. You flip them and see what a place is worth — 128, 64, 32 and so on. Beside them the same number in decimal, hexadecimal and binary, all three directions freely writable.

Plus a card on why it is sixteen of all things (four bits are exactly one hex digit), and one on where this turns up in operating: FT8 carries 77 payload bits per transmission, D-STAR runs at 4800 bit/s.

Decibels

The first control is the switch between **power · 10** and **voltage / current · 20**, because that is the expensive mistake. Below it the matching formula in plain language.

The converter runs both ways, and a table of values to remember shows what you ought to know by heart — with the honest note about where the rule of thumb rounds: **3 dB is not double but 1.995 times**. The display is rounded, the arithmetic is exact.

A card of its own for dBm: 0 dBm is one milliwatt, 30 dBm exactly 1 W, 37 dBm about 5 W — the usual limit for handhelds.

Calculator

A calculator whose feature set follows **what is permitted in the examination**: not programmable, no text memory. The four operations with precedence ($2 + 3 \times 4$ makes 14), brackets, square root, square, power, power of ten, logarithm.

Two peculiarities that real devices do not have and that help when practising: the result is there **while you are still typing**, as soon as the expression is complete — so you see at once when a bracket is missing. And there is an **ENG key** that explicitly writes down what it does, because it is called something different on every device.

Practice problems

Problems on six topics — Ohm's law, power, wavelength, decibels, standing waves, resonant circuit — filterable by class N, E or A.

Every problem can be expanded and then shows the **working in numbered steps**: what you think, what you type, what comes out. Only after that the answer and a note. Because the route matters more than the answer.

How to use it

Before the examination, but not as a substitute for your own device: **in the examination you bring your own non-programmable calculator with no text memory**. No particular model is prescribed. Practise with the device you will take — and use the tools here to *understand*.

And afterwards in the shack, whenever a decimal point slips.

Limits

All problems and explanations are original wording. The official question catalogue and the formula sheet of the German regulator (Bundesnetzagentur) are not reproduced here. An enquiry is in progress; should the authority agree, the catalogue will be added as a data package of its own, with nothing changing in the way the module is used.

The problems do not examine. There is no answer field and no mark — you tick off for yourself what you have understood. That tick does not survive closing the view.

The calculator has no memory, no history and no trigonometric functions. That is deliberate: it should do what the examination device does, and no more.

The module is deliberately not tied to the country setting, but its content follows the German examination.

Part 10 — Appendix

Settings at a glance

Via the gear at the top right of the home screen.

Station — callsign, locator, place name. See Part 1; almost everything hangs on this.

Country and licence class — control the band plan and the licence comparison.

Language — 46 languages. The default is the language of the device.

Notifications — switchable individually:

- **Band opening** at high solar flux
- **Aurora / storm** at high Kp
- **Contest starting soon**
- **Satellite pass** — ten minutes before good passes (max $\geq 20^\circ$) of your favourites; with no favourites, the ISS
- **Watcher** — when a monitored callsign appears (see Part 3)
- **Daily space weather briefing**, optionally twice a day, at a time of your choosing

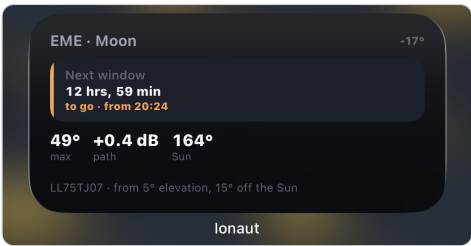
Plus the **background refresh**: at most every 30 minutes down to at most every 6 hours. Anyone wanting to be sparing with the battery sets it high.

Appearance — better readability (brighter type for subtitles and notes; it also follows the iOS “Increase Contrast” setting automatically), as well as two settings for the globe at the top of the home screen: whether it stays at the QTH or rotates freely, and whether aurora or a starfield lies behind it. The aurora veil follows the real K index.

Privacy — allow server functions. Switching that off loses the modules that compute on the Ionaut server (satellites, propagation map, cluster, D-STAR, Watcher, callsign lookup). The app then says in the affected view why there is nothing there — it does not pretend something is broken.

Customise home screen — leads into the edit mode from Part 1.

Widgets



The EME widget as a tile: next window, highest elevation, path loss, sun separation.

There is **one** Ionaut widget, and within it **five views** to choose from:

View	Shows
Space weather & bands	SFI, Kp, rating, open bands — the default
Grayline & QTH	solar times, grey-line window, which bands are due now
DX prediction	the prediction to a continent of your choosing
Clock & QTH	callsign, UTC and local time, locator
EME window (moon)	the next lunar window with its rating

That is why the widget gallery initially offers only “Space weather”: that is the default, not the whole range. You change it **after** placing the widget — long-press it, **Edit widget**, choose under *view*. For the DX prediction the target is chosen there as well.

The tiles come in small and medium for the home screen; for the lock screen there are the flat variants.

Limits

Two of the views compute for themselves — **Clock & QTH** and **EME window** need neither the network nor the app to be open. The others show what the app deposited the last time it was opened; how old that is, the tile says.

iOS decides for itself how often a widget may recompute. After placing it, it can therefore take a few minutes before real figures appear instead of the sample values.

And the widget uses the locator the app stored last. So after moving, open the app once, or the tile will still be computing from the old QTH.

Data sources and thanks

Ionaut computes for itself wherever it can — sun, moon, locator, bearing, band plan, antenna lengths, Morse. Everything else comes from people and institutions who make their data openly available. Without them this app would not exist.

Source	For
NOAA SWPC	space weather (SFI, Kp), aurora forecast (OVATION), D-RAP
NASA / SDO	solar images — <i>Courtesy of NASA/SDO and the AIA, EVE, HMI science teams</i>
SOHO (ESA & NASA)	coronagraphs C2/C3 (LASCO)
GIRO · prop.kc2g.com	ionosondes: real foF2 and MUF measurements
Celestrak	satellite orbital data (TLE)
AMSAT	Live OSCAR Satellite Status — who has heard which satellite
PSK Reporter	live reception reports
DX cluster network (DXSpider)	worldwide DX spots
ircDDB	D-STAR transmissions in real time
HamQTH.com	callbook (name, QTH, locator) · no warranty given
CQ · ARRL · DARC · IARU and others	contest announcements by the organisers
National amateur radio societies	repeater lists · curated, locations at town level
Open-Meteo	geocoding and weather
OpenFreeMap · © OpenStreetMap contributors	map tiles (ODbL)
Natural Earth	map data for the azimuthal map
MapLibre Native	map engine (BSD-2-Clause)
Apple Maps	location links

In the contest calendar every entry links to the organiser's own announcement — the rules are there, not here.

The same list, with licence texts, is in the app under **Settings → About & licences**. If it ever differs from this one, the one in the app applies: it is carried forward with every version.

Privacy

Briefly: **the app sends nothing about you.**

There is no user account, no sign-in, no tracking and no advertising. Your callsign and your locator are on your device. They leave it only when you trigger a query that needs

them — for instance when you look in Live spots to see who heard you, or when the Watcher is reading along for you.

All data sources are used solely for display and for computation.

The server functions can be switched off completely in the settings under **Privacy**. The full explanation is at ionaut.klohn.info/privacy.html.

One point that concerns the hobby rather than the app: **what you transmit is public**. Callsign and approximate location end up in the cluster, PSK and D-STAR reporting networks, whichever app you use. Actual visibility is controlled there, not here — for D-STAR, for example, via the `VIS ON / VIS OFF` setting of your own callsign (see Part 3).

Languages

Ionaut speaks 46 languages. What is translated is not only the labels but also the explanatory texts and the learning chapters — the part that matters.

None of it runs through a translator at launch: every line is in the app, finished. That costs effort with every change and is the reason the texts do not read as though they had been through a machine.

German and English are the source languages. Where a chapter has not yet been translated, the app says so openly and shows the English version rather than leaving a gap.

Reporting faults, asking questions

Ionaut is built by one person. Feedback therefore arrives directly and does get read.

- **General:** developer@klohn.info
- **Wrong or missing repeater data:** repeater@klohn.info
- **Website:** ionaut.klohn.info

It is particularly helpful if you add **which module, which version** (Settings → About & licences) and **what you would have expected**. The last of those is the most important: often it is not the arithmetic that is wrong but the label that is ambiguous — and only somebody reading it for the first time notices that.

Finally

This app stays free. There is no advertising, no subscription and no feature behind a pay-wall. Anyone who still wants to give something back will find a tip jar in the settings — voluntary, and without anything in the app changing as a result.

Good luck on the bands.

73 de A65RW