

HamClock 2.70 User Guide

This document and additional material may be found at <https://clearskyinstitute.com/ham/HamClock/>.

Welcome to HamClock. When first started, you may be asked to calibrate the touch screen, depending on platform. Then you have a chance to open the Setup screens. Both opportunities time out if ignored.

Setup provides three pages of configuration options. The exact choices available will depend on your platform but all options are shown below for completeness. **Orange** text denotes passive prompts for the corresponding **White** data fields to their right. **Cyan** text denotes on/off choices or other binary options.

Tapping on a white data entry field will place a green cursor where the next character will go. Tap **Delete** to erase the left character. Tap the **Page** number to see more options. When finished, tap **Done**. If any fields do not pass basic checks, they are marked with a red **Err** and you remain on the Setup screen until these are corrected.

Below some pages is a virtual keyboard for use on touch screens or with a mouse. On desktop systems, a keyboard may also be used for text entry and navigation using *tab* to step to the next prompt; *space* to toggle binary options; *escape* to cycle pages and *Return* for Done.

Setup Page 1:

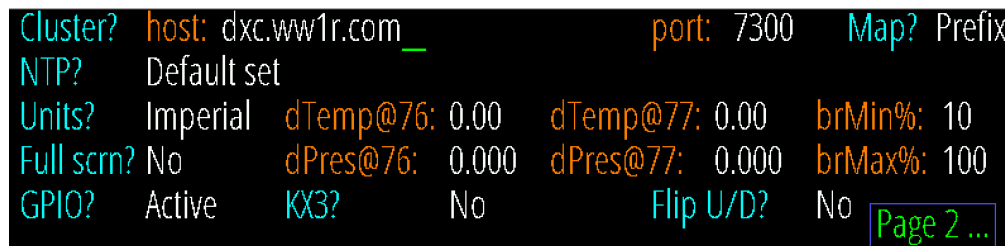
- **Call:** enter your call sign, up to 11 characters. This is also how you will login into a dx cluster, if used.
- **DE Lat, Long:** these fields are your station latitude and longitude. You may enter + - degrees or use N/S suffix with Lat and E/W with Long. These fields disappear if IP Geolocate or gpsd are active. May also be changed from the main HamClock screen by tapping DE lat or long value.
- **IP Geolocate?** If Yes, uses your public IP to set Lat and Long, and removes these prompts. This is usually fairly accurate, but always double-check the results.
- **gpsd?** Allows connecting to a gpsd daemon on your local network for Lat and Long. When active, the Lat and Long prompts are removed and you may enter the host name of your gpsd server. The port is always 2947.
- **WiFi?** This toggles whether to set up WiFi credentials. It is required on ESP clocks, optional on Raspberry Pi and not available on other platforms. When active, type the SSID network name and password in the given fields. On RPi, activate this only if you want to make a change; leave off otherwise
- **Log usage?** This allows you to voluntarily send us your HamClock settings to guide further development. All information is anonymous, your call sign is *not* logged.
- **Demo mode?** This causes HamClock to change its own settings automatically. See page 9.
- **Center Lng:** set desired center map longitude for Mercator projection.

```
Call: WBOOEW DE Lat: 32.00N Lng: 111.00W
IP Geolocate? No gpsd? No
WiFi: SSID: mywifissid Password:
mywifipassword
Log usage? Opt-In Demo mode? No Center Lng: 90W Page 1 ...
```

HamClock 2.70 User Guide

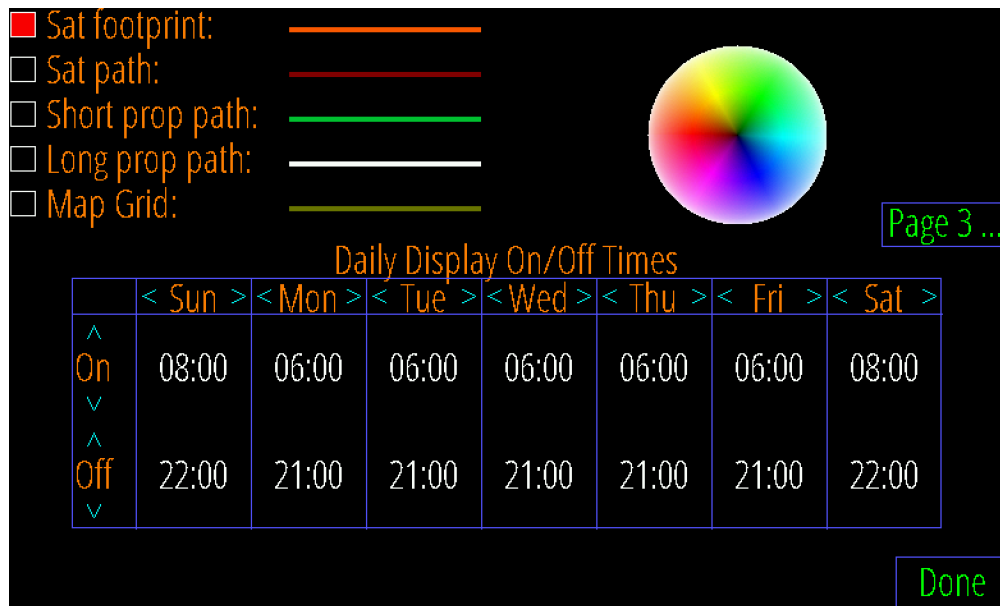
Setup Page 2:

- **Cluster?** This toggles whether you want to connect to an internet Spider DX cluster or local WSJT-X or JTDX program and whether and how you want spots plotted on the map. See page 8.
- **NTP?** This allows setting any one desired NTP server or using the list of built-in default servers.
- **Units?** Toggle between *Imperial* and *Metric* units for environment sensor and weather data.
- **Full scrn?** Set to Yes to force HamClock to fill all surrounding screen area with black.
- **GPIO?** Controls whether the GPIO pins on RPi or ESP are active. Set to *Off* to insure no interference with other devices that use these pins. dTemp, dPres and KX3 prompts are removed unless this is *On*.
- **dTemp, dPres:** temperature and pressure corrections added to each BME280 sensor, if installed. Page 10.
- **KX3?** Toggle whether to set the frequency of an Elecraft KX3 transceiver when tapping a DX Cluster spot. If active, select the baud rate to match the radio RS232 menu setting. GPIO must be Active. See page 10.
- **brMin%, brMax%:** display brightness range, if supported, as percent of hardware total.
- **Flip U/D?** Yes will render the display upside down, useful for some cabling situations. ESP only.



Setup Page 3:

- **Colors:** Select a color to change at left, then tap the color wheel to set that color and show a sample.
- **On/Off Times:** Use this table to set desired on and off (or dim) times for each week day. Tap just above or below each number to increase or decrease. Left and Right arrows copy to adjacent day. The main HamClock page will also display, and allowed editing, the current day settings. The effect is disabled if times are equal. Available only when full screen.



HamClock 2.70 User Guide

Cycle Call sign background colors
 Cycle Call sign foreground colors
 Up time, IP and WiFi signal strength, red if < -60 dBm
 Ahead one hour or minute
 Back one hour or minute
 Ahead one day, month, date or year
 Back one day, month, date or year
 Zero seconds
 Access Stopwatch, count down and Big Clock
 Current version. Red when old. Tap to install.
 Sync to UTC
 Tap to Lock screen on/off; Long-tap to restart or exit.
 Long-tap to toggle Day-of-Year

Cursor lat, long, grid, local time, bearing and distance from DE, prefix
 Short path
 Long path
 Sub-earth Moon location and phase from surface
 Hold to set DE
 Sun
 Rotating RSS feeds
 DE antipode
 Tap map to set DX
 NCDXF beacon
 4X6TU
 5Z4B
 457B
 256DN
 VR2B

eHam: My End Fed Stealth Antenna

Mercator projection centered at 0° longitude

Tap for map view options
 Style:
 ○ Countries
 ○ Terrain
 ● DRAP
 Grid:
 ○ Tropics
 ○ Lat/Long
 ○ Maidenhead
 Projection:
 ○ Azimuthal
 ● Mercator
 RSS
 Night
 Names

ISS
 Sat name unless in DX-pane
 Tap Sat location or name to see Pass.
 Ground track for one future orbit
 Concentric circles show where Sat is on horizon, 30° and 60° elevation

Azimuthal projection centered on DE

HamClock 2.70 User Guide

Select info, calendar, 2 analogs → DE: ☀ UTC-5 ← DE timezone adjust

DE lat/long/grid adjust → 40N 99W

EN00 5 @ 20:59 ← DE Sun events In or At
R @ 6:24

Repeat same DX → DX: 🛰 UTC+9.5 ← DX timezone adjust

Choose satellite → DX: 🛰 UTC+9.5

DX lat/long/grid adjust → 30S 141E

R @ 6:58 ← DX Sun events In or At
S @ 17:27 or Prefix

Path length, miles or km → 9036 mi @ 262 S P ← Short or Long path

Sat name; tap to change → ISS

Next rise or set at DE; HHhMM or MM:SS → Rise in 3:42

Sky dome seen from DE → NW NE SW SE

Pass duration; HHhMM or MM:SS → 10:00 34

Max pass elevation, degs → 34

30° Az/EI Horizon grid → 30° Az/EI Horizon grid

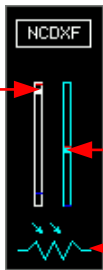
S at set end of pass → S at set end of pass

Tap anywhere for table of future passes → Tap anywhere for table of future passes

Next pass track; heavier when visible → Next pass track; heavier when visible

Display Brightness Control (ESP only)

Optional photoresistor reading



Indicates photoresistor is present

Display brightness, scaled to brMin to brMax. Tap to match current photoresistor reading.

Display On/Off Timer (full screen only)

Display off if no activity; 0 disables

DE On time today

DE Off time today



Tap just above or below each number to change

NCDXF Beacons on/off

Map color key



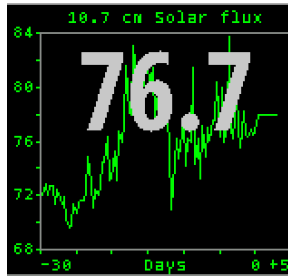
Frequency, MHz

HamClock 2.70 User Guide

- Panes: • Tap near the **top** for a menu of available choices, choose any desired collection to rotate automatically.
 • Some panes also use **lower** tap positions for specific functions as described below.

10.7 cm Solar flux

- current value
- 30 days history
- 3 days forecast



DX Cluster

dxo.wu1r.com:7300

7298.3	K5TA	0353
3670.0	K0UXU	0353
7221.4	KP2M	0354
3515.5	LZ8E	0354
7231.4	K2ADA	0354
7027.0	UN7ZW	0354
7178.4	N3OR	0354

Scrolling DX Spider spots

Telnet host:port. Green: Ok; Yellow: Connecting; Red: Error

Tap a line to set DX

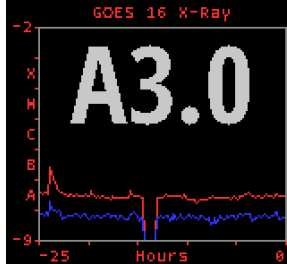
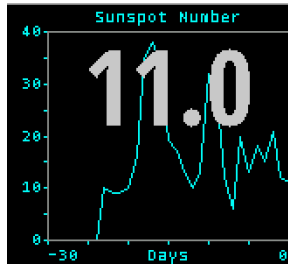
UTC HHMM

DX call

KHz

Sunspot number

- current value
- 30 days history
- Series 2.0
- data from sidc.be



GOES 16 X-Ray flare class

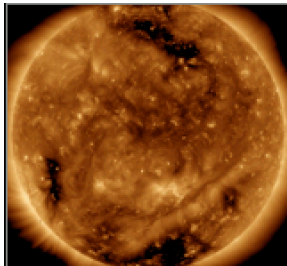
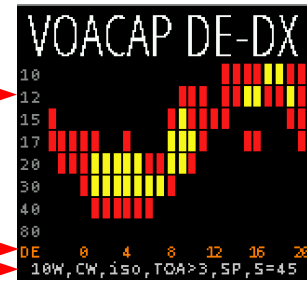
- current level, log(Wm²)
- 24 hour history

24 Hour VOACAP DE-DX path reliability map

Tap band for map

Tap time line to toggle DE or UTC labels; Now is always on left.

Tap power to change

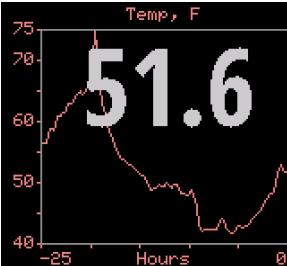


Solar Dynamic Observatory

- Composite 171+193+211 Å
- Magnetogram
- 6173 Å visible sunspots
- 193 Å coronal holes

Current weather

- Left pane is always transient DX
- Any pane can be persistent DX or DE
- Data is from openweathermap.org

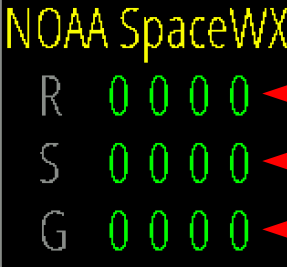
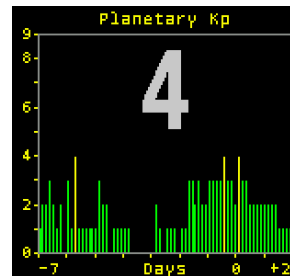


Optional Env Sensor

- Temperature
- Humidity
- Dew point
- Station pressure
- 24 hour history
- tap for next

Geomagnetic index

- planetary K
- 7 days history
- 2 days forecast



NOAA Space Weather

- now and 3 days forecasts
- scale 0 .. 5

Radio blackouts

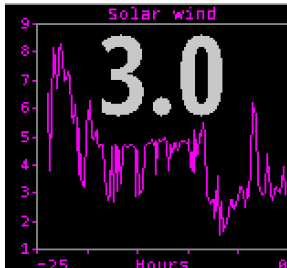
Solar Radiation Storms

Geomagnetic Storms

Moon with DE stats

- Az, El
- Next Rise or Set
- Speed: + away

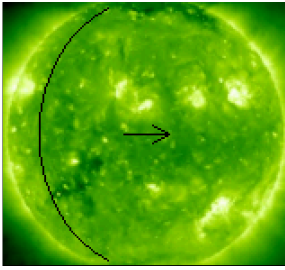
Tap in lower half to display EME planning tool (see page 6)



Solar Wind flux

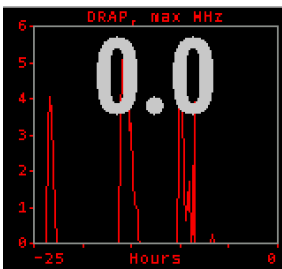
- 10¹² protons m² s⁻¹
- > 5 good chance for aurora
- 24 hour history
- see Notes on page 9

HamClock 2.70 User Guide

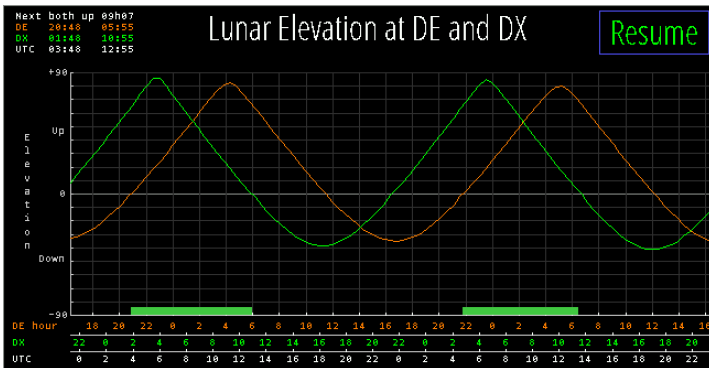


STEREO-A: The STEREO mission launched two spacecraft in 2006 into solar orbits at nearly the same distance as Earth. They were named STEREO-A and STEREO-B. The idea was to provide a full 360 degree view of the sun at all times. Unfortunately, STEREO-B was given up for lost in 2018 after four years of no contact. STEREO-A continues to function well but gradually changes its point of view. It currently follows Earth by about 35 degrees, providing an image that includes on its left edge what will rotate into Earth view over the next two days. This advantage is decreasing; by June 2023 STEREO-A will be aligned with Earth and will no longer provide any advance information.

The HamClock image shows the current STEREO-A image. The line shows the western solar limb as seen from Earth. To the left of this line is what will rotate into view within the next two days. The arrow marks the direction of rotation. For more information, see <https://stereo.gsfc.nasa.gov>.



The **DRAP** plot option shows the highest frequency attenuated by at least 1 db anywhere on Earth over the past 24 hours. Although the plot does not indicate the location where this occurred, it is usually centered on the Earth daylight side at that time. Also see the DRAP map option on page 9.



First display the Moon in any pane (see page 5) then tap in its lower half to show this **EME planning tool**. The plot shows the lunar elevation at DE and DX for the next few days starting now. The time axis is labeled in DE and DX local time and UTC. The table in upper left shows the duration and when the next interval occurs when the moon is simultaneously up at both DE and DX. All such periods are marked along the time line. Tap the plot anywhere for detailed information at that moment.

The rest of HamClock is unresponsive while this tool is up so tap Resume when finished or wait for the timeout of 60 seconds.

HamClock 2.70 User Guide

Notes

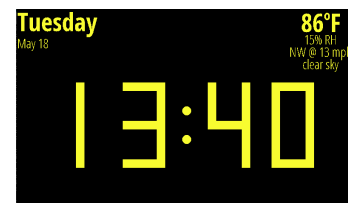
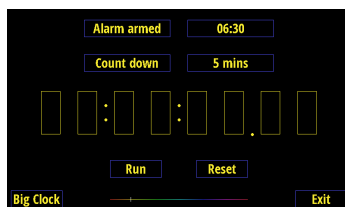
Time: The time shown in large white letters below your call always shows HamClock's idea of UTC. *Do not set this to your DE time or adjust it to correct DE time.* If your DE time is incorrect, tap the timezone offset button and adjust it using the popup menu provided. The times shown in the DE and DX panes are initialized to best-effort estimates of local standard time at these locations with respect to HamClock's UTC. No attempt is made to automatically account for savings time so add HamClock to your semi-annual routine of forward and backward adjustments. If the UTC button is black-letters-on-white-background then HamClock is using real UTC. But you may modify the time by tapping on various locations (see page 3). This can be useful, for example, to show a satellite location or the gray line or VOACAP predictions at some moment in the past or future. Doing so causes the UTC button to become white-on-red and say "OFF" as a stark reminder the HamClock is no longer tracking real UTC. Tapping the UTC button will return abruptly back to real UTC.

Stopwatch: Tap the stopwatch icon (beneath UTC seconds) to enter. Displays elapsed time in HH:MM:SS.SS. Tapping **Run** begins or resumes counting; **Stop** freezes display and counting; **Lap** freezes display but continues counting; **Reset** starts over; tap along the spectrum bar to select color; **Exit** returns to main HamClock page.

Alarm sets the 24 hour DE time that will be announced if *armed*. When armed, the alarm clock icon on the HamClock main page will be green (instead of gray) and the alarm time will be shown in Big Clock. When the alarm goes off it will be announced on the main page in the center pane; on the Stopwatch page by highlighting the Alarm control button; and on Big Clock by highlighting the alarm time. Tapping any of these will cancel the alarm and leave it set to repeat in 24 hours; these alerts also time out after 30 seconds. Use the control in the Stopwatch page to turn the alarm *off* altogether. See page 10 for hardware control.

Count down counts backwards from the value set at right, tap just above or below to increase or decrease down to 1 minute. If counting down is active: the main HamClock page shows the time remaining in lieu of the stopwatch icon; Countdown may be chosen as a Pane option; and the value is shown in Big Clock. It may be restarted from any of these locations with a tap or hold the main icon for 3 seconds to enter the Stopwatch page. See page 10 for hardware control.

Big Clock shows a large dedicated clock. Tap anywhere for a menu to control options including UTC or DE, 12 or 24 hour, date info, DE weather, analog second hand, and basic control over alarm and count down.



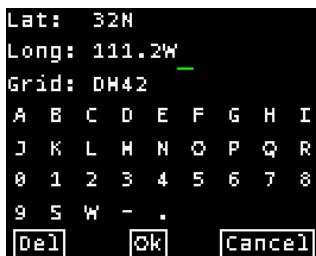
Brightness: If a photo resistor is installed on an ESP HamClock, toggling NCDXF will replace the beacon key with two vertical scales, the one on the left showing the current display brightness and the other the current photo resistor reading. Brightness is scaled from, and limited to, **brMin%** to **brMax%** from Settings. To calibrate a desired brightness response, start by exposing the photo resistor to a bright light intensity then tap on the display scale to set the desired display brightness at that intensity. Then expose the sensor to a dim light and tap again to set the desired brightness at that intensity. These settings may be reversed if desired to make the display brighter in dim lighting and dimmer in bright lighting. Some systems without a photo resistor provide a single slider to manually control display brightness.

On some systems, tapping NCDXF again will provide a menu of DE clock **On** and **Off** times at which the display will be set to **brMax%** or **brMin%**, respectively; set the times equal to disable both timers. **Idle** sets the number of minutes of no user tap activity after which the display will change to **brMin%**; set to zero to disable. All values may be adjusted up or down by tapping a little above or below their respective digits. The photo resistor only affects brightness while the display is ostensibly On.

HamClock 2.70 User Guide

Notes

Satellite pass: The lower left pane of HamClock is normally used to display information for the DX location. But if you tap on the DX label you may select one of several popular satellites. After making your selection, this pane is repurposed to display the satellite name; the time until next rise or set; and a diagram showing the overhead view of the next pass facing north. To emphasize this new purpose for the DX pane, the text color changes to red. Within the pass diagram, the set end of the pass is labeled with an S and the pass duration and maximum elevation are displayed. Before the satellite rises, the time is a countdown showing time until the next rise. Once the satellite rises, the count changes to the time remaining until set. When it sets, the next pass is calculated and the cycle repeats like this forever unless you tap on the name to choose a different satellite or tap the map to set a new DX location which restores the pane to displaying its information.



Setting DE and DX: Tapping lat, long or grid will display a dialog where these values may be edited to full precision either by tapping the virtual keyboard or using a real keyboard the same way as Setup. Opposite values will be computed automatically and invalid entries will be flagged when clicking Ok. Grid coordinates are based on the SW corner.

HamClock always uses full precision internally but, due to limited screen space, rounds the display to whole values. This may lead to unexpected results when entering fractional lat or long values. For example, suppose they are set to 35N and 110.1W so the grid will be DM45ka. The display will show 35N 110W grid DM45 which, unless one knows the internal values, seems incorrect because 35N 110W exactly is actually in grid DM55. When in doubt, open the dialog to review the values at full precision.

Elecraft KX3 frequency control: You can connect an Elecraft KX3 ACC1 Tip to an ESP Huzzah (pin 15) or RPi (pin 8) so when you tap a DX Cluster spot the frequency is assigned to transmit VFO A. This may work with other Elecraft radios with CAT control but this has not been tested. See page 10 for wiring info. HamClock makes no attempt to confirm accurate serial communication so if the radio does not respond, tap the DX spot again. The GPIO option on Setup Page 2 must be set to Active and the baud rate must match the KX3 RS232 menu setting for this to work.

DX Cluster: The Cluster control on Setup page 2 may be toggled On to allow entering the *Cluster host* (or IP) and *port* number of a DX Spider cluster node. Other cluster systems, such as AR-Cluster, are not supported at this time. A good list is at <https://www.ng3k.com/Misc/cluster.html>. When set up correctly, spots from the cluster will be automatically listed in the DX Cluster pane and optionally displayed on the map as they occur. Tapping an entry in this list will set DX to that location.

As a special case, the exact names **WSJT-X** or **JTDX** may be entered in Setup for the *Cluster host*. This will cause HamClock to connect with these popular programs. When properly set up, each time you double-click to work an FT8 station in WSJT-X, the station will appear in the DX Cluster pane of HamClock and automatically define DX to its location. Note the HamClock can only utilize FT8 messages that include the DX station's grid square. To complete this setup, you must do two things:

1. Open the WSJT-X application, open the *Reporting* preferences tab and set *UDP Server* to the broadcast address of your local network. For example, if your station network uses mask 255.255.255.0 and addresses such as 192.168.1.XXX, set the WSJT-X *UDP Server* to 192.168.1.255. If you are using other software that connects to WSJT-X UDP reports it must be changed to use this value as well.
2. While on the *Preferences* tab, note the value for *WSJT-X UDP Server port number*. Then set the HamClock *Cluster port* to match this value.

HamClock 2.70 User Guide

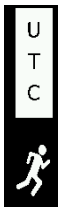
Notes

VOACAP: A graph of path percentage reliability predictions from DE to DX spanning 24 hours for each HF ham band can be assigned to any pane. If displayed in the left pane, it reappears after the DX weather information expires. The graph is black if reliability is less than 10%; red if less than 33%; yellow if less than 66% and green if above 66%. The predictions use VOACAP configured for CW mode; isotropic 0 dBi antennas on both ends; take-off angle greater than three degrees; quiet location noise (-153 db) and the current mean sunspot number. The transmit power can be adjusted by tapping in the lower left corner of the pane to choose between 1, 10, 100 and 1000 W. Whether short or long path is used is determined by the bearing selection in the DX pane. These configuration details are summarized in the caption. The graph always places the current time at the left edge. Tap the time line to toggle labels in UTC or DE local time.

Tapping a band number will set the background to a map showing world-wide propagation from DE on that band at HamClock's idea of the current time, coded the same red-yellow-green as above. The band button is yellow while updating; gray if successful to provide a persistent indication of the selected band map; or red if an error occurred. The pane values and/or map will update automatically each hour if visible. Tapping the active band number again will restore the normal background. Note the map update takes almost a full minute on ESP so please be patient; RPi is much faster although larger display formats will be proportionally slower.

Solar wind: Solar wind activity is a good predictor of geomagnetic disturbances such as auroral activity and unusual polar HF propagation. The available real-time metrics are density, in protons cm^{-3} , and speed, in km s^{-1} . The product of these values gives the flux, or number of protons flowing through a unit square per unit time, which is often a better predictor than either value alone. HamClock displays this product in units of 10^{12} protons $\text{m}^{-2} \text{s}^{-1}$ for which values above five or so suggest good chances for aurora.

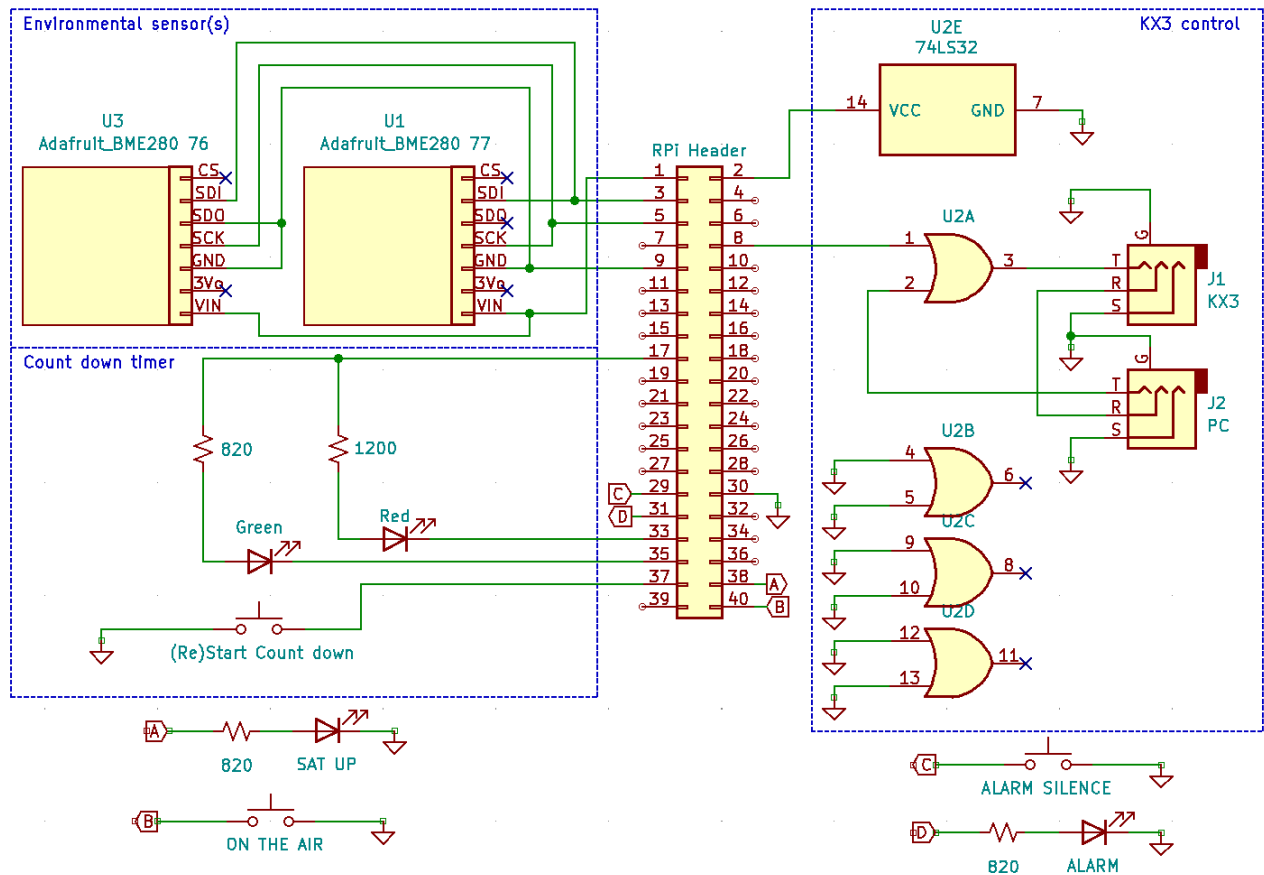
DRAP map: This background image option shows a near real-time display of the NOAA *D Region Absorption Predictions* model, or DRAP. The model predicts HF propagation absorption caused by solar X-ray and proton flux events. D layer absorption decreases with increasing frequency, so the map color-codes the highest frequency ray that is attenuated by at least 1 dB while passing through each location. Rays at lower frequencies will experience progressively greater attenuation of 30 dB or more. The color scale is gray for no absorption at any frequency progressing through a spectrum to indicate higher frequencies. Maximum absorption usually occurs at the current subsolar location. Also see the DRAP pane option on page 6 for a time history. For more information about DRAP, see <https://www.swpc.noaa.gov/products/d-region-absorption-predictions-d-rap>.



Demo mode: When enabled in Setup, the padlock changes to a running figure to indicate demo mode is active. This means HamClock will make a random setting change to itself every 30 seconds, including the plot panes, DX location, map view options and a few more. Meanwhile the Clock may still be used normally. Tap the figure to turn off demo mode. To engage demo mode again, you must restart and select it in Setup. Demo mode is not persistent, it must be selected each time HamClock starts.

HamClock 2.70 User Guide

Optional Raspberry Pi HamClock connections. The functions do not interact and may be chosen as desired.



- The BME280 is a temperature, pressure and humidity sensor, available on a breakout board from Adafruit <https://www.adafruit.com/product/2652>. Two sensors may be connected in parallel at addresses 76 and 77 as shown or one at either address. Bus extenders such as <https://www.sparkfun.com/products/14589> have been tested to 100 feet. This also works on the ESP8266 HamClock using Huzzah SDA↔SDI, SCL↔SCK, 3V and GND.
- A falling edge from a SPST switch or PTT line on RPi input pin 37 (re)starts the count down timer. Do not drive with greater than 3.3 V. The pin includes a weak pullup but an external 10K resistor to Vcc may improve reliability. The LEDs indicate the time remaining: Green when running; flashing Green when 1 minute or less remains; flashing Red when timed out. Not available on the ESP8266 HamClock.
- The KX3 control is shown in conjunction with a PC connection; see Page 8. If both the PC and RPi transmit at the same time, there will be no physical harm done but the messages will interfere and likely have no effect. If a PC connection is not required, connect the KX3 Tip directly to RPi pin 8. This also works on the ESP8266 HamClock using Huzzah pin 15.
- RPi output header pin 38 indicates a satellite is, or is about to be, up. Normally low, it cycles high at ½ Hz for 1 minute before rise then stays high until set. Do not source more than a few mA from this pin. Not available on ESP8266.
- RPi will change the call sign text to “ON THE AIR” while input header pin 40 is grounded such as from a PTT line. The pin includes a weak internal pull-up but add an external 10K resistor to Vcc if not reliably off when disconnected. Do not drive with greater than 3.3 V. Not available on ESP8266.
- RPi will bring pin 31 high while the alarm clock is “ringing”. The schematic shows an LED but a piezo buzzer works also or play any sound with <https://www.adafruit.com/product/2220>. Briefly grounding pin 29 will silence the alarm. Not available on ESP9266.
- The GPIO option on Setup Page 2 must be set to Active for any of these to function.

MAKE THESE CONNECTIONS AT YOUR OWN RISK, THE AUTHOR TAKES NO RESPONSIBILITY FOR DAMAGES.

© 2020-2021 Elwood Charles Downey ecdowney@clearskyinstitute.com