

HamClock 3.05 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 the platform. Then you have a chance to open the Setup screens. Both opportunities time out if ignored.

Setup provides several 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 discrete options. Tapping on a data entry field will place a green cursor where the next character will go. Tap **Delete** to erase the character to the left. Tap the **Page** arrows to move to next or previous. 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 corrected.

Pages with text fields include a virtual keyboard for use on touch screens or with a mouse. On desktop systems, a normal keyboard may also be used using *tab* to step to the next prompt; *delete* to erase a character, *space* to toggle discrete options; *escape* to change page and *Return* for Done.

```
Call: WBOEWF < Page 1 >
Enter DE Lat: 30.00N Lng: 100.00W Grid: EM00aa
or use gpsd? No
or IP Geolocate? No
WiFi: SSID: mywifissid Password:
mywifipassword
```

Call: enter your call sign, up to 11 characters.

DE Lat, Long, Grid: these fields are your station location. You may enter a grid or enter \pm degrees or use N/S suffix with Lat and E/W with Lng. These fields disappear if gpsd or IP Geolocate are active. May also be changed from the main HamClock screen by tapping the DE lat or long or grid value.

use gpsd? Allows connecting to a gpsd daemon on your local network for DE location and time. Enter the host name of your gpsd server; the port is fixed to 2947. When used, gpsd is used to set location once and update time continuously, or you may also choose to follow your location once per minute.

IP Geolocate? If Yes, uses your public IP to set Lat and Long, and removes these prompts. This may not be accurate so always double-check the results.

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. Note this only refers to login credentials, it does not control whether wifi is actually used, that is up to the host system.

```
Cluster? Yes WSJT-X? No < Page 2 >
watch:VE, VA, W Cluster Commands:
port: 7300 Off:
host: DXCLUSTER Off:
login: YOURCALL Off:
Off:
```

Cluster? This section controls DX Cluster or WSJT spotting. See pages 5 and 9 for details.

```
rigctld? Yes port: 4532 host: localhost < Page 3 >
rotctld? No
flrig? No
NTP? Use default set of servers
ADIF? file: $HOME/desktop/log.adif
```

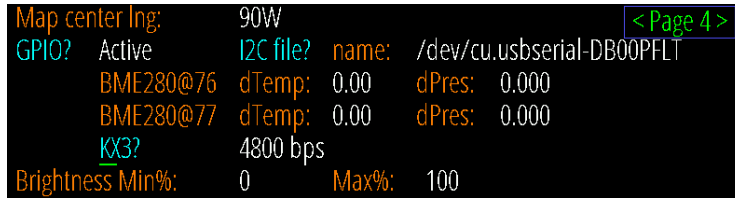
rigctld? rotctld? Whether and how to connect to **hamlib** for radio and/or rotator control. See pages 7 and 9.

flrig? Whether and how to connect to w1hkj's **flrig** for rig control. See page 9.

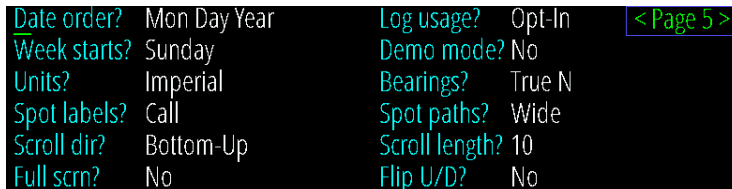
NTP? Set the name or IP of one NTP server of your choice; or set host to **OS** to use computer time; or use the list of built-in default servers.

ADIF? Set path to ADIF pane file relative to program working directory; may include env variables and ~.

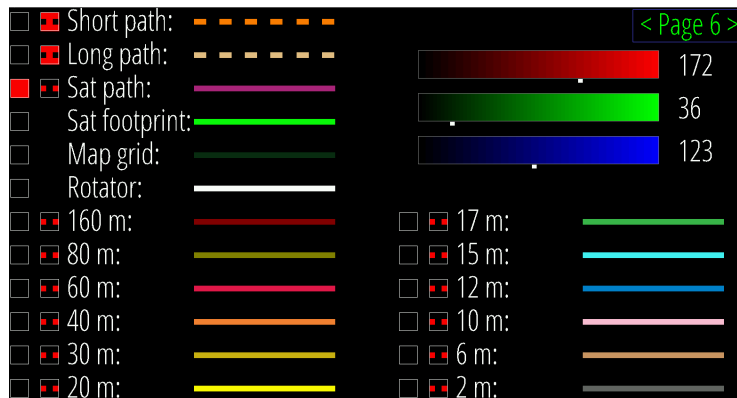
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Map center lng: set desired center map longitude for the Mercator or Robinson projections.
GPIO? Controls whether the native GPIO pins on RPi or ESP will be used by HamClock. See page 12.
I2C file? Host system name for the I2C bus connection, either native or via USB. See page 12.
dTemp, dPres: temperature and pressure corrections added to each BME280 sensor, if installed. See page 11.
KX3? Toggle direct KX3 frequency control Off or set serial baud rate. See page 11.
Brightness Min% and Max%: display brightness range, if supported, as percent of hardware total.



Date order? Choose one of three formats for all date displays.
Log usage? Choose whether to send us your HamClock settings *anonymously* to guide further development.
Week starts? Choose whether the first calendar column is *Sunday* or *Monday*.
Demo mode? Yes causes HamClock to change its own settings automatically. See page 10.
Units? Choose *Imperial* or *Metric* units for environment sensor, weather data and distances.
Bearings? Choose *True* or *Magnetic North* when displaying bearing and distance.
Spot labels and paths? Whether and how to label and draw Live, POTA, SOTA and DX Cluster calls and paths.
Scroll dir? whether scrolling panes fill from *bottom-up* or *top-down*.
Scroll length? number of additional lines beyond what is visible; applies to DX Cluster and POTA/SOTA.
Full scrn? Set to Yes to force HamClock to fill all surrounding screen area with black, when possible.
Flip U/D? Yes will render the display upside down, useful for some cabling situations on ESP only.



Map Colors: Select a color with the first column, then tap the color bars to edit and show a sample. The second column selects whether paths are drawn dashed. RGB components are shown quantitatively 0..255.

DE Daily Display On/Off Times							
	< Sun >	< Mon >	< Tue >	< Wed >	< Thu >	< Fri >	< Sat >
On	08:00	06:00	06:00	06:00	06:00	06:00	08:00
Off	22:00	23:00	23:00	23:00	23:00	23:00	22:00

On/Off Times: Use this table to set desired DE 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 the adjacent day. The main HamClock page will also display, and allowed editing, the current day settings (only) (see page 4). The display is never turned off if both times are equal. Available only when using full screen and on certain platforms.

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Tap to cycle Call sign background
 Tap to cycle Call sign foreground
 Up time, IP and WiFi signal strength, red if < -75 dBm, tap for meter
 Tap to shift time forward or back
 Tap to change time scale
 Big ? if time is not syncing
 Current version. Red when old. Tap to update.
 Tap to sync to UTC; red if not
 Tap to Lock screen on/off; Long-tap to restart or exit.
 Tap for Stopwatch, count down timer and Big Clock

DRAP
 Lat 26S
 Lng 138E
 Grid PG93
 LMT 08:53
 SP 256°
 8320 m1
 CQ 30
 ITU 59
 Pfx VK5

Map style – see page 10
 Roving cursor info, see page 10
 Long path
 Short path
 DE -hold to set
 Rotating RSS feeds
 Sun
 Sub-earth Moon location and phase from surface
 NCDXF beacon
 DX - tap to set

eHam: My End Fed Stealth Antenna

Mercator projection centered at 0° longitude

Terrain
 Style:
 ○ Countries
 ○ Terrain
 ○ DRAP
 ○ MUF
 ● Aurora
 ○ Weather
 Grid:
 ○ None
 ○ Tropics
 ● Lat/Long
 ○ Maidenhead
 ○ Azimuthal
 ○ CQ Zones
 ○ ITU Zones
 Projection:
 ○ Mercator
 ○ Azimuthal
 ○ Azim One
 ● Robinson
 □ RSS
 ■ Night
 ■ Cities
 [OK] [Cancel]

ISS
 S 4:38
 Sat name and next event time unless in DX pane
 Tap Sat location or name to see Pass.
 Ground track for one future orbit
 DX unless sat
 DE antipode unless sat
 Concentric circles show where Sat is on horizon, 30° and 60° elevation

Azimuthal projection centered on DE

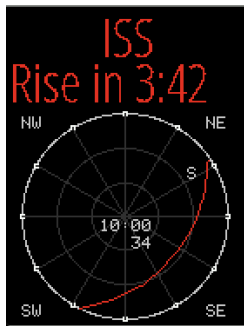
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The **DE** panel shows HamClock's idea of your location and local time. HamClock uses this location for many purposes from lunar angles to spot bearings. In this default configuration it shows local time and date, latitude and longitude, grid square and sun rise and set events. Tap **DE**: to select other formats. Tap location to edit lat, long or grid, see page 9. Tap **R** or **S** to toggle showing the time **at** which the next or previous events occur, or the interval **in** which they will or have occurred. Tap the timezone offset to update if necessary. Note that HamClock does not attempt to correct for daylight savings time.



The **DX** panel shows HamClock's definition of a second location independent from DE. Similar to the DE panel, it shows the local time and date at the location, its latitude and longitude, grid square and sun events. The same control options apply as in the DE panel, see above. In addition, the bottom line shows the distance and bearing to DX from DE. Tap **LP** or **SP** to toggle whether this refers to short path or long path. Tap **DX**: to show a list of earth satellites. If one of these is chosen, then this panel changes to display the next pass of the satellite; see next.

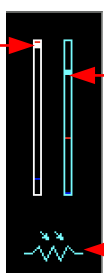


The **DX** panel can be repurposed to show details of the next satellite pass as viewed from DE. Below the satellite name is the time until the next Rise or Set event. The format will be **HHhMM** if the event is more than an hour away otherwise **MM:SS**. A schematic representation shows how the pass will appear in the sky above DE oriented as shown by the compass directions in each corner. Faint lines are drawn at 30° and 60° elevation and every 30° in azimuth. The setting end of the pass is marked with an **S**. Midway along the pass are shown the **duration** as MM:SS and **maximum elevation** in degrees. Tap anywhere in the circle for a menu of additional options.

- Below are descriptions of the tall narrow pane in the upper right corner of HamClock.
- Tap near the top for a menu of available choices; choose one, or more will rotate.
- Some choices also use lower tap positions for specific functions as described below.

Display Brightness Control (see page 8)

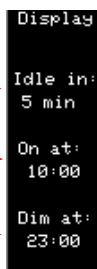
Optional light sensor reading



Indicates light sensor is present; see page 11

Display brightness, scaled to brMin to brMax in Setup page 4.

Display On/Off Timer (see page 8)



Period until display
 Off if no activity;
 0 disables

DE On time *today*

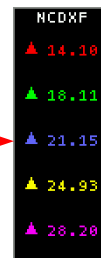
DE Off time *today*

Times are reset from table in Setup page 7 each midnight

Tap just above or below each digit to change

NCDXF Beacons

Map color key



Frequency, MHz

BME Env stats



Tap value to show matching Pane

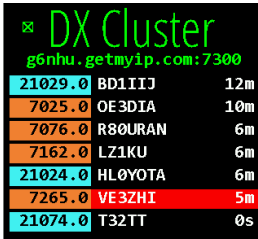
Space Wx Stats



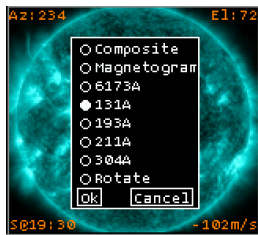
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The following paragraphs describe each option that may be shown in the top three **Panes** of HamClock.

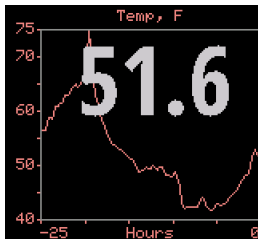
- Tap near the top center of a pane for a menu of available choices; choose one, or more will rotate.
- Choices may be assigned to one pane at a time, and each pane must be assigned at least one choice.
- Some choices also use lower tap positions for specific functions as described below.



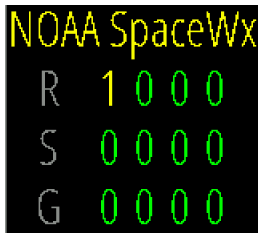
DX Cluster displays and maps spots from the cluster host defined in Setup page 2, subject to any filters which may also be defined there. Listing direction may be set in Setup page 5. Rows matching the watch list are colored red. See page 9 for more information on setting up a cluster. The host and port are shown in yellow while connecting, green while functional or red if there is an error. The columns are kHz, call and age. Tap any row to set DX and rotator and radio if configured. The list may be cleared at any time by tapping .



SDO shows current images from the Solar Dynamics Observatory satellite. The corners show information with respect to an observer located at DE including the Azimuth, Elevation, time of next Rise or Set, and radial velocity where positive values indicate the motion is away from the observer. Tap near the center of the image to display a menu allowing any one of several image types to be selected, or select **Rotate** to automatically cycle them all in turn. Tap lower left corner for a gray line planning tool: DE and DX share twilight when either of their lines are close together. On some systems, tapping in lower right corner will display a recent movie in a separate browser window.



If an optional BME280 environmental sensor is installed and working (see page 11), then several pane options are available whose names begin with **ENV** to display temperature, humidity, dew point or station pressure. The current value is shown along with a 24 hour history. As a special convenience, tapping near the bottom of the pane will cycle immediately to another ENV choice without having to use the normal menu. If two sensors are installed, the pane is split to show graphs from each, labeled with the respective I2C addresses.

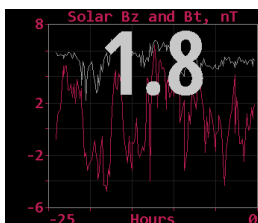


Space Wx shows the three main NOAA space weather scales. The left column is for the current conditions, and columns to the right are predictions for each of the next three days. All scales use the same range of values, zero through five, with larger numbers to indicate greater severity and public impact.

- R:** Radio blackout
- S:** Solar radiation storm
- G:** Geomagnetic storm



Contests lists amateur radio contests for the upcoming, or current, weekend. Tap near the center to toggle showing one per line or a pair of lines including the event time. Data are kindly provided with permission by Bruce Horn, WA7BNM.



Bz Bt shows the strength of the interplanetary magnetic field near earth in units of nano Tesla. B_z is the strength of the field pointing north, the same direction as the Earth's field. B_t is the vector sum in all directions, and thus is always the larger value. When B_z is negative, the fields are in opposite directions, partially cancelling the net shielding effect of the magnetosphere and negatively impacting HF propagation. Values of $B_z < -10$ can be significant.

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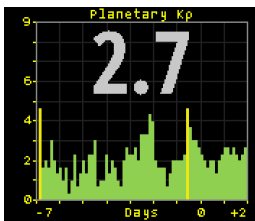
POTA ▲ 33
40

21074	AA0A	K-4487	2m
14074	KJ7JJ	K-5913	1m
14212	N3GE	K-8941	1m
21058	M0TTQ	G-0022	1m
14074	KE7BJ	K-4403	1m
14068	W8MND	K-8195	1m
7275	K4TCT	K-3845	1m

POTA and **SOTA** have separate panes for displaying a list of their current spots. Below the title is the total number of spots in the list. The table columns are kHz, call, location code and age. Spots are colored by band. **SOTA** only has one column for age so any older than 9 minutes are marked with a plus +. Tap the count to select the column by which the table is sorted. Tap a spot row to set DX and control radio and rotator if used. Spots are plotted but path information is not available.



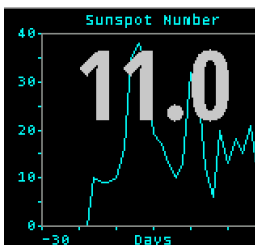
DE Wx and **DX Wx** show the current weather at DE or DX from OpenWeatherMap.org. If the location is not changed for at least an hour, an arrow will appear to indicate the pressure trend direction. When either location is changed by any means the left pane will temporarily show its weather, unless already selected on another pane.



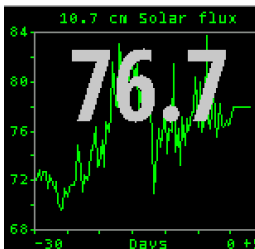
Planetary K shows the Kp index now, with a graph extending from 7 days prior to 2 days forecast.



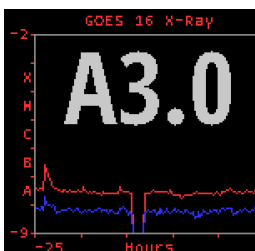
Moon displays a graphic of the lunar surface facing earth with the proper portion shown in shadow. The corners show information with respect to an observer located at DE including the Azimuth, Elevation, time of next Rise or Set, and radial velocity where positive values indicate the motion is away from the observer. Tap anywhere in the lower half to display an EME planning tool, see page 10.



Sunspot N shows the current SIDC sunspot number and 30 days history. Since one solar revolution is approximately this period and solar features typically evolve fairly slowly, the graph provides a crude prediction of solar activity for the next month. Tap in the lower half to show a longer history.

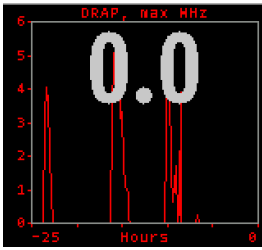


Solar Flux shows the current 10.7 cm measurement from National Research Council Canada, as well as a 30 day history and prediction for the next three days. Tap in the lower half to show a longer history.



X-Ray shows the current solar X-Ray levels and flare class with a 24 hour history from the GOES-16 satellite. The levels are the powers of a logarithmic scale as \log_{10} (Wm^{-2}). The blue line is the 0.05 - 0.4 nm band, red is the 0.1 - 0.8 nm band.

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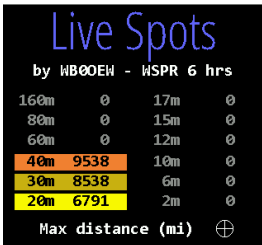


The **DRAP** plot option shows the highest frequency that is attenuated by at least 1 db anywhere on Earth over the past 24 hours. Although the plot does not indicate the location where this occurred, it is usually centered on the Earth daylight side unless there is a Polar Cap Absorption event in progress. Also see the DRAP map option on page 10. The signal paths are for an angle of incidence, α , of 90 degrees (straight up). For shallower angles, multiply the attenuation by $1/\sin(\alpha)$.

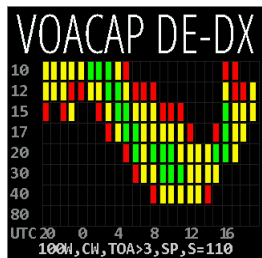


Rotator control: If **rotctld** is set in Setup page 3 then a Rotator option is available as a pane choice to control most rotators supported by hamlib. Set the *host* and *port* fields to the address of rotctld on your network. *You must get rotctld working on your system first, then consider controlling it from HamClock.* The **Az** row shows the rotator azimuth reported by rotctld and an angle graphic. Tap the arrows beneath to manually command left and right rotations of 5 and 20 degrees, with the current commanded position shown between in a smaller font. An azimuth beam will also be shown on the main map. If the rotator includes an elevation axis a second row, labeled **El**, provides similar functions.

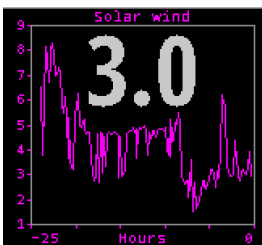
Tapping **Auto** will either track the current satellite, if one is set and there is an elevation axis, or keep azimuth pointing toward the short path of the current DX location. If the elevation axis can rotate beyond vertical to 180 degrees, *i.e.*, upside down, it will be used to avoid an azimuth wrap during tracking and will be indicated with a red arrow arc on the El row. All motion will cease while the **Stop** button is active or the Rotator pane is not visible. Sat tracking requires HamClock to be set to UTC (see page 8).



Live Spots shows personalized reports from WSPRnet.org, PSKReporter.info or ReverseBeacon.net. With WSPR and PSK you may choose spots posted **by** your own DE call or from your grid; or spots which others post **of** your DE call or grid. Using your grid allows you to explore propagation from your general location without transmitting. Note RBN only works with skimmer spots **of** your call (not **by**) because grids of the spotted transmitter stations are not available. Tap the band table to display a menu that controls these choices as well as maximum age; whether to show count or distance to farthest spot; and which bands to map. Paths show a circle ● at the TX end, a square ■ at the RX end and the furthest path for each band is marked with a target ⊕ and optionally labeled. Note ESP only maps the furthest spot on each selected band.



VOACAP: This pane choice shows a graph of path percentage reliability predictions from DE to DX spanning 24 hours for each HF ham band. Graph squares are black if reliability is less than 10%; red if less than 33%; yellow if less than 66% and green if above 66%. Predictions always use VOACAP configured for isotropic 0 dBi antennas on both ends; quiet location noise (-153 db) and the current mean sunspot number. Additional VOACAP parameters are variable and may be set by tapping the fields across the bottom: transmit power, mode, Take-Off-Angle at DE and SP/LP to select Short or Long path. The graph time axis always places now at the left edge. Tap the timeline to toggle labels in UTC or DE local time. Tapping the left half of a band row will show a world map of path reliability from DE, using the same color code. Tapping the right half of a band row will show a map of TOA from DE using the path with the best reliability. Tap the active row again in the same half to restore the normal background map.



Solar wind: This pane shows 24 hours history of solar wind activity. Solar wind 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 rate, 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 better chances for aurora.

Frequency	Call Sign	Time
10137.4	W6RBF	2.7y
10137.5	N4NX	135d
10137.5	N4NX	135d
10137.5	N4NX	135d
10137.5	NY4Q	135d
10137.5	NY4Q	135d
10137.5	K4SHA	135d

ADIF: This pane lists and maps up to the 1000 newest QSOs in the ADIF file named in Setup page 3. Entries are sorted by time and may be scrolled using the arrows. Rows matching the DX Cluster watch list are colored red. The file is reread every 30 seconds for handy monitoring or whenever the pane is tapped. Each record must define the fields CALL or CONTACTED_OP; QSO_DATE; TIME_ON; BAND or FREQ; MODE; GRIDSQUARE or LAT and LON. All others are silently discarded. Optional fields STATION_CALLSIGN, OPERATOR, MY_GRIDSQUARE, MY_LAT and MY_LON are filled from DE if absent. ESP shows far fewer and may only be loaded from the RESTful interface (see FAQ 42).

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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, gray line or VOACAP predictions at some moment in the past or future. Changing away from UTC causes the UTC button to flash red **OFF** as a stark reminder the HamClock is no longer tracking real UTC. Tapping the red button will return abruptly back to real UTC. A large question mark is shown when time is unknown.

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 screen.

Alarm sets the 24 hour DE time that will be announced if *armed*. When armed, the alarm clock icon on the HamClock main screen 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 screen in the center pane; on the Stopwatch screen 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 screen 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 screen 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 screen. See page 10 for hardware control.

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



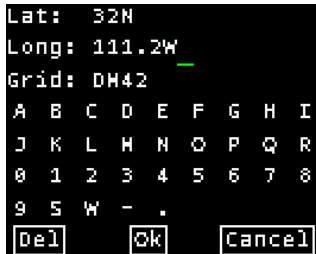
Brightness and Light sensor controls: If a light sensor is installed (aka "photo resistor" for historical reasons) and the Full Screen option in Setup page 5 is Yes, then the right pane may be set to show two vertical scales. The left shows the current display brightness and the right the current light sensor reading. Both include their respective calibration markers. Brightness is scaled from, and limited to, **Min%** to **Max%** from Setup page 4. If the display can only be turned on or off, the brightness scale will only show a marker at top or bottom. To calibrate a desired brightness response, start by exposing the light sensor to a bright intensity then tap in the upper half of the left scale to set the desired display brightness at that intensity (or just "on"). Then expose the sensor to a dim light and tap in the lower half to set the desired brightness at that low intensity (or "off"). Systems without a light sensor but with ability to control display brightness will provide a single slider to control display brightness manually.

On/Off timers: The upper right pane may provide a table of DE clock **On** and **Off** times at which the display will be set to Max% or Min%, respectively; set the times equal to disable both timers. **Idle** sets the number of minutes of no user activity after which the display will change to Min%; set to zero to disable. Changing the On or Off times will also set the On/Off table in Setup page 7 to match for the current day. Conversely, the pane's values will be reset from this table at each local midnight. If these timers turn the display Off, the light sensor will then **not** control display brightness again until either a timer commands the display back On or the user taps anywhere in HamClock to restore brightness.

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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. 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. Tap anywhere in the pane for a menu of options or tap the map to set a new DX location and restore DX info.



Setting DE and DX: Tapping lat, long or grid in the DE: or DX: panes will display a dialog where these values may be directly edited to full precision either by tapping the virtual keyboard or using a real keyboard the same way as Setup. Corresponding 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 main 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.

Rig control: Setup page 3 allows choosing *rotctld* or *flrig* so that tapping a DX Cluster or On The Air spot will send the frequency to your radio VFO A. Set the *host* and *port* fields to the address of the program on your network. Get it working on your system first, then consider controlling it with HamClock. You can also control a KX3 using an IO pin from an RPi or ESP Huzzah direct to a KX3 in the same way, see page 11.



Scroll controls appear automatically when panes have too many lines to display. *Up* shows how many more lines are above, *down* shows the number below. Tapping either arrow scrolls to reveal the next group of lines in the respective direction, retaining one for context. Setup page 5 allows setting whether the list grows top-down or bottom-up and the number of unseen lines. No scrolling on ESP.

DX Cluster: DX cluster control is on Setup page 2. Enter the *host*, *port* number and desired *login* name. The login must include your DE callsign somewhere. Spider and AR clusters are currently supported. You may also save up to four optional *Cluster Commands* that are sent once each time HamClock connects to the given cluster node if set to On. Use the commands appropriate to the type of node selected. Prefixes of interest may be listed in the *watch* field separated by space or comma. Filtered spots will be listed in the DX Cluster pane as they arrive (see page 5), displayed on the map and highlighted in red if they match a watch list prefix. If the path is plotted, the TX end is marked with a circle ● and the RX end with a square ■. If the cursor moves over either end, additional information is shown in the cursor info block (see page 10). Tapping an entry in the list will redefine HamClock's DX to that location and may also tune your radio (see page 9) or command your rotator (see page 7). For obscure reasons, the DX Cluster pane may not be shown in pane 1 nor be mixed with other choices in any pane. ESP8266 does not draw spots nor paths on the world map.

Toggling **WSJT-X?** to Yes will instead connect to WSJT-X (or compatible) on your local network. When set up properly, each time you reply to an FT8 contact, the station will appear in the HamClock DX Cluster pane list. Tapping an entry works the same as described above. Note only FT8 messages that include both station's grid squares are listed. Configure HamClock by opening the *WSJT-X Reporting* preferences tab. If you want applications running on more than one computer to receive WSJT-X reports then set *UDP Server* to either a multicast address (example 224.0.2.0) or the broadcast address for your network (example 192.168.1.255). If all applications are on the same computer, you can use 127.0.0.1. Then configure each application, including HamClock, to match. In all cases, leave the *UDP Server port number* set to the default of 2237.

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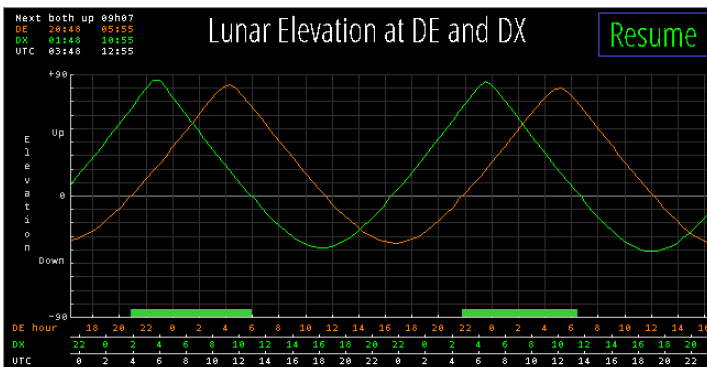
Lat	9N	NL7D
Lng	67W	DM42
Grid	FJ68	ZL1GSM
LMT	23:57	RF73
CQ	9	FT8
ITU	12	kHz 28075
Pfx	YV	Age 38m
SP	110°	SP 231°
	3224 mi	6794 mi

Roving cursor table: A box such as those shown at left will appear automatically in the upper left corner of the map whenever the cursor is over the map or a spot symbol. The contents change depending on context but may contain Latitude; Longitude; Grid; Local Mean Time (does not account for savings time); CQ and ITU zone designations; Prefix; TX and RX call and grid; Mode; Frequency; spot Age; Bearing and Distance from DE; and weather conditions. The bearing degree symbol becomes M if referenced to magnetic north (see Setup page 5). When displaying spot information the border color matches the assigned band color. The box disappears if idle for 30 seconds.

- Style:**
- Countries
 - Terrain
 - DRAP
 - MUF
 - Aurora
 - Weather
- Grid:**
- None
 - Tropics
 - Lat/Long
 - Maidenhead
 - Azimuthal
 - CQ Zones
 - ITU Zones
- Projection:**
- Mercator
 - Azimuthal
 - Azim One
 - Mollweide
- RSS
 - Night
 - Cities

Map view options: Tap the upper left map corner for this menu of viewing options.

- **Style** selects the overall map background design from the following choices:
 - political **Countries** or natural **Terrain**
 - **DRAP:** This map style 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. See also the DRAP pane on page 7 for a time history.
 - **MUF:** This map style shows the VOACAP model for median Maximum Usable Frequency between DE and other points in the world about half the time each month. Dropping down about 15% improves the path to about 90% reliability. The path may still not be unusable due to low signal power, local noise or variable space weather conditions. The map is color coded the same as DRAP.
 - **Aurora:** This map style shows the chances for aurora activity based on total ionospheric energy deposition. High activity is often associated with geomagnetic storm conditions. This map is best viewed with the Azimuthal projection.
 - **Weather:** shows color-coded temperature, pressure isobars and wind speed direction flags.
- **Grid overlay:** *none*; **Tropics** at ± 23.5 degrees latitude; **Lat/Long** every 15 degrees; first letter **Maidenhead** grid squares; **Azimuthal** distance and bearing every 15 degrees from DE; or **CQ** or **ITU zones**.
- **Projection:** classic **Mercator**; **Azimuthal** is front and back hemisphere views centered on DE and antipode, respectively; **Azim One** is full globe centered on DE (entire outer edge is the single DE antipode point); and **Robinson** which is often used in publishing.
- **RSS:** overlay lower map with live RSS feeds, rotating every 15 seconds.
- **Night:** whether to darken the map currently experiencing night time.
- **Cities:** whether to display sizable city nearest to cursor, if any.



The **EME planning tool** is shown by tapping in the lower half of the Moon pane (see page 5). The tool plots the lunar elevation at DE and DX for the next two days starting now. The time axis is labeled in DE and DX local time and UTC. The table in upper left shows the next period when the moon is simultaneously up at both DE and DX. All such periods are also marked along the time line. Tap the plot anywhere for detailed information at that moment. Tap Resume to restore normal HamClock operation or let it time out.



Demo mode: When enabled in Setup page 5, the padlock changes to a running figure to indicate demo mode is active. This means HamClock will autonomously make a random setting change to itself every 30 seconds, including the plot panes, DX location and map view options. 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. The Demo mode setting is not persistent, it must be selected again each time HamClock starts.

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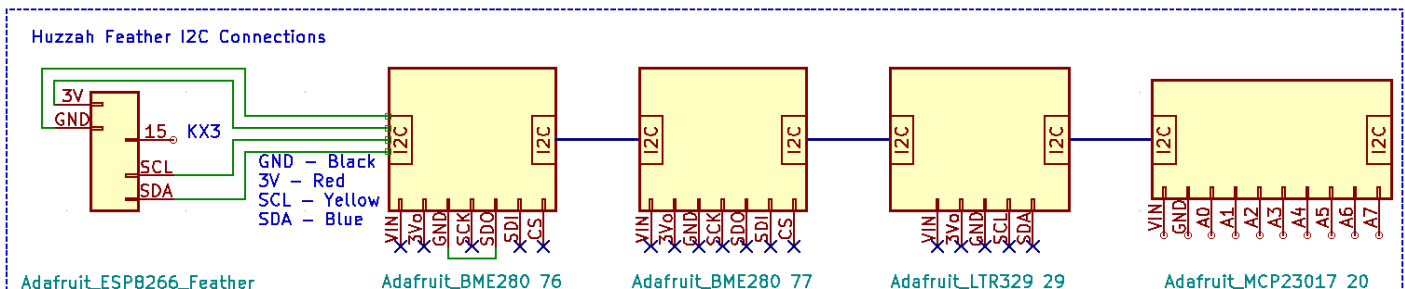
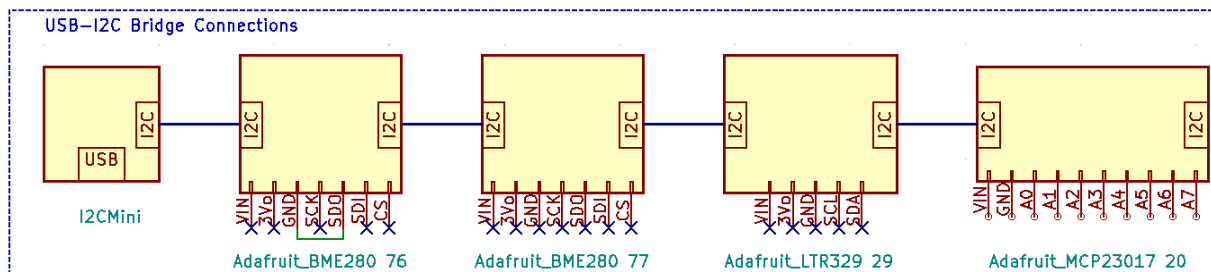
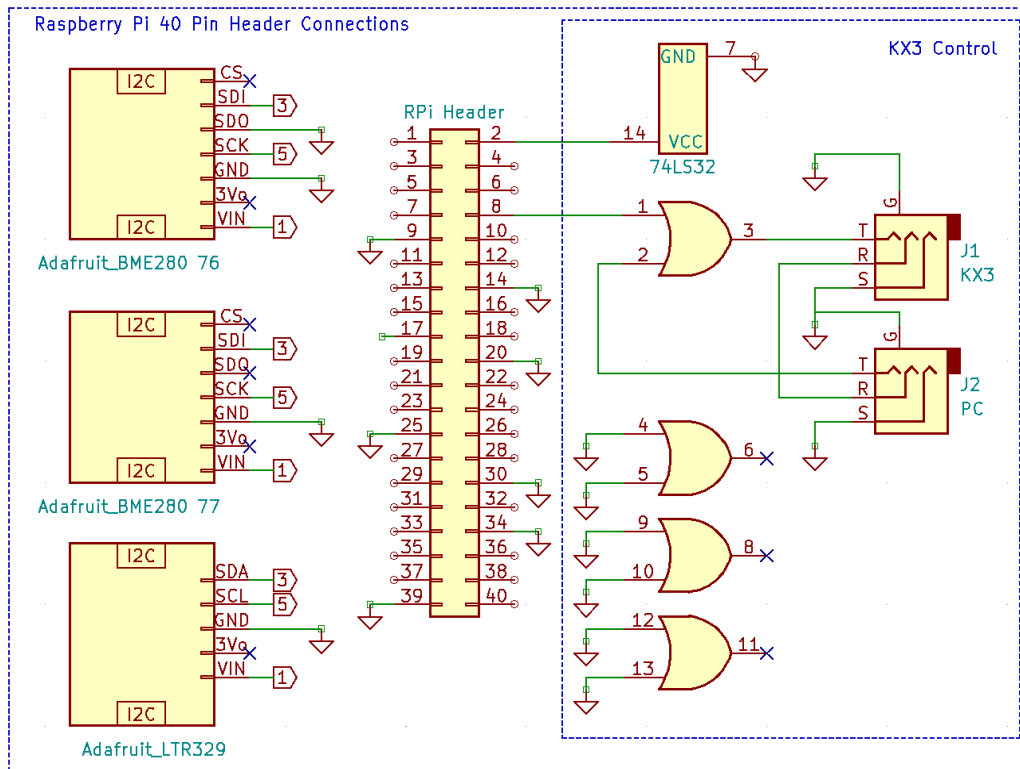
External IO Options

HamClock supports several optional external devices to enhance the operator experience. These include

- one or two BME280 environmental sensors for temperature, pressure and humidity;
- LTR329 light sensor for automatic dimming depending on ambient lighting (see Page 8);
- several switches and LEDs to complement the ON AIR indicator, timer, alarm clock and satellite status;
- Elecraft KX3 serial control, available only with Pi header pin 8 or Huzzah pin 15.

These devices may be connected to HamClock in three different configurations, as shown below. Devices may be connected in any order and all are optional.

- to the 40 pin header of a Raspberry Pi
- to any linux or Mac with a USB port using an I2CMini from i2cdriver.com, including the Pi if preferred
- to the ESP8266 Adafruit Huzzah Feather using its I2C pins SCL and SDA



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External IO Options, continued

The discrete GPIO options are described in the table below. Each is independent and may be chosen separately as desired. Connect the Terminal connections to either the Pi header or the MCP23017 port expander, depending on the HamClock configuration used on page 11. The MCP23017 is not needed if none of these are used.

On an ESP8266 or Raspberry Pi, Setup page 4 also includes a toggle named **GPIO**. Setting this Off prevents HamClock from using any of the native pins in order that they may be used for something else. To use the I2C header pins on a Pi this must be set to Active *in addition to* setting the proper file name (see next).

GPIO Option	Description	Terminal	Pi Header Pin	MCP23017 Pin
	A falling edge from a SPST switch or PTT line on terminal CD_4 (re)starts the count down timer. Driving voltage, if any, must not exceed 3.3 V. The LEDs indicate the time remaining: green when counting down; both when 1 minute or less remains; red when timed out.	CD_1 CD_2 CD_3 CD_4	17 33 35 37	VIN A0 A1 A2
	Output terminal SA_A indicates satellite visibility from DE. Normally low, it cycles high at 1 Hz for 1 minute before rise, stays high during the pass, cycles at 2 Hz during the last minute then stays low again after set.	SA_1	38	A5
	Grounding input terminal OA_1 with a switch or PTT line will change the call sign text to "ON THE AIR". Driving voltage, if any, must not exceed 3.3 V.	OA_1	40	A6
	Output terminal AL_1 will go high while the alarm clock is "ringing". The schematic shows an LED but a piezo buzzer works also. Briefly grounding input terminal AL_2 will silence the alarm.	AL_1 AL_2	31 29	A3 A4

All this flexibility does come at a price. You must determine and enter the name assigned by the host to the native or bridged I2C bus in the **I2C file** field of Setup page 4. The table below shows a sample of systems and *typical* names. One way to discover the *exact* name is to start a terminal session and run the command `ls /dev`. Look for something similar or, in the case of a USB-I2C bridge, remove and plug the device back in and see what changes. If you find both **tty** and **cu** names that are otherwise the same, always use the cu name.

Configuration	Typical I2C File name
Raspberry Pi 40 pin header	Debian /dev/i2c-1 FreeBSD /dev/iic0
USB-I2C bridge	Debian /dev/ttyUSB0 FreeBSD /dev/cuaU0 macOS /dev/cu.usbserial-DK0C3XGZ