HamClock 3.00 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:   WB0OEW                                              < 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 ± 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 >
 Path? Yes                           Spider Commands:
 port:  7300                 Off: rej/spot call k,w,n
 host:  dxc.wb3ffv.us        Off:
 login: WB0OEW-1             Off:
                             Off:
```

Cluster? This section controls DX Cluster or WSJT spotting. See page 9 for details.

```
rigctld?  Yes    port: 4532     host: ecd-imac27.local       < Page 3 >
rotctld?  Yes    port: 4533     host: 127.0.0.1
flrig?    Yes    port: 12345    host: ecd-imac27.local

NTP?      Use default set of servers
```

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 host or IP of one NTP server of your choice, or use the list of built-in default servers.

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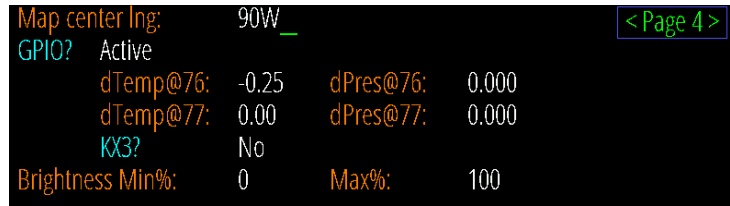
Map center lng: set desired center map longitude for the Mercator projection.
GPIO? Controls whether the GPIO pins on RPi or ESP are active. Set to *Off* to insure no interference with other devices that use these pins. dTemp, dPres and KX3 prompts are removed unless this is *Active*.
dTemp, dPres: temperature and pressure corrections added to each BME280 sensor, if installed. See page 11.
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 11.
Bright Min% and **Max%:** display brightness range, if supported, as percent of hardware total.
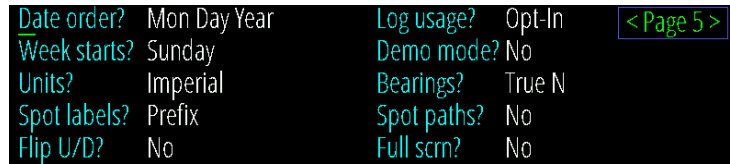
Date order? Choose one of three formats for all date displays.
Log usage? Choose whether to send us your HamClock settings *anonymously* to guide further development.
Week starts? Choose whether the first calendar column is *Sunday* or *Monday*.
**Demo mode?** *Yes* causes HamClock to change its own 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.
Flip U/D? *Yes* will render the display upside down, useful for some cabling situations on ESP only.
Full scrn? Set to *Yes* to force HamClock to fill all surrounding screen area with black, when possible.
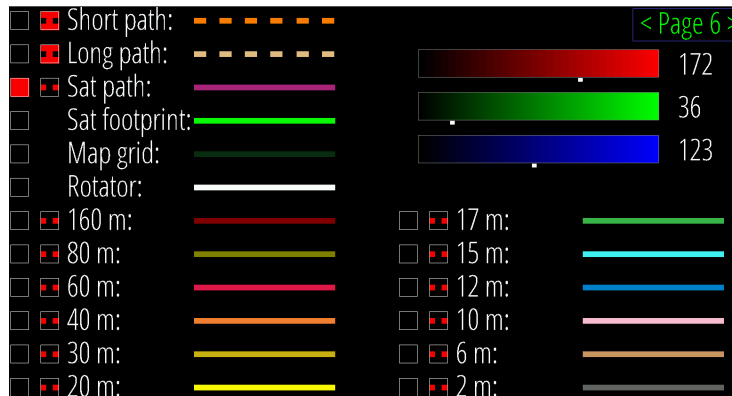
Map Colors: Select a color with the first column, then tap the color bars to edit and show a sample. The second column selects whether paths are drawn dashed. RGB components are shown quantitatively 0..255.

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 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 full screen.

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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

WB0OEW

Up 2d 16h   IP 192.168.7.113   Ver 2.30

Current version. Red when old. Tap to update.

Tap to shift time forward or back

21:12 09

Tap to sync to UTC; red if not

Tap to change time scale

Sat Nov 16, 2019

Tap to Lock screen on/off; Long-tap to restart or exit.

Access Stopwatch, count down timer and Big Clock

DRAP — Map style – see page 10

Lat   26S
Lng   138E
Grid PG93
LMT 08:53 — Roving cursor info, see page 10
SP   256°
      8320 mi
CQ   30
ITU   59
Pfx   VK5

Sub-earth Moon location and phase from surface

Long path

Short path

DE -hold to set

Sun

NCDXF beacon

DX - tap to set

Rotating RSS feeds

eHam: My End Fed Stealth Antenna

Mercator projection centered at 0º 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
○ Mollweide
☐ 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, 30º and 60º elevation

Azimuthal projection centered on DE

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The **DE pa**nel 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.
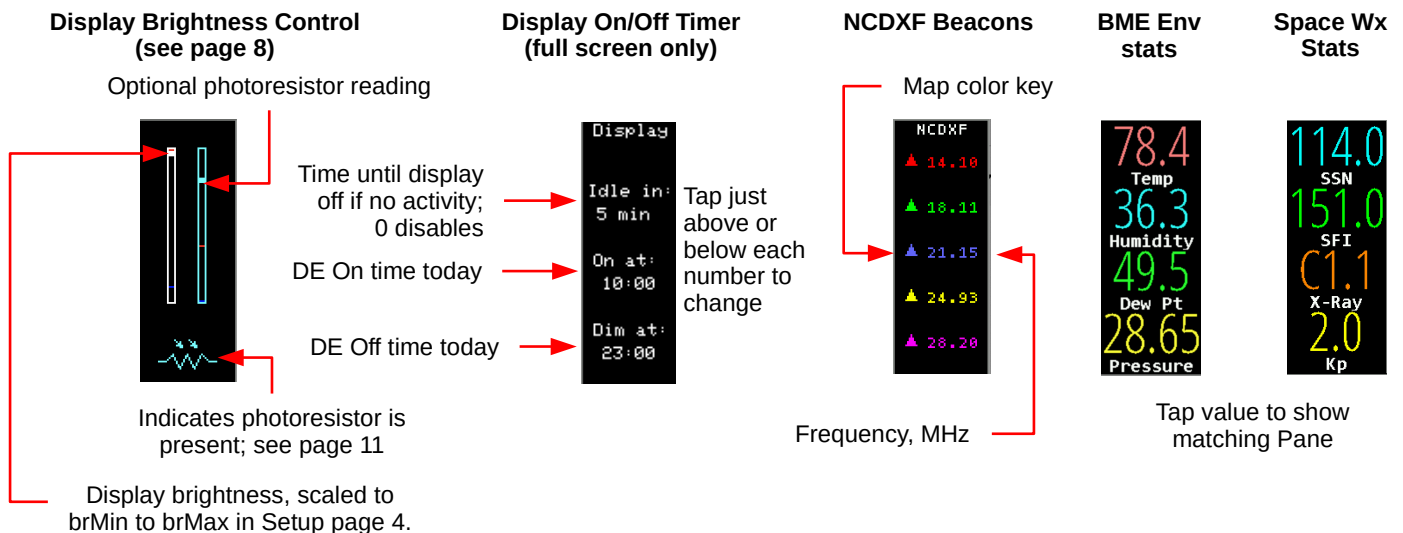
The **DX** panel shows HamClock's definition of a second location independent from DE. Similar to the DE panel, it shows the local time and date at the location, its latitude and longitude, grid square and sun events. The same control options apply as in the DE panel, see above. In addition, the bottom 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.
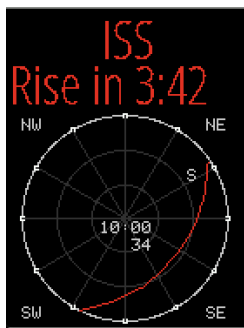
The **DX** panel can be repurposed to show details of the next satellite pass as viewed from DE. Below the satellite name is the time until the next Rise or Set event. The format will be **HHhMM** if the event is more than an hour away otherwise **MM:SS**. A schematic representation shows how the pass 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.

Pane 4: • This is 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)	Display On/Off Timer (full screen only)	NCDXF Beacons	BME Env stats	Space Wx Stats

Optional photoresistor reading

Time until display off if no activity; 0 disables

Tap just above or below each number to change

Map color key

DE On time today

DE Off time today

Indicates photoresistor is present; see page 11

Frequency, MHz

Tap value to show matching Pane

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

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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.
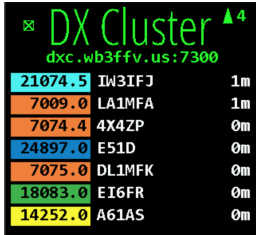
DX Cluster displays spots from the Spider host defined in Setup page 2, subject to any filters which may also be defined there. See page 9 for more information on setting up a cluster. The host and port are shown in yellow while connecting, green while functional or red if there is an error. The columns are kHz, call and age. Tap any row to set DX and rotator and radio if configured. Scroll arrows appear when the list will not fit in the pane, with counts indicating the number of unseen entries in each direction. The list may be cleared at any time by tapping ⊠ . Spots and paths, if enabled, are colored by band. Dot labels mark TX end with a circle ● and RX end with a square ■ .
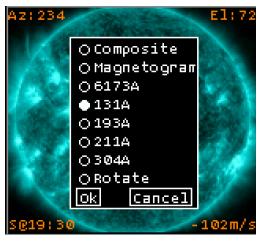
SDO shows current images from the Solar Dynamics Observatory satellite. The corners show information with respect to an observer located at DE including the Azimuth, Elevation, time of next Rise or Set, and radial velocity where positive values indicate the motion is away from the observer. Tap near 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 DE gray line timeline. On some systems, tapping in lower right corner will display a recent movie in a separate browser window.
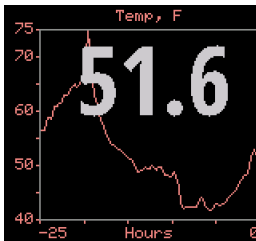
If an optional BME280 environmental sensor is installed and working (see page 11), then several pane options are available whose names begin with **ENV** to display temperature, humidity, dew point or station pressure. The current value is shown along with a 24 hour history. As a special convenience, 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.
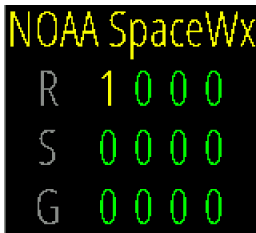
Space Wx shows the three main NOAA space weather scales. The left column is for the current conditions, and columns to the right are predictions for each of the next three days. All scales use the same range of values, zero through five, with larger numbers to indicate greater severity and public impact.

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

Contests lists amateur radio contests for the upcoming, or current, weekend. Scroll arrows appear when the list will not fit in the pane, with counts indicating the number of unseen entries in each direction. Tap near the center to choose whether to show the contest date and time below each title. Data are kindly provided with permission by Bruce Horn, WA7BNM.
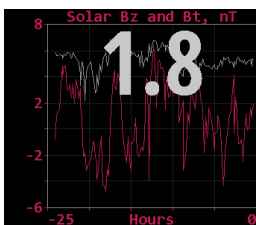
Bz Bt shows the strength of the interplanetary magnetic field near earth in units of nano Tesla. B_z is the strength of the field pointing north, the same direction as the Earth's field. B_t is the vector sum in all directions, and thus is always the larger value. When B_z is negative, the fields are 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 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. Scroll arrows appear at upper right when the list is too long to fit in the pane, with counts indicating the number of unseen entries in each direction. 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. Path information is not available for mapping.

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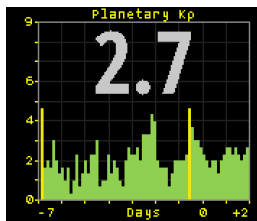
Planetary K shows the Kp index now, with a graph extending from 7 days prior to 2 days forecast.

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.
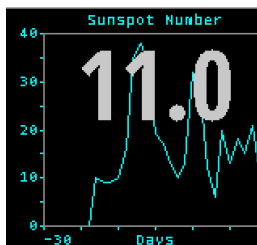
Sunspot N shows the current SIDC sunspot number and 30 days history. Since one solar revolution is approximately this period and solar features typically evolve fairly slowly, the graph provides a crude prediction of solar activity for the next month. Tap in the lower half to show a longer history.
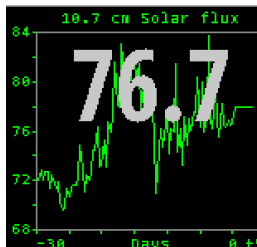
Solar Flux shows the current 10.7 cm measurement from National Research Council Canada, as well as a 30 day history and prediction for the next three days. Tap in the lower half to show a longer history.
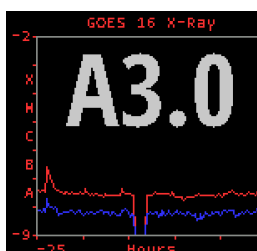
X-Ray shows the current solar X-Ray levels and flare class with a 24 hour history from the GOES-16 satellite. The levels are the powers of a logarithmic scale as $\log_{10}$ (Wm^{-2}). The blue line is the 0.05 - 0.4 nm band, red is the 0.1 - 0.8 nm band.

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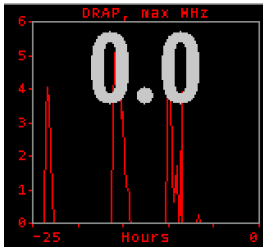
The **DRAP** plot option shows the highest frequency that is attenuated by at least 1 db anywhere on Earth over the past 24 hours. Although the plot does not indicate the location where this occurred, it is usually centered on the Earth daylight side unless there is a Polar Cap Absorption event in progress.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

**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).
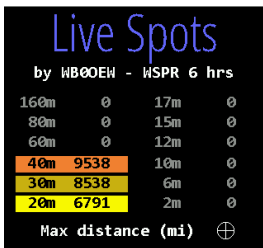
Live Spots shows personalized reports from WSPRnet.org, PSKReporter.info or ReverseBeacon.net. With WSPR and PSK you may choose spots posted **by** your own DE call or from your grid; or spots which others post **of** your DE call or grid. Using your grid allows you to explore propagation from your general 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 ⊕.

Note ESP does not show paths and maps only the furthest spot on each selected band.
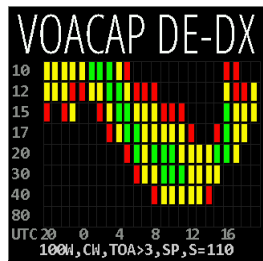
VOACAP: This pane choice shows a graph of path percentage reliability predictions from DE to DX spanning 24 hours for each HF ham band. If displayed in the left pane, it reappears after the DX weather information expires. The graph is black if reliability is less than 10%; red if less than 33%; yellow if less than 66% and green if above 66%. The predictions use VOACAP configured for 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. Tap the transmit power to select 1, 10, 100 and 1000 W; the mode to select CW, SSB, AM, WSPR, FT8 or FT4; or SP/LP to select Short or Long path. All configuration values are summarized across the bottom. 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 row will set the main 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 and frequency labels are yellow while updating; gray if successful; or red if an error occurred. The pane values and/or map will update automatically sometime during each hour. Tapping the active row again will restore the normal background map. 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.
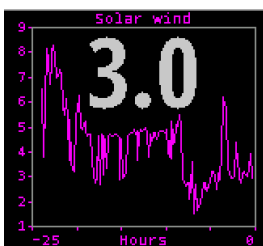
Solar wind: This pane shows 24 hours history of solar wind activity. Solar wind is a good predictor of geomagnetic disturbances such as auroral activity and unusual polar HF propagation. The available real-time metrics are density, in protons cm^{-3}, and speed, in $km\ s^{-1}$. The product of these 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 $m^{-2}\ s^{-1}$ for which values above five or so suggest better chances for aurora.

<h1 style="text-align:center">HamClock 3.00 User Guide</h1>

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.
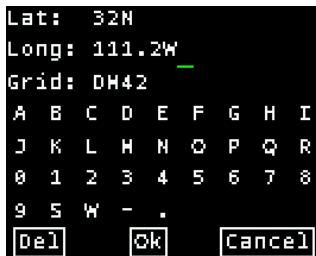

Brightness: If a photo resistor is installed on an ESP HamClock, the upper right pane can be set to show two vertical scales. The one on the left shows the current display brightness and the other the current photo resistor reading. Brightness is scaled from, and limited to, **Min%** to **Max%** from Setup page 4. To calibrate a desired brightness response, start by exposing the photo resistor to a bright light intensity then tap in the upper half of the display (left) scale to set the desired display brightness at that intensity. Then expose the sensor to a dim light and tap in the lower half to set the desired brightness at low intensity. Some systems without a photo resistor provide a single slider to control display brightness manually.

When configured for full screen, this pane can also 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 tap activity after which the display will change to Min%; 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.

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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. 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.

```
Lat:  32N
Long: 111.2W
Grid: DH42
A  B  C  D  E  F  G  H  I
J  K  L  M  N  O  P  Q  R
0  1  2  3  4  5  6  7  8
9  S  W  -  .
[Del]     [Ok]     [Cancel]
```

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 a pin from an RPi or ESP Huzzah to a KX3 to work 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.

DX Cluster: DX Spider spot control is on Setup page 2 (other cluster systems, such as AR-Cluster, are not supported at this time). Enter the *host* (or IP), *port* number and desired *login* name for a DX Spider cluster node, such as those listed at *https://www.ng3k.com/Misc/cluster.html.* Spots may optionally be plotted on the map with or without and *paths*. You may also save up to four optional *Spider Commands* that are sent once each time HamClock connects to the given cluster node if set to On. A good command reference is at *http://www.dxcluster.org/main/usermanual_en-12.html.* Now filtered spots will be listed in the DX Cluster pane (see page 5) and displayed on the map as they occur. 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. Note ESP does not show paths.

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. From there you may click it to set HamClock's DX object. Note only FT8 messages that include both station's grid squares will work. Configure as follows:

- Open the WSJT-X *Reporting* preferences tab. Set HamClock's *Port* field to match the *UDP Server port number* in WSJT-X.
- In the same WSJT-X *Reporting* tab, set *UDP Server* to the broadcast address of your local network, which means setting the last IP octet to 255. For example, if your station network uses 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. Or you can set the *UDP Server* field to the exact IP of HamClock but this will prevent having multiple programs listen to WSJT-X.

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Notes

```
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°
   3221 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, that is, the highest frequency for which the ionosphere will support communication between DE and other points in the world on 50% of the days of the current month at the current time of day. 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 *Mollweide* (pronounced "Mole vee' da") is the classic 1857 equal-area projection by Babinet.
- **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.
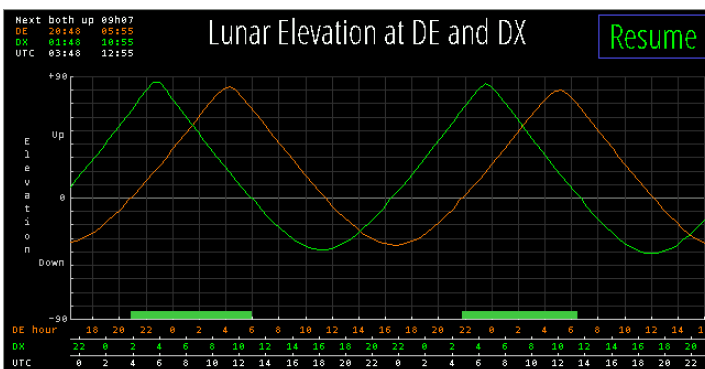
The **EME planning tool** is shown by tapping in the lower half of the Moon pane (see page 5). The tool plots the lunar elevation at DE and DX for the next two days starting now. The time axis is labeled in DE and DX local time and UTC. The table in upper left shows the next period when the moon is simultaneously 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.

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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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Optional Raspberry Pi HamClock connections. The functions do not interact and may be chosen as desired.
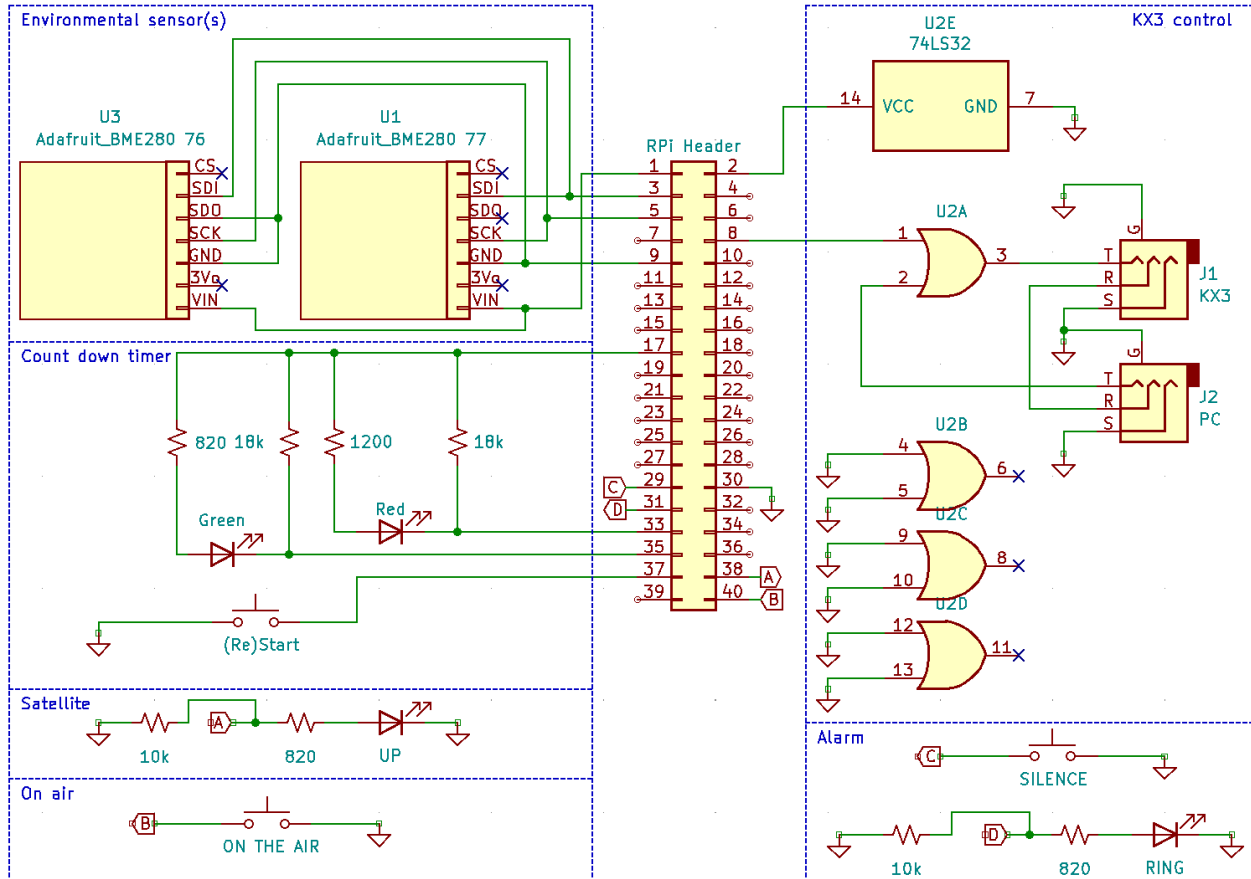
- The BME280 is a temperature, pressure and humidity sensor, available on a breakout board from Adafruit https://www.adafruit.com/product/2652. Two sensors may be connected in parallel at addresses 76 and 77 as shown or one at either address. Bus extenders such as https://www.sparkfun.com/products/14589 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.

- Wired KX3 control is shown in conjunction with a PC connection; see Page 8 for using hamlib. 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 satellite state info. Normally low, it cycles high at 1 Hz for 1 minute before rise, stays high during the pass, flashes at 10 Hz during the last minute then stays low again after 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 pin 1 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 4 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.