Audio Signals/Buzzer Support for Pixhawk Lite

APM:Copter V3.3.2-rc2-lw-rc3 (beta)

This document: http://lauren.vortex.com/phl-lw-info.pdf

Firmware download:
http://lauren.vortex.com/ArduCopter-v2-3.3.2-rc2-lw-rc3.px4
Public GitHub repository:
https://github.com/laurenweinstein1/ardupilot-lw

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The existing Pixhawk Lite (PHL) board does not provide any standard audio signaling output or buzzer support via the regularly released ArduCopter firmware.

APM:Copter V3.3.2-rc2-lw-rc3 is a custom version of APM:Copter (based on Arducopter V3.3.2-r2) which provides support (via Pixhawk Lite pins AUX1 through AUX6) for both passive audio devices (e.g. passive piezos that can play arbitrary tones) and active audio devices (e.g. buzzers that play a fixed tone).

Signaling melodies/patterns are separately optimized for passive and active audio devices, rather than duplicating Pixhawk "standard" tone sequences. The type of audio device installed is specified via a settable parameter.

Melodies (for passive piezos) and buzz sequences (for active devices, e.g. buzzers) are provided for the following events:

System initialization
Prearm fail
Prearm OK
Armed
Disarmed
GPS 2d lock
GPS 3d lock
GPS dgps lock
Loss of GPS lock
RC status change (transmitter on/off)
Lost flyer

MP3 files identifying the current audio signals are available here:
Passive devices (arbitrary tones):
http://lauren.vortex.com/phl-passive-signals.mp3
Active devices (e.g. buzzers):
http://lauren.vortex.com/phl-active-signals.mp3

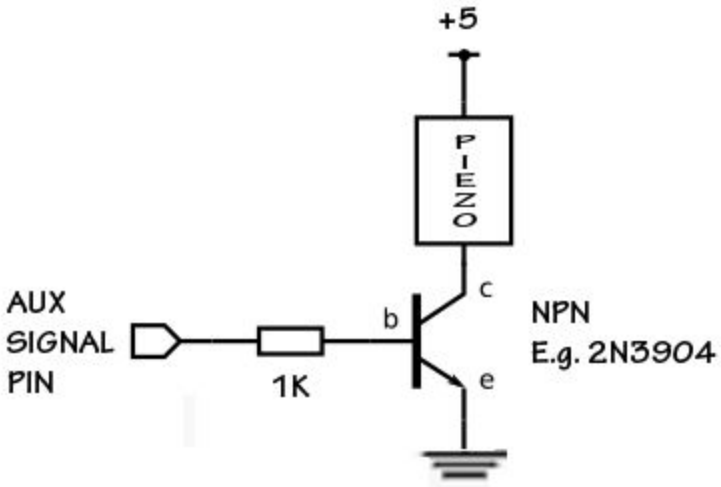
To assure non-interference with flight operations, these audio signals will only play when the flyer is disarmed (with the exception of the signal indicating the transition to **armed** status). When the **lost flyer** signal is triggered, it will play continuously until the PHL is rebooted or shut down.

The user can enable and disable the audio signaling, indicate whether they are using a passive or active audio device, select the AUX pin number to be used for the audio device, indicate whether the audio device has a "low" or "high" logic level off (silent) state, and choose a "limited audio signaling" mode with fewer audio signals if desired.

Hookup

Audio devices can be attached to any of AUX pin 1 through pin 6 that are not otherwise configured by the user. If a passive piezo (which is recommended) is used, it may (in theory) be attached directly to the PHL (ground and signal at the pins, +5 from elsewhere in the flyer unless positive voltage is being supplied to the PHL AUX pins center bus), but use

of a switching transistor is recommended to protect the PHL outputs and permit use of a higher voltage driving source if desired. For example, a very basic hook-up schematic for a typical passive piezo:



Other more elaborate (and potentially louder) hook-up configurations are also possible using additional components.

Configuration

To avoid creating new control parameters, four existing parameters have been "borrowed" for PHL audio signals control (four "EPM Grabber" parameters -- usually unused). These must be properly configured for your configuration/preferences, and can be set in the familiar manner via Mission Planner or other ground control software.

You must change EPM_REGRAB, EPM_GRAB, and EPM_RELEASE from their default settings to enable audio. These changes will not take effect until the system is rebooted.

Device Type

EPM_REGRAB

0=audio disabled,
15=passive device, 30=active device (buzzer)
Any other values disable audio
Default=0 (audio disabled)

If you're using a passive piezo that can play arbitrary tones, select 15. For an active piezo or other type of buzzer that plays a fixed tone (e.g., the YL-44), select 30.

AUX Pin Selection (AUX 1 through 6, inclusive)

EPM_GRAB

1100=AUX1, 1200=AUX2, 1300=AUX3, 1400=AUX4,
1500=AUX5, 1600=AUX6
Any other values disable audio
Default=1900 (audio disabled)

Select the desired output pin, as indicated above.

Logic level for device OFF

(Does logic low or high silence the device?)

EPM_RELEASE

1500=silent at logic low
1600=silent at logic high
Any other values disable audio
Default=1100 (audio disabled)

This setting controls whether logic level LOW or HIGH is used for the off (silent) condition of your particular audio device, whether passive or active. For example, a passive piezo wired as per the sample schematic above would be logic level LOW for off, and the EPM_RELEASE setting in this case would be 1500. On the other hand, the common YL-44 active piezo buzzer is logic level HIGH for off, and the appropriate setting for EMP_RELEASE would be 1600.

If you have this setting incorrect (reversed) for an active device like a buzzer, it will usually keep playing continuously except when signal sequences are supposed to be playing. Note that a "silent at logic HIGH" active device like the YL-44 will normally buzz continuously during the

firmware initialization sequence even if this setting is correct, but should stop when initialization completes.

While a passive piezo device won't usually sound noticeably different if you have this setting incorrect (reversed), setting it correctly is important to avoid unnecessary current drain and stress on the device.

Select full melody/pattern signals, or only a subset

EPM_NEUTRAL

1500=full signals
1600=subset of signals
Any other values disable audio
Default=1500 (full signals)

If this setting is changed to 1600 from its default of 1500, only a subset of the audio signals will be played. In particular, these are **System initialization, Armed, Disarmed, Lost flyer,** and certain **GPS Status** signals.

The GPS-related audio signals themselves are handled differently in this mode to avoid playing less important signals. If the GPS goes from no lock to 2d lock (which is not a useful lock status for flying), there will be no audio signal played. If the GPS goes from no lock -- or from 2d lock -- into 3d lock status, the **GPS 3d lock** signal will play. Similarly if the GPS goes from no lock -- or 2d lock -- directly into dgps lock, the **GPS dgps lock** signal will play. Once the GPS is in 3d lock or dgps lock, it will not play when shifting between those two lock modes, but if the GPS status changes to 2d lock or no lock, the **Loss of GPS lock** signal will play.

Please let me know if you have any questions or comments. Obviously there are no warranties or guarantees regarding this firmware, and you use it at your own risk. But it's working quite well for me! Have fun, and safe flying!