GRT Avionics

Use of the Hudly Heads-Up Display

Installation and Configuration Instructions

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Use of the Hudly Heads-Up Display

These instructions describe the use of the Hudly automotive after-market heads up display with the GRT Avionics EFIS. This installation is compatible only with GRT Avionics EFIS systems.

What is needed

Three main parts will be required.

- Hudly Automotive Heads-Up display
- A GRT EFIS enabled for heads-up display with a USB blue tooth dongle
- An android device to generate the video for the heads up display.

Ordering recommendations.

1. The Hudly is ordered from www.gethudly.com. When ordering, select the "Android" interface option.
2. If your EFIS does not include Bluetooth connectivity already, you will need a Bluetooth dongle (available from GRT Avionics or other sources). HX, HXr, and Sport SX EFIS systems include this connectivity as a standard feature, and is available as an option for the Sport EX, Horizon EX, and Mini-X and Mini-AP. Sport, Mini, and Horizon EX models require a USB hub for compatibility with the Bluetooth dongle. See the "GRT Remote App for Android" instructions for further details regarding the Bluetooth connection.
3. You will need an android device. See below for our suggestions.

Selecting an Android Device

An Android device, such as a cell phone, tablet or compute stick, running the GRT Remote App is required to generate the graphics that are shown on the HUD. The android device that runs the app must provide a means for generating a HDMI video output. With phones and tablets this is commonly done with "MHL", (you can check to see if your device is MHL compatible here: http://www.mhltech.org/devices.aspx) although newer phones and tablets may have other means of generating HMDI video.

Our preferred device is neither a tablet or a cell phone, but a "compute stick" or "mini pc". These are small android based computers with no display that generate HDMI video output. They can be powered by aircraft power (via a 12V USB adapter), are small, turn on and off with aircraft power. Many versions android compute sticks are available in the $35-50 price range. We tested the Timingpower.com Android Mini PC RK3288 ($40) and it worked great.

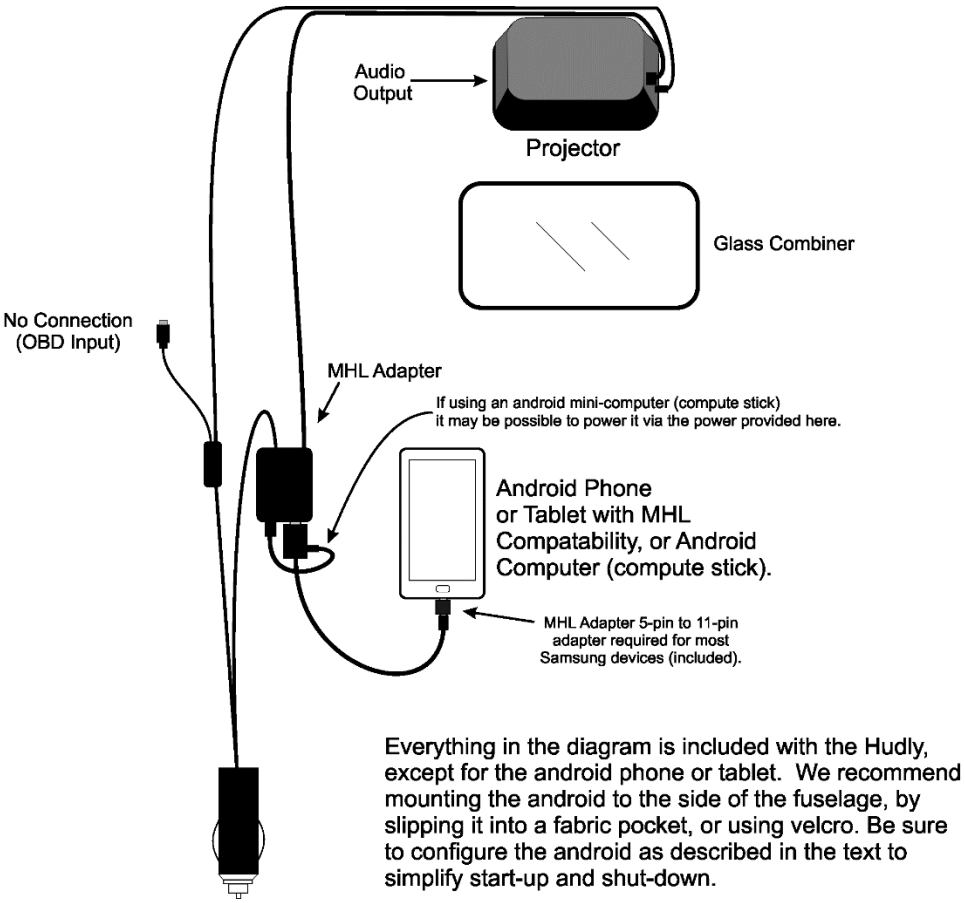
To use the Android Mini PC a short HDMI cable is required to connect it to the Hudly, and a 2 amp USB power adapter is required. Since the Hudly plugs into a 12V cigarette lighter power socket, as will the USB power adapter, a "Y" power adapter may also be required for your airplane.

In addition, loading software into the Android Mini PC, and making user setttings will require a monitor or TV that accepts HDMI input, and a Bluetooth mouse.

Changing user settings in the mini PC can be done using the Hudly as the display, but is difficult due to the current size/format of the set menu. We recommend making user settings at home with a monitor or TV.

Electrical Connections

All electrical connections are made with the cable assembly supplied by Hudly. For our application, the following diagram illustrates the connections. Note that the android device will receive its EFIS data via the Bluetooth connection to a GRT EFIS.



Electrical Connections to the Hudly

Audio

The android device can also serve as a music player, as audio will pass from the Android, into the Hudly. An audio connection will be required in this case from the Hudly projector, to the airplane's intercom system. Music will be

selected and played on the android using the appropriate music player app on the android. While selecting the music, HUD video will not be displayed.

Mounting the Projector and Combiner Glass

The Hudly is installed using double-sided foam tape. We found this method works great for the projector. The combiner glass will probably shake at some RPMs, as we found in our company RV-6A. We found a simple “U” shaped bracket, secured to the glareshield with double-sided foam tape completely eliminated all vibration, resulting in a very clear image at all RPMs. Double sided foam tape, without the protective backing removed on one side, was applied to the bracket so that it could grip the glass combiner.

The combiner glass should be about 7.3” from the projector. Hudly supplies a template to help achieve this. We found that it is not critical that it be exactly at this distance, and found that positioning the glass slightly further away made the image slightly larger, and still allowed plenty of head movement.

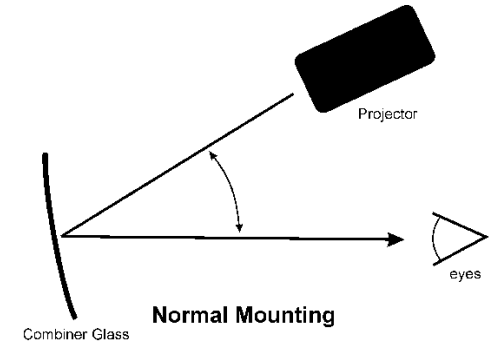
For our RV-6A, we mounted the projector first, directly in front of the pilot, and positioned the combiner glass about a quarter inch further away than suggested by their template. It took a few tries to get the combiner glass positioned exactly where we liked it, but the foam tape residue comes off without too much difficulty. Evaluate the image with the android providing video to the hudly so you can see the full screen.

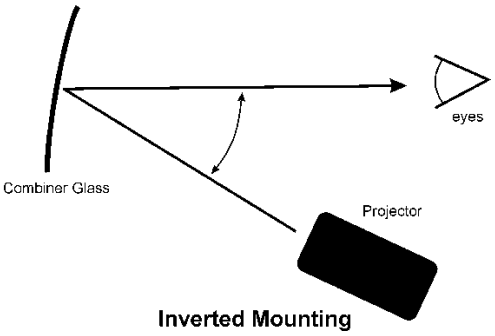
Position the combiner glass directly in front of you. This is where you will want it when you are flying.

Above: The simple bracket we used to eliminate vibration of the combiner glass. From the pilots perspective, the bracket was barely noticeable, although we are sure it could be made smaller without compromising its performance. Note the backing on the foam tape between the combiner glass and bracket. This may not be necessary.

Projector Location Options

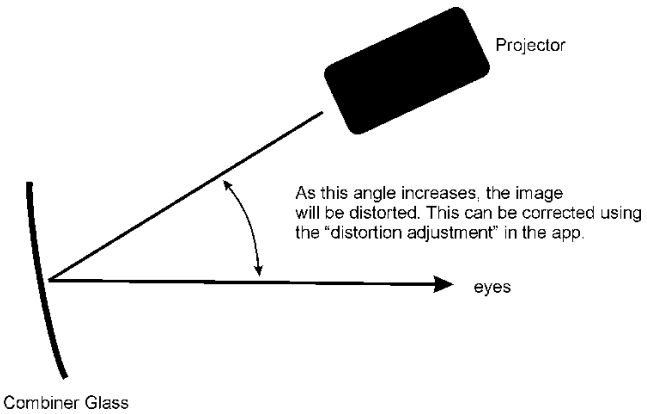
The app allows the hudly projector to be mounted in its normal position (above the combiner glass), as shown here. An upcoming version of the GRT Remote app will allow for an inverted image, allowing the projector to be mounted below the combiner glass.





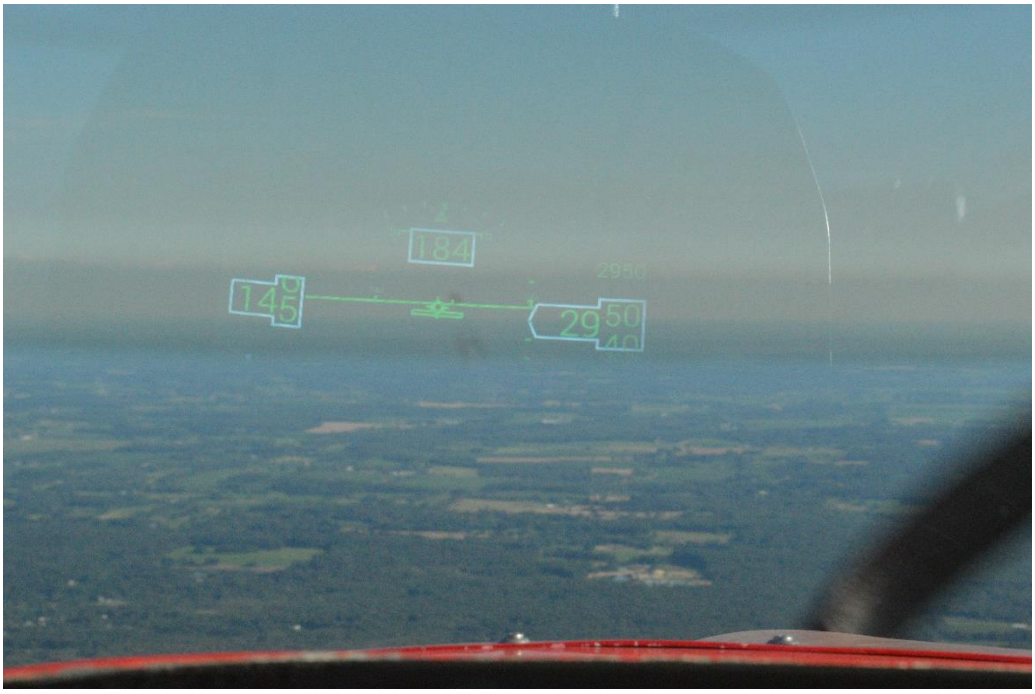
Correction Optical Distortions

The image displayed on the combiner glass becomes distorted (straight lines appear curved) as the angle illustrated below increases. This can be compensated using the “Correction for HUD screen distortion” in the app’s set up menu. Trial and error is required with this setting. We found a setting of 15 was optimal in our installation.



The image can also appear to be tilted to one side. This is corrected by adjusting the position of the projector in its “roll” axis. The projector mount allows it to be moved in roll.

This image shows that the HUD needs a slight adjustment in “roll”, and a slight distortion correction to correct the curvature of the horizontal lines.



Configuring the App

Selecting HUD Mode

Follow the “GRT Remote App for Android” instructions for installing the app. Be sure to load the “GRT Remote App w/ HUD Support” version of the app. Once the app is installed, select the “Menu”, and scroll down near the bottom of the menu settings. Select “PFD-HUD Mode”. Select the “Hudly” option. This option will set optimize the graphics for the Hudly, and will cause the app to bypass the main menu at startup, and start in HUD mode. This allows HUD video to be generated without any user inputs, upon power up of the android, when an auto-start app is used to start the GRT Remote app.

Set the Distortion Correction

This is described above.

Other Settings

The speed/distance units used for HUD must be selected on the setup menu, and other settings as described in the GRT Remote App user manual.

Simple Start-Up and Shut-Down

We recommend loading an app and configuring it to automatically start the GRT Remote app when the android is powered up. We used, “Auto Starter”. Be sure to select only the GRT Remote app to start automatically. It may also be necessary to adjust the timeout of the screen so that it does not timeout before the GRT Remote app is launched.

When configured in this manner, starting up the EFIS is a matter of just turning on the android. The android will boot up, and start the HUD app automatically. Shutdown is equally simple, although you must acknowledge on the android screen that you wish to shut-down. The MHL adapter will keep the android charged. The Hudly will turn on when power is applied, and will begin using the android output automatically.

If you use an Android compute stick, the “Auto Starter” app is required.

An upcoming version of the app will allow it to start itself automatically at power-up.

Flying with the HUD

Refer to the “GRT Vision Addendum to the GRT Remote App User Manual” for a description of the symbology provided by the HUD.

New HUD Only GRT Remote Functions

Runway Overrun/Low Approach Protection Function (ROLAP)

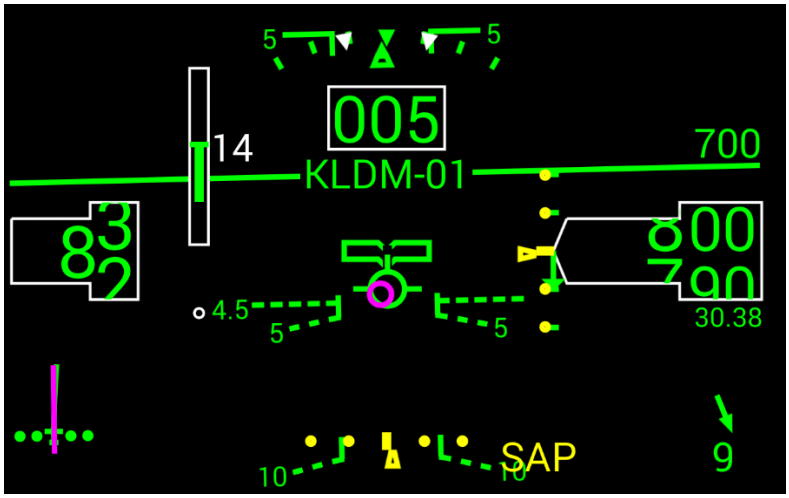
This function is designed to address accidents involving over-running the available runway, as well as shallow approaches that could result in collision with obstacles. The function requires no pilot input, activates automatically at 250 feet above the runway, and continues to monitor the approach and landing until the airplane exits the runway. The function turns off if the vertical speed indicates a climb, such as would occur on a go-around. Alerting is provided via large colored text near the center of the HUD screen for low approach, overrun, or when using the runway margins that have been set.

The ROLAP function predicts the runway required based on the current airplane speed and baro-altitude, and accounts for the effect of density altitude. This estimate is continuously updated, allowing the pilot to be alerted if the flare is extended with the use of power.

CAUTION: The ROLAP function assumes the landing roll distances entered set in the app, and does not account for the possible loss of braking action due to wet or icy runway surfaces.

CAUTION: The ROLAP function uses baro-altitude for its prediction, and thus is dependent on the pilot to correctly set the barometric pressure before landing.

Note: The ROLAP function is available for all runways included in the US government navigation database for US airports.



Show above, landing on runway 01 at KLDM. The ROLAP function is predicting 1400 feet of runway will remain beyond the landing distance plus margin set in the app. The green rectangle within the white rectangle illustrates the current prediction of the runway that will be used from touchdown to full stop. Winds are currently 9 knots, nearly on the nose. Synthetic approach is active.

Required App Settings

Stall Speed (in selected units) – The ROLAP function will assume the airplane is on the ground when the airplane is at or below this speed. Enter the stall speed in the landing configuration, in the units set for the app. The default setting is 57.

Landing Configuration Glide Angle – The flight path angle below level flight when the airplane is gliding with idle power, flaps and gear configured for landing. This angle can be computed from as Arcsin(descent rate in feet per minute/(5280/60 * approach speed in mph), or Arcsin (descent rate in feet per minute/(6076/60 * approach speed in knots). The entry must be made in degrees. The default setting of 7.5 degrees is a good setting for most airplanes. Typical settings will be in the 5-8 degree range.

Landing Rollout Distance – The distance in feet required to stop the airplane from the stall speed entered above.

Landing Margin Distance – This distance in feet will be added to the prediction of runway required. If the predicted runway remaining is less than this distance, a "RUNWAY LENGTH" alert will be generated.

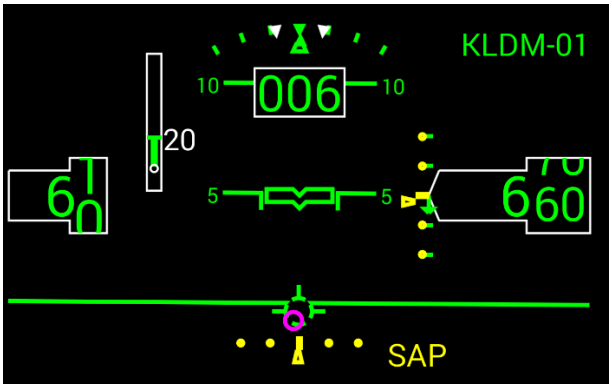
Disable Runway Remaining Display – When checked, this inhibits the runway required display unless runway margins, overshoot, or low approach are predicted. The intent of this setting is to allow minimum clutter on the HUD display during approach and landing. This entry defaults to unchecked.

Automatic Runway Detection

The navigation database, combined with various software logic, is used to determine when the airplane is descending toward a runway. No user input is required. When the runway is detected, the HUD will display the runway show it in large font in the middle of the screen, and then move it to smaller font on the upper right portion of the screen.

Runway Required Display

At 250 feet above the runway, the runway symbol will appear. A solid rectangle will appear within the runway symbol indicating the predicted runway required. A green rectangle indicates the predicted runway usage is within the bounds of the actual runway with margins as entered in the ROLAP settings. This rectangle will be yellow if the landing margins will be violated, and red if the ROLAP function predicts insufficient runway is available to stop the airplane on the available runway.

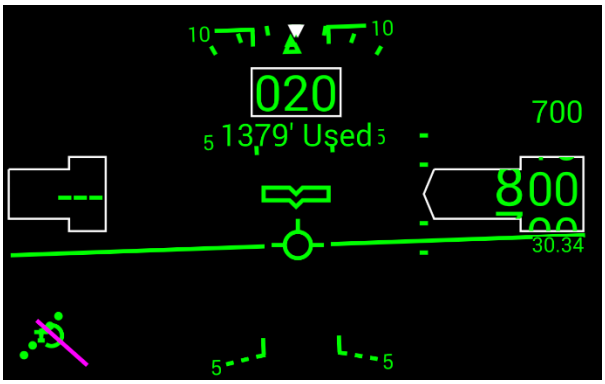


Overrun/Low Approach Warnings

If the runway ROLAP function predicts the airplane will not be able to stop in the available runway, the word "OVERRUN" will appear on the HUD. Similarly, if the airplane descends below a 2 degree slope to the near end of the runway, the message "Low Aprch". These alarms will also change the color of the predicted runway use rectangle to red. (Caution: This 2 degree limit is arbitrary, and does not imply obstacle clearance is assured when above this limit.) In either case, the pilot should take immediate action if either of these warnings appear.

Runway Used Measurement

Upon reaching less than 3 mph, or turning off the runway, the app will compute the amount of runway used. This will be displayed in the center of the screen initially, and then move to the upper right corner. The distance shown will be that required to slow from the stall speed set in the app, to the point you reached 3 mph or less, or when you turned off the runway. This display is intended to make you aware of your personal landing distance requirements.



Automatic Screen Declutter during Landing

When the runway has been detected, certain items on the HUD will be removed when the airplane passes over the approach end of the runway. They will be restored if the airplane excutes a go-around, stops, or turns off the runway. The items that are removed include the HSI/Map display in the lower left corner, barosetting, selected altitude and winds.

Other HUD Symbology Changes

- Numerous changes have been made to optimize the graphics for use with the Hudly, including re-sizing and colors.
- The pitch ladder has changed. Pitch ladder rungs below the horizon are now angled to point to the horizon to enhance awareness of pitch above/below the horizon.

Known Bugs

- The lateral/vertical deviation indicators function only with the synthetic approach at this time. This will be corrected to show ILS, GPS and VOR deviations in the next release.
- The graphics for the pitch limit indicator need improvement, but correctly show approaching stall.