# SafeTurn Plus™ Portable Mini-Glass Advisory Instrument

## Technical Specifications / Operation

*Last updated 4/28/2026 (rev. C)*

The RADIANT SafeTurn Plus is designed to show simultaneous turn (yaw) and bank (roll) information, plus barometric altitude, Kollsman, vertical speed (VSI), and AGL (advisory). Yaw information is derived from a solid state gyroscope. Roll information is derived from a solid state accelerometer. Altitude is derived from an internal barometric pressure sensor; VSI and AGL are computed from altitude and user configuration. The right-side vertical tape is repurposed as an advisory AGL tape in this build. All information is presented digitally and graphically on a single vivid LCD screen, inside a portable case.

## 1. Introduction

SafeTurn Plus is a portable, battery-powered turn coordinator / inclinometer that expands SafeTurn's proven gyro/accel engine with an integrated Altimeter + VSI + AGL "mini-glass" feature set. It uses the same foundational processing used in our panel instruments—gyro/accel processing, selectable Gyro Filter, calibration flow, and digital filtering/stabilization—adapted to a handheld, self-powered format. SafeTurn Plus is not TSO'd or NORSEE-approved and must be treated as an advisory aid only; do not use as a primary flight instrument.

## 2. What's in the Box

- SafeTurn Plus instrument
- USB charging cable (type may vary by production batch)

Optional accessory: Panel Mount Holster (sold separately) for 3-1/8″ instrument holes or flat-surface mounting.

## 3. Controls & Indicators

### Front display (primary items)

- Turn indicator (left/right) with smooth, readable motion
- Slip/Skid "Ball" (lateral acceleration)
- Digital yaw rate (°/s); graphical turn indication is optimized around the normal-rate range, while the digital readout extends beyond the graphic range up to the display limit (see §10)
- Digital altitude window
- Digital Kollsman window (IN/HPA), user adjustable
- Digital VSI (numeric) and VSI tape (trend)
- Digital AGL window plus advisory AGL tape (the right-side vertical tape is repurposed as an AGL tape in this build; user configurable, see §6.4)
- FIL indicator: bottom-row label "FIL" followed by a single digit (0–3) showing the active gyro filter setting; cycle with Both (long press)

- Battery Gauge (top-left): four stacked segments (Green/Green/Yellow/Red) with a small “button” cap at the top

### Buttons (same two-button philosophy as SafeTurn)

- **Left (short press):** BARO − (decrement Kollsman by one step)
- **Right (short press):** BARO + (increment Kollsman by one step)
- **Left (long press):** DIM step — advances brightness through 8 levels (0→1→2…→7→0). Holding Left continues to roll the brightness at ~1 Hz.
- **Right (long press, hold ~4 s):** CAL — stores yaw/accel offsets and reboots the unit.
- **Both (short press, simultaneous):** STD — snaps Kollsman to the standard pressure setting (29.92 inHg or 1013.5 hPa, depending on unit selection).
- **Both (long press, simultaneous):** Gyro Filter cycle 0→1→2→3→0 (retained across power cycles).

### Automatic functions

- Digital filtering and stabilization: firmware applies low-pass filtering and other digital stabilization to keep yaw, ball, and barometric readings smooth in normal cockpit conditions
- Settings retention: Kollsman value, Kollsman units (IN/HPA), Gyro Filter setting, yaw/accel calibration offsets, and AGL configuration are retained across power cycles. Brightness (DIM) is not retained — the unit powers up at the default brightness level each time.

### Side of unit

- USB port (for charging only)
- USB charging LED (inside unit, visible when under charge)
- Power switch (slide up to turn on)

## 4. Power & Battery

- Internal single-cell Li-ion (nominal 3.7 V)
- Typical runtime: ~5 hours (full brightness), 10+ hours (reduced brightness), up to ~20 hours (minimum brightness). Actual runtime varies with temperature and usage.
- Charging: connect to USB power. A full charge is recommended prior to first use.

### 4.1 Battery Gauge Behavior

Four vertical segments (top to bottom): Green / Green / Yellow / Red

- Top Green: near-full state of charge (nominal ≥ ~3.85 V)
- Second Green: healthy mid-range (nominal ~3.70–3.84 V)
- Yellow: reduced capacity (nominal ~3.50–3.69 V)
- Red: low / critical battery (nominal < ~3.45 V); the red bottom segment forms the base of the battery gauge, while charge state is shown by how many of the upper segments remain lit

***Notes:*** *Thresholds are nominal and may vary slightly with load and temperature. The gauge self-heals if any part of the screen is repainted by other functions.*

## 5. Mounting Options

- Portable use: place on a stable, visible surface in your cockpit. The display is sunlight-readable; reduce brightness for night/low light.
- Panel Mount Holster (optional accessory): a rigid enclosure that screws into a standard 3-1/8″ instrument hole (no electrical connection). It provides a convenient parking spot in your aircraft. The holster can also be mounted to flat surfaces using corner holes or adhesive tape.

**CAUTION:** Ensure the instrument and any mount do not interfere with flight controls or required instrumentation.

## 6. Setup and Configuration (SafeTurn Plus)

SafeTurn Plus ships ready to use, but several items are user-configurable. All setup is done with the same two buttons. The setup wizard is reached only at power-on by holding a button while turning the unit on; there is no in-flight setup menu.

### Button behavior (setup wizard)

- **Left (short press):** decrement value by 1
- **Right (short press):** increment value by 1
- **Left (long press):** decrement value by 10
- **Right (long press):** increment value by 10
- **Both (long press, simultaneous):** commit the current value and advance to the next field

***Note:*** *There is no automatic timeout. Each field requires an explicit Both-long press to commit. The wizard ends after the last field is committed and validation passes; values are then written to flash and the unit drops into normal operation. CAL stores gyro/accel offsets only; it does not adjust BARO/units/AGL setup. Set BARO units and AGL values via the wizard first.*

### 6.1 Entering Setup

Setup is reached only at power-on. Choose one of the following:

- Hold Left while powering on: release once the Kollsman units chooser appears to enter the interactive setup wizard. The wizard begins with the Kollsman units chooser (§6.2) and then advances into AGL setup (§6.4.2).
- **Hold Right while powering on:** force-loads the AGL / VFR-pattern defaults (Val0 = 400, Val1 = 800, Val2 = 900, Val3 = 1200 ft; MPH; AGL mode), writes them to flash immediately, and proceeds straight into normal operation. No prompts and no chance to edit values; release the button at any time after boot.
- **No button held:** normal startup using last-saved settings.

### 6.2 Selecting Kollsman Units (IN / HPA)

When you hold Left at power-on and release, the unit displays a Kollsman units prompt with two big-digit boxes: 2992 (inHg) on the left and 1013 (hPa) on the right.

1. Hold Left while turning the unit on. Release once the Kollsman units prompt appears.
2. Press **Left** to select **IN** (inHg-based baro convention, U.S. style; default value 29.92).

3. Press Right to select HPA (hPa-based baro convention, international style; default value 1013.5).

The unselected box is cleared, the choice is written to flash, and the wizard advances automatically into AGL setup after a brief confirmation hold.

***Note:*** *This step sets only the Kollsman convention (IN vs HPA) and loads its standard default value. The actual Kollsman value is adjusted later during normal operation with Left/Right short presses (BARO − / BARO +).*

## 6.3 Setting BARO / Kollsman (Normal Operation)

BARO (Kollsman) aligns the displayed altitude to local pressure setting. It is adjusted during normal flight operation, not in the setup wizard.

1. Press Left (short) to decrement Kollsman by one step.
2. Press Right (short) to increment Kollsman by one step.
3. Press Both (short, simultaneous) to snap Kollsman to the standard pressure setting (29.92 inHg or 1013.5 hPa, depending on the units selected during setup).

**Step size:** one step is **0.01 inHg** in IN mode and **0.5 hPa** in HPA mode.

The Kollsman value is automatically saved to flash after each adjustment.

## 6.4 AGL Setup (Advisory)

AGL on SafeTurn Plus is baro-derived (advisory). It is intended for quick pattern/training awareness and must not be treated as terrain-aware or certified AGL.

### 6.4.1 AGL Reference (“Zero”)

The AGL reference is set automatically. On the first valid altitude reading after each power-on, SafeTurn Plus latches the current pressure altitude as “zero AGL.” From that point, AGL is reported as feet above that latched reference.

- To re-zero AGL on a different field, simply power-cycle the unit on the ground at that field.
- There is no user-adjustable AGL reference field; the zero is captured automatically at startup.

***Practical tip:*** *Power the unit on while at field elevation, in stable conditions, before each flight to ensure an accurate AGL zero.*

### 6.4.2 Setting AGL Tape Range and Bands (Wizard)

After Kollsman units are selected (§6.2), the wizard collects four values that define the AGL tape. These are entered as free-form integers (not preset choices). Each field is edited with Left/Right (±1) and Left-long/Right-long (±10), and committed by pressing Both (long).

**Per-field input limits:** every AGL field accepts integer values from **0 to 9999** (the editor clamps any input to this range). 9999 is therefore the absolute maximum entry for any AGL configuration field.

*The four fields, in order:*

- **Field 3 — Val0:** lower AGL cue (e.g., “takeoff complete” / lower band start). Range 0–9999.
- **Field 4 — Val1:** pattern altitude / mid band. Must be greater than Val0. Range 0–9999.

- **Field 5 — Val2:** top of the white sideband. Must be greater than Val1. Range 0–9999.
- **Field 6 — Val3:** AGL “redline” / top of tape. Must be greater than Val2 and less than 10000.

If the four values do not satisfy Val1 > Val0, Val2 > Val1, Val3 > Val2, and Val3 < 10000, the wizard discards the entry and the previously stored values are kept. Val0 may be 0.

**Example (typical VFR pattern, MPH/feet):** Val0 = 400, Val1 = 800, Val2 = 900, Val3 = 1200. This is also the default loaded by the Right-at-boot shortcut described in §6.1.

### 6.4.3 How AGL Values Map to the Tape Arcs

The four AGL values define the colored arcs painted on the right-side AGL tape. Using the VFR-pattern defaults (Val0 = 400, Val1 = 800, Val2 = 900, Val3 = 1200) as an example:

- **Green arc:** from Val0 to Val1 (e.g., 400–800 ft) — normal pattern band.
- **Yellow arc:** from Val1 to Val3 (e.g., 800–1200 ft) — cautionary range up to redline.
- **White sideband:** visible on the right edge from Val0 up to Val2 (e.g., 400–900 ft) — a flap-OK / normal-flight cue band.
- **Red “redline” mark:** drawn at Val3 (e.g., 1200 ft) — top-of-tape limit.

***Tip:*** *Choose Val0…Val3 to match your mission. For pattern work, set Val1 to your published pattern altitude and Val3 to your highest expected pattern-related altitude. The arcs scale automatically.*

### 6.5 Adjustable Items During Normal Operation

Outside the setup wizard, the following items can be adjusted at any time. Most are written to flash and retained across power cycles; brightness is the exception.

- **BARO / Kollsman:** Left short = −1 step, Right short = +1 step, Both short = STD. Step size is 0.01 inHg in IN mode and 0.5 hPa in HPA mode. Retained across power cycles.
- **Brightness (DIM):** Left long press steps brightness through 8 levels (0→1…→7→0). Holding Left continues rolling at ~1 Hz. **Not retained** across power cycles — the unit powers up at the default brightness level each time.
- **Gyro Filter:** Both long press cycles 0→1→2→3→0. Retained across power cycles. The current value is shown beside the on-screen “FIL” label on the bottom row.
- **Calibration (CAL):** Right long press, held approximately 4 seconds, stores yaw and tilt reference offsets and reboots the unit. CAL does **not** modify Kollsman value, units (IN/HPA), or AGL configuration.

## 7. Calibration (CAL)

Perform calibration on a level reference (bench) or in straight-and-level, unaccelerated flight.

1. Establish stable, level conditions.
2. Press and hold **Right** for approximately 4 seconds. CAL fires automatically when the hold timer is reached.
3. The unit will store the yaw and tilt reference offsets and reboot; normal operation resumes automatically.

**Scope:** CAL stores **only** the current yaw and tilt reference values. It does **not** modify Kollsman value, Kollsman units (IN/HPA), AGL configuration, or any other setup item. If altitude or AGL is reading incorrectly, check those settings instead — CAL will not correct them.

### When to calibrate

- After first use or significant maintenance
- If the ball does not center while wings-level
- If a turn is indicated while straight

If calibration is attempted during turns/acceleration, results may be inaccurate. Repeat under proper conditions.

## 8. Care & Safety

- Do not expose to liquids, fuels, or solvents.
- Avoid extreme temperatures; very low temperatures reduce battery runtime.
- Charge only with appropriate USB power sources.
- This product contains a Li-ion battery. Do not puncture, crush, or short the battery. If the case is damaged, discontinue use.

## 9. Troubleshooting

- Ball not centered / turn indicated while straight: perform CAL under proper conditions (level/unaccelerated).
- Display too bright at night: reduce brightness with Left long press.
- Short runtime: cold temperatures and high brightness reduce runtime; recharge fully and reduce brightness.
- Altitude seems “off”: verify Kollsman setting matches local baro; confirm unit system (IN/HPA) is correct (set during the boot wizard, §6.2).
- AGL seems “off”: power-cycle on the ground at field elevation to re-latch the AGL zero. Confirm AGL band values (§6.4.2) are correct for your mission. Remember AGL is advisory and baro-derived (not terrain-based).
- Wrong Kollsman convention (IN vs HPA): the units selection is made only at boot. Power the unit off, then hold Left while powering it on and select the desired convention.

If problems persist, contact support@radiantinstruments.com with your order information and a description of the behavior.

## 10. Specifications (typical)

- Power: 1-cell Li-ion (nominal 3.7 V)
- Runtime (typical): ~5 h full brightness; 10+ h reduced; up to ~20 h minimum brightness
- Indicators: 4-segment battery gauge (two greens, yellow, red); the red bottom segment forms the base of the gauge, while charge state is shown by how many of the upper segments remain lit
- Controls: Left short = BARO −; Right short = BARO +; Left long = DIM step (8 levels, not retained); Right long (~4 s) = CAL; Both short = STD; Both long = Gyro Filter cycle 0–3 (retained, shown beside on-screen “FIL” label)
- Setup access: power-on with Left held = interactive setup wizard (release after boot); power-on with Right held = AGL/VFR-pattern defaults loaded immediately
- Processing: firmware with digital filtering and stabilization (selectable Gyro Filter 0–3)

- Displayed turn rate ranges: Graphical airplane up to ~±5.0 °/s; Digital yaw readout extends beyond the graphic range up to ±20.0 °/s (display cap); very small yaw values are clipped to 0.0 °/s for steadiness
- Altimeter range: 0–20,000 ft (typical)
- Dimensions / weight: 2.5 x 2.5″; ~50 grams (portable enclosure)
- Operating temperature: 0 to 45 °C
- Warranty: 3 years

**Regulatory:** Advisory use only. Not TSO'd/NORSEE-approved. Do not rely on SafeTurn Plus as a primary flight instrument.

## 11. Accessory: Panel Mount Holster (Optional)

A dedicated holster that fits a 3-1/8″ panel cutout or flat-surface mount. No electrical connection; simply provides a secure place to park the instrument in your aircraft. Sold separately.

## 12. Disclaimers

Products from Radiant Technology are not designed to be used in applications where their failure would endanger safe flight or human life in any way. They are intended solely for use in VFR conditions. They are not certified to meet any Technical Standard Order and are not produced under a Parts Manufacturing Authority (TSO / PMA).

As a result, if permanently installed in the aircraft, they are suitable only for use in experimental and ultralight aircraft, and in Light Sport Aircraft, if meeting the requirements of the respective manufacturer. Specifically not for use as a primary display instrument in certified aircraft.

## 13. Warranty

Your new Radiant Technology instrument carries a three-year warranty from the invoice date. Please contact us at support@radiantinstruments.com should your product need warranty service. There is an additional charge for international warranty service.

## 14. Return / Refund Information

Must be returned in new, uninstalled, resalable condition within 14 days after receipt. Ship to Radiant Technology, PO Box 20690, Wichita KS 67208.