Advanced Avionics Workshop

Making the technology work for you

Presentation Outline

- GMA 345 Audio Panel
  - Two-channel Monitoring
  - ICS Isolation
  - Split Comm
- GTX 330ES Transponder
  - "Buttonology"
  - Basic Usage
  - Advanced Features
- Carburetor Probes
- Break
- CGR 30P Engine Analyzer
- General Autopilot Tips
- Stec 55X
  - Stec Overview
  - Heading & Nav Modes
  - Vertical Modes
    - ST-360 Operation
  - Coupled Approaches

GMA 340 Audio Panel

GMA 340 Buttonology

Comm Receiver Selector Buttons

Navigation Audio Selector Buttons

Marker Beacon Sensitivity / Mute Button

Marker Beacon Lamps

Audio Playback

Music Input

Pilot Music Volume

Pilot ICS Volume

Isolation Buttons

USB Charger

Copilot/Passenger ICS Volume

Mic Selector / Split-Com Buttons

Overhead Speaker Toggle

BT Pairing / Phone Selection

Copilot/Passenger Music Volume

Feature Set Overview

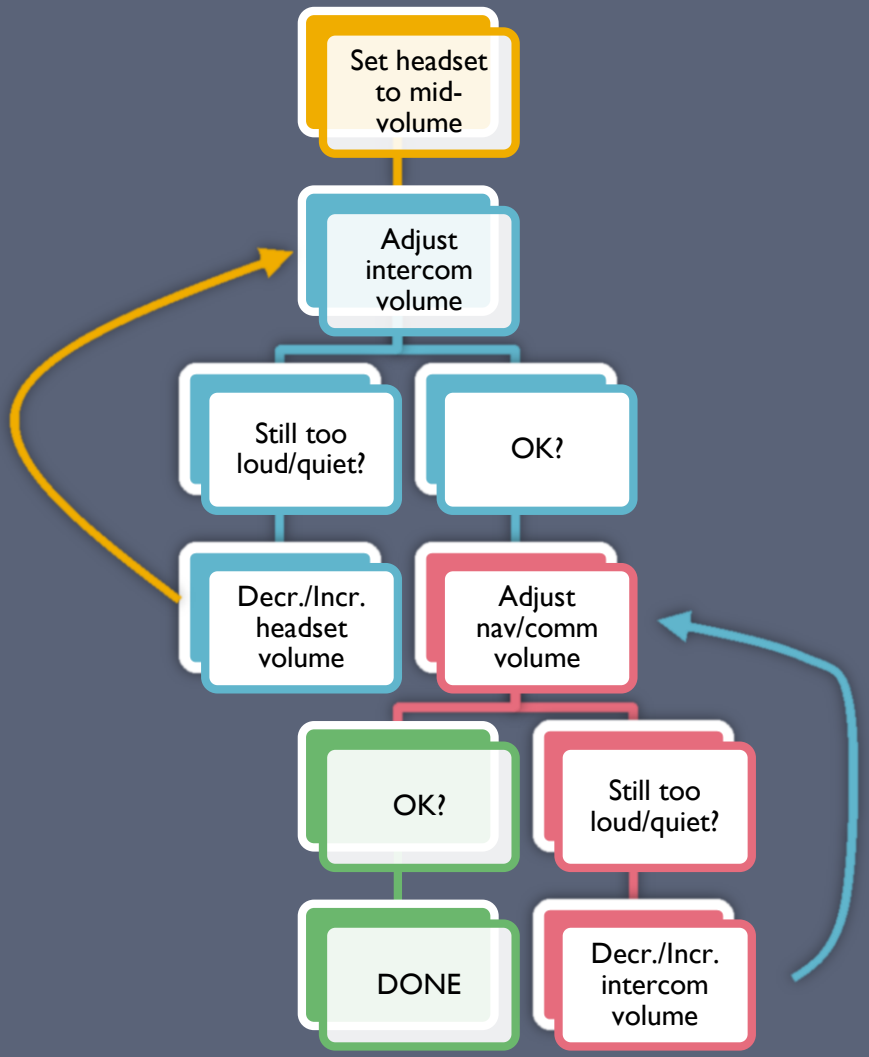
- Failsafe operation
  - Failsafe circuit connects pilot's headset and microphone directly to COM 1 in case power is interrupted
- Single or multiple COM selection
  - Can select a single COM channel for audio input/output, or monitor multiple COM channels and transmit on a single COM channel
- Split COM capability
- Pilot / Crew isolation from passengers
- Integrated marker beacon receiver
  - Marker beacon lamps are always active

Intercom Control

- VOX Squelch Control
  - Automatic squelch control

- Left knob – Pilot's ICS control
  - Small knob – Unit on/off and ICS volume
  - Large knob – Music volume
- Right knob – Copilot & Passenger ICS control
  - Small knob – Copilot & passenger ICS volume
  - Large knob – Copilot & passenger music volume

Intercom/Radio Adjustment



- Volume adjustment
  - One recommended method is shown to the left
    - Step 1: Set headset to low-to-mid volume
    - Step2: Adjust the intercom to a comfortable level
    - Step 3: Adjust nav/com volume to a comfortable level
    - Step 4: Fine-tune with the headset volume

ICS Isolation & Split COM

ICS Isolation

- PILOT mode: Pilot is isolated from everyone else, and aircraft radios are dedicated to the pilot
- CREW mode: Pilot and copilot share a common ICS channel; passengers cannot communicate with the crew or hear the aircraft radios

Split COM

- Activated by pressing both Com 1 & 2 Mic buttons
  - COM 1 is dedicated to the pilot, COM 2 is dedicated to the copilot
    - Some bleed-over between the two channels may exist
  - Both pilots can listen to NAV 1, NAV 2, and MKR as selected
- Deactivated by pressing one of the Mic buttons again

Audio Channel Selection

Additional audio source selector buttons

Primary audio selector buttons

- COM 1/2 MIC
  - Selects a COM channel for both transmit & receive
- COM 1/2
  - Selects an additional COM channel for audio monitoring (no mic)

- When multiple COM receive channels are selected, audio input for that channel remains active regardless of which channel is selected for microphone use

Additional Features

- Audio Playback
  - GMA345 records up to 60 seconds of audio
  - Press PLAY to replay the last recorded audio
    - Each subsequent press replays the previous recorded audio
  - Press MKR/MUTE to stop playback
    - Incoming COM signal also stops playback
- Music
  - Music playback available through a music jack or BT device
    - Source selected using the SEL button
  - Playback automatically muted on incoming COM
    - Passenger muting can be disabled
- Bluetooth Phone
  - TEL allows using your Bluetooth-equipped phone through the audio panel

GTX 330ES Transponder

ADS-B 1090ES transponder

GTX 330 Buttonology

IDENT Button

Mode Selection Keys

Function Button

Cursor Button

Clear/Reset Button

Code Selection Buttons

Start/Stop Button

Increase Value / 9

Decrease Value / 8

Basic Features

Mode Selection Keys

- Off
  - Powers off the unit
- Stby
  - Selects standby mode
  - This is the default power-up mode
- On
  - Selects Mode A (altitude not reported)
- Alt
  - Selects Mode A & C/S
  - Automatically selected when liftoff is sensed

Code Selection

- VFR
  - Sets the transponder to squawk 1200
- 0-7
  - Used to set the squawk code. Code is activated when the 4th digit is entered.
  - Pressing CLR moves the cursor back one digit
    - Resets to the previous code when the first digit is cleared

Advanced Features

Function Keys

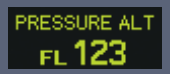
- FUNC
  - Changes the page shown on the right side of the display
    - Pressure Altitude
    - Flight Time
    - Count Up & Count Down Timers
- START/STOP
  - Starts and stops the altitude monitor, count up, count down and flight timers
- CLR
  - Resets the timers
  - Cancels the previous keypress

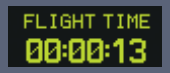
Function Operations

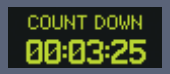
- Flight Time
  - Controlled by the START/STOP and CLR keys
  - Timer begins when liftoff is sensed
- Count Up Timer
  - Controlled by START/STOP and CLR keys
- Count Down Timer
  - CRSR – Initiates starting time entry
  - 0-9 – Used to set the starting time

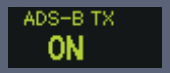
Function Modes

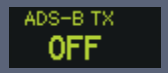
- Pressure Altitude
- Flight Time
- Altitude Monitor
- OAT/Density Altitude
- Count Up Timer
- Count Down Timer
- Contrast
- Display
- ADS-B Status





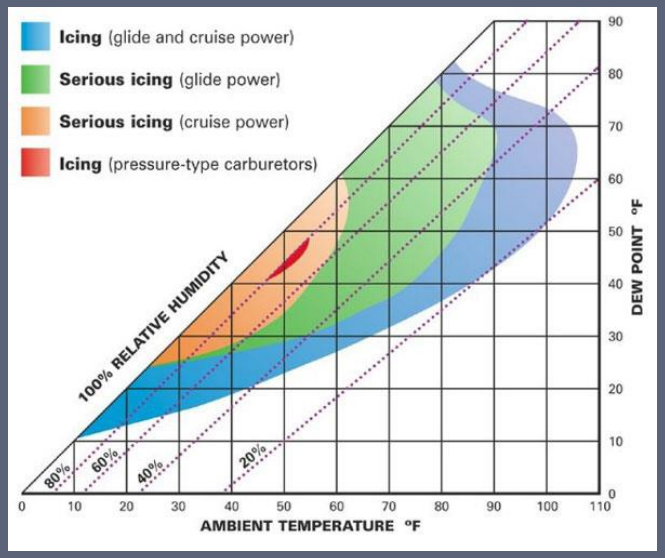






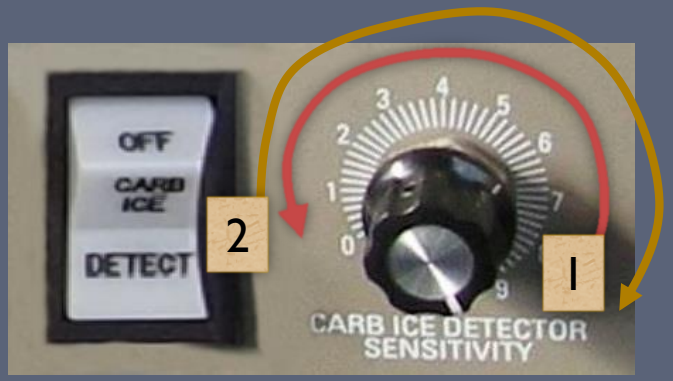
Carburetor Probes

Carb Temp Gauge



- Displays the temperature inside the carburetor venturi
- Keep the temperature either below -15C (5F) or above 5C (41F) when carb icing conditions exist
- Temperature is not accurate below ~1500 RPM

Carb Ice Detector



- Probe consists of a light emitter and a light sensor.
  - When carb ice forms, it develops on the probe tip, reducing the light received by the sensor and activating the annunciator.
    - Probe is not accurate below ~1500 RPM
- Calibrating the sensor
  1. Rotate the sensitivity knob fully counterclockwise so the carb ice light is on
  2. Rotate the sensitivity knob clockwise until the carb ice light just goes out

Break Time!

CGR-30P Engine Analyzer

CGR-30P Knobology

Primary Gauges

Selection Indicator

Selectable Screen Display

Primary gauge annunciators

Change Screen

Rotary Knob – Move cursor / change digits / select function

Exit / Cancel

CGR-30P Screens

Main & Secondary Screens

- Main (default) screen.
- Press and hold E from any page to get back to this page

- Secondary screen
- Displays less-critical data

Fuel Screens

Used to set fuel quantity before flight

Displays fuel usage

When a GPS destination is set, it also calculates fuel to/at destination

Usage Tips

- Always set the fuel quantity during preflight
- Wait for the display to finish booting up before starting the engine
- Ensure the EGT/CHT bar graph is in "Hottest" mode

- During the run-up and mag check, verify:
  - Each mag that is turned off displays the appropriate "MAG L" or "MAG R" annunciation in the RPM gauge
  - There is an EGT rise when one mag is selected, followed by a drop when both mags are re-selected
  - The carb temp gauge shows a rise when carb heat is applied, and a drop when carb heat is turned off

General Autopilot Tips

How to make the autopilot work for you

Autopilot Safety

- Know all of the ways to disconnect the autopilot
  - Yoke-mounted disconnect switch (if installed)
  - Autopilot master switch OFF
  - Pull the autopilot circuit breaker
- Disabling runaway pitch trim
  - Manually engage the electric pitch trim
  - Pull the electric pitch trim circuit breaker
  - Disconnect the entire autopilot (see above)
- Always be prepared for an out-of-trim condition when disengaging the autopilot
  - Especially if automatic pitch trim is not enabled
- *Always be ahead of the autopilot, and ready to hand-fly if necessary*
- Practice in VFR conditions, or with a safety pilot who is fully proficient in its operation

Autopilot Tips

- Basic heading (HDG) mode is your friend
  - If in doubt, control the autopilot with the heading bug
- Do not use the autopilot in moderate to severe turbulence, or while in icing conditions*
- Initiate course interception within 45° of desired course
  - Greater intercept angles will likely result in course overshoot
- Make heading adjustments in 90° or less increments to ensure a turn in the desired direction

- *Only use coupled approaches (LOC+GS capture) if you are fully proficient in the autopilot's operations*

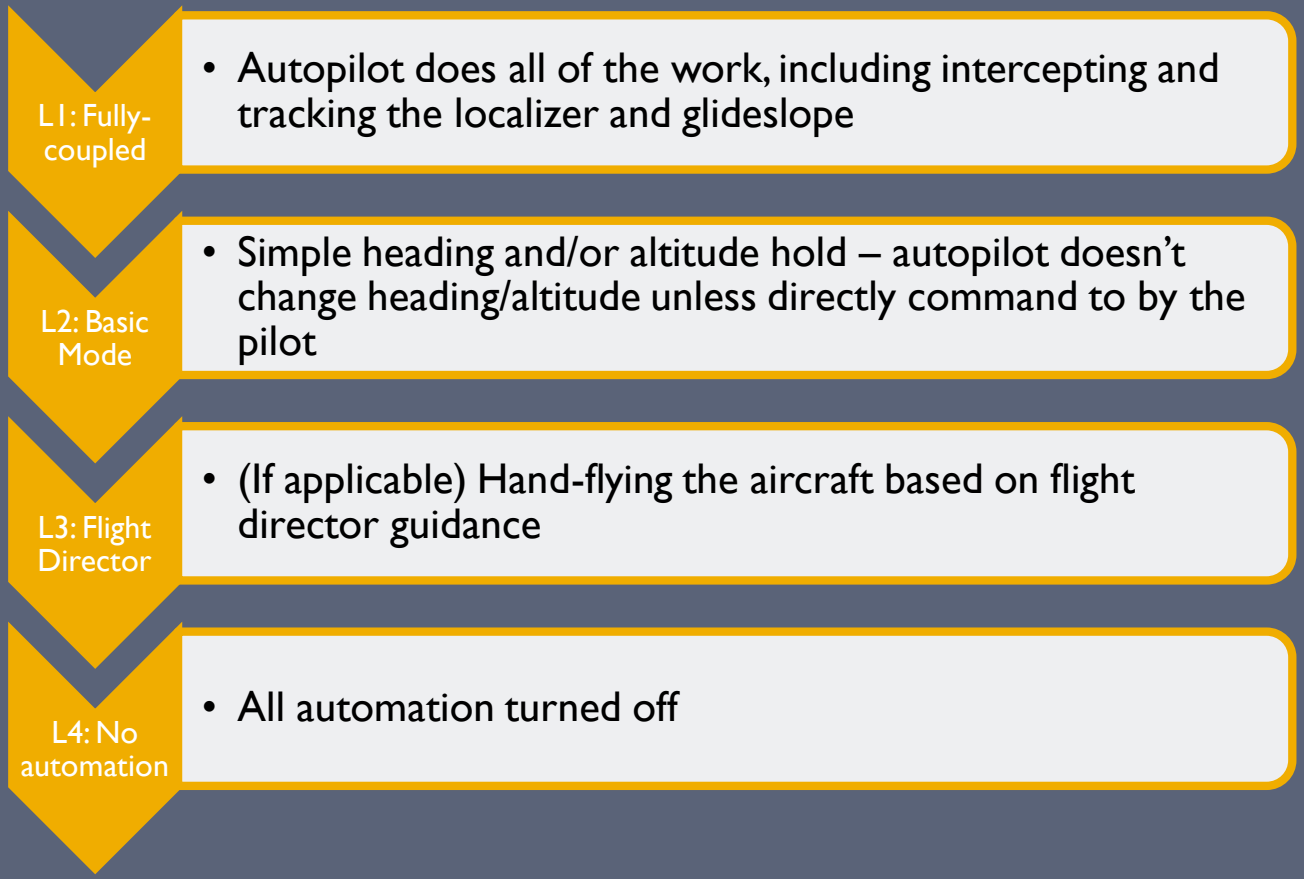
* *Never intentionally fly in icing conditions in a non-FIKI approved aircraft!*

Autopilot Tips (Cont.)

- Consider that single-pilot charter operations require an operational autopilot for IFR dispatching
  - Learn the capabilities of the autopilot installed, and practice to proficiency
- When in doubt, disconnect!
  - Don't let the autopilot do something you weren't expecting. If it does, either disconnect it, or revert back to basic heading hold.
- Whenever there is a course or altitude change coming up, *monitor the autopilot* to ensure it does what you expect
- After initially engaging the autopilot, monitor the aircraft for a few seconds to ensure the autopilot is working
- When using V/S hold, keep your hand near the autopilot as you near your level off altitude, so as not to bust the altitude

Automation Levels

- Use the concept of automation "levels"



Automation Levels

- The pilot can move up and down the different levels as the need arises
  - Example) Disengaging all automation to avoid a midair (L4), then reengaging the autopilot for level flight and manual course interception (L3/L2), and finally reengaging GPSS mode to reestablish the assigned course and altitude (L1).

Avoiding the WIDN Syndrome

- WIDN: What's it doing now?
  1. Study and understand how all of the autopilot modes that you intend to use are designed and function
  2. Be ready for the autopilot to do something different than you expect
  3. Move up and down the automation levels as necessary to resolve a WIDN situation
- In resolving un-commanded pitch changes, most pilots' (correct) initial reaction is to disconnect the autopilot and figure out why it did that later.
- However, the first reaction to an un-commanded roll is often to try and troubleshoot what it's doing, rather than the correct action which is to disconnect the autopilot and THEN troubleshoot.

Autopilot Suggestions

- Use the autopilot en-route when you are reaching *task saturation* (such as copying a new IFR clearance, reviewing the weather to make a diversion decision, etc)
  - Even basic HDG or NAV mode can be useful
- When flying a non-precision approach, use the autopilot to maintain altitude and nav tracking beyond the FAF
  - This will help ensure you don't unintentionally descend below the MDA or drift off course while counting down to the MAP and looking for the airport
- When flying a coupled precision approach beyond the FAF, if the aircraft is stable and on glideslope and localizer, minimal trim and power changes will be necessary for landing.

Stec 55X

Rate-based 2-axis autopilot

Overview

- Rate-based autopilot
  - Derives attitude information from the turn coordinator
  - GPSS mode operational even with a complete vacuum failure
- Two-axis autopilot – controls pitch and roll
- GPSS mode – all course guidance derived from the GPS, including turn initiation
- Available modes
  - Heading hold
  - Nav (VOR/GPS) tracking
    - Standard (OBS+HDG)
    - GPSS
  - Approach mode
    - Including back-courses
  - Altitude hold
  - Vertical speed hold
  - Climb/descend to selected altitude
    - With installed ST360

Buttonology – Stec 55X

HDG + NAV – Pilot Selectable Course Intercept

REV – Reverse Sensing Mode

ALT + VS – Climb/Descend to Selected Altitude (ST-360)

VS Selector / Altitude Adjustment Knob

HDG – Heading Hold

NAV – VOR/GPS Course Tracking

APR – Approach Mode

ALT – Altitude Hold

VS – Vertical Speed Hold

One of the lateral modes (HDG, NAV, APR/REV) must be engaged *before* any vertical mode (ALT, VS, GS) can be engaged

Heading & Nav Modes

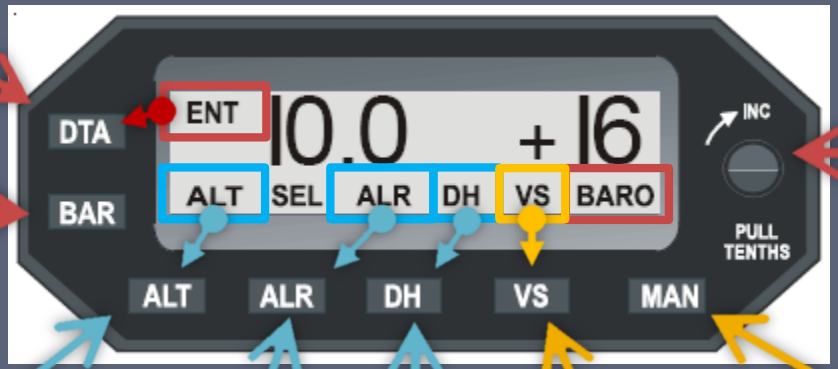
- Heading (HDG) Mode
  - Tracks the heading set with the heading bug
- En-route Navigation (NAV) Mode
  - Tracks the selected OBS course
  - The heading bug must also be set to the course heading
- NAV GPSS Mode
  - Activated by pressing NAV twice
  - Same as NAV mode, but all course guidance is derived from the GPS, including turn lead-ins and holding patterns
- Pilot-selectable Course Intercept (HDG+NAV)
  - Same as NAV mode, but the heading bug is used to set the initial intercept course
  - Need to reset the heading bug once the course is captured
- Approach (APR) Mode
  - Same as NAV mode, but with increased sensitivity
- Back-course (REV) Mode
  - Same as APR mode, but for tracking the localizer back-course inbound

Altitude Modes

- Altitude Hold (ALT)
  - Holds the current pressure altitude when the mode is engaged
  - Altitude adjustments in 20 foot increments made with VS selector knob (CW+, CCW-)
- Vertical Speed Hold (VS)
  - Hold a set vertical speed
    - If aircraft is level, the V/S should be set with the VS selector knob
    - If the aircraft is in a climb or descent, engagement will hold the current V/S
  - Adjustments in 100 fpm increments made with VS selector knob (CW+, CCW-)
- Automatic climb/descent*
- Pitch trim
  - Manual pitch trim
    - Unit will annunciate "TRIM ^" or "TRIM v" as required
    - An audible annunciation will continue for 4 seconds
      - The appropriate "TRIM" indication will remain lit until trim is met
  - Automatic pitch trim
    - Unit will auto-trim and annunciate "TRIM ^" or "TRIM v" while trimming
    - "TRIM" will flash if the trim is run for more than 7 seconds
    - Auto trim will be disabled any time a fault is detected
    - Using the electric pitch trim while ALT or VS modes are selected will disconnect the autopilot

* Details on the following slide

Buttonology – ST-360



Data Entry Button

Barometric Entry Button

Input Selector Knob

Altitude Read Out / Selector

Altitude Alerter

DH Alerter

V/S Selector

Manual Mode Button*

* Disconnects the ST-360 from the 55X

ST-360 Altitude Selector/Alerter

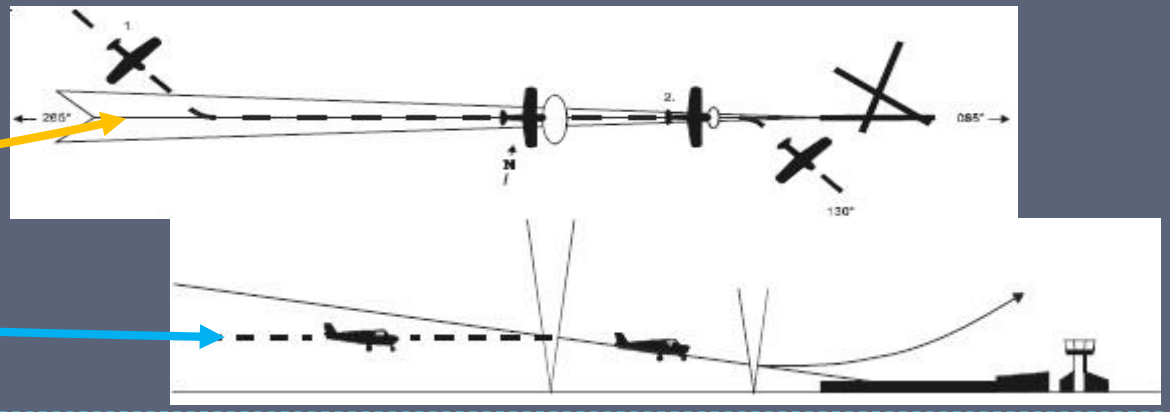
- Setting the barometric pressure
  1. Verify "ENT" is displayed and "BARO" is flashing
     - If not, press DTA followed by BAR
  2. Set the baro pressure
     - Pull the knob to set the tenths, push to set the tens
  3. Press DTA to accept the set pressure
- Setting the level-off altitude
  1. Press DTA until "ENT" and "ALT" are displayed, and "SEL" is flashing
  2. Set the desired level-off altitude
     - Pull the knob to set in 100s, push to set in 1000s
  3. Press DTA to accept the altitude
- Enabling automatic climb/descent mode
  - Press ALT+VS on the 55/55X head unit

ST-360 Altitude Selector/Alerter (Cont)

- Setting the decision height
  1. Press DTA to annunciate "ENT"
  2. Press DH – The "DH" annunciation will flash
  3. Set the decision altitude
     - Set to the nearest 100' rounded *up*
  4. Press DTA to activate
     - An audible alert will sound at 50' above and 50' below the set DH
- Setting the altitude alterter
  1. Set the altitude as described previously
  2. Press ALR to arm the alerter function
     - An audible alert will sound at 1000' and 300' from the selected altitude
     - Following altitude capture, alerts will be generated when altitude is off by 300'

Glideslope Intercept & Tracking

- Conditions to arm automatically
  - NAV flag out of view
  - GS flag out of view
  - Autopilot must be in NAV+APR+ALT mode
  - Aircraft must be within
    - 50% of CDI needle deflection of LOC centerline
    - 60% or more <u>below</u> the GDI needle deflection of GS path
      - Manual GS capture still possible while within 20% or less <u>above</u> GS path



Glideslope Intercept & Tracking

- Mode progression
  1. NAV+APR + ALT
     - Approach mode armed
  2. NAV+APR + ALT+GS
     - Glideslope mode armed
  3. NAV+APR + GS
     - Glideslope captured

- Manually arming GS capture
  1. Press ALT…
     - …*once* if in ALT mode
     - …*twice* if in VS mode

Stec 55X Tips

- When in NAV mode, autopilot course guidance is provided by *both* the heading bug & OBS selector
  - When in NAV\GPSS mode, autopilot course guidance is provided directly from the GPS
- When using HDG+NAV or HDG+APR mode, once HDG extinguishes, reset the heading bug to the desired course.
- Any *flashing mode annunciator* means that feature has been selected but there is a condition preventing it from being active.
- When disconnecting the autopilot, if you press and hold (or press again) the disconnect switch, it will stop the disconnect warning beep from continuing.

Conclusion

Final Take-Aways

- Advanced technology can be used to *maintain the same utility of the aircraft with an increased level of safety*, or *maintain the same level of safety with increased utility*.
  - It's up to you as PIC to determine which viewpoint to take.
- Beware of "risk compensation": taking greater risks when a safety device exists, thereby offsetting the safety gains.

- In order to take advantage of the advanced capabilities of the available technology, you must understand what is available and how to use it.
  - As with all skills, you must continually practice using these features to maintain proficiency in them.

More Information

- Flying 20 Club "Library"
  - GMA 345 Manual
  - GTX 330ES Manual
  - CGR-30P Manual
  - WX-500 Stormscope Manual
  - Stec 55X Manual
- AOPA Safety Advisors
  - Single-Pilot IFR
- FAA
  - AIM
    - Traffic Information Service
  - Advanced Avionics Handbook (FAA-H-8083-6)

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