Advanced Avionics Workshop

Making the technology work for you
Presentation Outline

- GMA 340 Audio Panel
  - Two-channel Monitoring
  - ICS Isolation
  - Split Comm
- GTX 330 Transponder
  - “Buttonology”
  - Basic Usage
  - Advanced Features
- FS-450 Fuel Scanner
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GMA 340 Audio Panel
GMA 340 Buttonology

- Marker Beacon Lamps
- Marker Beacon Audio Select/Mute
- Audio Selector Buttons
- Annunciator Test Button
- Navigation Audio Selector Buttons
- Pilot ICS Volume
- Pilot ICS VOX Squelch
- Marker Beacon Sensitivity Button
- Split COM Button
- ICS Isolation Buttons
- Transceiver Selection Buttons
- Overhead Speaker Toggle
- Copilot/Passenger ICS Volume
- Copilot/Passenger ICS VOX Squelch
- Marker Beacon Sensitivity LEDs
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
  - Clockwise rotation increases the amount of mic audio (VOX level) required to break squelch
  - Fully counter-clockwise is the “hot mic” position

- Left knob – Pilot’s ICS control
  - Small knob – Unit on/off and ICS volume
  - Large knob – Mic VOX squelch level

- Right knob – Copilot & Passenger ICS control
  - Small knob
    - In: Copilot ICS volume
    - Out: Passenger ICS volume
  - Large knob – Copilot & passenger mic VOX squelch level
Intercom/Radio Adjustment

- **Volume**
  - One recommended method is shown to the left

- **Squelch**
  - Should be set so there is no audio clipping when talking at a normal volume
  - Too little squelch, and the mic will stay open (“hot mic”)

One recommended method is shown to the left.
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

- Toggled by pressing “COM 1 / 2”
  - COM 1 is dedicated to the pilot
  - COM 2 is dedicated to the copilot
  - Both pilots can listen to NAV 1, NAV 2, and MKR as selected
  - Note: there can sometimes be some bleed-over between the two channels.
Audio Channel Selection

- **COM 1/2/3 MIC**
  - Selects a COM channel for transmit & receive

- **COM 1/2/3**
  - Selects an additional COM channel for audio monitoring (no mic)

- When multiple COM channels are selected, audio input remains active regardless of which channel is selected for microphone use.
GTX 330 Transponder

Mode-C/S 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 GTX 330
- **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, or resets to the previous code when the first digit is selected
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
Traffic Information Service (TIS)

- Provides estimated position, altitude, altitude trend, and ground track for up to 8 intruder aircraft within 7 NM horizontally, +3,500 and -3,000 feet vertically of the aircraft.
- Coverage area extends out to 55 NM from ASR 7/8/9 radar sites.
- System is being decommissioned in favor of TIS-B (ADS-B In).
FS-450 Fuel Scanner
Fuel Scanner Overview

- **Fuel Flow Rate**
  - Fuel flow in GPH
- **USD**
  - Total fuel used, in gallons
- **REM**
  - Fuel remaining, in gallons
- **H.M.**
  - Time to empty, in hours.minutes
- **REQ**
  - Fuel required to next GPS destination
- **RES**
  - Fuel reserve at GPS destination
- **REQ-RES**
  - Nautical miles per gallon
Quick Reference

- **No fuel added**
  1. On initial power up, see “FILL ?n”
  2. Tap STEP to exit

- **Reset fuel used**
  - Tap STEP until the “USD” indicator lights up
  - Hold AUTO for 3 seconds to reset fuel used to 0

- **Fuel tanks filled**
  1. See “FUEL GAL” followed by “FILL ?n”
  2. Tap AUTO
    - For full tanks, see “FILL 72*”
    - For tanks at tabs, tap AUTO again to see “FILL 55*”
  3. Tap STEP to exit
Quick Reference (Cont.)

- **Adding/removing fuel**
  1. Hold both STEP and AUTO until you see “ProG ModE”, followed by “FUEL ?n”
  2. Tap AUTO and see “FUEL ?y”
  3. Tap STEP and see “FILL ?n”
  4. Tap AUTO until you see “FILL Add”
  5. Tap STEP and see “0.0 GAL”
    - Hold AUTO to increase
    - Tap AUTO to decrease
  6. Tap STEP to exit
WX-500 Stormscope
Stormscope Overview

- Detects electrical discharges from thunderstorms within 200 nm of the aircraft
- Antenna detects intra-cloud, inter-cloud and cloud-to-ground discharges from thunderstorms in all phases of development
- Works in the air or on the ground

Advantages
- Can detect thunderstorms in all states of development; weather radar will only detect storms when there is precipitation
- Not subject to attenuation – can see “behind the storm”

Disadvantages
- Calculating the distance is not an exact science: is a strong signal from a weak flash nearby, or an intense flash far away?
Display Modes

**Strike Mode**
- Displays individual strikes in their calculated location
- Strikes will often show up in a radial pattern from the aircraft

**Cell Mode**
- Algorithmic depiction of the location of individual cells
- Can be used to correlate the location of storm cells
Interpreting the Data

- Use “strike” mode when storms may be developing for more immediate detection of strikes
- Look for clusters of strikes to estimate the location of storm cells to avoid
  - Atmospheric instability associated with cumulus clouds, or developing or dissipating storms might cause randomly scattered discharge points
- Use “cell” mode when there are developing storms for better estimation of actual storm cell locations
- Monitor the strike data as you go, and look for trends in the location and frequency of the strike points
- Be sure to clear the screen when heading changes are made
  - Some installations will automatically couple with the aircraft heading
DO NOT USE FOR STORM PENETRATION PURPOSES!

Strike detection is best used for strategic AVOIDANCE of storms

Unlike data link weather, stormscope data is real-time

Despite the impreciseness of the data, it is still useful for avoiding storms

- There is a strong correlation between electrical discharge and convective wind shear
Break Time!
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
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.

- 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
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”
  1. Autopilot does all of the work, including intercepting and tracking the localizer and glideslope
    - Example) Stec 55X in GPSS mode on an LPV approach
  2. Simple heading and/or altitude hold – autopilot doesn’t change heading/altitude unless the pilot directly commands it
  3. (If applicable) Hand-flying the flight director (autopilot off)
  4. All automation off

- 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.
Piper AutoControl IIIB

Attitude-based roll computer
Overview

- **Attitude-based autopilot**
  - Receives input from the AI
  - Unavailable for use if there is a vacuum failure or AI instrument failure

- **Provides the following modes**
  - Roll mode
    - Essentially a wing-leveler with commandable turns
  - Heading hold
  - En-route navigation tracking
  - Terminal (approach) navigation tracking
    - Localizer approaches
    - Back-course approaches
  - 9-15 pounds of force to override the servos
Heading hold

Roll Control

1. Select A/P ON and HDG OFF
2. The roll knob will bank the aircraft left or right, up to a 30-degree bank

HDG (Heading) Mode

1. Align the DG to the magnetic compass
2. Set the desired heading to hold with the heading bug
3. Rotate the mode selector switch to “HDG”
4. Select A/P ON and HDG ON
Nav tracking

- Two different VOR/GPS modes
  - **NAV mode**: Used for en-route navigation (damps out short-term deviations)
  - **OMNI mode**: Used for terminal-area (VOR/RNAV) approaches
- Navigation source is determined by the CDI
  - GPS or VOR

1. Rotate the mode selector switch to “NAV” or “OMNI”
2. Tune in a VOR station (or set the nav source to GPS) and set the OBS to the desired course
3. Set the heading bug to the desired course
4. Select A/P ON and HDG ON
Two different localizer modes

- Standard LOC
- Localizer back-course

No vertical coupling is available – must hand-fly the glideslope

- However, this is still much easier than having to hand-fly both lateral and vertical paths

1. Rotate the mode selector switch to “LOC NORM” or “LOC REV”
2. Tune in the localizer and set the OBS to the localizer course
3. Set the heading bug to the localizer course
4. Select A/P ON and HDG ON
Stec 55/55X

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
    - Pilot-selectable course intercept
  - Approach mode
    - Including back-courses
  - Altitude hold
  - Vertical speed hold
  - Climb/descend to selected altitude
    - With installed ST360
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
- Altitude Read Out / Selector
- Altitude Alerter
- V/S Selector
- DH Alerter
- Manual Mode Button*

* Disconnects the ST-360 from the 55/55X
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
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 alterter 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 **below** the GDI needle deflection of GS path
      - Manual GS capture still possible while within 20% or less **above** 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
More Information

- Flying 20 Club “Library”
  - GMA 340 Manual
  - GTX 330 Manual
  - FS-450 Fuel Scanner Manual
  - WX-500 Stormscope Manual
  - AutoControl IIIIB Manual
  - Stec 55/55X Manuals

- AOPA Safety Advisors
  - Single-Pilot IFR

- FAA
  - AIM
    - Traffic Information Service
  - Advanced Avionics Handbook (FAA-H-8083-6)

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