

PRIMER G1000 WITH GCF 700 AUTOPILOT CHECKLIST.

Introduction: G1000 with the GCF 700 Flight Control System offers endless programming and procedural possibilities. The following notes are meant to supplement (not replace) an assumed basic understanding of the capabilities of this system and IFR procedures.

Basics: It is highly recommended the student review a video home study course on the G1000 and GFC 700 Automatic Flight Control System at least 2 to 3 weeks prior to starting a West Coast Adventure course. There is an online course which can be purchased on the Garmin site, or DVD courses from Sporty's or King Schools will be a good place to begin. Also recommend is to download the G1000 Cessna Nav III Pilots' Guide from the Garmin web site for reference while studying the basics. NOTE: when reviewing these materials, "guidance" refers to directional or navigation information from the GPS and not autopilot control of the aircraft. This information is transferred to the human-pilot by display on the moving map, given as altitudes on the Flight Plan, or bugs on the PFD. This "guidance" can also be routed to the autopilot for aircraft control. In general, "Guidance" is provided by the GPS unit. "Tracking" is provided by either the human or autopilot.

GFC 700 Automatic Flight Control System (AFCS) overview: The AFCS consists of two general components: 1) Flight Director, 2) Autopilot. The flight director (**FD**) consists of the brains of the flight control system. This is where navigation inputs from several sources (GPS, VOR, ILS and the AHRS) are integrated with the Flight Plan. The information is processed and directional commands are provided to the Autopilot (**AP**) as well as the purple Command Bars on the Primary Flight Display (PFD). The **AP** has several modes of following the commands from the **FD**. These modes are controlled by the various buttons (**NAV, APR, VNV, BC, VS, FCL**) that will be reviewed in brief as they pertain to the procedures outlined in the check list.

The first important thing to know is both the **AP** and **FD** are ON and ready when the system is booted at initial start up. However, they will NOT assume control of the aircraft until the pilot ENGAGES them. The FD is apparent as it places the purple COMMAND bars above the yellow position bars in the PFD attitude indicator. The pilot could "follow" the command bars or let the autopilot make the yellow references follow the Command bars to guide the aircraft.

In the Garmin Pilot guide, both the Altitude Select Knob and Altitude Key are referred to with the abbreviation ALT. Pay special attention to KNOB vs KEY. The knob changes your desired target altitude. The Key captures your CURRENT altitude.

Always check autopilot status bar BEFORE and AFTER pushing autopilot buttons to ensure the AP is engaged in the mode you expect.

The following is an overview of the AP by function keys:

AP FD

HDG ALT

NAV VNV

APR BC

VS Nose UP

FLC Nose DN

AP – “engages” BOTH the AP and FD. If no other modes programmed, defaults to ROL and Pitch mode (see GARMIN PILOT GUIDE for specifics). AP is the MUSCLE (tracking) of the Automatic Flight Control System. Most of the buttons described are to PROGRAM how the autopilot will respond to the FD inputs.

FD- If AP is “engaged” the FD key is disabled as FD has already been engaged as above. This is because the AP will not do anything without commands from the FD. If AP is “dis-engaged”, FD will toggle the purple command bars on and off. FD is the BRAINS of the Automatic Flight Control System.

HDG – “engages” AP in Heading mode. The aircraft will immediately start turning to where ever the heading bug is set. Therefore “sync” the heading bug to your current heading before “engaging” heading mode. Then turn bug to your desired course. Used primarily when following ATC vectors on departure procedures or vectors to intercept final approach course. Also, if flying vectors, be careful about “Activating Approach” as the autopilot may take you BACK to an IAF instead of where you want to go.

ALT- this KEY captures and maintains your CURRENT altitude. Useful in stopping a descent especially after the FAF on a VOR approach.

NAV- causes the aircraft to follow navigation signal currently on display on the HSI (use CDI soft key to toggle input modes). If HSI is purple, then the navigation source is GPS. If the HSI is Green, the navigation signal being followed is the signal frequency programmed in the NAV 1 or 2 radio (ILS, VOR, LOC).

VNV – activates Vertical Path Tracking (VPTH) from the ENROUTE and TERMINAL phases of the flight plan. Vertical Path Tracking stops at Glide Slope/Glide Path intercept or FAF depending on the approach. Glide slope/Glide path is present on approaches with vertical guidance (ILS, LPV, LNAV+V), typically GPS or RNAV approaches with a runway number (GPS Rwy 32).

APR – increases AP sensitivity to NAV signals on the **FINAL APPROACH** course to fly tighter standards. This includes **LATERAL** navigation and **VERTICAL** navigation

signals. APR will “arm” the autopilot to capture BOTH the Glide Slope and Localizer on an ILS or the Glide Path and LNAV signals on a RNAV/GPS approach. In regards to VERTICAL navigation, **APR** takes over where **VNV** leaves off and provides autopilot vertical control on the final approach course upon GS/GP intercept. In some cases (ILS, LPV, LNAV/VNAV, LNAV+V), APR may be “armed” some time before reaching the final approach course without disrupting other autopilot functions to allow seamless vertical navigation from the en-route to the final approach segments. On VOR approaches, there is no glide slope or glide path, but **APR** is still important for tighter tolerances to fly the lateral navigation signals. On VOR approaches the autopilot flies the lateral navigation signal, the human pilot controls descent with Vertical Speed mode for the step downs from the FAF to the MAP.

BC- Back course sensitivity and sensing. This allows the autopilot to increase lateral tracking sensitivity and follow back course signals, just as the APR improves VOR tracking. NO vertical guidance. NO vertical tracking.

VS- Vertical speed controls the rate of autopilot altitude change in fpm. The pilot controls aircraft speed with power control. Use the Nose UP/DN buttons to adjust to desired rate. In general, this is a preferred mode to control DESCENT. Be sure to REDUCE power on descent to prevent over acceleration, and ADD power just before level off to prevent slowing to unsafe stall speeds.

FLC –Flight level change adjusts the pitch of the aircraft to maintain a specific airspeed. In general, this is a preferred mode for CLIMBING. The aircraft speed is adjusted with the Nose UP/DN buttons. This is useful for maintaining Vy, Vx but most often is used for a cruise climb at 105 kts to prevent CHT rising above limits (375 degrees).

ROL mode: this is the default mode of wings level and NO navigation source. There is no button for this. The autopilot will revert to this mode when toggling between CDI navigation sources if one of the sources does not have a valid navigation signal. The function of all the autopilot buttons above are “ON” and “OFF”. If the autopilot is currently in HDG mode and you select HDG mode again, it will turn HDG mode off and the autopilot will default to ROL mode. **Always check autopilot status bar BEFORE and AFTER pushing autopilot buttons to ensure the AP is engaged in the mode you expect.**

OTHER COMMANDS, BUTTONS AND KNOBS THAT MERIT ATTENTION:

Altitude Capture: There is no single button to arm/disarm this function. This is a function that is built into several of the autopilot modes including VS, FLC, VNV, GA and Pitch Hold. When Altitude capture is “armed”, either ALTS or ALTV is announced in white letters in the top of the PFD. Altitude capture will lock onto the altitude in the Flight Plan for the ACTIVE way point (indicted in purple to right of Altimeter strip) or the altitude selected with the Altitude Select Knob (indicated in BLUE on top of Altimeter strip) which ever is HIGHEST. Descent or climb WILL NOT occur unless the Altitude is changed to the target level in the blue box above the altimeter BEFORE engaging these navigation modes. **Hence the rule of TWIST the Altitude Select knob BEFORE you TOUCH an autopilot button (VS, FLC, and VNV).**

IMPORTANT: *Altitude capture is inactive when locked onto a Glide Slope or Glide Path and the Autopilot will fly the aircraft all the way down (into) to the runway. N91FR is NOT certified for flight into known terrain.*

Altitude Select Knob- located on the lower left of both the PFD and MFD. TWIST this knob BEFORE engaging VS, FLC or VNV. This sets the desired altitude in BLUE above the altimeter box on the PFD. This acts as a safety stop to prevent the aircraft from going beyond the selected altitude while the autopilot is engaged. VS, FLC, VNV of the autopilot modes “arm” altitude capture when engaged. Once the autopilot captures the desired altitude, the next altitude can be set without causing the aircraft to deviate from its currently captured altitude.

Baro Minimums: These are usually the MDA or DA that should be set when the Approach procedure is loaded. May be verified or changed by toggling the TMR/REF soft Key. This feature sets a white bug on the altimeter strip and provides a verbal announcement of “Minimums” to alert the pilot to manually stop the descent. The altitude set in baro minimums will NOT be captured by the autopilot.

GA- Go Around switch (a red button) is right next to the Throttle for a reason. Give full throttle first, and then press the GA button. Pressing the GA switch does four (4) things:

- 1) Disengages the Autopilot
- 2) Sets the FD to wings level (purple command bars)
- 3) Sets the FD to 7 degrees pitch up (purple command bars)
- 4) Activates the MAP procedure in the Flight Plan

Initially, the pilot manually stops the descent. If confused or uncertain, make the yellow bars on the attitude indicator follow the purple command bars to get you started. Once you have started climbing, you can re-engage the autopilot

CDI- Toggles the navigation source information to the HSI and to the autopilot. **As a safety function, toggling the CDI puts the autopilot in ROL/PITCH mode** which will probably disrupt what ever fancy programming had been previously set.

PUTTING IT ALL TOGETHER: The Check list

Most of the check list is intuitive for the C-182. However, certain items deserve further elaboration. These items are meant to keep you AHEAD of the aircraft.

INITIAL

Initial AltitudeSet: You must set the initial altitude you intend for ENROUTE so the autopilot knows where to level off.

HeadingSet: Heading bug set with the heading knob to the initial leg of the departure procedure or course leg if DP not required. If you don't set correctly before AP is engaged, you may fly where you really don't want too. See below.

TOGA (GA Button) Engage: GA switch is activated. This places the command bars in wings level and 7 degrees pitch up in anticipation of activating the autopilot shortly after take off. The autopilot will then maintain the climb while the pilot completes other tasks on the check list safely.

HDG (conditional) Engage. Might also read "ARM" instead of engage. If the departure procedure requires the pilot to follow a heading instead of a course, pressing the HDG will arm but not actually engage the autopilot. The autopilot will not fly the heading until AP button is depressed. Make sure the HDG bug is set correctly as above.

ENROUTE

Don't relax yet. There are several things that should be done so you are ready to talk to the final approach control at the destination airport. Here are some tips that will make you seem like you are a pro.... Or at least minimize the pauses, gasps and "uh..um ...uh" on the radio.

ATIS or AWOS copied: Get this information BEFORE you contact the approach control. You want to say three "A's" when you contact approach control:

- 1) **Altitude** (ie "7000")
- 2) **ATIS** (ie "Whiskey")
- 3) **Approach** ("Request".... ILS, VOR etc)

So it will sound something like this:

PILOT: "Approach, 91FR, 7000, Whiskey, Request".
APPROACH: "91FR, go ahead with request"

PILOT: “Request the ILS 7, missed with the published HOLD”
OR
“Request ILS 7, full stop”

APPROACH PROCEDURES:

TIP: Once on a stabilized final approach coarse, SYNC the Heading bug. This is helpful if you loose your autopilot and have to hand fly the approach. It is also very helpful to maintain heading on the initial part of a missed approach.

- 1) When cleared to IAF or IF
 - a. FLT PLAN- select or highlight IAF or IF that you have been cleared to, then use the DIRECT too button to navigate direct too that waypoint. **This is the preferred method.**

b. **PROCEDURE-** select or highlight “ACTIVATE APPROACH”.

i. You are OUTSIDE the IAF

2) When being vectored to final “VTF” and ONLY when on VTF.

a. PROCEDURE- select or highlight “Activate Vectors to Final”

NOTE: this will remove all waypoints before the FAF and all options to navigate to those points unless you delete and reload whole approach.

NOTE: once a way point on the approach is the next active way point or you see a purple line going to a way point on the approach, the approach has been “Activated”, way point sequencing will continue through the approach.

The first two steps are common to all approach procedures.

- 1) **VTF- use PROC button, Activate VTF or use FLT PLAN and Direct to IAF:**
- 2) **Altitude..... FAF:** Use the Altitude KNOB to set the altitude to FAF intercept allows VNV (VPTH) to track down to the FAF on VOR/BC approaches and also allows VNV (VPTH) to descend until GS/GP intercept on ILS, LVP, LNAV/VNAV approaches. Once GP/GS is captured, the autopilot will descend all the way to the runway.

ILS/RNAV APPROACH (GS/GP): This procedure will allow the autopilot vertically TRACK on approaches that supply vertical navigation with a Glide Slope (ILS) or Glide Path (LPV, LNAV/VNAV). For RNAV approaches, the HSI remains purple in GPS mode. For ILS approaches, the G1000 will automatically change the navigation source on the HSI to NAV1 (color will change on HSI from purple to green).

- 1) **APR:** This allows the autopilot to capture both the Localizer and Glide Slope(GS) or Glide Path(GP) with increased sensitivity.
- 2) **NRST:** This will show the distance to the airport for communication purposes on the CTAF or with the tower.

VOR/BC APPROACHES: The best advice for VOR/BC or other step down approaches is to DIVE and DRIVE. It is important to calculate a GENEROUS descent rate based on estimated ground speed that will allow the aircraft to descend to the intercept altitude BEFORE the step down fix or FAF (review approach plate and calculate before departure if possible). This allows the pilot to stay ahead of the aircraft and set up for the next descent. There is a lot happening immediately before and after the FAF. So it pays to get down to the intercept altitude ahead of time.

After 1) activating the procedure and 2) setting altitude to the FAF, the following steps must be accomplished on VOR/BC approaches:

ON LEVEL OFF TO Ground based FAF INTERCEPT (definitely before the FAF):

- 1) **CDI set to NAV1:** The HSI should turn Green. On VOR/BC approaches, the G1000 does not automatically switch navigation source on the HSI. This must be done manually by pressing the CDI soft key. *If you fail to change navigation sources with the CDI key, the autopilot will follow the GPS course which is technically not legal and frequently offset from the VOR or BC course.*
- 2) **APR (for VOR) or BC (for Back Course):** Increases AP sensitivity and signal interpretation for these approaches. NO vertical tracking.

CROSSING FAF:

- 1) **VS** – puts autopilot in Vertical Speed mode so the pilot may control the descent to the next step down fix or MDA.
- 2) **NOSE DN** – Hopefully you have done your homework and calculated a generous descent rate that will allow you to DIVE and DRIVE.
- 3) **ALT** – pressing this button on the AP will capture and hold the MDA as you approach it. Remember to ADD throttle just before so you do not get too SLOW. Now DRIVE it to the MAP.

DESCENT FROM FAF: If you have done a good job with the above steps, the aircraft should be on a stabilized descent to the MAP. Then the GUMPS-A procedure can be carried out. This is the same as most descent on final approaches with the addition of “A” for altitude. **This is where the Altitude knob is used to select the highest altitude in the missed approach procedure (usually the holding pattern altitude).** With this all set, if you have to do a Go Around, when you activate the autopilot, it will climb to the Missed Approach Holding Pattern Altitude (MAHP).

G asOn Both
U nder carriage Cowl Flaps Closed
M ixture.....Rich
P rop..... Forward
S witches Land/Runway lights on
A ltitudeset to MAHP

MISSED APPROACH: This should almost be self explanatory at this point.

- 1) **Full Throttle**
- 2) **TOGA (GA button).....Engage:** This does the four things previously mentioned: Disengages Autopilot, Commands wings level, 7 degrees pitch up and activates the missed approach. The pilot has full control of the aircraft.
- 3) **APEngage:** Once the pilot has ensured the aircraft is in a positive rate of climb, beyond the MAP, and reach an appropriate altitude for the AP.
- 4) **NAV.....Engage:** allows the autopilot to track the navigation signals from the Missed Approach Procedure in the Flight Plan.

Once you are in a stabilized climb, return to the **CLIMB** portion of Check List.

NOTE: if you do not use the TOGA button or do not have one installed, way point sequencing will be “Suspended” upon crossing the MAP and must be manually “unsuspended” to continue way point sequencing to the MAP procedure and hold. Be careful not to begin navigation to hold until reaching initial safe altitude on published

approach (90% of approaches climb straight ahead to prescribed altitude before turn to hold)

Unpublished holds (with the Automatic Flight Control System): You are going to use the G1000 to turn the holding waypoint into a SUPER VOR. (this method is outdated if you have a newer software version or G1000 NXI)

- 1) OBS: press the OBS soft key to stop automatic waypoint sequencing just prior the holding fix. This will allow you to SET the inbound radial with the CRS knob. The inbound course will be PURPLE.
- 2) CRS: use this knob to set the course on the HSI so the tail of the arrow is on the outbound course.
- 3) SYNC: the HDG bug by pressing the Heading KNOB once established on the inbound radial.
- 4) HDG: select this autopilot mode when you reach the holding fix and are ready to turn outbound. Then use the Heading bug to steer to the outbound course (Reciprocal of inbound plus wind correction angle)

Fly outbound in HDG mode, Fly INBOUND leg in NAV mode.

NOTE: on newer software versions, G1000 NXI, there is a capability to program unpublished holds. On the FLT PLAN- High light the desired holding way point or enter it. Select ENTER. A menu will come up that allows you to plug in the parameters of the hold including the EFC time. This creates a GPS hold in the flight plan the autopilot can fly with no further pilot intervention. Go play with it, it is intuitive and easy to use.

A few More Tips:

On Flying Approaches:

SLOW the aircraft down before the IAF if possible and definitely 2 to 3 nm before intercepting the FAF. Bring the throttle back to 18 to 20 inches (Turbo 182) and add a notch (10 degrees) of flaps. This will buy you time and make a stabilized approach much easier to manage. This is especially helpful when hand flying the approach and requires slower descent rates. Keeps you AHEAD of the aircraft.

Clearance for the Approach: The Controller will give you a PTAC.

Position: “91FR you are 5 miles from LINDA (FAF)
Turn: Turn to heading 140

Altitude: Maintain 3500 until intercept localizer
Clearance: Cleared for the ILS Approach 14"

Pilot response: "91FR, maintain 3500, cleared for the approach"

Once you have been given your final approach intercept vector, you have some liberty to modify your heading for the intercept. ATC is mostly concerned that you maintain the altitude until intercept.

Hand off to Tower: Some time before the FAF, Approach should hand you off to tower.

Approach Control: "91FR, contact tower 119.3"

Pilot: "119.3, 91FR"

Switch to Tower frequency:

Pilot: "Tower, 91FR is with you on the Approach"

Tower: "1FR, report LUCY" (if MM, you will hear tone)
Or
"1FR, report 4 mile final" (have NRST window up?)

When over reporting point:

Pilot: "Tower, 1FR is on 4 mile final"

Tower: "1FR, winds are 220 at 10 kt, cleared to land 14"

Pilot: "1FR is Cleared to land, 14"

When going missed, get the aircraft under control and pointed in the right direction, then make the call to report the missed. Shortly there after, the tower will hand you off to Approach.