

# **DeltaGliderIV User manual**

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# 1.0 - Introduction



Welcome to the DeltaGliderIV addon!

The DeltaGliderIV is one of the most advanced vessel addons existing in Orbiter. It includes 70 animated parts, 30 different meshes (not including payloads and Mmu), 24 textures (not including extra skins), advanced effects (like turning wheels, crash debris, reentry heat shield and wing vapor), an onboard computer, 12 custom autopilots and 37000 lines of newly optimized C++ code. All buttons and systems on the panel are fully functional. Even with all the new features, great care was taken so that the DGIV still runs at an average of 40-80fps on my old 1.7 Ghz P4 with a Tl4200 graphic card.

The DeltaGliderIV, despite its futuristic look and the fact that it contains technology that is impossible, is also one of the most realistic ships in Orbiter in the sense that it puts the human in the center of the simulation. You must now take care of your crew members and can no longer claim a « successful flight » with a reentry angle of 90°, an ascent at 20G, a landing at 20m/s or such thing that exceeds usual limitations of the human body or hardware.

With great attention to detail, the crew's individual reactions to G are very realistic where vector, force and duration of G are all taken into account. Heartbeat and O2 consumption increase under stressful conditions, the calculator really works and can do complex calculations, etc. etc. Dozens of small details like these are hidden behind the many buttons and systems available.

A real DeltagliderIV might not have a cargo bay, it might require rocket launch assist to the moon or only be capable of short flights around the earth with unpowered reentry, but that's not really the purpose of the DelaGliderIV addon. It is meant at first to make you dream, learn about space flight and explore Orbiter's solar system with an exceptional and fun ship. If you prefer such realism, you can always choose to fly using a very low power engine (Mark I) with low O2 and fuel reserve.

My DeltaGlider\*\* series has existed for four years and each year it was improved and more things were added. The total work time on it now reaches one year. Of course it would have been impossible to make without all the fantastic people that supported my work or helped in various degrees. I thank them first and foremost.

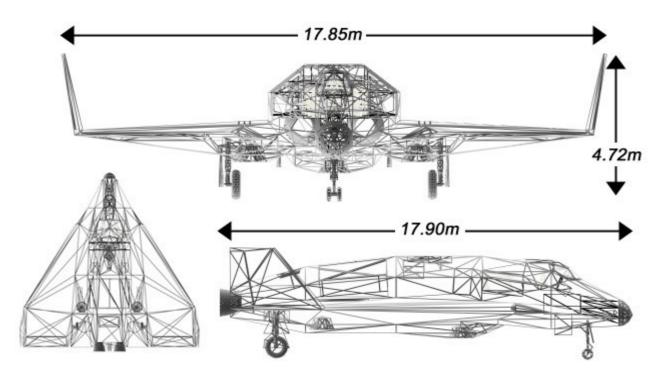
This addon was made with passion for passionate people, I hope you'll enjoy my work.

Daniel Polli (aka DanSteph) Vulbens/France December 2013

« If knowledge can create problems, it is not through ignorance that we can solve them.»

Isaac Asimov 1920-1992 (RIP)

# 2.0 - DGIV Technical data



Total Length: 17.90m

Total height: 4.72m (with gear)

Wingspan: 17.85m Wing area: 113.49 m2 Weight empty: 12.052 tonnes

Max take off weight: 27 tonnes (Earth, MKIV engine)

Max landing weight: 19 tonnes (Earth)
Max Crew: 5 (4 passengers, 1 pilot)

Max Payload: 3.5 tonne

Take-off speed: 180 m/s (Earth at 22 tonnes)
Landing speed: 175 m/s (Earth at 19 tonnes)

Engine Power: (MKI 50KN - MKII 200KN - MKIV 260KN - MKV 320KN)

# 3.0 - Initial configuration

The DGIV can be configured for short or very long trips using different O2 and fuel settings. This is done with the DG4config.exe program. If you have deleted the desktop shortcut you can find this program in your Orbiter/Sound/DeltaGliderIV folder. This program allows you also to configure engine power and effects settings.



**IMPORTANT:** Engine power, O2 reserve and fuel reserve are saved and reloaded from each scenario. When you load a scenario, your DGIV will use the settings from that scenario and the settings made with the DG4config.exe program will not be used. To load your new configuration in the DGIV you must load the settings - this is done using the "load setting" button on the DGIV's lower panel:

load DG4config.exe setting button on lower panel.



You can check which settings your DGIV has on the Technical plate on the bottom panel. It's a good idea to check this plate before any trip so you don't run out of O2 or fuel.

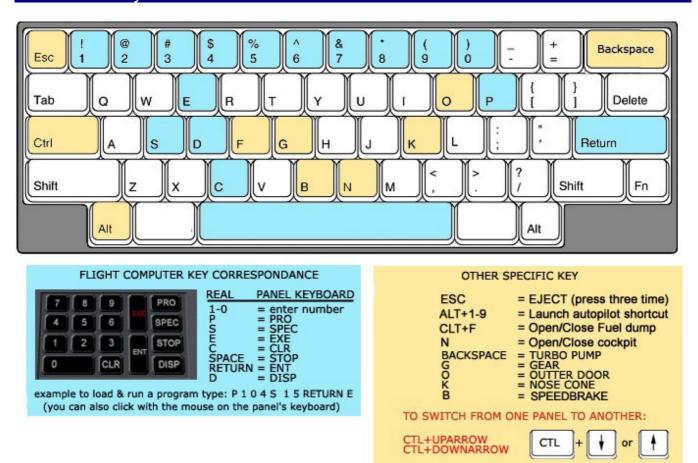




**Tips:** O2 reserve is sufficient for 5 crew members. A "two week reserve" would last 10 weeks with only one crew member. You can check the actual consumption and reserve prediction using the crew display button "RES"

**Tips:** Using the cheat settings "invulnerable crew" or "ship never burn" is not a good idea. First it defeats the main goal of DGIV which is to give you a vessel where you must take into account the life of your crew and second you may experience odd effects because the DGIV was not designed for cheating.

# 4.0 - DGIV keyboard controls



Autopilot setting keys have a corresponding help text on the program display (D1 display)



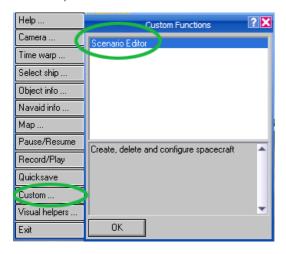
example of help key text on autopilot display (in gray)

# 5.0 - Loading passengers, payload and changing DGIV skin

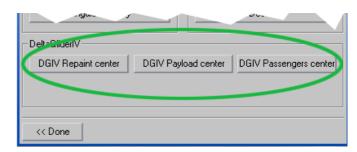
You can use the scenario editor of Orbiter to load passengers, a payload, or to change the skin of your DGIV and those settings will be saved in your scenario.

Press F4, select "custom" select "Scenario editor" then click "edit" with a DGIV selected and then choose "DGIV Passengers center" "DGIV payload center" or "DGIV repaint center"

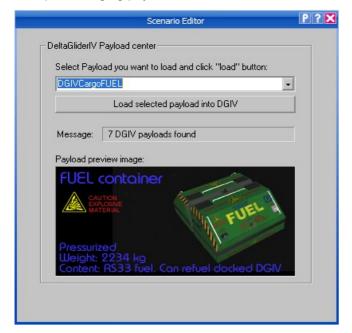
Press F4, click "custom" and select scenario editor:



Select DGIV, click edit and select "repaint" "passengers" or "payload"



Example: changing payload or DGIV skin:





**Important:** if you don't have the scenario editor in "custom" you must activate its module: in Orbiter launchpad go to "modules" tab, select "scnEditor" and click "activate selected"

# 6.0 - Check-lists and check vessel state display



Before you go flying for the first time in the DeltaGliderIV, READ THE CHECK-LISTS! They are CRUCIAL to successfully operating your craft. The check-lists are displayed in the CHECK-LIST MFD. You can view this MFD on the lower panel (press CTRL + DOWN ARROW to access it).

The left ("<<<") and right (">>>") buttons on the MFD cycle through each check-list sequentially. You can scroll the currently displayed check-list by using the up or down buttons on the left side of the MFD. To see a list of all available check-lists, press the "MNU" button.

These check-lists are taken from the check\_list.txt file located in the "/sound/deltagliderIV" directory in your Orbiter installation folder, and can be edited as you desire.

You can find a « printer friendly » version of those check list in the folder sound/deltagliderIV/check list.html



### The check state display:

Once a check-list is completed and your vessel set for a stage you can ask the computer if the vessel is in the right configuration. You can find this feature on the **computer** display, choose option 6 in menu then select the stage you want. The computer will tell you if something is missing or if the configuration is set correctly.



### Computer tips:

The computer display is located on bottom panel (CTL+down arrow) and you also have a backup display on the main panel. You can access it's options either by clicking with mouse on the Computer keyboard on the bottom panel (button "DISP") or by typing on your real keyboard by hitting the "D" key and then a number. ("D" as "DISP" then a number to choose in menu the option you want)





# 7.0 - Panel

The panel is in three parts, you can switch between them with key CTL+UP arrow or CTL+DOWN arrow. The panel was designed for a maximum resolution of 1280x1024 but if you run it in 1152x864 all instruments will still show. At lower resolutions you'll need to scroll left or right with arrow keys to see all the instruments. Most buttons or instruments are self explanatory, so we'll describe here only the special or important ones.

The upper panel:



### A - Power managment

The little blue arrows show dependencies between systems. The Right button powers each DGIV system, the computer button powers the computer and autopilots - you can set this button off/on to reboot the computer. You can set the radio button off if you don't want to hear Orbiter sound radio ATC.

The power for all systems come from GEN1 and GEN2 which are powered by APU. The APU can be started if there is power on the start bus, the start bus is powered either by EPU (on ground or when docked) BATT (which is charged during flight by GEN1) or Emergency power. On the ground, if you select EPU/BOTH and the EPU button is off you can set the GEN and APU button to OFF and all power will come from EPU (External Power Unit)

Emergency power is a fuel cell that can power the DGIV in case of APU failure. Push this button and set the selector to Emergency power. In this case you must reduce the power comsumption so the fuel cell lasts longer. You can display the time remaining with D4 display on computer and the actual comsuption with the most right blue display.

A red light on a button means there was a power fault. You just need to push it twice to reset and engage the system again.

To power On or Off the DGIV, simply follow the check-list that is on the lower panel.

RADIO TIPS: The Radio power button forces OrbiterSound to play ATC even if you disabled ATC option in SoundConfig.exe. Simply turn radio power OFF if you don't want ATC anymore.

### B - Airlocks gear, nosecone and dock

Here you can find the airlock and outer door buttons. You also have the gear command and hydraulic power. Note that hydraulic power must be ON to operate the Gear (this is a safety, if the button is off you can't accidentally lower the gear)

You can also find the undock button, it will light green if you are docked.

### **C – Strobe and seat belt** (control crew - wear spacesuits)

Here you can find the Strobe button and Seat belt button which is very important: when off the crew will wear normal clothing, you can't eject from ship. When On they wear spacesuits and can eject and your crew can live for a period if there are critical conditions in the cabin (0 pressure, low or high temperature). This button must remain On during any dangerous phase of your flight or when eject is suitable. (eg: It's a bad idea to eject on Mars because the chute will not slow you down enough). Bell button is just there to wake up your crew ;)

The midle panel:



#### A - Ship control

This button is very important, it allows you to set ship's control. Atmo auto will switch automatically beetween RCS and flaperon control in regard of dynamic pressure. You can switch also beetween linear and rotational RCS thruster, (numpad key « / » work also) or force control to elevons, noseweel, or off.

#### B - Mini Hud

This controls the mini Hud where various important information can be displayed. This is the only display that shows your ship's actual weight, which is very useful before landing or reentry (max landing or reentry weight is 19 tonnes)

You can customize this display and display other data using the utility Sound/DeltaGliderIV/CustomHud.exe

### C - Computer backup display

This is the computer backup display. The main computer display and keyboard are on lower panel.

# **D – Warning light**

These lights give you warnings and indications about faulty systems or critical conditions such as high G, high temperature, etc. etc. You can check if all the lights work with the little grey button before flight. If a button is lit because you have a warning or a system failure you'll also have a text on the Zone E display.

# E - Messages display

Gives you indications about all things that happen in the DGIV; button presses, autopilot messages, system failures, etc etc. Critical messages are displayed in red. If a warning is displayed you'll also hear a warning sound. to stop this warning sound simply press on the grey/red button.

### F - Remote countdown

This is the backup for the remote thrust, a system that allows you to fire thrusters with a delay, very useful for preplanned burns. Burn set-up controls are on the lower panel, but you have a backup start/stop countdown button here also so you can start countdown while watching MFD or while you're outside.

# **G** – Trim display

Trim is not used often but is very useful in atmospheric flight to set your ship's flight plane to neutral. Setting of the trim tabs is done by the « insert » and « delete » keyboard keys.

#### The lower panel:



# A - Check-list MFD

Maybe the most important display, the « Check-list MFD » allows you to display all check-lists to operate the DGIV.

# **B - Load setting and config display**

The upper button allows you to load the setting (fuel, o2 consumption, engine power, etc. Etc.) made with the external Dg4config.exe program. Settings are saved in the scenario so when you load a scenario the DGIV will not have loaded the last settings set in dg4config.exe but those saved in scenario. The bottom plate allows you to control which settings are in use for this DGIV. Default settings for almost all scenarios included in package set a DGIV ready for earth & moon operation, 15 day reserve, and enough fuel to reach the moon. It's important before any longer trip to check this plate and set a reserve suitable to your trip duration using dg4config.exe and then load those setting in your DGIV.

#### C -Life support, crew and EVA managment

This panel is explained more in details further in this documentation. Notice the MFD that displays all cabin settings, reserve settings and crew data aboard. Notice also the new Windows ray filter button that really changes the opacity of the windows.

#### **D** – Engine and fuel panel

Here are all the engine and fuel controls, on the top you have input valves to refuel the DGIV (see check-list). The engine valves must be open otherwise thrusters cannot operate. You can transfer fuel from one tank to another. You can engage turbo pump (post combustion) that gives you more power either by pressing « BackSpace » or clicking on « turbo pump » button. To engage turbo you must already have engine set to 100%. In the middle you can find the remote thrust that allow you to delay planed burn. A backup start/stop button is on the middle panel so you can start a countdown while watching MFD.

Retro and hover thrusters are protected by doors so that they do not burn during reentry. You can force those

doors to open or close (safety during reentry) but it is best to leave them on Auto; they will open automatically when a thrust is requested either by your commands or by autopilot command.

#### E - Main computer

This is the main computer and keyboard. The keyboard works, but you can also use your real keyboard to input commands. The main computer maintains your autopilot and can display a lot of information like damage, vessel state, hull temperature, G, speed, etc etc. Notice that the calculator is fully functional.

#### F- Antenna control

« AE35 » \*grin\* Antenna is mainly useful to detect objects bearing azimuth and distance if you don't want to cheat with Orbiter F9 key.

### G - UMmu turbopack and Cargo bay

This controls turbopack and cargo doors and release/grapple of payload or turbopack. If you want to grapple a turbopack or a cargo simply place it near the door and click on « grapple » button. On the ground the DGIV's cargo bay must be over a payload and turbopack and must be just below the corresponding door for grapple to work.

**TIPS:** you can load a cargo using the Orbiter scenario editor.

# 8.0 - Crew safety

In the DeltagliderIV you must take care of crew aboard. excess G, lack of O2 reserve or incorrect setting of cabin's atmosphere can kill your crew, as can a bad re-entry into the atmosphere or a ground impact.

#### **Excessive G:**

The effect of too many G's on the body in real life mainly depends on three parameters:

- 1. G vector (negative G, positive G)
- 2. G force
- 3. G duration

The DeltaGliderIV models all three parameters. They are accurately modeled to represent real effects from G forces. High G forces will damage your crew's health and can even cause death; similarly, G forces that are sustained for short periods of time will not be as harmful (relatively) as the same forces sustained for longer periods of time.

#### How G effects cause damage in real life:

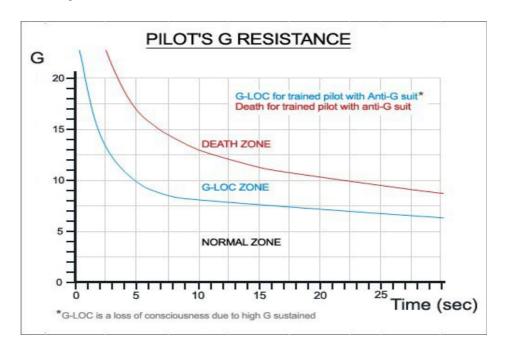
As blood drains into the lower parts of the body, it leaves the brain without oxygen. This can lead to "G-LOC" (G-induced Loss Of Consiousness), or even death if the brain is deprived of oxygen long enough.

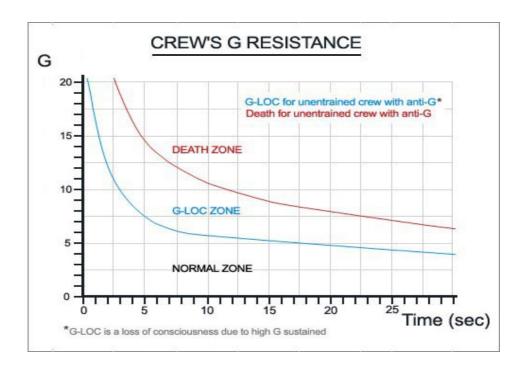
Scientific tests have showed that people experience health effects from G forces differently. Physical conditioning and age are factors that can help determine a person's ability to withstand G forces. A person in good physical condition, with sufficient training, can sustain 3G-5G more than an untrained person.

In the DeltaGlider this disparity is simulated by the status and age of the crew, as specified by you in the configuration screen. For any given age, the Pilot will be able to sustain about 3G more than the passengers in the DeltaGlider II because of his training. In addition, since very old or very young people have less ability to withstand the effects of G force stress, the age you select for your pilot will determine his or her relative ability to resist G stress.

You can see below how the pilot and passengers react to G effects in the DeltaGlider IV (all crew and passengers on the DG4 are wearing anti-G suits to help manage G stress effects). The data was collected from real-life information; however, keep in mind that these graphs represent averages. In real life, some people can experience G-LOC at only 2G, while others only succumb to G-LOC at significantly higher G stresses than most normal people can withstand.

#### Impact of G forces on your crew:

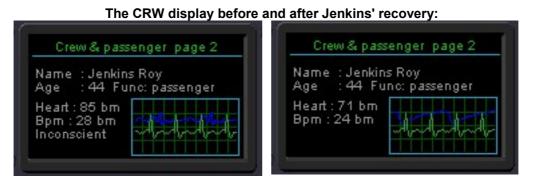




As you sustain more and more Gs, you will first see the passengers experience G-LOC. After this, if nothing is done to reduce Gs, will die (you can monitor the health of the crew in the Life Support MFD section of the lower panel--press the "CRW" button). The pilot will experience G-LOC shortly afterwards.

If the pilot (you) falls into G-LOC, all other sounds will cut out and you will hear a heartbeat sound. If the "loss of control" option is enabled in the configuration, the spacecraft will tumble out of control; you won't be able to press most keys or click on panel buttons. However, you WILL still have control of the RCS so that you can correct your flight attitude to reduce the Gs (think of it as if there were an "automatic pilot" that kicks in if the pilot experiences G-LOC).

The crew will recover from G-LOC after a bit of time with reduced Gs. The amount of delay until full recovery is achieved depends on the severity of the G force they sustained and the time they sustained it. The recovery delay can be as long as a minute.

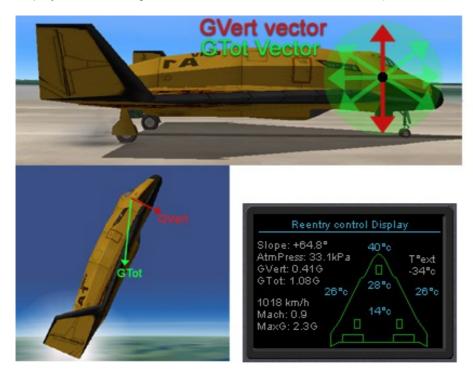


If no action is taken under high G conditions, and the pilot dies, you will completely lose control of the vessel (unless you specified otherwise in the initial configuration).

#### **Display G Force in DGIV:**

G-Force is displayed in the « reentry » display « D3 » on computer display. The « GVert » represents vertical vector (from head to feet) and « GTot » the total of G force which is the sum of all vectors (including vertical vector). « GVert » is more important because such G cause the worse effect on your crew, also negative GVert force have even more effects as in reality. MaxG show the maximum G you experienced during your whole flight.

Right reentry display show situation on Ground, Gvert and GTot are equal to 1.0G (same vector), below the display when climbing at 65°, Gvert is 0.41G and GTot 1.08G (more than 1.0G due to engine acceleration)



# How to avoid G forces in Orbiter:

Your trajectory is the main thing that can generate G forces; specifically, the most dangerous situations are reentry or aerobraking in an atmosphere. If your re-entry trajectory is at the wrong angle, you may find G forces build to an unacceptable level for your passengers and crew. Even if you re-enter at the correct re-entry angle, you must also make sure that the vessel's pitch (angle of attack) stays within the correct range for a successful re-entry.

For a correct re-entry you should place your perigee so that it's just inside the high atmosphere. The higher your speed, the higher your perigee should be so that you have more time to "bleed off" speed in the high atmostphere.

When it's time to deorbit, you have a very useful display in the flight computer to guide you in your descent. Press "D", then "2", and the de-orbit MFD display will show your predicted re-entry angle, range to ground, and speed. There is a tutorial in this doc that demonstrates a complete re-entry from the ISS using the autopilot and the correct instruments: Click here for the tutorial.

### Impact with ground:

If the DeltaGliderIV hits the ground with a vertical impact speed of more than approximately 20 m/s (72 km/h) the crew will die. Even at lesser impact speeds, the crew can lose consciousness; so make sure to land as gently as possible!

Reentry control Display

15°c

15°c

15°c

15°c

15°c

15°c

Slope: +0.0°

GTot: 1.00G

Mach: 0.0 MaxG: 1.0G

AtmPress: 101.3kPa GVert: 1.00G

# 9.0 - Life support system

In the DeltagliderIV, crew breathe O2 and exhale CO2 back into the cabin. The missing O2 is replaced from the O2 tanks and the CO2 is eliminated by the CO2 remover. Total consumption of O2 and the amount of CO2 expelled is based on number of crew aboard and their heart rates. The N2 tanks replace air lost when you operate the airlock and repressurize the cabin when you set a higher pressure. They are much smaller than the O2 tanks.

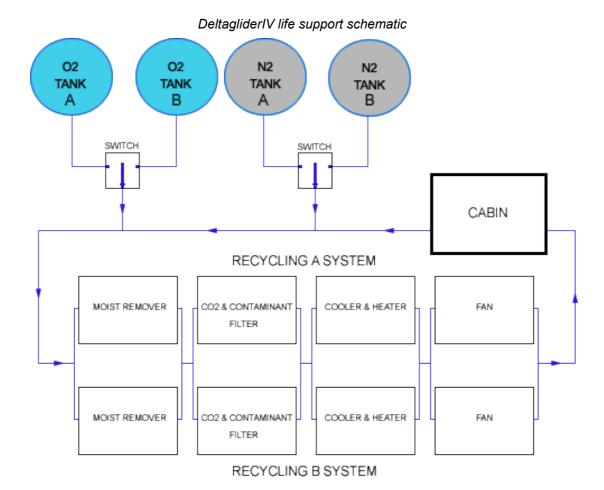
You must manage all these systems to keep your crew healthy. The best way to do so is to follow the check-lists carefully. You're not obligated to make all the pressure and O2 level changes required in each check-list, but they may add to the realism. (notice: since apollo1 accident cabin O2 is not anymore set to 100%)

### Two systems for safety!



You have two O2 tanks and two N2 tanks (A and B), as well as two recycling system (A and B). However, note that the A and B switches are unrelated; in other words, the recycle button A doesn't command tank A. They are separate systems.

Usually both recycling AB and tank AB should all be ON when you're in a critical flight phase like landing or take off for safety reasons. When both A and B tanks are ON, the O2 or N2 needed is taken from the A tank until it is empty, at which point it will switch to B. You can also mix the A and B recycling circuits. For example, setting MOIST to "A", CO2 to "B", COOLER to "A", and FAN to "B" will work.

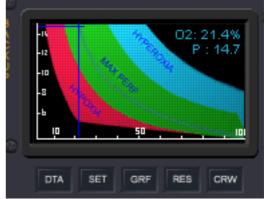


### One MFD to see everything you need

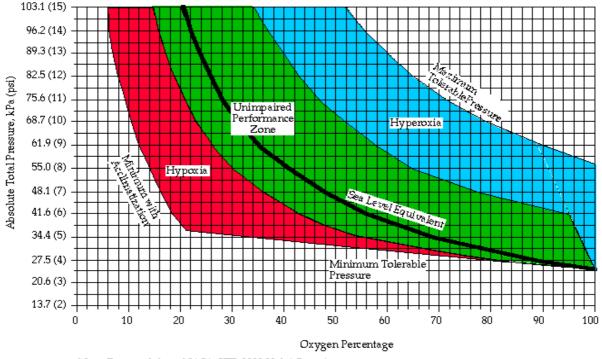


On the lower part the MFD are buttons that help you monitor and control crew health, O2 consumption, automatic system settings, and more. Click each

button to see what information is displayed. You can set the cabin temperature, pressure, and other parameters by clicking the "SET" button.



During critical phases of flight (landing, de-orbiting, take-off) stress on the crew can be high. The chart below gives some idea of the percentage of O2 needed to maintain the health of the crew for given pressures (the DG4 follows this chart exactly).



Note: Extracted from NASA-STD-3000 Vol. 1 Rev. A

Figure 2.1.3-1 Physiological Effects of Oxygen Concentrations

# CO2:

Usually, in a home, the CO2 levels can vary as much as 300 - 2000 ppm. Several studies have shown that CO2 does not seriously impact human health until levels reach approximately 15,000 ppm. This level is more than 40 times greater than the normal concentration of atmospheric CO2. At extremely high levels, i.e., 30,000 ppm (these concentrations are usually never be reached in a standard home), the symptoms can include nausea, dizziness, depression, convulsions, and vomiting. At extremely high levels, loss of consciousness may occur. The seriousness of the symptoms is dependent on the concentration of carbon dioxide and the length of time the individual is exposed. At CO2 concentrations of 100,000 ppm or more, death is almost certain.

The moral of this story--make sure the settings levels in your DG4's cabin are safe!!!

# 10.0 - Autopilots



The onboard flight computer controls all autopilot functions, including the "stock" functions like "prograde", "retrograde", "killrot", and so on but include also 8 custom DGIV autopilots like ascent, auto reentry, atmospheric flight, hover, etc etc. If the flight computer is not operating for any reason, you will not be able to run any autopilot functions.

For stock autopilot functions, you can press on your usual key to load and engage the autopilot. You can also use a more complicated way using the autopilot's name in the flight computer (eg: "PRO202SPEC0" for the killrot function). See the list below for details on all the functions available through the programmed flight computer.

**IMPORTANT:** you can find a list of all autopilots available in the <u>Check-list MFD</u> on the lower panel, see « Flight computer operation » check list. This is very useful if you do not want to fly with the documentation next to you.

### Operating the autopilot:

You must first LOAD the autopilot then EXECUTE it. To do so you can either click on the flight computer's keyboard with your mouse, or type on your real keyboard (for a full list of commands via your real keyboard, see the <a href="keyboard command chart">keyboard command chart</a>)

For example typing on your real keyboard: "P104S40E" will load and execute the re-entry autopilot; "P903S42E" will load and execute the ascent autopilot with a launch heading of 42 degrees. If you use the panel's keyboard you must click « PRO » 110 « SPEC » 0 then click « ENT » to load it and « EXE » to execute the loaded program (in this example atmospheric flight) You can also either simply stop the autopilot and keep it loaded with button « STOP » (space on keyboard) or stop it and unload the program with button « CLR » (C on keyboard)

#### Programable autopilots shortcut key:

You can also load and execute all autopilots including DGIV custom autopilots by programmable shortcut key as « ALT+1 » for example. Very useful if you do not want to remember all autopilots or check the check list each time you want to use one.

By default the shortcut are as follow: (numbers are top keyboard number, not numpad)

ALT+1 PRO400SPEC01	Taxiing hold speed (maintain a speed of 10 m/s)
ALT+2 PRO400SPEC18	Aproach hold speed (maintain a speed of 180 m/s)
ALT+3 PRO400SPEC25	Flight hold speed (maintain a speed of 250 m/s)
ALT+4 PRO300SPEC0	Docking auto (Automatically dock your DGIV)
ALT+5 PRO110SPEC0	Atmospheric flight autopilot (heading, altitude &speed)
ALT+6 PRO903SPEC40	Earth ascent to low orbit. (normal take-off, use « 904 » if you want hover take-off)
ALT+7 PR105SPEC40	Automatic reentry.



You can view or change those default shortcut key and program up to nine shortcuts using the « Programs shortcut setting » on flight computer. Type « D7 » or click on « DISP » and « 7 »

Changes made will be immediately applied for all DGIVs in Orbiter and will be kept until you change them.

#### Stock Orbiter autopilots functions available:

The following autopilot functions are available via the flight computer: (you can still use the orbiter stock key as « numpad 5 » for killrot for example)

PRO200SPEC0 Killrot PRO200SPEC1 Prograde PRO200SPEC2 Retrograde PRO200SPEC3 Normal PRO200SPEC4 Antinormal PRO200SPEC5 Horizon level PRO200SPEC6 Holdalt

#### **Custom DGIV autopilot functions available:**

The following autopilot functions are also available via the flight computer:

PRO104SPEC40 Manual rentry (Hold attitude with selected AOA) PRO105SPEC40 Auto reentry (keep a low temperature reentry profile) PRO110SPEC0 Atmospheric flight (usefull for cruise flight, maintain heading altitude and speed) PRO200SPEC7 Manual Hover Auto Hover PRO200SPEC8 PRO300SPEC0 Docking Auto (dock you to any ship with a docking port) PRO400SPECnn Hold speed (« nn » stand for a number, usefull for aproach, taxiing and cruise flight) PRO500SPEC0 Null relative speed in regard of a close object (in space only) PRO903SPECnn Ascent autopilot (were « nn » is a number, automatic launch from earth into low orbit) PRO904SPECnn Earth ascent autopilot with automatic hover take-off. PRO905SPECnn Moon ascent autopilot with automatic hover take-off. PRO906SPECnn Mars ascent autopilot with automatic hover take-off.

# 10.1 -Presentation of DGIV custom autopilots

**IMPORTANT:** The best way to learn autopilots is to launch the tutorial scenarios (see scenarios in « DeltaGliderIV/ (Tutorial Learn DGIV - Whats cool) » however we'll present some of them that have particularity below:

### PRO104SPECNN - Manual reentry autopilot

Usefull for reentry on planets with atmosphere.

« NN » stand for the AOA you want to hold (usually 40° at start of reentry)

This is a « keep attitude » autopilot, you are in charge of managing the AOA and bank during reentry so you do not burn up. You can change AOA and bank see DISP 1 (D1) display when autopilot is running for help about which key to use.

#### PRO105SPEC40 – Automatic reentry autopilot

Useful for reentry on earth, and can teach you also how to do a « burn proof » reentry.

This autopilot will take care to reenter you so you do not burn in atmosphere. It is not meant to land you were you want it will just manage your AOA so you do not burn, It is your responsability to have a correct orbit before reentry and to perform the brake burn at the right time to land where you want. (see tutorial scenario) This autopilot will manage AOA to keep a correct vertical speed to maintain temperature within acceptable range You can only change bank see DISP 1 (D1) display when autopilot is running for help about which keys to use. This autopilot will disengage himself once reentry completed at about 2500 km/h (700 m/s)

**TIPS:** reentry autopilot work also somewhat on Mars, not tested on other planets.

### PRO110SPEC0 – Atmospheric autopilot

Useful for cruise, take-off, taxiing, return to base, end of reentry stage.

It will hold altitude, speed and heading and can work up to 25km high on Earth. This works also on Mars but you must maintain at least 800 m/s at low altitude and even more at higher altitude.

Can be engaged in flight or on ground, in this latter case it will take off automatically.

You can change heading, speed or altitude to hold, see DISP 1 (D1) display when autopilot is running for a help about which keys to use.

#### PRO90\*SPECNN – Ascent autopilot

Ascent autopilots can take-off automatically either with conventional take-off (aircraft style) either by hover take-off and will put you in Orbit with an ECC of 0.0000 (the final altitude depends on your weight, engine and fuel setting) They are designed to work best with default Mark IV engine and default fuel setting.

Simply engage them on ground and watch your vessel taking off (the autopilot even raise gear if you forget them)

Ascent autopilots list: (all autopilots raise gear automatically at 15 meter)

PRO903 Conventional take-off from earth.
PRO904 Hover take-off from Earth.

PRO905 Hover take off from Moon.
PRO906 Hover take-off from Mars.

**Important:** during ascent autopilot you can force heading by +-10° with numpad key 4 and 6. This is to help you fine tune the final Inclination. But as INC builds slowly during ascent you may simply destroy the final INC if you try to correct it too early. So use this late in ascent, watch the Align plane MFD to help you (Rinc and Rate parameters) The heading correction is displayed in D1 (program) and D3 (reentry) display.

The scripts of ascent program are in « Sound/DeltaGliderIV/Prog » directory, you can edit existing or add more, simply copy one and rename it for example PRO908SPEC.txt and edit it with a text editor. Set debug parameters to 1 to help you tune your new autopilot and launch it as usual (le: PRO908SPECNN).

« NN » stand for the launch heading you want, it depend of the Orbital inclinaison of the target orbit you want to reach. For mir for example it would be 90° while for ISS it would be 42°.

The formula to calculate a launch heading is:

Launch Azimuth = arcsin (cos (desired\_orbital\_inclination) / cos (launch\_ latitude))

To be more elegant you can calculate that with the DGIV inboard calculator see: Calculating Launch Azimuth with DGIV calculator

Cool things to try: Launch an ascent autopilot with hover take-off and fix a ground camera near the way it will pass, (F4-camera-ground-current)... looks like the millenium falcon taking off.;)

### PRO200SPEC7 and PRO200SPEC8 – Hover autopilot

Hover autopilot is often underestimated but it's a very useful autopilot to make a controlled descent on a satelite or planet without an atmosphere. Once you have full control of your descent rate, it's a piece of cake to make a nice trajectory that ends exactly over the pad. Control your speed with retro and control lateral trajectory with RCS in translation mode. There are two modes: Auto descent PRO200SPEC8 which automatically maintains a descent speed of -40 m/s maximum and lands you smoothly. Or the hover autopilot PRO200SPEC7 which maintains the vertical speed you specify. See tutorial scenario for a complete walkthrough.

# 11.0 -Calculating Launch Azimuth with DGIV calculator

The formula to calculate a launch heading is:

Launch Azimuth = arcsin (cos (desired\_orbital\_inclination) / cos (launch\_ latitude))

To be more elegant you can calculate that with the DGIV inboard calculator:

#### **Example:**

Take the scenario « Earth/Landed KCS departure ISS » Open the Orbit MFD set ISS as target SET Projection to EQU (click on FRM button) and notice the target « INC » value=51.56° Now open the surface MFD and note your latitude = 28.591° N

Open the calculator with « D8 » key, go on bottom panel and click with mouse on the following button:

```
« 28.591 COS M1 » (now you have the cos of latitude stored in memory 1)
```

« 51.56 COS / MR1 ENT ASIN » (you made cos of inclinaison, and divided this result by memory 1 then asin)

Result= 45.075° Engage PRO903SPEC45 or PRO904SPEC45 to launch with this heading.

Wait! Usually ascent for ISS is 42° so why is there such a difference? Because the real calculation is a bit more complicated: you have to take in account hte earth's rotation, final orbital speed, etc. etc. This said if you launch with such heading you'll be off by only 3° Relative Inc, a 28 second align plane burn. So even slightly off this calculation can be useful for you in many situations. It's very more satisfying to calculate that yourself than simply blindly read what others tell you to do.

If you want to launch southbound simply do 180°-45.075° = 134.925° (« 180-45.075 ENT » on calculator)

IMPORTANT: you cannot launch if the target INC is lower than your Latitude. For MIR there is no solution as it's INC is at 26.96° (lower than your latitude wich is 28.59°) this is why we launch at 90° and align plane later.

TIPS: You can find the launch azimuth formula and the DGIV calculator way of doing it in the check-list MFD « 12 - flight computer operation »

#### Accurate calculation:

If you want to be precise, you'll have to use the formula below. Is it worth a 28 second burn? Maybe! There is some beauty in a precise trajectory, but such complexity may be useless sometimes. You decide.

The complete formula is as follows:

Rough Launch Azimuth = arcsin (cos (desired\_orbital\_inclination) / cos (launch\_ latitude))
Real Launch Azimuth = atan(tan(Rough Launch Azimuth) - SpeedOnEarth/(FinalOrbitVelocity\* cos(Rough Launch Azimuth)))

**SpeedOnEarth** = **407.9** can be found on Orbit MFD left parameter VEL

**FinalOrbitVelocity** = **7699.0** Your target's speed. (target ISS see right VEL parameter)

Now calculate the Rough Launch Azimuth. You must not have the result in Degree but in radian so do the following:

« 28.591 COS M1 51.56 COS / MR1 ENT SPEC ASIN M2 » (« Spec » will pass the calculator in Radian)

Rough Launch Azimuth = 0.7867 (Result stored in M2)

Now type:

« MR2 COS \* 7699.0 ENT M1 407.9 / MR1 ENT M1 » (Result stored in M1)

#### And continue:

#### « MR2 TAN - MR1 ENT SPEC ATAN »

#### Final Accurate Launch Azimuth = 42.8491°

So, the complete DGIV calculator formula is as follow:

YourLat = Actual latitude DesInc = Wanted inclinaison FinalSpeed = Target Orbital speed

**Actual Speed** = Actual speed (due to planet rotation)

« YourLat COS M1 Desinc COS / MR1 ENT SPEC ASIN M2 MR2 COS \* FinalSpeed ENT M1 ActualSpeed / MR1 ENT M1 MR2 TAN – MR1 ENT SPEC ATAN »

If you want this formula instead of the rough one in the check-list MFD simply edit the file « sound/DeltaGliderIV/check\_list.txt » find the place were is the old formula and replace by the above. Take care that the horizontal place is very sparse as you'll need to cut the line several times.

#### **Excercice:**

Take the scenario « Mission /Fly me around the moon » and try to reach Luna OB1, you'll have to apply such calculation: (try it by yourself with above formula without watching below)

<u>« 41.118 COS M1 91.48 COS / MR1 ENT SPEC ASIN M2 MR2 COS \* 1480 ENT M1 3.49 / MR1 ENT M1 MR2 TAN – MR1 ENT SPEC ATAN »</u>

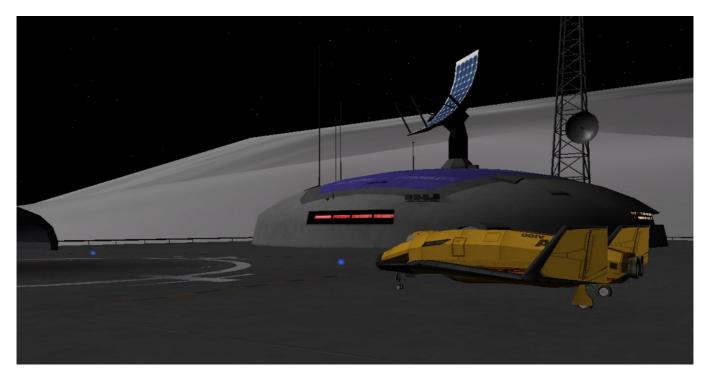
#### Result= -2.0997°

So, as -2° is not possible we'll simply do 360° (equal to 0°) minus -2° =358° open map MFD wait that Luna OB1's trajectory pass over you and launch PRO905SPEC358

Finally , if you want to know more about this see the OrbiterWiki page: <a href="http://www.orbiterwiki.org/wiki/Launch\_Azimuth">http://www.orbiterwiki.org/wiki/Launch\_Azimuth</a>

# 12.0 - Prelude II - An advanced base

Prelude II is an advanced base for Orbiter included in DeltaGliderIV package.



Prelude II bases include the following features:

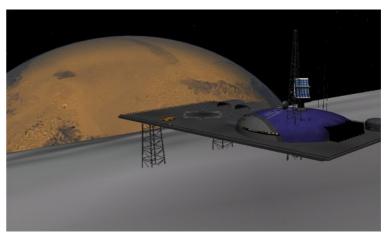
- Compatible UMmu (DGIV crew can enter, exit the base).
- One base can contain up to 40 UMmu crew.
- Animated solar panel that follow the sun.
- Animated airlock.
- Different skins included (skin SDK available on site).
- Animated pad lighting that change automatically when a ship is landed on pad.
- Custom sounds (ambiance, feedback voice).
- Flat or « mountain » pad (so it can be positionned for example on Phobos or on flat ground).
- User menu to manage airlock, EVA crew members, select skin, select socle, randomly renew crew members.
   Etc.

A Prelude II base can be positionned using Orbiter Scenario Editor (Select «DGIVPreludeII» ship) or you can select some DGIV scenarios that include it already. The fact that your landing gear may sometimes sink a bit into the pad is an Orbiter limitation, not a bug.

The base main menu:



The « mountain » style pad on Phobos



# 13.0 -Know bugs – limitation

#### Crash to desktop:

If you experience Crash to desktop during <u>EVA ingress</u> or <u>DeltaGliderIV destruction</u> it is 99.99% probable that you have another addon MFD or module that has kept a handle on DGIV or Ummu after is deletion. There is no workaround you can do for this, delete object is a normal Orbiter procedure. Keeping a handle is a bad programming practice as handle will point on nothing once an object deleted. The only solution is to ask the other addon's author to not keep Objects's handle but instead <u>object's name</u>, get the handle by name each timestep and <u>always</u> check returned handle before using them. Take care: the culprit may be an addon in a scenario but also a <u>plugin module</u> or a <u>MFD</u>

Some other addons may use tricks that are very dangerous such as spawning more than 60 docking ports or having mesh model with more than 100'000 polygons. Such bad practice may lead in some case to CTD also.

This said the DeltaGliderIV is very stable on a fresh installation of Orbiter 2006+P1 and works nicelly with most other addons.

Note: In some rare case where one addon makes DGIV CTD it seem that moving all prelude, DGIV and Ummu vessel on top of scenario before other addons \* may \* cure the problem.

### Sun image disappears during reentry or high G turn:

Sun image disappears when the heat shield or wings vapor effect are running: this is a know bug with one Orbiter function, Martin is aware of that and will correct it for next Orbiter version. Once the effect stops the image of the sun reapears. Anyway the sun image is rarely in field so this may not be too bad. If you can't sustain this limitation simply disable both effects using dg4config.exe

#### Wheels or UMmu sunk a bit in Prelude II station or are over ground:

As Phobos ground is not flat and the station very large I had to use a trick to not see half a DGIV sunk into ground, so the station's ground is a bit lower than the zero. At some place you'll see ships a bit over ground while on some others you'll see a small part of wheeel sinking into ground.

### No shadows on Prelude II base pad:

Prelude II is a vessel and can't receive a shadow. The big advantage of having a vessel is that you can spawn them everywhere with the scenario editor and don't need to edit the base configuration of Orbiter with a base that would exist in all scenarios. Second advantage is that in contrary of base, the textures are filtered and look way better.

Third avantage is that you can have a DLL and so an active base. Fourth avantage: as ships are not exactly over ground (see above) the shadow would look a bit off.

The drawback is that you don't have shadow on pad. One possible workaround would be to remove the pad from Prelude II (base's menu allow that) and declare the pad's mesh as a base using usual Orbiter config file. You'll just need to place the « Prelude II » vessel exactly over this pad and you would have both advantages: a vessel and shadow on ground (with textures not filtered, one can't have everything) (Note: I planned this workaround for Symphony IV the « big brother » project of Prelude II that wasn't released due to time, but I didn't test it on Prelude II)

The meshes of pad are located in Meshes/DGIVPreludeII/PreludeIIPad.msh or Meshes/DGIVPreludeII/PreludeIIPadMountain.msh

# Ascent autopilot doesn't put me at the exact altitude:

Autopilot final altitude depends on your engine and fuel setting, but it may also depend of your framerate (despite the fact that autopilots are insensible to framerate they can't work excatly the same when they can control the ship every 50 meters instead of every 500 meters wich is the case with a low framerate), Autopilots were designed to work for a fully fuelled DGIV, with MarkIV and normal fuel comsumption. Apart Mark II and below the autopilot will still work but with some difference in the final altitude. This is not too bad anyway.

# 14.0 - Frequently asked question – Other bugs

The FAQ is on the dansteph.com forum click here: <u>DGIV Frequently Asked questions / Bugs</u>
The advantage of a forum over documentation is that I can update this thread with new question or late bugs.

# 15.0 - Making addons, payload, scenarios or skins for DeltaGliderIV

A lot of things can be customised and added for DGIV:

- New DeltaGliderIV skin
- New payload skin (you can simply make new skins for containers and thus add a new container type)
- New payload (active with a dll module or simply a mesh)
- New Prelude II Skin
- New ascent autopilots
- New exciting adventure scenarios

You can find skin SDK (photoshop layered textures) and help text to make payloads or other things in the **« More DGIV download section »** of my site, use the top search banner to bring only the « Utility and SDK » section: <a href="http://orbiter.dansteph.com?disp=dgIVMore">http://orbiter.dansteph.com?disp=dgIVMore</a>

If you have made a new scenarios, skin or whatever for DeltaGliderIV you can upload it on my site using this link: <a href="http://orbiter.dansteph.com?disp=dglVUpload">http://orbiter.dansteph.com?disp=dglVUpload</a>

# 16.0 -Downloading or uploading more addons for DeltaGliderIV

All third-party addons for DGIV can be found in the **« More DGIV download section »** of my site, use the top search banner to sort by addons type (scenarios, skins, popularity etc etc) or search for a specific addon: <a href="http://orbiter.dansteph.com?disp=dgIVMore">http://orbiter.dansteph.com?disp=dgIVMore</a>

If you have made a new scenarios skin or whatewer for DeltaGliderIV (see above) you can upload it on my site using this link: <a href="http://orbiter.dansteph.com?disp=dglVUpload">http://orbiter.dansteph.com?disp=dglVUpload</a>

# 17.0 -Thanks and legal stuff

#### Thanks:

First thanks goes of course to **Martin** himself; without him and his Orbiter creation, none of this would have happened! Second thanks to the whole community of Orbiter, which is mainly composed of friendly and educated people. Special thanks to **Roger "Frying Tiger" Long**, who gave me the permission to use his DeltaGlider model. (that was four years ago, there is not much original polygon in the model but the basic shape remain;)

#### Special thanks to all beta testers:

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Matt "sunshine135" Dimock willy88 Quick\_Nick Voyager Pagir Brian "n122vu" Crane Kyle "G2g591" Elbert JoshB Picto

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Special thanks to my **familly**, the best things that ever happened in my life, my wonderful wife **Christine** who has supported me for years and my wonderful kids, **Laureline** and **Julien**.

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# 18.0 - Contact & About me

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#### About me:

My real name is Daniel Polli, aka "DanSteph" in the Orbiter community. I'm Swiss and was born in 1965 at Geneva in Switzerland and live presentely in France near Geneva. I'm married to Christine, who gave me two beautiful children: Julien (1999) and Laureline (2001), the two best gifts of my life.

As nobody can live from fresh air or program for free for months without income I have now my own company where I'm the only employee and have done one addon shareware for Flight simulator 2004, « FsPassengers » which has had an excellent review and is now popular in the flight simulator world. Being independant is not an easy task with incredible income. If you love flight simulator and like my work don't forget to check also my shareware FsPassengers. (Free demo)

**Avsim:** « I have never encountered any software for MSFS that has given me such an overall sense of what it's like to fly as a profession. » **Read AvSim review >>>** 

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