Microsoft / FlightFX

Archer Midnight – Microsoft Flight Simulator User Manual

For Microsoft Flight Simulator 2020 & 2024

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Preface

FOR SIMULATION USE ONLY - DESIGNED FOR SINGLE-PILOT OPERATIONS

This manual is designed to provide clear and concise instructions for operating the Archer Midnight electric vertical take-off and landing (eVTOL) aircraft within Microsoft Flight Simulator. The content herein is tailored for both new and experienced pilots, offering detailed guidance on the unique aspects of the Archer Midnight's operation. This simulation is based on an early development version of the aircraft and may not fully reflect the final production model. Some concessions have been made to simplify single-pilot operations within the simulation environment.

PHOTOSENSITIVE SEIZURE WARNING

A small percentage of individuals may experience seizures when exposed to certain visual stimuli such as flashing lights or patterns commonly found in video games. This can occur even in individuals with no prior history of epilepsy or seizures. If you experience any symptoms such as dizziness, vision changes, twitching, or loss of consciousness, stop playing immediately and consult a physician.

To minimize the risk of photosensitive seizures:

- Play in a well-lit room.
- Take regular breaks, especially if you feel tired or fatigued.
- If you or a family member has a history of seizures or epilepsy, consult a doctor before using this simulation.

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About Archer Midnight

The Archer Midnight is a cutting-edge electric vertical take-off and landing (eVTOL) aircraft, designed to revolutionize urban air mobility. This aircraft is tailored to short-distance air taxi services, ideal for transporting passengers between city centers and airports. Capable of carrying a pilot and four passengers, the Midnight is optimized for back-to-back flights of around 20 miles, with a total payload capacity exceeding 1,000 pounds.

Development History

Archer Aviation Inc., headquartered in San Jose, California, was founded in 2018 by Brett Adcock and Adam Goldstein. Their mission was to pioneer sustainable air travel, focusing on urban air mobility (UAM) solutions that reduce the environmental impact of traditional transportation. Archer's goal is to make air taxis an accessible and sustainable transportation option for city dwellers.

Archer's initial project, the Maker, was a proof-of-concept aircraft that helped validate their technology. In 2022, Archer introduced the Midnight, which represents a significant leap forward from the Maker. Designed for commercial use, the Midnight features advanced flight control systems and quieter operations, making it ideal for dense urban environments. The aircraft's efficient design allows for rapid turnarounds between flights, providing an innovative solution for city transport.

For more information on Archer Aviation, visit: https://archer.com/aircraft.

Sustainability and Innovation

Archer's commitment to sustainability is at the core of its operations. The Midnight is designed to operate with zero emissions, utilizing advanced battery technology. Additionally, the aircraft's low noise footprint (less than 65 dB during takeoff and landing) makes it suitable for use in residential areas and other noise-sensitive zones (Archer | Home)(dcf-fm).

Design Features

- **12 Fully Electric Motors**: The Archer Midnight is equipped with 12 electric motors. Six motors on the leading edge are housed in maneuverable nacelles that can tilt to aid in both vertical and horizontal flight. The remaining six motors on the trailing edge remain fixed and provide stability during all flight phases.
- **Redundancy and Safety**: The Midnight's motors and power systems are designed with full redundancy, ensuring continued operation even in the event of a motor failure.
- **Silent Operation**: The Midnight operates with near-silent propulsion, emitting minimal noise during take-off, hover, and flight, making it perfect for urban environments.

- **Single Pilot Operation**: The aircraft is designed for single-pilot operation, carrying up to four passengers and cargo payload of 1,000 pounds.

Specifications

- **Dimensions**: 25 feet in length with a 39 foot wingspan.
- **Power**: Fully electric, powered by high-efficiency battery systems.
- **Range**: 100 miles on a full charge, designed for short, frequent flights.
- **Maximum Cruise Speed**: 120 knots (indicated).
- **Endurance**: Comparable to other eVTOL competitors with fast charging capabilities allowing for quick turnarounds between flights.

Cockpit Overview

1. MFD (Multi-Function Display)
2. PFD (Primary-Flight Display)
3. MFD SOFTKEYS
4. PFD SOFTKEYS
5. GTC (Garmin Touchscreen Controller)
6. LEFT-HAND INCEPTOR (LHI)
7. RIGHT-HAND INCEPTOR (RHI)
8. PARKING BRAKE
9. BRAKE PEDALS
10. AUTOPILOT PANEL
11. REMOTE CONTROL PANEL
12. AIRCRAFT MODE SWITCH
13. POWER LIFT SWITCH
14. PITOT HEAT
15. ELT SWITCH
16. DIMMER SWITCH

The Archer Midnight's cockpit is designed to provide maximum situational awareness and ease of operation for single-pilot flights. It integrates advanced avionics, ergonomic controls, and a user-friendly interface, ensuring that pilots can easily manage the aircraft across all phases of flight.

Left Hand Inceptor (LHI) Overview

1. HVR (Hover) Hat Switch
    a. Forward (Increase Speed)
    b. Backward (Decrease Speed)
    c. Press (Switch between HVR and SPD modes)
2. TOGA (Take Off/Go-Around) Switch

Recommended Keybinds For LHI

SPD ACCEL……..Increase Flaps
SPD DECEL……..Decrease Flaps

Right Hand Inceptor (RHI) Overview

1. AP (Autopilot Disconnect Switch)

Key Components

- **Garmin G3000 Integrated Flight Deck**: A state-of-the-art flight management system that offers a fully integrated navigation and flight control solution. It includes both a Multi-Function Display (MFD) and a Primary Flight Display (PFD), ensuring that all critical flight data is easily accessible.
- **Primary Flight Display (PFD)**: Displays essential flight information such as altitude, attitude, heading, airspeed, and other critical indicators. The PFD also offers a split-screen moving map for enhanced situational awareness.
- **Multi-Function Display (MFD)**: Shows detailed aircraft systems data, including power management, energy consumption, and remaining battery capacity.
- **FBW (Fly-By-Wire) Controls**: The Midnight is equipped with fly-by-wire technology, enabling intuitive control via two Inceptors:

    - **Left Hand Inceptor (LHI):** Controls the throttle and overall speed of the aircraft.
    - **Right Hand Inceptor (RHI):** Controls altitude, pitch, and bank depending on the current flight mode.
- **Garmin Touchscreen Controller (GTC):** Allows for seamless navigation, system management, and flight planning through a user-friendly touchscreen interface.
- **Garmin Remote Panel**: Controls displays on MFD and PFD.
- **Garmin Flight Control**: Contains Autopilot Settings and Controls.
- **Flight Mode Annunciator** (FMA): Displays the active flight mode (e.g., hover, forward flight) and status of critical systems such as navigation mode and autopilot settings..
- **Softkeys**: Located beneath the PFD and MFD, these buttons allow interaction with system menus and flight settings.
- **Speed Button (Contains ACCEL/DECEL Switches)**: Automatically sets acceleration/deceleration rates for the aircraft to either a hover or forward flight , depending on flight phase.
- **Speed Hold / Hover Hold**: Depending upon flight mode, setting the LHI to Center position will enable Hold mode.

Energy Management Display

The energy management system of the Archer Midnight is critical to ensuring safe and efficient operation. The energy display shows vital information about battery capacity, and range endurance. Understanding these metrics helps pilots optimize the aircraft's performance during different flight phases.

- **Energy Bar**: Display remaining battery capacity.
- **Flight Time**: Provides real-time updates on remaining flight time based on current energy usage.

Quick Reference Guide

Pre-Flight

- **Aircraft Mode**: Move switch to GND (Ground) position.
- Press softkey to clear right Multi-Function Display (MFD) Splash Screen.
- **Battery Status**: Check battery charge on the MFD (Energy bar - 150 KWh).
- **Flight Controls**: Check the LHI (Left-Hand Inceptor) and RHI (Right-Hand Inceptor) for proper responses using the Control Margins section on the MFD .
- **Flight Plan**: Program the route using the GTC (Garmin Touch Controller).
- **VSpeeds**: Set Speed Bugs using the GTC.
- **Local Altimeter**: Set Barometric Altimeter as needed (Use B key as shortcut).
- **External Lights**: Activate position and strobe lights (optional - activate Signature light) using the GTC.
- **Pitot Heat**: Turn ON as needed.

Startup

- **Aircraft Mode**: Move switch to FLY position.
- **System Check**: Wait for FCS (Flight Control System) and TPS (Thrust Propulsion System) checks to complete [engine nacelles will cycle position and CAS (Crew Alerting System) messages will appear]
- **System Check Complete**: FCS and TPS CAS Messages will extinguish on the PFD (Primary Flight Display).
- **Parking Brake**: Release Parking Brake.
- **Crew Alerting System Messages**: Ensure no Red or Yellow CAS notifications remain.

Taxi

- **Throttle Control**: Use the LHI to adjust taxi speed, keeping it up to 15 knots. To accelerate, move the throttle control to more than 3/4 full-forward. Once you reach the desired speed, pull the throttle back to the centered position.
- **Steering**: Use the RHI twist axis for directional control.
- **Stopping**: Apply brake as needed.

Take-off (Vertical)

- **Landing Lights**: Turn ON (CAS Message Appears).
- **Parking Brake**: Release (if ON).
- **Throttle Setting**: Set LHI to Mid-Point (Use Control Margins Indicator on MFD for assistance).
- **Vertical Speed Control (RHI)**: Pull back to initiate lift-off.
- **Climb**: Maintain steady climb rate of 96 knots and monitor altitude on PFD.
- **Airspeed**: Increase LHI to full.
- **Transition from Hover to Forward Flight**: Use the "Set Accel" switch on LHI to transition from HVR (Hover) to SPD (Forward Flight).

Take-off (Conventional)

- **Landing Lights**: Turn On (CAS Message Appears).
- **Parking Brake**: Release (if ON).
- **Throttle Setting**: Set LHI to full forward (Cross Check with Control Margin).
- **Minimum Safe Speed**: Aircraft should achieve a forward speed of 78 KIAS before applying back pressure to the RHI.
- **Take-Off/Go-Around (TOGA)**: Press TOGA button during take-off roll (Flight Director will pitch up).
- **Vertical Speed Control (RHI)**: Pull back gently to initiate lift-off (Follow Flight Director V-bars).
- **Climb**: Maintain steady climb rate at 96 knots, monitor altitude on PFD.

Forward Flight

- **Airspeed (LHI)**: Push forward to accelerate.
- **Cruise Speed**: Recommended Cruise Speed is 117 knots indicated (KIAS).Speed Hold: Engage Speed Hold for constant airspeed (Center Throttle Axis until "SPD HLD" appears on FMA).
- **Energy**: Track power usage via the battery display on MFD.
- **Autopilot**: AP (Autopilot) is available via the GFC (Garmin Flight Controller) panel.

Landing (Vertical)

- **Decelerate**: Pull back LHI to reduce speed.
- **Vertical Speed (Descend)**: Initiate descent by pushing forward on RHI (recommended to not exceed 900 fpm or 80 KIAS).
- **Hover Mode**: When speed drops below 70 knots, mode will switch from "SPD" to "HVR."
- **Positioning**: Use RHI to translate laterally and vertically to target landing spot (Combine these maneuvers while descending if desired)

- **Throttle**: Place LHI in mid-point once firmly on the ground to prevent drifting. (Use Control Margins Indicator on MFD for assistance).

Landing (Conventional)

- **Decelerate**: Pull LHI back to reduce speed.
- **Approach Speed**: Use an approach speed of 80 knots ("SPD HOLD" can help keep speed constant)
- **Descend on Approach**: Use RHI to descend by pitching down.
- **Vertical Speed (RHI)**: Manage descent rate (target -300 fpm, do not exceed 900 fpm or 80 knots).
- **Flare**: Lightly flare using the RHI while cutting power using the LHI.
- **Braking**: Use brakes as required.

Shutdown

- **Parking Brake**: Set to ON.
- **Lighting**: Extinguish lights as needed.
- **Aircraft Mode**: Switch to Off to secure the aircraft after landing.

Definition Of Flight Phases

The Archer Midnight operates across four key flight phases, each requiring specific control inputs. Understanding these phases is critical for mastering the aircraft's performance during various maneuvers.

1. Ground Phase

- **Condition**: The aircraft is stopped on the ground, with parking brake engaged.
- **Controls**:
    - LHI: Controls acceleration: pushing fully forward commands an acceleration of 4 knots, while keeping it centered maintains the current ground speed.
    - RHI: Manages steering on the ground via twist axis for precise control during taxi maneuvers.

2. Thrust-Borne Flight Phase (Hover)

- **Condition**: The aircraft becomes airborne at speeds below 40 knots by relying entirely on vertical thrust.
- **Controls**:
    - LHI: Regulates forward and backward ground speed. Pushing it fully forward commands a forward speed of 30 knots, pulling it fully backward commands a reverse speed of 5 knots, and centering it brings the vehicle to a full stop and holds position.
    - RHI: Controls vertical speed (climb or descent), lateral and heading movements, and altitude hold.

3. Transition Flight Phase

- **Condition**: The aircraft is transitioning from vertical thrust to wing-borne flight as the speed increases between 40 and 80 knots.
- **Controls**:
    - LHI: Regulates acceleration and deceleration during the transition.
    - RHI: Controls pitch and vertical speed throughout the transition phase.

4. Wing-Borne Flight Phase (Conventional)

- **Condition**: The aircraft is in forward flight at speeds above 78 knots, with the wings generating the majority of the lift.
- **Controls**:
    - LHI: Manages acceleration. A full forward deflection commands maximum acceleration, a full backward deflection commands maximum deceleration, and centering the control maintains the current indicated airspeed (IAS).

    - RHI: Manages pitch and roll, allowing for conventional aircraft maneuvers.

Flight Mode Transitions

- **Forward Flight to Hover**: The Midnight automatically transitions from forward flight to hover mode when the aircraft decelerates below 40 KIAS.
- **Hover to Forward Flight**: The pilot initiates the transition to forward flight by one of the following methods:
    - Use the “HVR” switch on the LHI by pressing down the LHI thumb stick. This activates the transition from “HVR” to “SPD” mode, as indicated on the FMA.
    - Move the LHI thumb stick forward to command “SPD ACCEL,” causing the aircraft to accelerate to a cruise speed of 120 KIAS and transition to forward flight when appropriate.
- **Forward Flight to Hover**: Activated by pulling the LHI back to decelerate below 40 knots. The nacelles tilt upward, shifting from wing lift to vertical thrust, bringing the aircraft into hover mode. Alternatively, the pilot can use the “SPEED DECEL” switch to reduce speed below 50 knots and transition from SPD to HVR mode.

Control Responses In Different Flight Phases

The Archer Midnight's control inputs are dynamically adjusted based on the flight phase, providing optimal handling in each mode. Understanding how the inceptors (LHI and RHI) respond in various phases ensures smooth, safe operation.

Inceptor	Axis	Ground Phase	Hover Phase	Transition Phase	Conventional Flight Phase
LHI	*Forward/Backward*	*Speed Control (Taxi)*	*Speed Control (Hover)*	*Acceleration/Deceleration*	*Acceleration/Deceleration*
RHI	*Forward/Backward*	*Vertical Speed Control*	*Vertical Speed Control*	*Vertical Speed Control*	*Pitch Control*
RHI	*Left/Right*	*Steering (Ground)*	*Bank/Side-Slip Control*	*Bank Control*	*Bank Control*
RHI	*Twist (Clockwise)*	*Steering (Ground)*	*Heading Control*	*Heading Control*	*Yaw Control*

Inceptor Functions by Flight Phase

1. Ground Phase

- **LHI (Left Hand Inceptor)**: Controls acceleration. Pushing the inceptor forward increases speed, while centering it maintains the current speed. Caution is advised, as sustained full forward deflection can cause the aircraft to accelerate into the Conventional Take-off Phase. It's recommended to push the inceptor up to three-quarters full to establish a forward taxi speed, then return it to the midpoint to hold the set speed.
- **RHI (Right Hand Inceptor)**: Used for ground steering by twisting the inceptor left or right. Be cautious, as vertical control is also active at this time, and an inadvertent backward pull on the RHI could cause an unintended lift-off.

2. Hover Phase

- **LHI (Left Hand Inceptor)**: Adjusts forward ground speed. Full forward deflection commands forward movement up to 30 knots, while full backward deflection enables a low-speed reverse movement (moving the aircraft backward). Keeping the throttle at the midpoint holds the aircraft stationary or maintains the current speed, whether moving forward or backward. Deflecting left or right commands a side-slip.

- **RHI (Right Hand Inceptor)**: Controls vertical speed. Pulling back commands a climb (up to 750 feet per minute), while pushing forward initiates a descent. Deflecting left or right changes the aircraft's heading.

3. Transition and Conventional Flight Phase

- **LHI (Left Hand Inceptor)**: Used to control acceleration and deceleration, allowing the pilot to adjust or maintain forward speed. When centered, it engages speed hold.
- **RHI (Right Hand Inceptor)**: Controls pitch and roll for conventional maneuvers like turning and climbing or descending. Twisting the inceptor adjusts yaw for directional changes.

Operations

The Archer Midnight's operational procedures are designed to ensure efficient, safe handling across all phases of flight. This section outlines the key steps for startup, taxi, lif=toff, transitioning to forward flight, deceleration, and hover.

Startup

Procedure:

1. **Aircraft Mode**: Move Aircraft Mode Switch to GND position to initiate the power sequence.
2. **Garmin System Boot**: Wait for the Garmin G3000 system to fully initialize.
3. **Clear Splash Screen**: Press the softkey on the MFD to proceed to the system synoptics page.
4. Set Pitot Heat Mode as needed.
5. Ensure P/L (Power/Lift) Toggle switch is ON (P/L enabled light is illuminated on FMA).
6. Use Sim Actions Softkey to manage cabin doors and invoke Ground Charger cart for battery replenishment as needed. Charging and Cooling CAS messages will appear in PFD.

Tips:

- Ensure all systems are active and functioning before proceeding with taxi or take-off.
- Familiarize yourself with the flight management system layout to quickly access key flight information.

Taxi

Procedure:

1. **Sim Actions Menu (PFD)**:
    - Secure the doors and dismiss the Ground Charger cart.
    - Confirm the status of each door using the door softkeys (check for OPEN/CLOSED status) and perform a visual check from the exterior view.
2. **Interior Lights**:
    - Set to "No Smoking/Seatbelts On." Passenger LCD displays should show illuminated icons.
3. **Exterior Lights**:
    - Adjust as needed for the conditions.
4. **Aircraft Switch Mode**:
    - Set to FLY mode.
5. **Parking Brake**:
    - If the parking brake is on (indicated by a CAS message on the PFD), release it.

6. **Taxi Speed**:
    - Move the LHI to the three-quarters position to establish taxi speed, then return it to the centered position to maintain the speed.
7. **Steering**:
    - Use the bank (left/right) function of the RHI to steer the aircraft.
8. **Brakes**:
    - Apply brake control as needed during taxi.

Tips for Ground Taxiing:

- Apply small throttle adjustments for smooth taxi operations and avoid inadvertent acceleration into take-off modes. Always return throttle to centered mode to maintain current speed.
- The Midnight is highly agile, so precise steering is possible even in tight spaces.
- Conventional braking is available to manage forward taxi speed.

Lift-Off

The Archer Midnight is capable of both vertical take-off / landing (VTOL) and Conventional take-off / landing (CTOL), providing maximum flexibility in airport and destination use..

Vertical Procedure:

1. **Set Aircraft Mode to FLY**: Ensure the aircraft is ready for take-off.
2. **Control Vertical Speed**: Pull back on the RHI to initiate vertical lift-off. Adjust the deflection to control climb rate.
3. **Altitude Hold**: Center the RHI to maintain the current altitude.

Tips for Vertical Lift-Off:

- Center the throttle to maintain stationary hover, or move gently forward to induce a forward speed under 40 knots.
- Avoid sudden RHI movements to ensure stable take-off.

Conventional Procedure:

1. **Set Aircraft Mode to FLY Mode**: Ensure the aircraft is ready for takeoff.
2. Set LHI to full forward position to accelerate to VMSS (Minimum Safe Speed - 78 knots indicated)
3. **Optional**: While take-off roll is occurring, Press Take-Off/Go–Around button on LHI to set the Flight Director V-Bars to the proper take-off angle. TO - TO (Take-Off / Take-Off) will also illuminate on the FMA.

4. **Control Vertical Speed**: Pull back on the RHI to initiate CTOL lift-off. Adjust the deflection to control climb rate. If pilot activated TOGA mode during take-off roll, they can match the aircraft pitch (Yellow bars) to the Flight Director V-bars to maintain optimal pitch up angle. Best angle-of-climb is 80 KIAS, Best rate-of-climb is 96 KIAS.
5. **Altitude Hold**: Pitch down the RHI to maintain the current altitude once at desired cruise level and release to set the angle.

Tips for Conventional Lift-Off:

- Ensure speed is at VMSS (78 knots) before rotating off the runway.
- Use TOGA to guide optimum pitch angle during the first several hundred feet of climb.
- Once above 200', use Best AoC (80 KIAS) or RoC (96 KIAS) as required to reach cruise altitude.

Transition To Forward Flight

Once airborne using VTOL , the Archer Midnight can transition from vertical hover to forward flight by increasing airspeed (use "HVR" switch to transition from "HVR" to "SPD").

Vertical Lift-off Procedure:

1. **Increase Airspeed**: Push the LHI to full forward deflection to command forward acceleration, transitioning the aircraft out of hover mode. (Optionally, use SPD ACCEL switch).
2. **Monitor Nacelles**: As speed increases above 40 knots, the nacelles will tilt forward, transitioning the aircraft into forward flight.
3. **Flight Mode Annunciator**: The FMA will update as the aircraft shifts from hover mode to forward flight mode.

Key Considerations:

- Forward flight is more energy-efficient, so it is advisable to transition out of hover as soon as practical to conserve power.

Conventional Lift-off Procedure:

1. N/A - the Archer is already in forward flight upon conventional take-off

Deceleration and Landing

In both VTOL and CTOL modes, reducing speed while managing altitude per recommended descent schedule efficiently uses remaining battery life while remaining out of potentially hazardous Vortex Ring State.

Vertical Landing Procedure:

1. **Reduce Speed**: Pull back on the LHI to decelerate. The nacelles will gradually tilt upward as the speed decreases. (Optional - use SPEED DECEL switch).
2. **Descent Parameters**: It is recommended not to exceed 900 fpm or 80 KIAS while in descent.
3. **Hover Transition**: Once speed drops below 50 knots, the aircraft will enter hover mode. Use the RHI to manage vertical speed.
4. Maneuver as necessary to land at a parking spot.

Tips:

- Use the SPEED DECEL switch to invoke the deceleration process, particularly during approach for landing.
- Do not exceed 900 fpm or 80 KIAS in descent to minimize entering Vortex Ring State.
- Monitor airspeed and altitude closely to ensure a smooth transition back to hover.

Conventional Landing Procedure:

1. Reduce Speed: Pull back on the LHI to decelerate. To decelerate to approach speed of 90 KIAS
2. Establish Approach Speed: Set your approach speed to 90 knots and use Speed Hold to maintain that speed all the way all the way to main gear touchdown. Use the RHI to manage vertical speed.
3. Flare as you would with a conventional fixed wing aircraft, touch down speed is around 78 KIAS.
4. Once mains and nose are fully in contact, cut power all the way back using the LHI and use brakes to come to a full stop.

Flight Assistance and Automatic Functions

The Archer Midnight is equipped with a fully integrated Garmin Flight Control Autopilot. The GFC provides fully coupled autopilot inputs in all axes and managed ascent and descent modes (FLC, VS, VNAV).

Mode: Speed Hold / Hover Hold

Overview: The Speed Hold/Hover Hold mode maintains a constant airspeed by automatically adjusting thrust. This reduces pilot workload during forward flight and helps optimize energy consumption.

- **Operation**: The pilot invokes “SPD HLD” (Speed Hold) or “HVR HLD” (Hover Hold) by bringing the LHI to the centered position.

Activation:

- Toggling: Speed Hold can be activated by centering the Left Hand Inceptor (LHI).
- FMA Display: "SPD HLD" will be shown on the FMA when Speed Hold is active or “HVR HOLD” if in Hover mode.

Energy Management Strategies

Effective energy management is crucial when operating the Archer Midnight, especially considering the limitations of battery-powered flight. Understanding how different flight phases affect energy consumption allows pilots to maximize range and flight time while ensuring enough power remains for safe landings.

Battery Capacity and Energy Usage

The Archer Midnight uses high-efficiency lithium-ion batteries, with a total capacity displayed as a percentage on the MFD. The remaining energy is critical for planning flight duration and managing transitions between flight phases.

- **Key Metrics**:
    - **Battery Capacity**: Measured in kilowatt-hours (kWh) and shown as a percentage on the MFD.
    - **Range and Endurance**: Shows how far or how long the aircraft can fly based on current energy consumption.

Flight Phase Impact On Energy Usage

Each flight phase consumes energy at different rates. To optimize performance, pilots should understand how these phases affect energy draw:

- **Hovering**: This is the most energy-intensive phase, using significant power to maintain altitude.
    - Recommendation: Minimize time spent in hover mode to conserve energy, especially during extended flight.
- **Forward Flight**: Once the aircraft transitions to wing-borne flight, energy consumption decreases significantly.
    - Recommendation: Transition to forward flight as soon as practical to maximize range and reduce energy draw.
- **Climbing**: While climbing requires more power than cruising, it is less energy-intensive than hovering.
    - Recommendation: Perform moderate climbs to avoid excessive energy consumption. Use AoC or ROC as required as this is the most optimum V Speeds for this maneuver.

Range Vs. Endurance Considerations

Balancing range and remaining battery life is vital for safe and efficient operation. The MFD provides real-time updates on both metrics, allowing the pilot to adjust accordingly.

- **Range**: Represents how far the aircraft can travel based on current energy consumption and speed.
- **CTOL versus HOVER**: Ranges are updated based upon the intended flight mode.

Energy Management Techniques

To optimize energy consumption, pilots can use the following techniques:

- **Prioritize Forward Flight**: Hovering consumes the most power, so transition to forward flight as soon as possible to conserve energy.
- **Monitor Remaining Battery Life**: Regularly check the MFD for current battery life remaining usage. Adjust speed and altitude to optimize battery life during different flight phases.
- **Use Speed Hold**: Engaging Speed Hold mode during forward flight helps maintain efficient energy consumption by keeping airspeed steady.
- **Use Cruise Speeds**: the Archer's recommended cruise speed is 117 KIAS at sea level. Traveling at this rate helps with efficient battery consumption while not compromising on speed of advance.
- **Plan for Contingencies**: Always reserve enough battery power for unexpected delays or missed approaches, especially when performing vertical landings.

Post-Landing Procedures

After touchdown, the Archer Midnight automatically transitions to a safe post-landing state, ensuring the aircraft is secured for egress.

Procedure:

1. **Power Reduction**: Once the aircraft detects weight on wheels, it will automatically cut power to the motors to and secures propellers to allow safe ground personnel transit and movement. .
2. **Switch to GND Mode**: Use the Aircraft Mode switch to invoke GROUND MODE. This locks the nacelles in the upright position and disables flight controls, ensuring safe egress for passengers and crew.

Key Considerations:

- **Gentle Touchdown**: A controlled, slow descent ensures a smooth and safe landing. Avoid hard landings, as these could damage the aircraft.
- **Parking Brake**: Enabling the Parking brake is another system setting that prevents inadvertent maneuvering and take-off.

Emergency Procedures

In rare instances, pilots may face emergencies that demand quick and decisive action. While the Archer Midnight is equipped with various safety systems designed to reduce risks, it is crucial for pilots to understand the proper response to handle emergencies effectively, especially in simulation scenarios. Familiarity with these systems and emergency procedures is key to maintaining control and ensuring safety.

Power Loss or Battery Depletion

Situation: Sudden loss of power or significant battery depletion can lead to the aircraft losing thrust, especially during hover or landing phases.

Procedure:

1. **Monitor Battery Levels**: Continuously monitor the battery status on the MFD during flight. If the battery drops below critical levels, prepare for an emergency landing.
2. **Switch to Forward Flight**: If hovering when power is low, immediately transition to forward flight to conserve energy.
3. **Emergency Descent**: Begin a controlled descent using the RHI. Keep the descent rate manageable to avoid a hard landing.
4. **Landing**: Aim for the closest flat, safe surface. Once the aircraft touches down, power off the systems to conserve remaining energy.

Prevention:

- Regularly check energy consumption and always maintain a buffer for emergency landings.
- Avoid prolonged hovering, which depletes battery reserves more quickly than forward flight.

Loss of Control Due to Environmental Factors

Situation: External conditions such as high winds, turbulence, or gusts can cause the aircraft to become unstable, particularly during hover.

Procedure:

1. **Transition to Forward Flight**: If hovering becomes difficult due to wind, transition into forward flight to regain stability.
2. **Manual Adjustments**: Use manual controls for pitch and yaw to stabilize the aircraft.
3. **Controlled Descent**: If necessary, begin a controlled descent using the RHI, keeping the descent rate manageable.

Prevention:

- Check weather conditions before flight and avoid flying in areas with extreme turbulence or high winds.
- Practice hover maneuvers in light wind conditions to become familiar with how the aircraft responds.

Troubleshooting/FAQ

During flights, you may encounter issues that require troubleshooting. The following section addresses common problems and how to resolve them to ensure smooth operation.

Aircraft Does Not Respond to Inceptor Inputs

Problem: The aircraft is unresponsive to Left Hand Inceptor (LHI) or Right Hand Inceptor (RHI) inputs.

Solution:

1. **Check Flight Mode**: Ensure the aircraft is in FLY mode. If the aircraft is in GND mode, it will not respond to inceptor inputs.
2. **Control Mapping**: Verify that your control mappings in Microsoft Flight Simulator are correct. Ensure that the LHI is mapped to the throttle axis and the RHI is mapped to pitch, roll, and yaw axes.
3. Check Parking Brake is OFF.
4. **Restart Systems**: If the issue persists, restart the simulator or reset the aircraft to its initial state.

Aircraft Drifts During Hover

Problem: The aircraft drifts during hover mode, making it difficult to maintain position.

Solution:

1. **Recalibrate Controls**: Ensure that your joystick or throttle is properly calibrated. Drift may occur due to unintentional inputs caused by incorrect calibration. Recalibrate through the simulator settings.
2. **Check Wind Conditions**: Strong winds may cause drift. Use manual inputs on the RHI to counteract drift.
3. **Energy Management**: Ensure that there is sufficient power to maintain hover. Low battery power can reduce rotor efficiency, leading to drift.

Aircraft Consumes Battery Too Quickly

Problem: The aircraft depletes its battery faster than expected, limiting flight duration.

Solution:

1. **Forward Flight**: Minimize time spent hovering, as it consumes significantly more power than forward flight. Transition into forward flight as soon as possible.

2. **Monitor Energy Draw**: Regularly check the energy display on the MFD to track power consumption. Adjust speed and altitude to optimize energy use.
3. **Direct Route Planning**: Ensure that your flight route is efficient, with minimal deviations or unnecessary maneuvers that could increase energy consumption.
4. **Minimize System Load**: Reduce non-critical system usage to extend battery life.

Nacelles Fail to Transition

Problem: The nacelles do not transition between vertical and horizontal positions during the hover-to-forward flight transition or vice versa.

Solution:

1. **Check Airspeed**: Ensure that the airspeed is appropriate for the transition. The nacelles will begin to tilt forward once the airspeed exceeds 40 knots.

Flight Mode Annunciator Fails to Update

Problem: The Flight Mode Annunciator (FMA) does not correctly display the current flight mode, such as hover, forward flight, or transition.

Solution:

1. **Recheck Flight Status**: Verify the current flight phase using the PFD and MFD. The FMA should update once the aircraft reaches the appropriate airspeed for each mode.
2. **Manual Reset**: Toggle flight modes manually using the MFD softkeys. If the FMA does not update, try resetting the aircraft's systems.
3. **Restart the Simulator**: If the problem persists, restart the flight to reset the avionics.

Glossary of Technical Terms

- **FBW (Fly-By-Wire)**: A flight control system that replaces traditional manual flight controls (e.g., cables and pulleys) with electronic systems. In FBW, pilot inputs are converted into electrical signals that control the aircraft's flight surfaces. This system allows for more precise control and the implementation of safety features such as envelope protection. FBW also reduces pilot workload by managing complex inputs, especially in variable flight conditions.
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- **LHI (Left Hand Inceptor)**: The inceptor (control lever) located on the left side of the pilot's seat. The LHI is responsible for controlling throttle, speed, and acceleration. In hover mode, it adjusts ground speed, while in forward flight, it controls acceleration and deceleration. The LHI is mapped to the throttle axis and also has functions for activating automated flight modes such as Speed Hold.
- **RHI (Right Hand Inceptor)**: The inceptor located on the right side of the pilot's seat, responsible for controlling altitude, pitch, and bank. During hover, it manages vertical speed (climb/descent), and during forward flight, it controls pitch (nose up/down) and bank (left/right). The RHI also allows the pilot to adjust yaw (turning the aircraft left or right) by twisting the handle.
- **FMA (Flight Mode Annunciator)**: A display in the cockpit that indicates the current flight mode and important status information. For example, the FMA will show whether the aircraft is in hover, forward flight, or transitioning between modes. The FMA also displays automated flight modes such as Speed Hold and Hover Hold, providing visual feedback to the pilot on the active flight systems.
- **MFD (Multi-Function Display)**: A digital screen in the cockpit that provides comprehensive information about the aircraft's systems, energy usage, navigation, and operational status. The MFD can display flight plans, battery levels, power consumption, range estimates, and other critical data in real time. Pilots can also access the aircraft's control menus through soft keys located on the MFD.
- **PFD (Primary Flight Display)**: A cockpit display dedicated to presenting essential flight information such as altitude, airspeed, heading, attitude, and flight mode status. The PFD typically includes a moving map for situational awareness, as well as flight director cues (e.g., V-bars) to help pilots maintain optimal flight paths.
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- **VTO (Vertical Take-off)**: The capability of the Archer Midnight to take off vertically without requiring a runway. During vertical take-off, the nacelles remain in an upright position, providing lift purely from the rotors. This feature allows the eVTOL to operate in confined spaces like urban environments and helipads, where runway space is unavailable.
- **Waypoint**: A geographical reference point used for navigation, typically defined by GPS coordinates. Waypoints are used in flight planning to create a route that the aircraft will follow. In the Archer Midnight, the Decel to Waypoint function will automatically slow the aircraft as it approaches the designated waypoint, allowing for precise arrivals.

- **Pitch**: The movement of the aircraft's nose up or down, which affects altitude and airspeed. Controlled via the RHI (Right Hand Inceptor), pitch adjustments allow the pilot to climb, descend, or maintain level flight. In forward flight, pulling back on the RHI raises the nose (climb), and pushing forward lowers the nose (descent).
- **Bank**: The tilt of the aircraft to the left or right, which determines the angle of turns. Banking is controlled via left or right deflection of the RHI. In wing-borne flight, the Archer Midnight behaves like a traditional fixed-wing aircraft, banking to the left or right to change direction.
- **Yaw**: The rotation of the aircraft's nose left or right around its vertical axis. Yaw is controlled by twisting the RHI or using rudder pedals if available. Yaw adjustments are essential during hover to change the aircraft's heading without affecting its position.
- **Nacelle**: The housing structure for the aircraft's engines and rotors. The Archer Midnight's nacelles are mounted on both the leading and trailing edges of the wings. The six leading-edge nacelles can tilt to transition between vertical lift and forward thrust, allowing the aircraft to switch between hover and forward flight modes.
- **Speed Hold**: An automated flight mode that maintains a constant airspeed by adjusting the throttle while in forward flight. When Speed Hold is engaged, the pilot can use the Accel and Decel thumbstick to change target speeds, and the aircraft will automatically adjust power to maintain that speed.
- **Hover Hold**: An automated flight mode that maintains a constant airspeed by adjusting the throttle while in hover flight. . This mode is useful to maintain a target forward or backward speed during hover, reducing the need for manual inputs from the pilot.
- **Envelope Protection**: A safety feature built into the fly-by-wire system that prevents the aircraft from exceeding safe operational limits. For example, envelope protection might limit the aircraft's maximum bank angle to prevent dangerous rollovers, or it may prevent excessive pitch angles that could lead to stalls.
- **Energy Draw**: A measurement of how much power the aircraft is currently consuming, displayed in kilowatts (kW). Energy draw is a critical metric for managing battery life and ensuring that the aircraft has sufficient power for hover, forward flight, and landing. The MFD shows real-time energy draw, helping the pilot optimize power usage.
- **Hover Mode**: A flight phase where the aircraft maintains a stable position and altitude using vertical thrust alone. In hover mode, the aircraft relies on its rotors for lift rather than forward momentum. This mode is useful for take-off, landing, and precise maneuvering over a fixed point.
- **KIAS (Knots Indicated Airspeed)**: A measurement of the aircraft's airspeed in knots (nautical miles per hour), as shown on the airspeed indicator. Indicated airspeed is not corrected for altitude or temperature variations and provides a direct reference for managing safe flight speeds.
- **G-Force**: The acceleration experienced by the aircraft and its occupants, measured in units of gravity (G). In aviation, G-force is typically felt during maneuvers such as turns, climbs, and descents. The Archer Midnight's flight control system limits G-forces to ensure passenger comfort and structural safety.

- **RPM (Revolutions Per Minute)**: A measurement of how fast the rotors are spinning, expressed as the number of full rotations per minute. Monitoring RPM is essential for managing thrust and ensuring the motors are operating within safe parameters.
- **KWh (Kilowatt-hour)**: A unit of energy measurement that represents the total power consumption of the aircraft. The Archer Midnight's battery capacity is measured in kWh, and understanding this unit is essential for energy management and flight planning.
- **GROUND MODE**: A mode where power to the motors is cut, and the nacelles are locked in the upright position for safe boarding and deboarding. In GROUND MODE, all control inputs are disabled, preventing accidental motor activation or movement during ground operations.
- **Fly Mode**: The primary operational mode where the motors are powered, and control inputs are enabled, allowing the aircraft to take off, hover, and fly. The pilot can toggle between FLY MODE and GROUND MODE using the AIRCRAFT MODE switch.
- **V-Tail**: A tail configuration where two slanted tail surfaces combine the functions of both horizontal and vertical stabilizers. The V-tail design improves aerodynamic efficiency and reduces drag, contributing to the aircraft's overall performance and fuel economy.

Archer Midnight eVTOL Flight Checklists

Disclaimer: This checklist is intended for simulation purposes only. It is designed for use with the Archer Midnight eVTOL aircraft within Microsoft Flight Simulator 2024. It does not reflect real-world flight procedures and should not be used for actual flight operations.

Pre-Flight Checklist

- **Battery Status**: Check battery capacity on the MFD, ensuring sufficient charge for the flight.
- **Aircraft Mode**: Confirm the aircraft is in GROUND MODE.
- **Flight Controls**: Perform a control check—ensure the LHI and RHI respond appropriately.
- **System Check**: Power on Garmin G3000 and clear the splash screen.
- **Flight Plan**: Program the flight plan into the GTC if applicable.
- **External Lights**: Activate position and strobe lights.
- **Weather Check**: Review weather conditions for potential wind or turbulence.

Startup Checklist

- **Aircraft Mode**: Set the aircraft to FLY Mode via the MFD softkey.
- **Flight Mode Annunciator**: Verify that the FMA displays FLY Mode.
- **System Initialization**: Wait for the Garmin G3000 system to initialize fully.
- **Energy Management Display**: Check energy bars, flight range, and power status.
- **Cockpit Lights**: Adjust interior lighting as necessary.

Taxi Checklist

- **Aircraft Mode**: Confirm aircraft remains in FLY Mode.
- **Throttle Control (LHI)**: Set taxi speed using forward deflection of the LHI (up to 15 knots).
- **Steering Control (RHI)**: Use the RHI twist axis or rudder pedals to steer during taxi.
- **Braking**: Test brakes.
- **External Lights**: Ensure taxi lights and signature lights are active if required.
- **Monitor Energy Usage**: Watch energy draw during taxi; minimize unnecessary power usage.

Vertical Take-Off (VTO) Checklist

- **Flight Mode**: Verify FLY Mode is active.
- **Vertical Speed Control (RHI)**: Gently pull back the RHI to initiate lift-off.
- **Climb Rate**: Maintain a steady climb, adjusting the RHI for a controlled ascent.
- **Altitude Check**: Monitor vertical speed and altitude on the PFD.
- **Energy Management**: Keep an eye on power draw, especially during ascent.

Transition to Forward Flight Checklist

- **Airspeed Control (LHI)**: Push the LHI to full forward deflection to accelerate.
- **Nacelle Transition**: Monitor the nacelles tilting forward as airspeed increases past 40 knots.
- **FMA Confirmation**: Check the FMA to confirm the transition to forward flight.
- **Level Flight**: Use the RHI to maintain level flight by adjusting pitch as needed.
- **Speed Hold**: Engage Speed Hold mode if a constant airspeed is desired.
- **Monitor Energy Draw**: Track energy consumption as the aircraft transitions to wing-borne flight.

Cruise (Forward Flight) Checklist

- **Altitude & Heading**: Ensure the aircraft is maintaining the correct altitude and heading.
- **Speed Management**: Use the Speed Hold Joystick to maintain a steady speed if desired.
- **Level Hold**: Engage Level Hold mode for straight and level flight.
- **Energy Monitoring**: Regularly check battery capacity, range, and power consumption on the MFD.
- **Flight Plan Monitoring**: Confirm the aircraft is following the designated flight path or GPS route.
- **Environmental Check**: Monitor weather conditions, turbulence, and winds.
- **Communications**: Stay in contact with air traffic control or applicable communications channels.

Deceleration & Approach to Hover Checklist

- **Deceleration (LHI)**: Gradually pull back the LHI to reduce speed below 80 knots.
- **Activate Decel to Hover**: Press the DECEL button to automate the transition to hover mode.
- **Monitor Airspeed**: Watch as the airspeed drops below 40 knots and the nacelles tilt upward.
- **Vertical Speed Control (RHI)**: Adjust the RHI to manage vertical speed during the transition to hover.

Hover Checklist

- **RHI Control**: Use the RHI to manage altitude and vertical speed.
- **LHI Control**: Use the LHI for forward speed control or hover position adjustments.
- **Energy Monitoring**: Check energy levels, as hovering consumes significant power.
- **Monitor Drift**: Watch for drift due to wind, and use manual inputs to correct position.

Landing Checklist

- **Align with Landing Zone**: Use RHI and LHI to position the aircraft above the landing zone.
- **Reduce Vertical Speed (RHI)**: Gently push forward on the RHI to initiate a controlled descent.
- **Final Descent Rate**: Target a descent rate of -300 feet per minute for a smooth landing.
- **Monitor Altitude**: Use visual and instrument cues to manage altitude during the final descent.
- **Touchdown**: Upon detecting weight on wheels, the aircraft will automatically reduce power to the motors.

Post-Landing Checklist

- **Switch to GROUND MODE**: After safely landing, use the AIRCRAFT MODE switch to transition the aircraft to GROUND MODE.
- **Power Off Motors**: Confirm that power to the motors has been cut after touchdown.
- **External Lights**: Turn off landing and position lights as necessary.
- **Passenger Safety**: Confirm passengers are secure and prepare for disembarkation.
- **Energy Status**: Check remaining battery capacity and log energy consumption for flight reporting.

Shutdown Checklist

- **AIRCRAFT MODE Switch**: Turn the AIRCRAFT MODE switch OFF after flight systems are powered down.
- **Flight Log**: Record flight data, including battery usage, flight time, and any irregularities.
- **Post-Flight Inspection**: Perform a quick post-flight inspection of the aircraft, checking for any visible issues or required maintenance.

Disclaimer: This checklist is intended for simulation purposes only within Microsoft Flight Simulator 2024. It is not applicable to real-world flight operations or any real eVTOL aircraft.