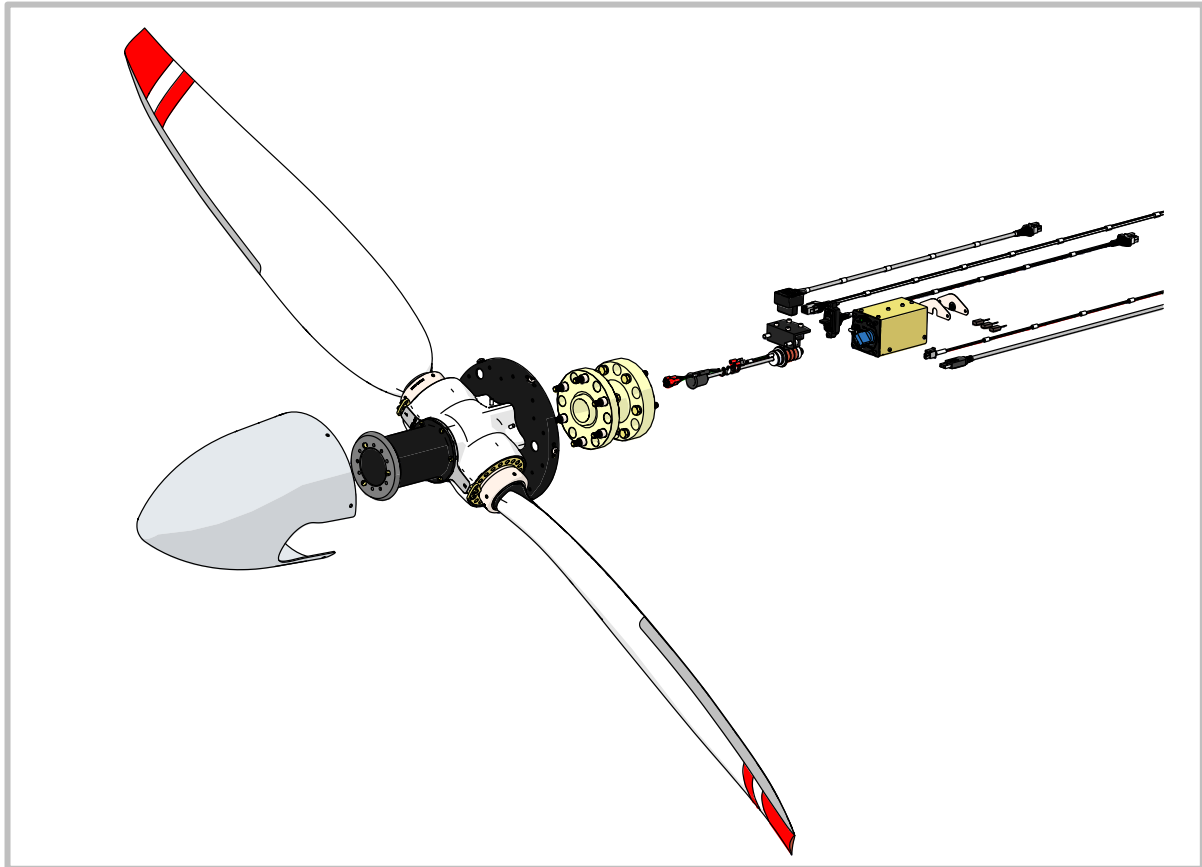


REVISION	CHANGE	APPROVED	DATE
1	Provisional Release	JTS	27/11/2025

ASI-2-1

DESCRIPTION OF AIRMASTER PROPELLER SYSTEM

GUIDE



SUBJECT:

Product Description

ASSEMBLY NO:

AP-xxx

APPLICABILITY:

All propeller models

TABLE OF CONTENTS

1.1	Airmaster Propellers	3
1.1.1	Introduction	3
1.1.2	Performance	3
1.1.3	Ease of Operation	3
1.1.4	Safety and Reliability	4
1.1.5	Modular Design & Customization	4
1.1.6	Installation & Setup	5
1.1.7	Maintenance	5
1.2	Hub Assembly	6
1.2.1	Hub Design	6
1.2.2	Pitch Change Mechanism	6
1.2.3	Pitch Limits	7
1.2.4	Adjustable Pitch Stops	7
1.2.5	Pitch Change Motor	8
1.3	Blade Assembly	8
1.3.1	Blade Design	8
1.3.2	Blade Selection	8
1.3.3	Blade Retention Assembly	8
1.4	Mount Kit Assembly	9
1.5	Spinner Assembly	10
1.6	Control System Assembly	11
1.6.1	Control System Design	11
1.6.2	AC200 or AC300 Controller (Electric Governor)	11
1.6.3	Manual Control Switch	12
1.6.4	Electrical Looms	12
1.6.5	Programming	12
1.6.6	Diagnostics Facility	12
1.6.7	Airmaster Proprietary Software	13
1.7	Slipring Assembly	13
1.8	DSD Propeller Model	14
1.8.1	Description	14
1.9	Special Pitch Functions (Optional)	15
1.9.1	Feather (Option)	15
1.9.2	Beta / Reverse (Option)	15
1.9.3	Pre-Rotate (Option)	15
1.9.4	Remote (Option)	16

1. TOPIC

1.1 Airmaster Propellers

1.1.1 Introduction

Airmaster manufactures electrically actuated constant speed propeller systems designed to deliver high performance, reliability, and simplified operation for light aircraft.

In a constant speed configuration, the electric governor (AC200 or AC300 controller) automatically adjusts (governs) propeller pitch to maintain a target engine/propeller RPM selected by the pilot. If RPM rises above the target, pitch is increased (adjusted coarse), if RPM falls below the target, pitch is reduced (adjusted fine).

This document covers the key benefits of an Airmaster propeller system and provides a description of each major sub-assembly.

1.1.2 Performance

Compared with equivalent fixed-pitch propellers, Airmaster systems typically provide performance gains:

- ~20 - 30% in take-off.
- ~10% in climb.
- ~15% in cruise.

Depending on configuration and whether the propeller is optimised for STOL or cruise operation.

During take-off, the propeller allows the engine to achieve its full rated RPM, enabling maximum available horsepower and thrust. Because internal-combustion engines generally reach peak efficiency near peak torque RPM, the ability to govern engine speed independently of airspeed provides a significant advantage for cruise economy.

Advanced software within the Airmaster controller enables rapid, accurate governing with pitch change rates of approximate 5°/s (up to 10°/s for DSD propeller models). Firmware and parameters updates can be applied in the field, ensuring that operators are up to date with the latest capabilities.

1.1.3 Ease of Operation

Electric variable pitch hubs combined with digital control systems greatly simplify constant-speed propeller use. The Airmaster controller reduces propeller management and engine speed control to a simple setting selection (Take-off, Climb, Cruise).

A “Hold” speed function allows the pilot to manually set and adjust an RPM that differs from the presets, similar to automotive cruise control.

The controller provides unobtrusive yet clear visual feedback on the status of the propeller from inside the cockpit, including:

- Pitch adjustment status.
- Pitch limit indications.

- Speed-signal confirmation.
- Fault alarm indications (for the propeller).

1.1.4 Safety and Reliability

The controller employs a highly reliable solid-state design. However in the event of a control fault, the pilot may select manual over-ride (MAN) mode. This selects an alternative control path to normal automatic operation, enabling direct pitch by use of a separate manual control switch.

Optional propeller pitch functions (e.g. feather, reverse) include additional safeguards to prevent inadvertent, or incorrect activation. These layers of protection include:

- Multi-step pilot actuation.
- Mechanical hard stops
- Back up pitch limit microswitches
- Software mechanisms that prevent activation unless correct operating conditions are met

1.1.5 Modular Design & Customization

A key aspect of the flexibility of Airmaster products is its wide range of component options. All propellers conform to a modular architecture consisting of the following main assemblies:

- Hub
- Blade
- Mount Kit
- Spinner
- Slipring
- Control System

Each assembly is tailored to the design requirements of the aircraft and engine combination. Each assembly is produced as a complete unit, and a high degree of compatibility between product groups enables wide configuration flexibility and simplifies installation as well as servicing operations.

When practical, assemblies are designed for backwards and cross-compatibility.

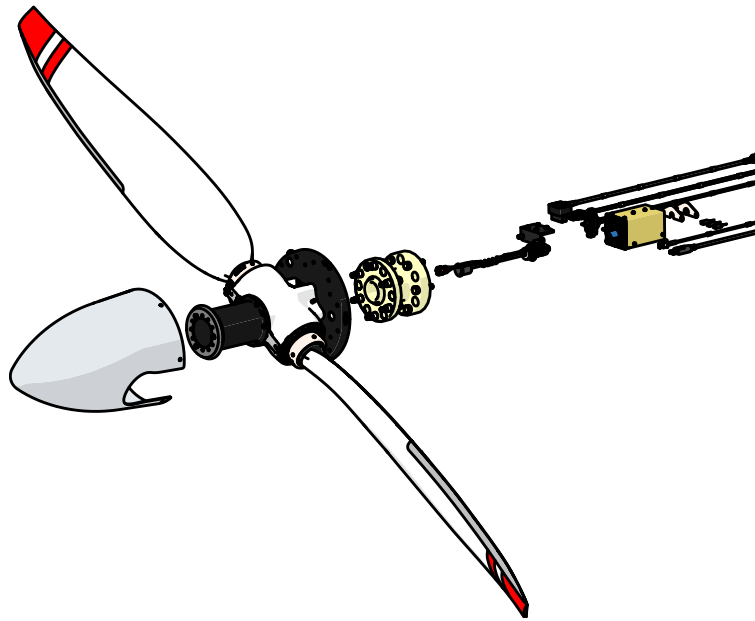


Figure 1. Main assemblies of an Airmaster propeller system.

1.1.6 Installation & Setup

Airmaster propellers are supplied fully finished, with most components pre-assembled. Installation is straight-forward and only minor assembly may be required.

Airmaster provides high-quality, comprehensive instructions, documentation and engineering drawings to assist operators in installing and setting up the propeller. Support, sales and engineering advice is always available directly from the factory.

The following tasks are generally required when setting up a propeller (before first flight):

- Static run up to check fine/coarse RPM limits (at WOT) and adjust pitch stops as required.
- Dynamic balancing. Propellers are statically balanced at the factory, but verification on the aircraft is recommended.
- For DSD propeller models: automatic hub calibration cycle.
- Full functional testing with the engine off and running.

1.1.7 Maintenance

Maintenance for an Airmaster propeller is straight forward. At the first 25,50, 100 hours, then subsequently at 100hr intervals:

- Re-grease hub and blade retention assemblies.
- Inspect propeller components using the Airmaster checklist.
- Replace slipping brushes at prescribed intervals. This is a low-cost, soldering operation, a spare set of brushes is supplied with each propeller.

1.2 Hub Assembly

1.2.1 Hub Design

The Airmaster propeller hub is a single high strength component machined from solid Aluminium billet. The single shell design allows for an even distribution of stress within the hub material, thus providing a stronger and safer propeller. The exterior surface is protected by a two-pot epoxy paint finish.

Compatible engine flange patterns include:

- **Rotax:** 4-inch PCD (AN5 or AN6 bolts)
- **SAE-1:** 4.375-inch PCD (AN6 or AN7 bolts).
- **SAE-2:** 4.75-inch PCD (AN7 or AN8 bolts).

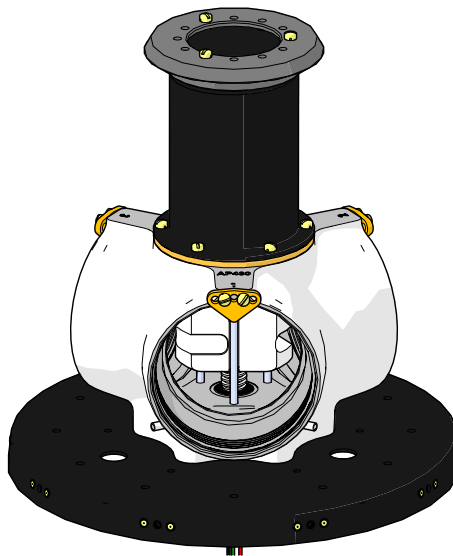


Figure 2. Hub Assembly (AH-430CF shown).

Internal components are machined from a variety of high-quality engineering materials to ensure strong fatigue-resistance and long service life.

Select parts (e.g. the pitch change slide) are manufactured from sacrificial acetal plastic to protect critical components in the event of a prop strike.

1.2.2 Pitch Change Mechanism

Pitch control is provided by an electric gearmotor driving a precision-screw mechanism that positions a pitch change slide. The slide interfaces with cam followers attached to the base of each blade assembly, ensuring equal blade adjustment.

Airmaster use a proprietary thread design with a closely matched, phosphor bronze guided nut to minimise backlash and inter-blade pitch error. This ensures smooth, flutter free operation for the entire life of the propeller.

1.2.3 Pitch Limits

Pitch range is defined by a robust system of:

- **Fixed hard stops.**
Which provide physical limits to the movement of the pitch change mechanism.
- **Adjustable pitch stops.**
Which are factory-set but can be fine-tuned. This is usually required during initial set up.

1.2.4 Adjustable Pitch Stops

The propeller's adjustable pitch stops are located inside the hub, in the area housing the pitch change motor. This area can be accessed by removing the spinner cone and the black motor cap.

Each pitch stop consists of a cylindrical pitch feedback cam connected to the pitch change slide via a threaded pitch feedback rod. The cam activates a corresponding microswitch in the propeller's electrical circuit, which controls power supplied to the pitch change motor.

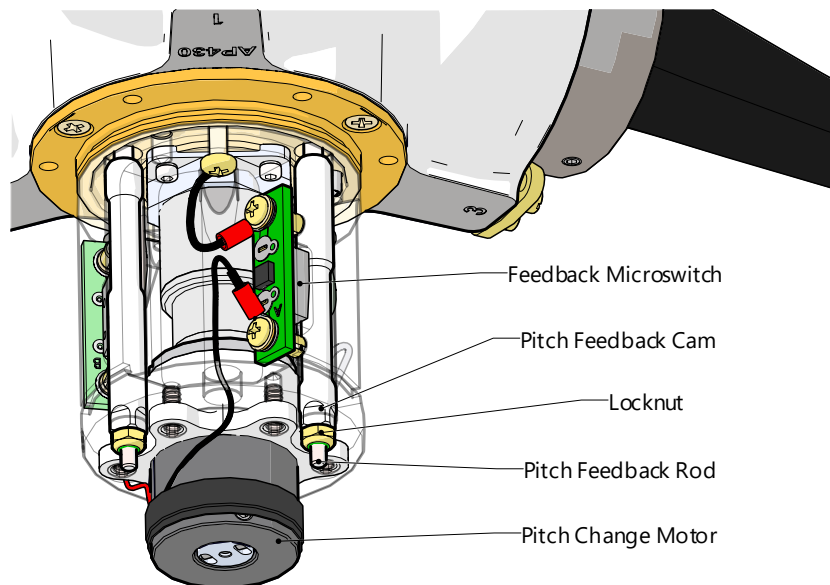


Figure 3. Components of Pitch Change Mechanism (AP430 shown).

As the pitch change mechanism moves fore and aft within the hub it adjusts the propeller blade pitch. When the mechanism reaches a preset position (configured by the operator), the pitch feedback cam triggers its microswitch, stopping the pitch change motor. This prevents further pitch movement in that direction and ensures the blades remain within the defined operating range.

Operators can fine-tune the activation point of each microswitch by rotating the associated cam on its feedback rod, thereby setting the desired propeller pitch limit (and corresponding engine speed).

The pitch change mechanism (and controller design) can facilitate additional special pitch functions for example feathering or reversing pitch function.

1.2.5 Pitch Change Motor

Airmaster hubs use a custom high-precision servo drive with high torque density, metal gear heads, and stainless-steel construction.

A magnetic brake prevents pitch drift and locks the propeller at its previous pitch setting in the event of power loss. This means the propeller can be operated safely as a fixed pitch propeller until the fault is rectified.

DSD propeller models use a brushless servo motor with digital encoder. This provides high durability, faster pitch change rates (up to 10°/s) and precise pitch feedback control.

1.3 Blade Assembly

1.3.1 Blade Design

Only fully composite blades of verified suitability are used (wood or aluminium options are not available). For some applications, blade manufacturers have designed custom blades especially for Airmaster propellers.

All blades feature in-built leading-edge shields to prevent blade erosion. Most commonly this is electroformed nickel, but stainless steel and other options are available.



Figure 4. Blade Assembly (AB-WWRB72B-430T shown).

1.3.2 Blade Selection

Blade selection considers performance, cost, durability, weight and appearance. Airmaster will generally recommend a suitable blade type or provide alternative options for incorporation into a customised propeller system.

Generally there are various blade finish options available to specify the colour or finish on the top side, underside and blade tips.

1.3.3 Blade Retention Assembly

Airmaster propellers incorporate a blade retention system that allows the blade assemblies to be removed simply and with repeatable accuracy. This facilitates shipment, servicing and ease of maintenance.

The propeller blade is retained in a high-strength steel ferrule component using tapered collet sleeves that are held in place by a special ferrule nut. The blade assembly incorporates all the required bearings, seals and retention devices.

The blade assembly is retained in the propeller hub by a retention nut and a simple locking plate. The retention nut features a high strength buttress thread to enable simple installation and removal.

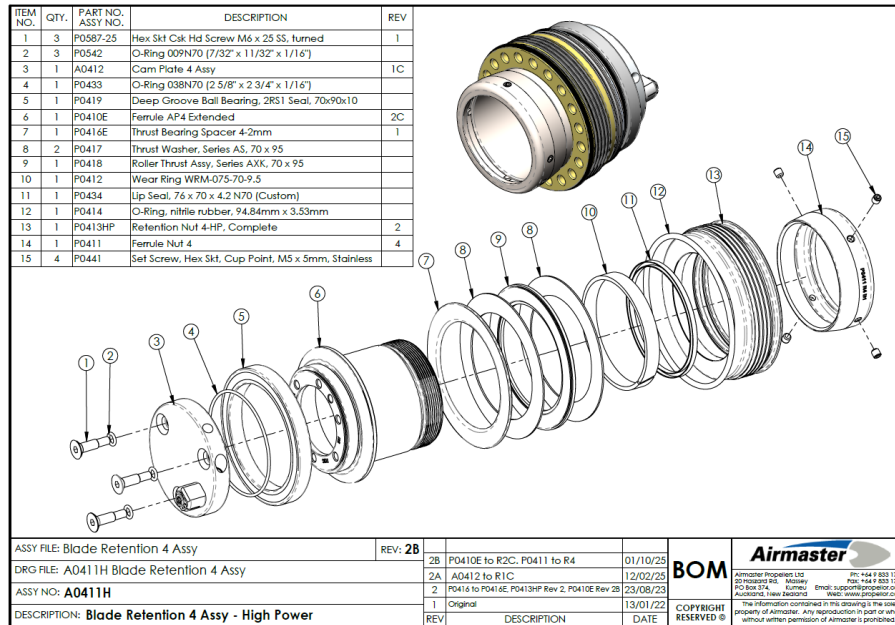


Figure 5. *Airmaster drawings showing components of the Blade Retention Assembly.*

1.4 Mount Kit Assembly

The propeller's mounting position may need to be adjusted relative to the engine flange to ensure adequate clearance between the spinner backplate and the engine cowling. This adjustment is achieved using a spacer, extension or adapter assembly (referred as 'mount kits').

Airmaster manufactures a large range of mount kits to ensure the propeller fits perfectly. These are manufactured in-house from high grade aluminium billet to ensure concentricity and neat fit. Mount kit requirements are generally pre-determined, and the appropriate solution is supplied with the propeller.

All mount kit types are protected from the elements in an applicable way:

- Extensions (Alodine)
- Spacers (Anodise)
- Adapters (Alodine)
- Drive lugs (Stainless steel)
- Bolts (Cadmium plated)

AN (mil-spec) hardware is used throughout the mounting range to ensure consistent quality and simple part replacement.

Nord-Lock® washers are incorporated to guarantee long life vibration resistance and to eliminate lock-wiring requirements. They secure bolts from loosening due to vibration or dynamic loads and work by requiring a higher torque to untighten than is required to tighten them.

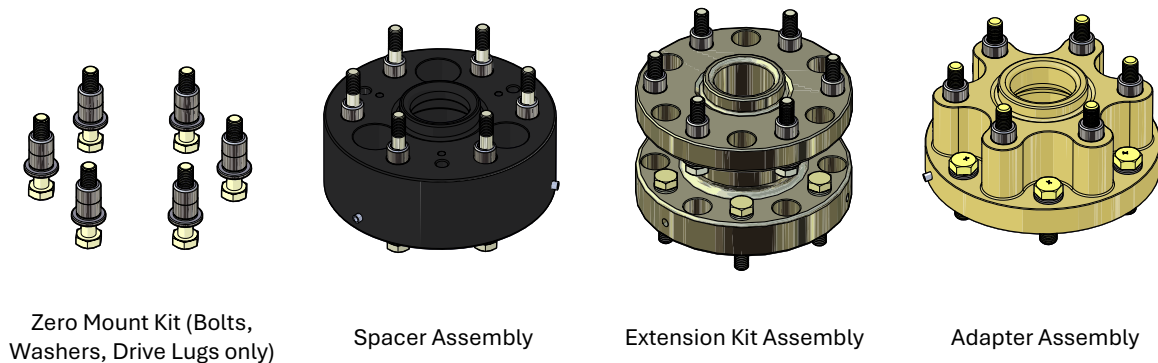


Figure 6. *Mount Kit Assembly options.*

1.5 Spinner Assembly

Each propeller includes a complete spinner assembly, consisting of the spinner cone, backplate, adjustable front support and required fasteners. All spinner components are fully finished and fitted from the factory.

Airmaster spinners and backplates are manufactured from spun aluminium to ensure they are concentric and perfectly balanced.

Spinner cones are available in highly polished aluminium, matte aluminium, or painted gloss white finishes. Custom carbon fibre spinner cones may be manufactured upon request.

The front support ensures the spinner remains completely centralised, eliminates any lateral play and minimises backplate stress and fatigue. The front support is threaded and incorporated into the head of the hub; it is adjusted to support the nose of the spinner cone.

Airmaster backplates feature pre-drilled holes in convenient locations to accept balance weights (AN3 bolts and screws) to assist dynamic balancing requirements. Airmaster propellers are statically balanced at the factory but a dynamic balance on the aircraft is generally recommended. Airmaster backplates feature a black anodised finish.

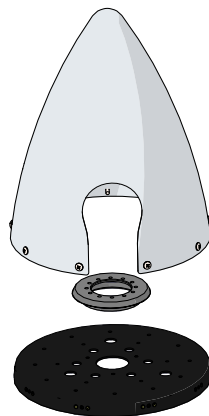


Figure 7. *Components of Spinner Assembly.*

1.6 Control System Assembly

1.6.1 Control System Design

The control system is responsible for controlling the propeller's pitch change operations. The Airmaster controller is a solid-state microprocessor-based device that performs electronic governing.

To measure propeller RPM, a solid-state magnetic sensor in the sensor-brush assembly (mounted to the aircraft engine) detects the passing of a magnet integrated inside the propeller's slipping assembly. An RPM signal is registered and sent to the controller, which compares the current propeller speed with the target RPM selected by the pilot.

A digital control loop determines and adjusts the power delivered to the pitch change motor by solid state power drivers. The nonlinear response of the control loop is controlled by various parameters set in the controller's software. These control parameters determine how the response of the controller is affected by the size of the speed error, or whether the error is decreasing or increasing.

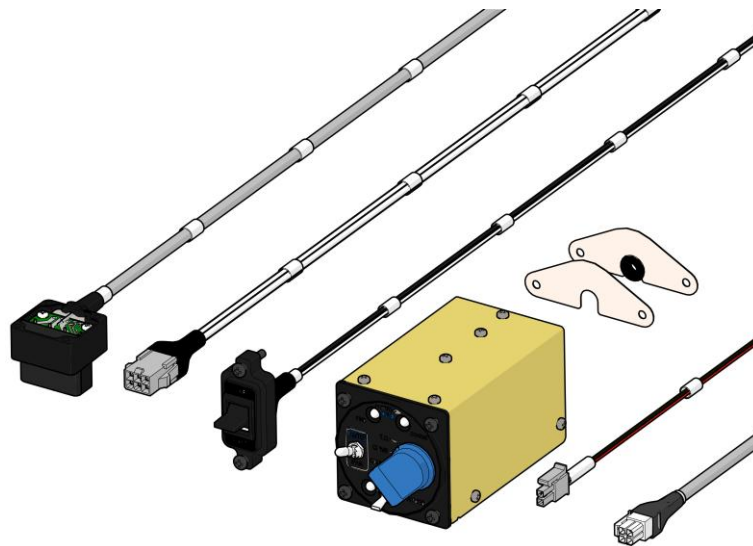


Figure 8. Components of Control System Assembly.

1.6.2 AC200 or AC300 Controller (Electric Governor)

The AC200 and AC300 controllers developed by Airmaster are designed to work exclusively with Airmaster propellers to deliver true constant speed operation.

The Airmaster controller mounts in the aircraft's instrument panel using a standard 2-1/4in instrument cut-out. The ergonomically designed pilot interface incorporates a distinctive blue propeller control setting selector and three indication lamps.

The propeller control setting selector is a rotary switch, which the pilot uses to select the desired preset governing speed, hold governing speed, or special pitch function (when applicable). The three indication lamps provide visual feedback of the propeller's operational status to the pilot. A manual over-ride option is also provided on the controller.

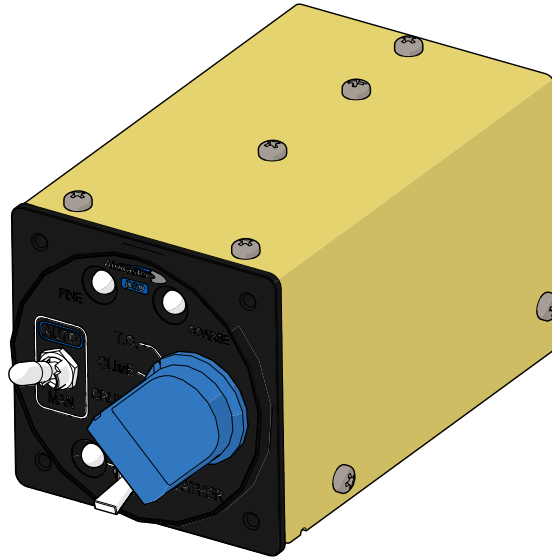


Figure 9. AC300 controller (feathering version) shown.

1.6.3 Manual Control Switch

Mounted separately to the controller is a manual control switch, which is used to control propeller pitch directly when manual over-ride mode is enabled, or to set a new target engine/propeller speed when hold mode is selected.

1.6.4 Electrical Looms

Custom manufactured cables are supplied with the control system to support the connection of the main control system components including the controller, manual control switch and sensor-brush block.

1.6.5 Programming

The controller can be programmed using a windows computer with an RS-232C serial connection. This allows adjustment of preset speeds and other operational parameters.

1.6.6 Diagnostics Facility

AC200 controllers that are hardware version 5 or higher, as well as all AC300 controllers (for DSD propeller models) incorporate a diagnostic module that records all propeller activity and statistics (like a 'black box'). This data may be useful for troubleshooting faults or improving propeller tuning.

Diagnostic data is accessed using Airmaster software running on a MS Windows PC (Windows 10 or 11); a laptop is recommended so that it may be taken to the controller inside the cockpit.

1.6.7 Airmaster Proprietary Software

The Airmaster control system includes a USB-serial cable designed for the Airmaster controller. The USB-serial cable is used to connect the propeller controller to a Windows PC (Windows 10 or 11). This is required for utilising any applications in the Airmaster Software Suite which include:

- **Airmaster User Program.**
Used for adjusting controller parameters (e.g. preset target speeds) and other settings programmed into the controller.
- **Airmaster Controller Firmware Programmer.**
Used to update controller firmware version.
- **Airmaster Diagnostics Program.**
Used to download and view diagnostic data from the controller (when supported).
- **Airmaster Hub Firmware Programmer.**
Used to update hub firmware version (applicable for DSD hub models only).
- **Airmaster Hub Calibrator Program.**
Used to calibrate the DSD hub; and for adjusting hub parameters such as the virtual stop values or other settings programmed into the hub (applicable for DSD propeller models only).

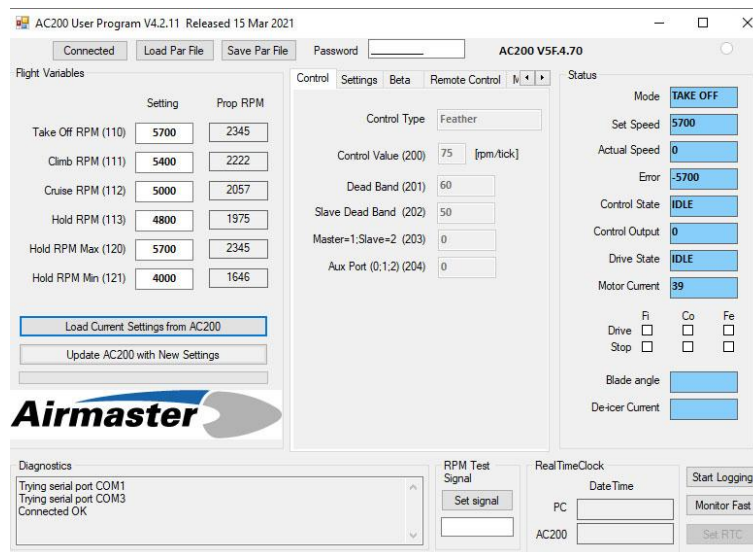


Figure 10. Screenshot of Airmaster User Program.

1.7 Slipping Assembly

Power is transmitted to the propeller hub by a sensor-brush assembly mounted to the engine gearbox (included within the control system assembly), and across a slipping assembly. A magnet embedded in the slipping assembly enables rpm signal detection. Mounting hardware for the sensor-brush block is generally supplied.

Airmaster manufactures two types of slipping assembly:

- **Standard Sliprings:**
Disc-shaped assemblies featuring long-life phosphor bronze rings (highly corrosion-resistant). Typically mounted to the spinner backplate, but may be fitted to a mount kit assembly (e.g. spacer or extension) to make contact with the sensor-brush block. These sliprings are available in standard Rotax, SAE-1 and SAE-2 sizes.
- **Mini Sliprings:**
Barrell-shaped assemblies featuring long-life pure copper rings (highly corrosion-resistant). Designed for Rotax 912 and 914 series engines which feature a hollow propeller shaft.

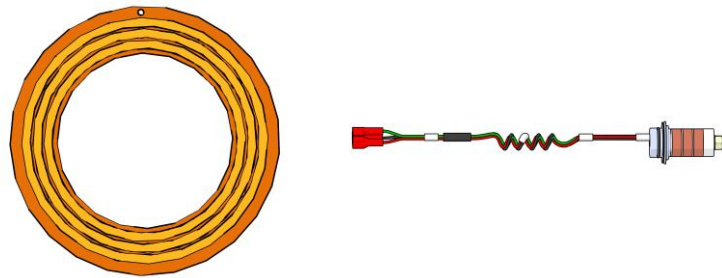


Figure 11. (Left) Standard slipring. (Right) Mini Slipring.

1.8 DSD Propeller Model

1.8.1 Description

Digital servo-drive (DSD) propeller models (released 2024) can sense and command propeller blade angle with digital accuracy due to the use of a durable brushless pitch change motor with digital encoder.

Benefits include:

- Precise pitch positional feedback
- Rapid pitch change response (up to 10°/s)
- Higher power capacity (up to 24V).
- Wider pitch range (-30° to 88°total pitch range).
- Both feathering and reversing pitch functions can be combined.

During initial setup of the propeller, operators must complete a hub calibration cycle which allows the controller to accurately determine propeller blade angle based on the hub geometry.

The propeller's AC300 controller will indicate that calibration is required by displaying a hub miscalibration alarm, this is observed as a double-red flash of the FEATHER/BETA lamp (as applicable).

The propeller will function normally if the hub is in an uncalibrated state, however the blade angle perceived by the propeller may be uncertain.

Calibration of the hub also requires defining virtual stops for feather or reverse functionality (this generally is completed by Airmaster when applicable). The propeller's fine and coarse pitch stops should still be physically set by adjusting the relevant pitch feedback cams when required.

1.9 Special Pitch Functions (Optional)

1.9.1 Feather (Option)

The feather facility is an option for Airmaster propellers, it enables the propeller to attain a feather pitch angle (typically around 81°), which exceeds the standard coarse pitch limit. This is designed to minimize drag and maximize gliding distance in the event of an engine failure or may be chosen intentionally for gliding flight (e.g. motor gliders).

The hub and controller are especially configured for this option, but previously non-compliant assemblies can be upgraded.

- Feather operation can be performed either automatically or manually.
- The propeller can automatically return to normal pitch after the feather operation.
- A 2-stage activation is required to prevent inadvertent activation of automatic feather operation.

1.9.2 Beta / Reverse (Option)

The beta (reverse) facility is an option for Airmaster propellers, it enables the propeller to attain beta pitch angles (typically -20°) which are below the normal fine pitch limit. This provides reverse thrust, which is primarily designed to aid water maneuvering for amphibious aircraft.

The hub and controller are especially configured for this option, but previously non-compliant assemblies can be upgraded.

To prevent inadvertent activation of beta operation, multiple safeguards are in place:

- A two-stage activation is required: beta engage, then beta drive. The propeller must also be intentionally driven into the beta pitch region by use of the manual control switch.
- The controller prohibits either stage from occurring if engine speed exceeds a defined limit.
- A mechanical hard stop (centrifugal throw-out arm) prevents adjustment in the beta pitch direction if engine speed exceeds a limit which would not normally be encountered in flight.

1.9.3 Pre-Rotate (Option)

The pre-rotate facility is an option for Airmaster propellers, it enables the propeller to attain (near) neutral pitch angles which are below the normal fine pitch limit (approximately 0°). This provides minimal drag and is primarily designed for achieving maximum pre-rotation speed during run up for autogyro aircraft.

The hub and controller are especially configured for this option, but previously non-compliant assemblies can be upgraded.

To prevent inadvertent activation of pre-rotate operation, multiple safeguards are in place:

- A two-stage activation is required: pre-rotate engage, then pre-rotate drive. The propeller must also be intentionally driven into the beta pitch region by use of the manual control switch.
- The controller prohibits either stage from occurring if engine speed exceeds a defined limit.
- A mechanical hard stop (centrifugal throw-out arm) prevents adjustment in the beta pitch direction if engine speed exceeds a limit which would not normally be encountered in flight.

1.9.4 Remote (Option)

The remote facility is optional for Airmaster propellers, it enables remote command of the propeller controller by an external computer via a serial RS232 link at 19,200 baud. This facility requires a specific setting of controller parameters and the use of a separate remote-control program.

The controller is especially configured for this option, but previously non-compliant controllers can be upgraded.