

APM:Copter 3.3 Update for Helicopter User Notes

Critical Notes

- Motor Stop During Auto Modes

- In AC3.2, if the user shut down the motor (Ch8) while flying in Alt Hold, Loiter, etc, the altitude controller would attempt to hold altitude, until the point at which the rotor speed became too low to maintain lift at full collective. At that point, the helicopter would begin to fall, usually with little/no cyclic control and thus attitude control was lost.
- In AC3.3, instead of attempting to maintain altitude, the controller will immediately output negative pitch. This will cause the helicopter to immediately descend at a high rate. However, a side effect is the rotor speed will likely be maintained, and thus attitude control, resulting in the helicopter descending in a controlled fashion.
- Users are cautioned that shutting off the rotor control input during automated flight is very dangerous, and should never intentionally be performed. This function should only be used to stop the motor output should a collision be imminent.
- Acro and Stabilize modes will continue to allow direct pilot control over the collective pitch, and are suitable for autorotation flight practice. However, please see note below about DISARM_DELAY parameter.

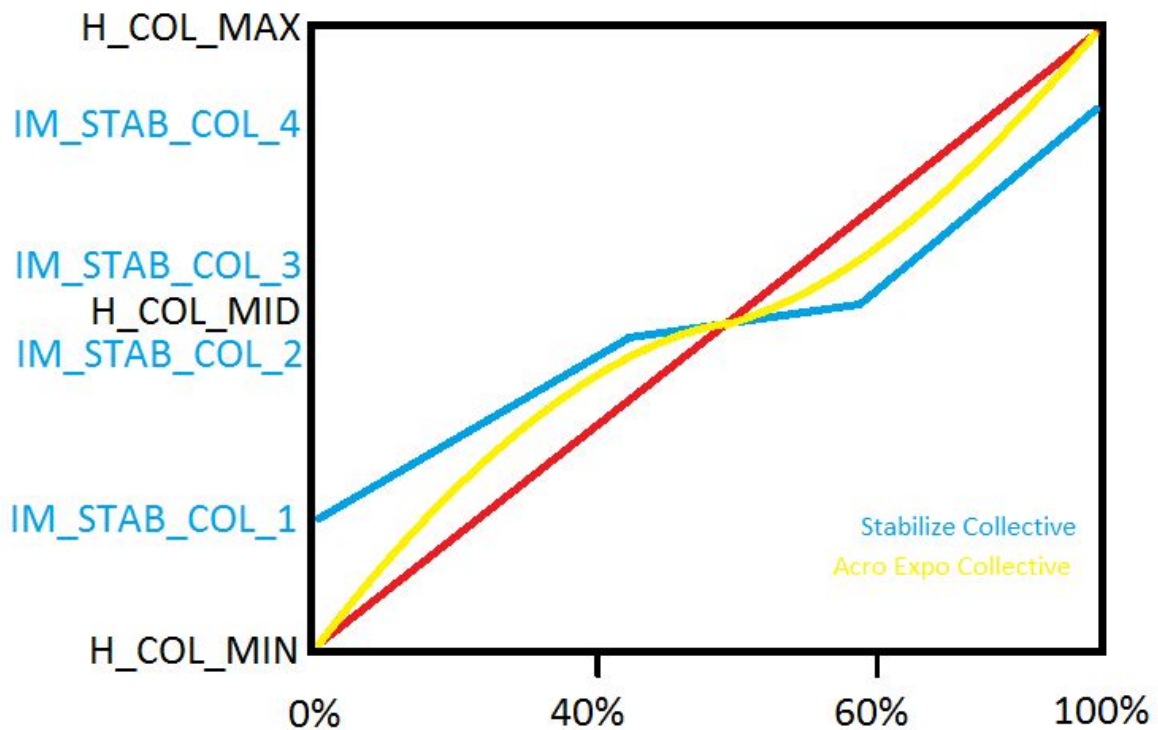
- Parameter Changes Upon Updating

- The parameter enumeration table has changed, and this will result in undesired parameter changes after update. Users must review their parameters after the update procedure.
 - H_COL_MIN will revert to default of 1250
 - H_COL_MAX will revert to default of 1750
 - H_GYRO_GAIN will inherit old value of H_COL_MIN
 - H_PHANG will inherit old value of H_COL_MAX
 - H_TAIL_TYPE will inherit old value of H_ROL_MAX
- In particular the change to H_PHANG will certainly cause a crash.
- Users are instructed to:
 - Using Ground Control Software, use Full Parameter List to save parameter file before firmware update.
 - After firmware update, reset all parameters to default, Mission Planner provides a convenient button for this on the Full Parameter List

- Users can then use the Compare function on the Full Parameter List to update any parameters they would like. However, do not simply revert ALL parameters from AC3.2. Some of them may have changed, such as EKF_ etc. Only revert those parameters that you understand and have changed yourself. This is likely to include all H_*, ATC_*, RCx_*, RATE_*, STAB_*, etc.

Feature Additions/Changes

- **Added 4-point Stabilize Collective**
 - H_COL_MIN and H_COL_MAX replaced by IM_STAB_COL_1 - IM_STAB_COL_4
 - IM_STAB_COL_1 functionally replaces H_STAB_COL_MIN
 - IM_STAB_COL_4 functionally replaces H_STAB_COL_MAX
 - IM_STAB_COL_2 provided knee-point at 40% collective input
 - IM_STAB_COL_3 provides knee-point at 60% collective input
- **Added Acro Collective Expo**
 - IM_ACRO_COL_EXP, defaults to 0
 - Creates Collective Expo feel centered on 0 collective input for easier hovering



- **Acro/Stabilize Collective Damper**
 - Change from Acro Col to Stab Col no longer jumps, but slews over ½ second. Changing from an auto mode to Stabilize or Acro always responds instantly
- **Added Cyclic Ring Function**
 - H_ROL_MAX and H_PIT_MAX replaced by singular H_CYC_MAX
 - This prevents over-driving the swashplate in the corners
- **All Helicopter setup parameters take effect immediately when disarmed.**
 - No need to use Reset Swash button on Heli Setup Page
 - No need to set H_SV_MAN to 1, then back to 0 to reset swash
- **H_SV_MAN functionality expanded with new options**
 - H_SV_MAN = 0, servos are under full PID control
 - H_SV_MAN = 1, servos are under direct stick input control
 - H_SV_MAN = 2, max collective, max yaw, zero roll/pitch
 - H_SV_MAN = 3, 0 pitch collective, zero roll/pitch/yaw
 - H_SV_MAN = 4, min collective, min yaw, zero roll/pitch
 - H_SV_MAN = 5, servos move through full range automatically
- **Open-Loop 3-point throttle curve suitable for simple gas helicopter control added**
 - H_RSC_MODE = 3 to access function
 - New parameters:
 - H_RSC_DZ - Ignore, no effect
 - H_RSC_TRIM - Ignore, no effect
 - H_RSC_MIN - PWM Minimum Limit for Throttle Servo
 - H_RSC_MAX - PWM Maximum Limit for Throttle Servo
 - H_RSC_REV - Reverse Servo Output
 - H_RSC_IDLE - Idle Setting, 1 = 0.1% (50 = 5%)
 - H_RSC_POWER_LOW - Zero Pitch Setting, 1 = 0.1% (200 = 20%)
 - H_RSC_POWER_HIGH - Full Pitch Setting, 1 = 0.1% (1000 = 100%)
- **H_RSC_MODE = 0 no longer valid**
 - In AC3.2, it was possible to set H_RSC_MODE to 0, and have the ESC plugged directly into the RC Receiver, bypassing autopilot control of the ESC. It has become increasingly difficult to maintain the code for this setup. And since this setup results in a potentially unsafe operation, it is no longer allowed. You must route the ESC signal through the Flight Control unit. Setting H_RSC_MODE = 1 = Ch8 Passthrough should offer similar operation as bypass, with added safety of system arming/disarming.
- **Added H_RSC_CRITICAL parameter.**

- This controls when the system believe flight control is no longer possible. Set to a value below which you will never attempt flight. ie: If using H_RSC_MODE = 1 = Ch8 Passthrough, and you are using Ch8 on a knob to regulate rotor speed in flight, never allow Ch8 to go below H_RSC_CRITICAL. Defaults to 500, which is 50%. Most governed ESC's will shut off the motor below 40-50% anyway.

In the case of H_RSC_MODE = 2, system assumes linear ramp up/down time. ie: If H_RUNUP_TIME is 10 seconds, and H_RSC_CRITICAL is 500, then the system will assume rotor speed is too low to fly 5 seconds after switching off the motor control.

Also, if landed in Alt Hold, Loiter, etc. and motor is switched off, and rotor speed drops below H_RSC_CRITICAL, then the pilot attempts to take off again, the helicopter will not attempt to take-off until the rotor is restarted and Runup time is completed.

This is mainly used for ground handling. In Acro and Stabilize, when you change from disarmed state to armed state, the copter will not attempt to lock-in a yaw heading until the rotor speed goes above H_RSC_CRITICAL. However, it will not revert to unlocked state in the air if the rotor is shut down, such as autorotation, until the copter is first disarmed.

- **Added Pirouette Compensation**

- Controlled by ATC_PIRO_COMP parameter.
- Rotates Pitch and Roll Rate Integrals for more stable pirouettes

- **Added RCx_FUNCTION = 30 Engine Run Enable function**

- This allows assignment of a free output channel to switch PWM output on and off when armed and disarmed.
- Can be used for a gas helicopter ignition system control signal for extra safety

- **Added DISARM_DELAY parameter.**

- Change the automatic disarm time from 10 seconds to whatever you want up to 127 seconds. If set to 0, automatic disarm function will be turned off completely. This would be particularly useful for gas heli operation.

Note that helicopter pilots should be particularly aware of this parameter. When the Ch8 rotor control switch is turned off, the heli will disarm in 5 seconds if this parameter is left on the default of 10. If pilot is practicing autorotation flight, the heli could disarm in flight, preventing rotor re-start. If doing auto-rotations, suggest to set DISARM_DELAY to 120 seconds, (providing 60 seconds before disarming) or 0 to stop automatic disarm completely.

- **H_RSC_IDLE parameter operation with H_RSC_MODE = 1 or 2.**
 - If user is using H_RSC_MODE 1 or 2, the H_RSC_IDLE value will be sent to the ESC when Armed but Ch8 Motor Switch is Low.
 - Defaults to 0
 - Some ESC's, such as HobbyWing Platinum Pro V3 contain logic where the soft-start will be skipped if the signal goes does not return to 0. ie: ESC does not start the motor until PWM signal is above 40%. If signal goes from >40% to 5%, then back to >40%, the soft-start will be skipped. This is useful for auto-rotation practice, as the motor will re-start quickly.
 - ESC output always returns to 0 when disarmed.

- **Added ATC_HOVR_ROL_TRM parameter.**
 - Defaults to 400 = 4.00° roll to the right.
 - Used to automatically compensate for tail rotor thrust in all flight modes except for Acro
 - Eliminates need to set helicopter "level" to be non-flat. If you have done in-flight leveling adjustment previously, you should re-level the helicopter flat.
 - Output of Roll Trim is zero while system thinks it is on the ground.
 - Roll Trim begins only when pilot attempts to lift off.
 - If motor is switched off in the air (autorotation) roll-trim returns to zero since no motor torque is being created.
 - Roll-Trim remains at all speeds in flight. In future, will return to zero as speed builds.

- **Added RATE_xxxx_I_L_MIN parameters.**
 - Defaults to 300
 - This is a minimum level, below which Rate I-terms will not Leak back to zero.
 - Allows copter to better automatically trim itself in flight, to compensate for servos being not perfectly level, or CG offsets.
 - Should be set low enough that copter will not tip-over when the rotor is started on the ground.
 - I-Max parameters remain in effect, Integral will never climb above I-Max
 - Integral will leak between I-Max and I-Lean-Min
 - When helicopter is in dynamic flight (speed greater than 5 m/s or forward pitch greater than 15°), Integral does not leak. This is unchanged from AC3.2.

- **H_FLYBAR_MODE = 1**
 - Flybar mode has been debugged and fully tested by Tridge
 - In Acro Mode, Pilot inputs are passed directly through to servos with no PID or AHRS corrections. This makes Flybar mode possible to maintain controlled flight should the AHRS/EKF fail.

- **H_TAIL_TYPE = 1**
 - External Gyro mode has been debugged and fully tested by Tridge

- **ToDo: Tachometer Input**

General Changes Highlight:

- **Added ACRO_EXPO function**
 - This affects all vehicles, but helicopter pilots should be reminded
 - In Acro Mode, Roll, Pitch and Yaw input rates will have Expo applied similar to the classic function that would be programmed in a Transmitter.
 - This allows users to easily have an Expo on the Acro Rates, without having to set Expo in their Tx so that Stabilize, Loiter, etc, can retain linear inputs.
- **RCMAP function has been fixed.**
 - It is now easier to use a Spektrum radio, as the RCMAP functions have been fixed.
 - If you have previously used this function, please check your setup, as you may have done a “workaround” which will no longer function properly.
- **EKF Changes**
 - Extended Kalman Filter now the default and ONLY AHRS system available (old DCM method only used for logging).
 - Further improvements to Gyro/Accel filtering have greatly improved system performance and vibration tolerance.
 - Helicopter Rate parameters will likely change from AC3.2. AC3.2 settings should be a good starting point, but you will likely be able to increase Rate P and D settings over levels of AC3.2 without encountering vibration-induced problems.