

# ArduPilot Methodic Configurator

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WHY, WHAT, HOW?

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# ArduPilot Methodic Configurator

Why ArduPilot Methodic Configurator exists?

What does it do?

How does it do it?

Is it reliable?

Is it compliant?

# Why ArduPilot Methodic Configurator exists?

- ArduPilot supports:
  - Over 244 different STM32 flight controller boards and then some ESP32 and Linux boards
  - Hundreds of different additional sensors
  - Many different propulsion systems

- It must be configured and tuned to operate correctly
  - Configuration is complex requiring many interdependent steps
  - Order and interdependency is unclear for many users

- Extensive documentation exists, but ...
  - It is complex, over 1600 unique webpages
  - Requires the users to learn a lot and manually use different tools
  - Many users incorrectly configure their vehicles

*ArduPilot Methodic Configurator*  
was created to address these issues

# Common pitfalls addressed by AMC

- Missed mandatory configuration steps
- Wrong sequence of steps, causing previous steps to be invalid. For example:
  - Autotune before notch filter
  - MagFit before current sensor calibration
  - No GNSS when doing compass calibration, etc, etc
- A lot of trial and error, with an unnecessary number of test flights
- Not all relevant components parameter are found under one prefix. For example:
  - ESC settings are found under: ESC\_, SERIAL\_, MOT\_, SERVO\_, CAN\_,
  - GNSS settings are found under: GPS\_, SERIAL\_, CAN\_, NTF\_
- When doing a configuration step, where is the relevant documentation for that step?
- Where is the relevant documentation for the flight controller?
- When reviewing a configuration there is no way to find out why a parameter change was made

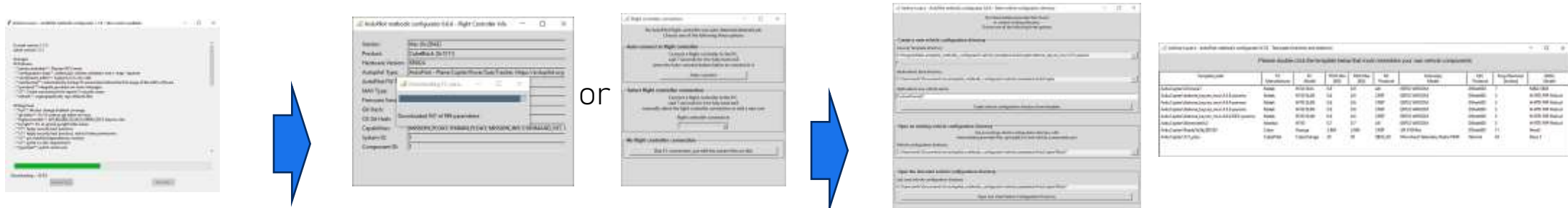
# What does it do?

Feature	Mission Planner, QGroundControl, ... etc	ArduPilot Methodic Configurator
full automatic configuration	No	No
configuration type	manual <sup>1</sup>	semi-automated <sup>2</sup>
explains what to do	No	Yes
explains when to do something	No	Yes, explains the path
explains why do something	No	Yes
configuration method	a different menu for each task, some tasks have no menu, so you need to dig into the 1200 parameters	each task only presents you a relevant subset of parameters
parameter documentation	Yes, only on the full-parameter tree view	Yes
displays relevant documentation	No	Yes
makes sure you do not forget a step	No	Yes
checks that parameters get correctly uploaded	No (MP), unsure (QGCS), yes (MAVProxy)	Yes
reuse params in other vehicles	No, unless you hand edit files	Yes, out-of-the-box
documents why you changed each parameter	No	Yes
tutorials and learning resources	No, scattered and not integrated	Yes, context-aware help integrated
auto. install lua scripts on the FC	No	Yes
auto. backup of parameters before changing them	No	Yes

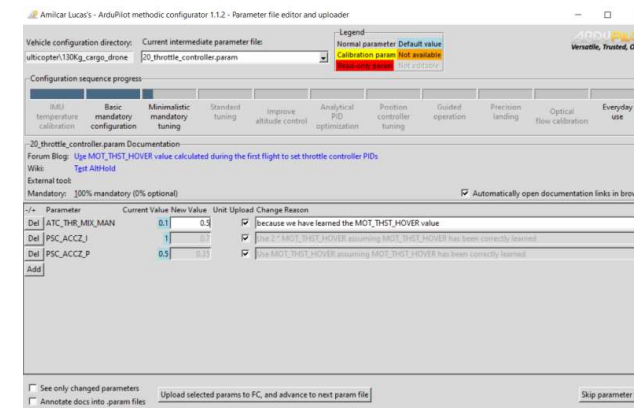


# How it does it?

It uses a Wizard-like interface to:



4. Enter vehicle components information and how they are connected to the flight controller



# Parameter configuration steps categories

- Interdependencies mandate that they are done in a fixed sequence
- Each category contains multiple steps
- Each step is a *.param* file

IMU temperature calibration

Assemble all components except the propellers

Basic mandatory configuration

Assemble the propellers and perform the first flight

Minimalistic mandatory tuning

Standard tuning

Improve altitude control

Analytical PID optimization

Position controller tuning

Guided operation

Precision landing

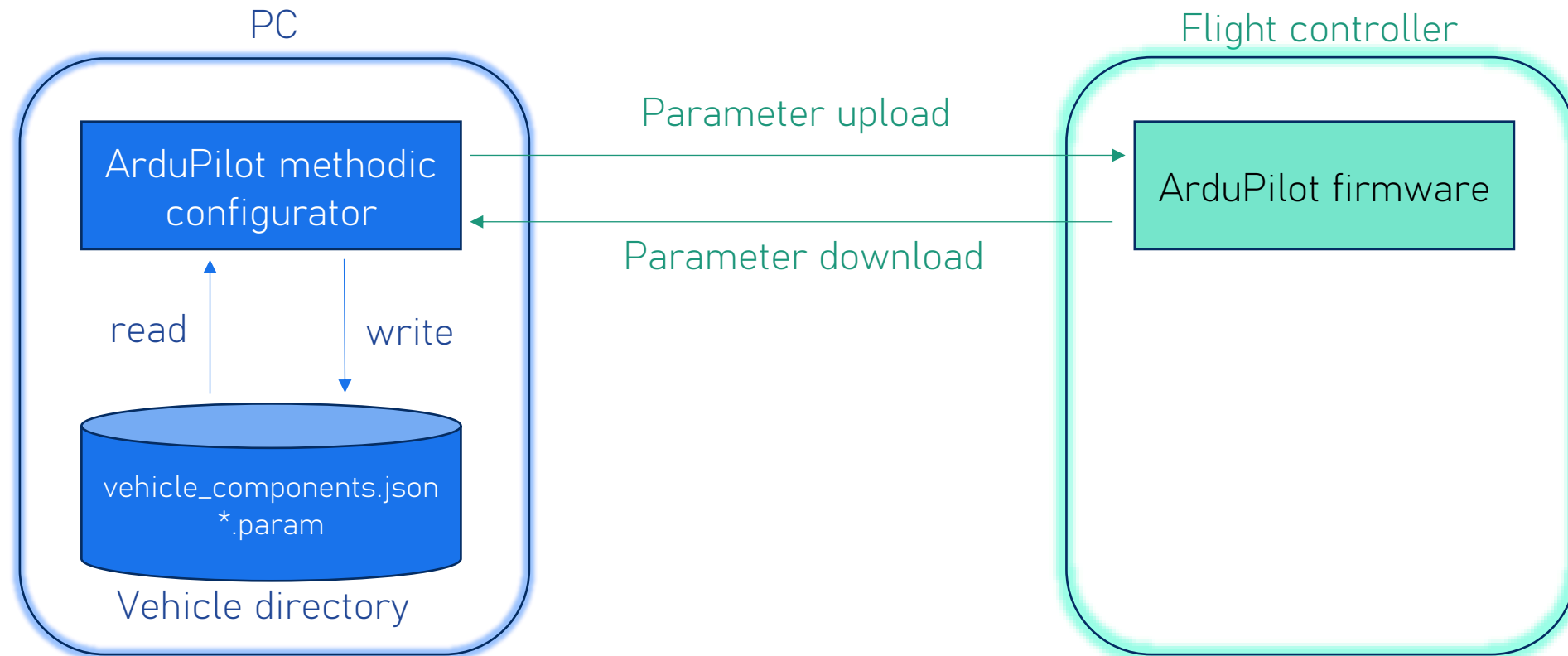
Optical flow calibration

Everyday use

# Local files and remote flight controller

To avoid confusion, the software is consistent:

- The verbs ***read*** and ***write*** are used for local files
- The verbs ***upload*** and ***download*** are used for flight controller operations





# Parameter configuration steps

Steps that require **no** experimental data gathering:

Set the parameter values directly in a single `*.param` file and upload them to the flight controller

Steps that require experimental data gathering:

or

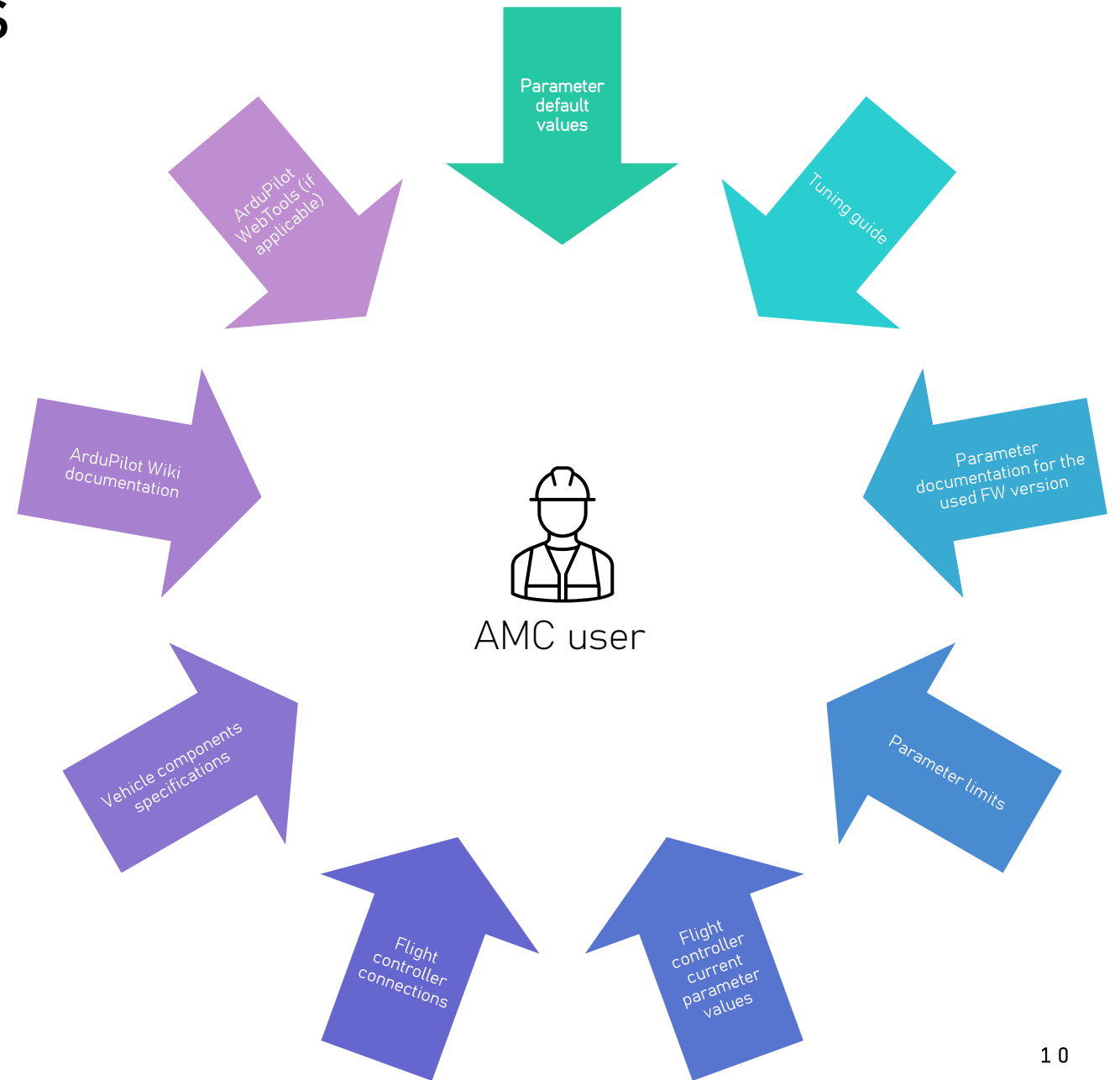
1. Setup the `*_setup.param` parameters to configure the data gathering experiment, and upload them to the flight controller
2. Conduct the data gathering experiment as explained in [the linked tuning guide](#)
3. Analyze the collected data as explained in [the tuning linked guide](#)
4. Store the resulting parameters in a `*_results.param` file, most times by automatically downloading them from the flight controller

# Integrated decision aids

The software automatically correctly sets some parameters based on user provided information but asks user permission to upload them to the FC.

When setting the parameter values the user has many sources of information available in the software GUI.

Some tools/webpages open automatically in a browser window, the user needs less clicks and less *googling*



# Is it reliable?



600g



900g



2900g

- the software has been used by hundreds of ArduPilot developers and users.
  - From beginners to advanced.
  - On big and small vehicles.
- It contains over 484 automated regression tests
- It has no known bugs



7Kg



50Kg



350Kg

# Is it compliant? 1/2

## Usability

- Uses *What you see is what gets changed* paradigm. No parameters are changed without the users's knowledge
- Translated into [multiple languages](#)
- No visible menus, no hidden menus.

## Code Quality

- [PEP 8](#) Python code style guidelines, [PEP 484 type hints](#), [PEP 621](#) project metadata standards
- Follows object-oriented design principles and [clean code practices](#)
- Implements comprehensive error handling and logging, with 5 verbosity levels
- Automated changelog in [Keep a Changelog](#) format
- Complies with [Python Packaging Authority](#) (pypi) guidelines

## Software Development

- Maintains comprehensive [assertion-based test coverage](#) through [pytest](#)
- Uses [semantic versioning](#) for releases
- Follows [git-flow branching model](#)
- Implements [automated security scanning and vulnerability checks](#)
- Implements [git pre-commit hooks](#) to ensure code quality and compliance on every commit
- Implements reproducible builds with [pinned dependencies](#)
- Uses containerized CI/CD environments for consistency
- Implements automated dependency updates and security patches using [renovate](#) and [dependabot](#)

# Is it compliant? 2/2

## Open Source

- Complies with [OpenSSF Best Practices](#) for open-source projects
- Uses [REUSE specification](#) for license compliance
  - Uses CI job to ensure compliance
  - Uses [SPDX license identifiers](#)
- Maintains comprehensive (more than 5000 lines) documentation
- Implements [inclusive community guidelines](#)
- Provides [clear contribution procedures](#)

## Security

- Regular security audits through [Snyk](#), [codacy](#), [black duck](#) and other tools
- Follows [OpenSSF Security Scorecard](#) best practices
- Uses [gitleaks](#) pre-commit hook to ensure no secrets are leaked
- Implements secure coding practices, runs [anti-virus in CI](#)
- Maintains [security policy and vulnerability reporting process](#)

# Usage 1/2

Current configuration step  
Usually, you do not manually change this

Parameter attributes legend  
Detailed information on mouse-over

All this project's files  
are stored here

Documentation for  
this configuration  
step

Click on the blue texts to  
open in browser

Amilcar Lucas's - ArduPilot methodic configurator 1.1.2 - Parameter file editor and uploader

Vehicle configuration directory: ultracopter\130Kg\_cargo\_drone

Current intermediate parameter file: 20\_throttle\_controller.param

Legend

- Normal parameter
- Default value
- Calibration param
- Not available
- Read-only param
- Not editable

Configuration sequence progress

- IMU temperature calibration
- Basic mandatory configuration
- Minimalistic mandatory tuning
- Standard tuning
- Improve altitude control
- Analytical PID optimization
- Position controller tuning
- Guided operation
- Precision landing
- Optical flow calibration
- Everyday use

20\_throttle\_controller.param Documentation

Forum Blog: [Use MOT\\_THST\\_HOVER value calculated during the first flight to set throttle controller PIDs](#)

Wiki: [Tstt AltHold](#)

External tool:

Mandatory: 100% mandatory (0% optional) ☒ Automatically open documentation links in browser

Parameter	Current Value	New Value	Unit	Upload	Change Reason
ATC_THR_MIX_MAN	0.1	0.5		<input checked="" type="checkbox"/>	because we have learned the MOT_THST_HOVER value
PSC_ACCZ_I	1	0.1		<input checked="" type="checkbox"/>	Use 2 * MOT_THST_HOVER assuming MOT_THST_HOVER has been correctly learned
PSC_ACCZ_P	0.5	0.35		<input checked="" type="checkbox"/>	Use MOT_THST_HOVER assuming MOT_THST_HOVER has been correctly learned

☐ See only changed parameters

☐ Annotate docs into .param files

Upload selected params to FC, and advance to next param file

Skip parameter file

Shows your progress  
through the  
configuration phases

- Each phase contains configuration steps that must be completed in sequence
- Greyed-out phases are optional and can be skipped

# Usage 2/2

Delete this parameter from this step  
(Do it if it does not apply to your vehicle)  
It will remain on the FC

Current flight controller value

When selected upload the new value to the flight controller  
Usually, you do not manually change this

Document the reason you changed this parameter to the new value at this configuration step

- Allows you and others to understand why this change was made
- Forces you to think
- Provides traceability

-/+	Parameter	Current Value	New Value	Unit	Upload	Change Reason
Del	ATC_THR_MIX_MAN	0.1	0.5		<input checked="" type="checkbox"/>	because we have learned the MOT_THST_HOVER value
Del	PSC_ACCZ_I	1	0.7		<input checked="" type="checkbox"/>	Use 2 * MOT_THST_HOVER assuming MOT_THST_HOVER has been correctly learned
Del	PSC_ACCZ_P	0.5	0.35		<input checked="" type="checkbox"/>	Use MOT_THST_HOVER assuming MOT_THST_HOVER has been correctly learned
Add						

↑ Add a parameter to this configuration step  
(your vehicle has special needs)

↑ Only show parameters that will be modified by the upload

↑ Upload these parameters (and only these) to the flight controller

↑ Skip all these parameters and got to next configuration step  
Usually, you do not need this

☐ See only changed parameters  
☐ Annotate docs into .param files



# Customization without changing source code

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The **vehicle components are customizable** without changing the python source code.

- Fully defined in the vehicle\_components.json file.
- Follows [vehicle\\_components\\_schema.json](#).
- Copy the vehicle\_components.json file to your vehicle directory, edit it and you'll have all your new components in the GUI.

The **configuration sequence is customizable** without changing the python source code.

- Fully defined in the [configuration\\_steps\\_ArduCopter.json](#) file.
- Follows [configuration\\_steps\\_schema.json](#).
- Copy the [configuration\\_steps\\_ArduCopter.json](#) file to your vehicle directory, edit it and you'll have changed the configuration sequence on the GUI. You can change, add, remove or reorder any of the steps.

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## Additional information sources

[Configuration guide](#)

[User manual](#)

[Use cases](#)

[Software architecture](#)


All these resources include an **ArduPilot-trained AI chatbot** on the bottom right corner

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# Summary

- Reduces human error probability
- Increases configuration speed
- Increases consistency and reproduce-ability
- Improves documentation and traceability



The background of the slide is a vibrant blue watercolor wash. It features soft, blended strokes of various shades of blue, ranging from deep navy to bright cyan, creating a textured, artistic effect. The colors are more concentrated on the left side and fade towards the right.

Thank you for your  
attention

let's make better  
ArduCopters

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