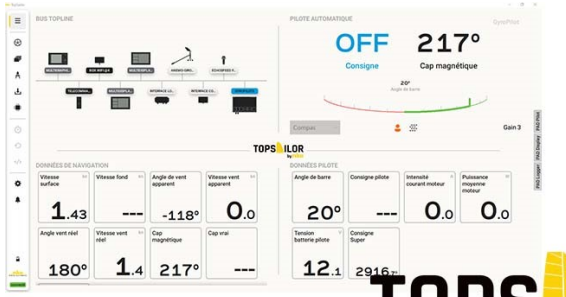
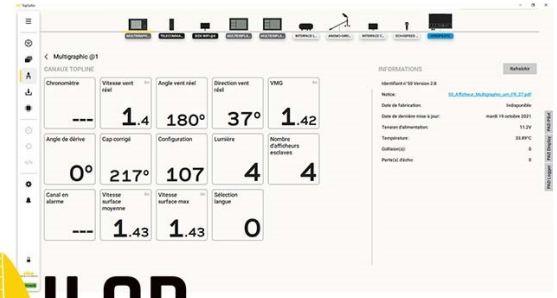
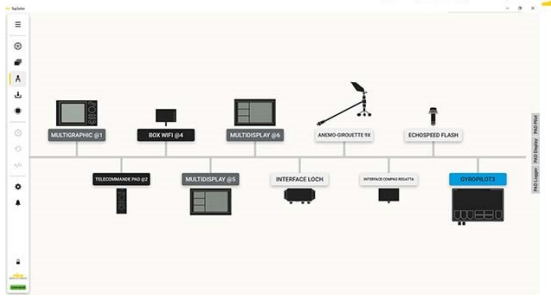
GYROPILOT 3
USER GUIDE & SETTINGS







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Synopsis

- COMPARISON GYROPILOT 3 / GYROPILOT 2
- AUTOPILOT ARCHITECTURE
- MAIN MODES
- MAIN AUTOPILOT SETTINGS
- SCENARIOS
- SUPER MODES
- SAFETY IMPROVEMENTS

COMPARISON : GYROPILOT 2 / GYROPILOT 3

Robustness
- Securing the switch to AUTO and MOBs
- improved MOB algorithm
- Temporary heading maintained whothout compass nor wind data
- Suppression of rudder movement in the event of loss of the rudder angle sensor
- Conservation of piloting in the event of overcurrent

Simplicity
- Better diagnosis in the event of a problem with the navigation system
- more LEDs on the front for instant troubleshooting
- ease of implementatiton with connectors
- simplicity of configuration by display : actuator, clutch, rudder angle sensor
- removal of external fuses
- improved handling of a rudder linear sensor

Performance
- New generation of more efficient electronic components
- Faster and finer steering algorithms
- Improved maneuver control

Improvements
- Added burst mode overlay
- Addition of the Heel mode overlay
- True wind mode included as a standard feature (no longer an option)
- Improved GPS mode
- Added VMG/polar mode
- improvement of rotating mast management
- Consideration of wind tables in the pilot wind
- Improved Tiller algorithm with velocity feedback

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DIFFERENCES BETWEEN GYROPILOT2 AND GYROPILOT3

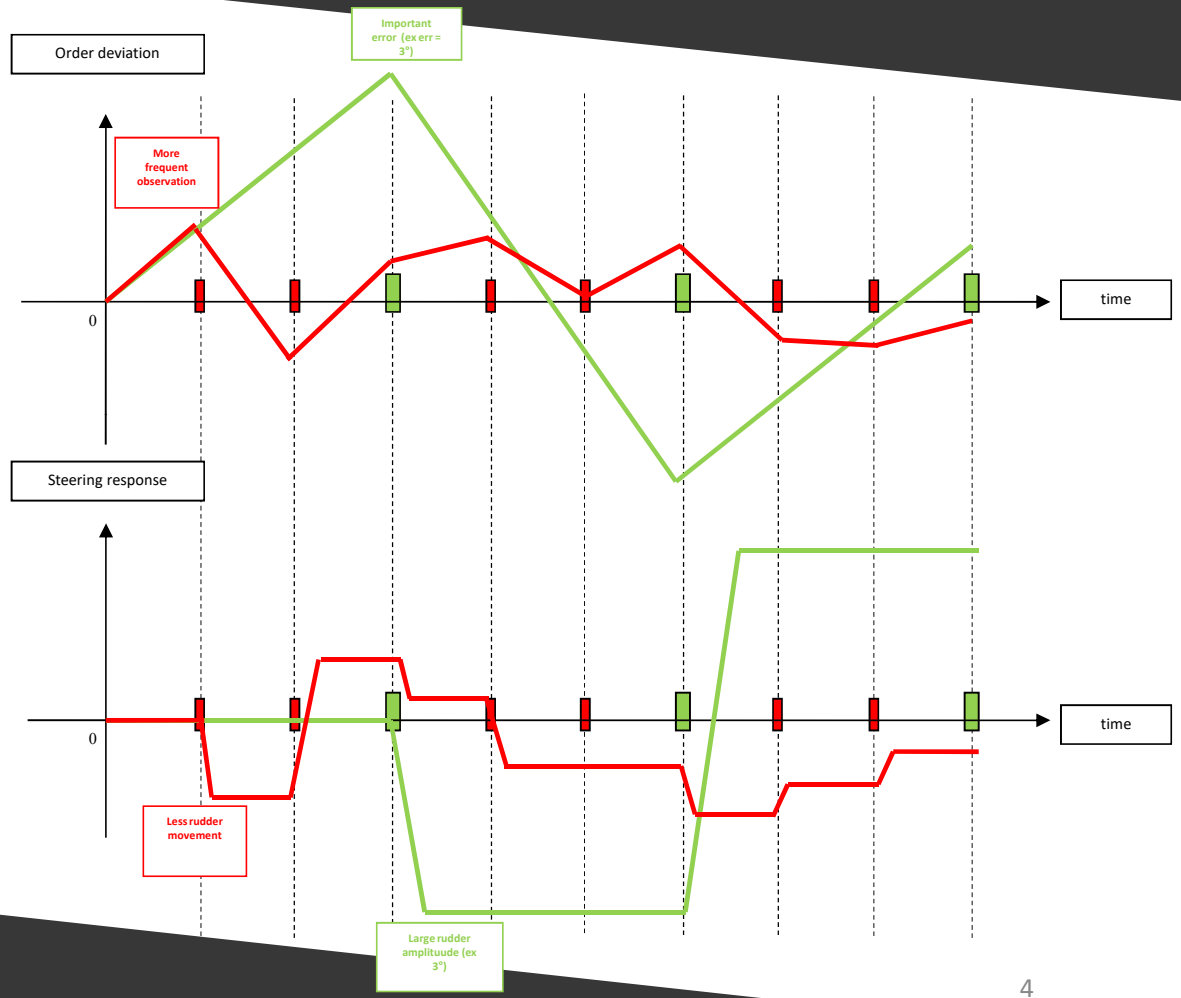
Always remember that:

- More frequent autopilot algorithm = reacts more quickly to a setpoint error

  → Less rudder movement because autopilot corrects faster

  →better order monitoring

  →for the same setting, different setting range



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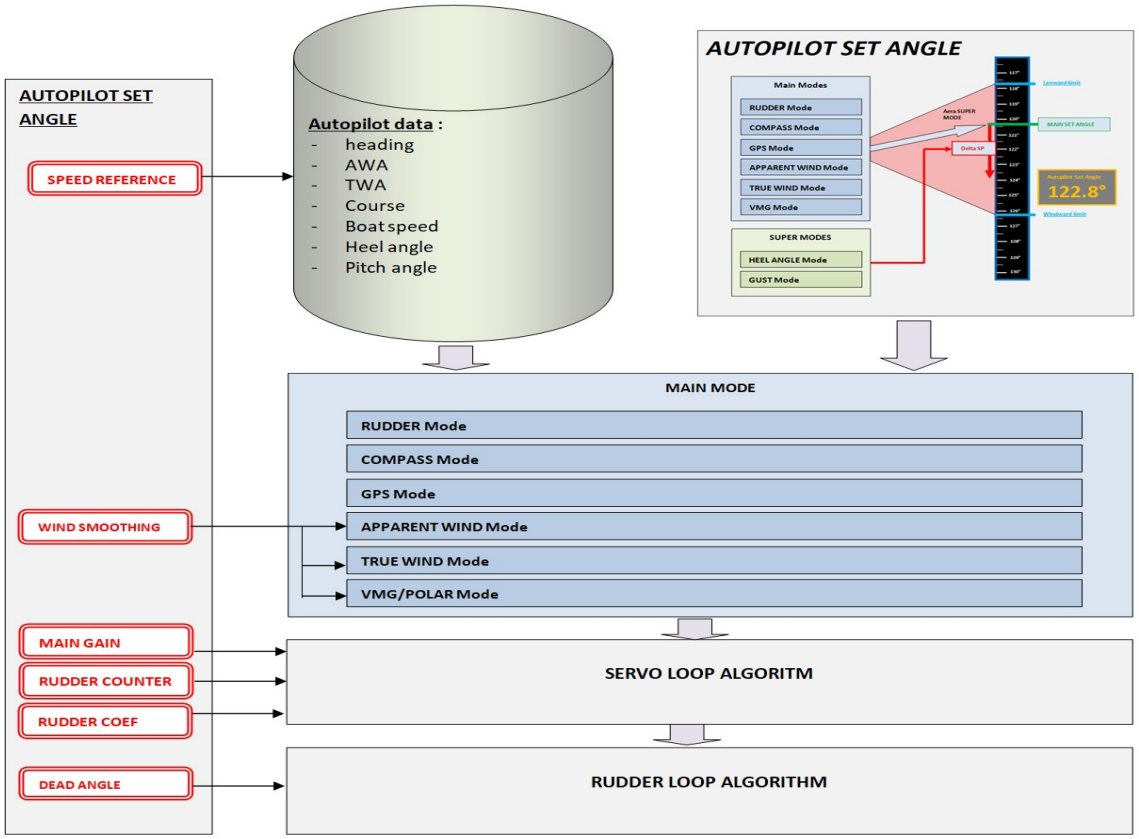
AUTOPILOT ARCHITECTURE

HOW THE AUTOPILOT MONITORS A SETTING



MAIN MODES

The main modes are :

- **RUDDER MODE** : autopilot follows a rudder angle
- **COMPASS MODE** : autopilot follows a heading
- **APPARENT WIND MODE** : autopilot follows an apparent wind angle smoothed by « wind damping » setting.
- **TRUE WIND MODE** : autopilot follows a true wind angle smoothed by « wind damping » setting.
- **VMG MODE**: autopilot follows an optimal up or down wind angle. It is obtained from the boat's polar.
- **GPS MODE** : autopilot follows a waypoint activated by the skipper.

TILLER MODE :

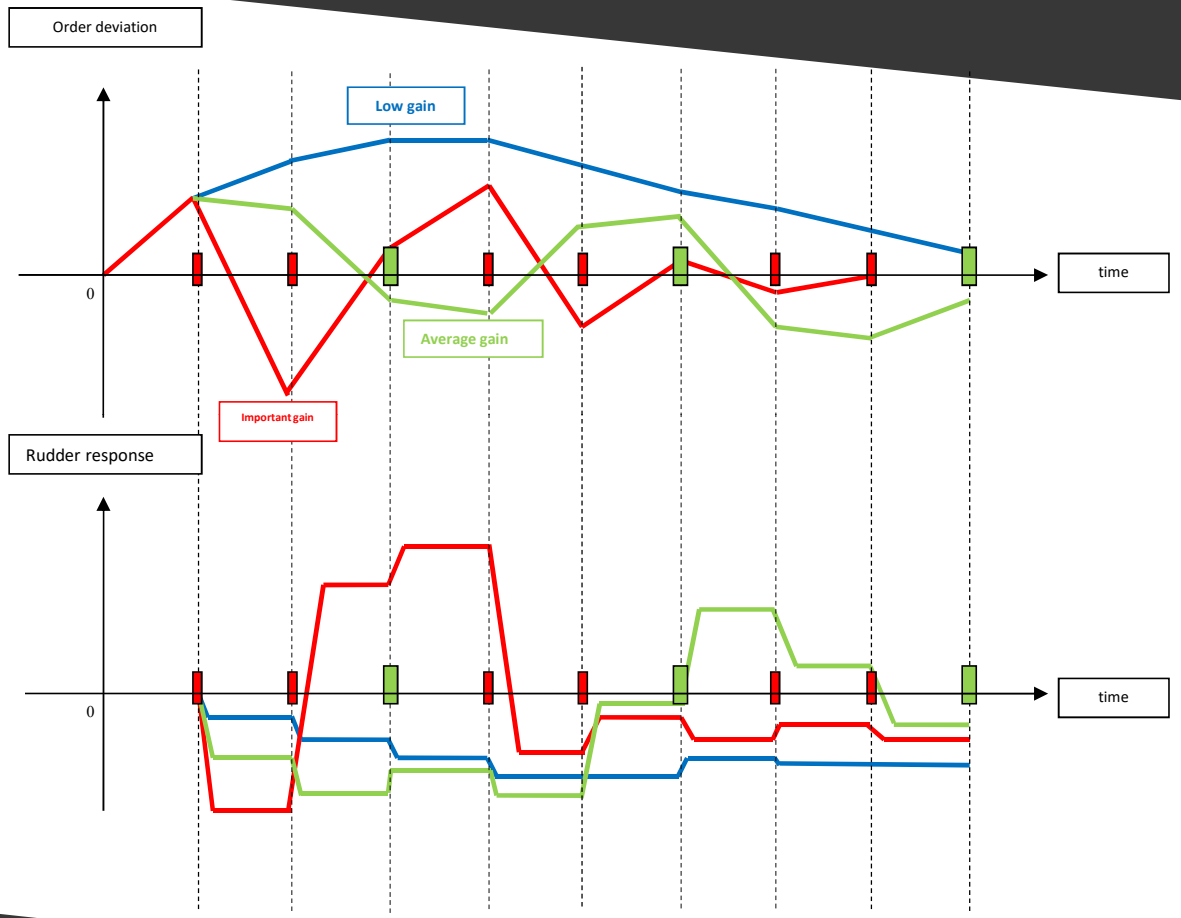
- In the autopilot, there is a special mode called "tiller mode" which can be activated if a tiller (joystick) has been previously connected to the Gyropilot 3. If the autopilot is activated in one of the main modes previously defined, then activating the Tiller automatically switches the pilot to helm mode and the helm will follow the variations of the joystick.
- If the joystick is deactivated, the pilot reverts to its previous main mode
- There are two types of "tiller mode" control:
  - Position feedback: the position of the joystick defines the angle of the boat's actuator
  - Speed control: the position of the joystick defines the boat's rudder variation speed (default control)

AUOPILOT MAIN SETTINGS

- In theory :
  - Simple monitoring
  - Continuous time in the autopilot
  - GyroPilot 3 settings = GyroPilot 2 settings
- In practice :
  - Need to manage the rudder response delay depending on the situation :
    - Boat inertia
    - Rudder shape response time
    - Max speed of the ram/drive unit
    - Sensor delay
  - GyroPilot 3 faster than GyroPilot 2
    - The autopilot settings act differently than on the GyroPilot 2
- The GyroPilot 3 2022 :
  - The first objective was to stabilize the autopilot: platform reliability, autopilot control, tacking, jibing, MOB etc...
  - The work that begins for NKE and the sailors: finding the right settings!! Work on the adjustment ranges if those are unsuitable

Main gain

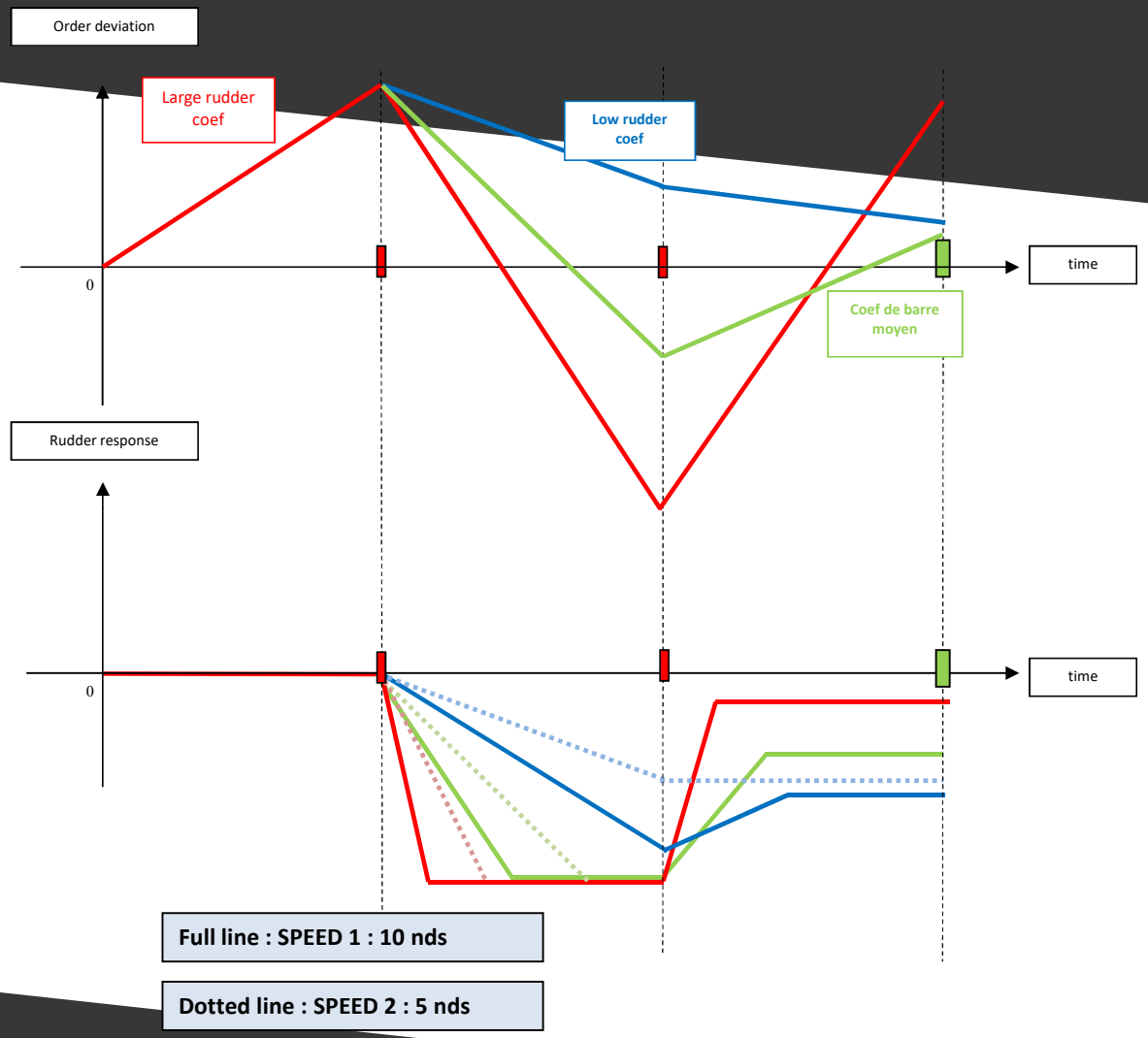
- Main gain controls rudder amplitude
  - This setting affects all modes except rudder mode
  - Setting range : [1 to 9]
- A high gain setting will cause :
  - A larger rudder amplitude response to an order deviation
  - A faster autopilot reaction to a yaw
  - the pilot returns more quickly to the original set order
- In theory, the greater the gain, the better the order tracking
- In practice, too much gain generates too fast and too wide a rudder stroke
  - Rudder moving too much
  - Significant overshoot of the order, risk of a boat oscillating around the order
- In practice, a gain that is too low causes a boat that does not follow its orders well.
  - Weak rudder
  - Boat very often far from its order



RUDDER COEFFICIENT

- **Rudder coefficient** controls the responsiveness of the rudder :
  - Settings depend on boat speed
  - This setting affects all modes except rudder mode
  - Setting range : [1 to 53]
- **Large rudder coefficient results in :**
  - a more frank and quick rudder response
- **In practice, autopilot reach more quickly the rudder angle that the pilot wants to reach and therefore it generates a secondary effect of increasing rudder amplitude,**

  ➔ **a sensation similar to the main gain: it increases the amplitude and the reactivity**



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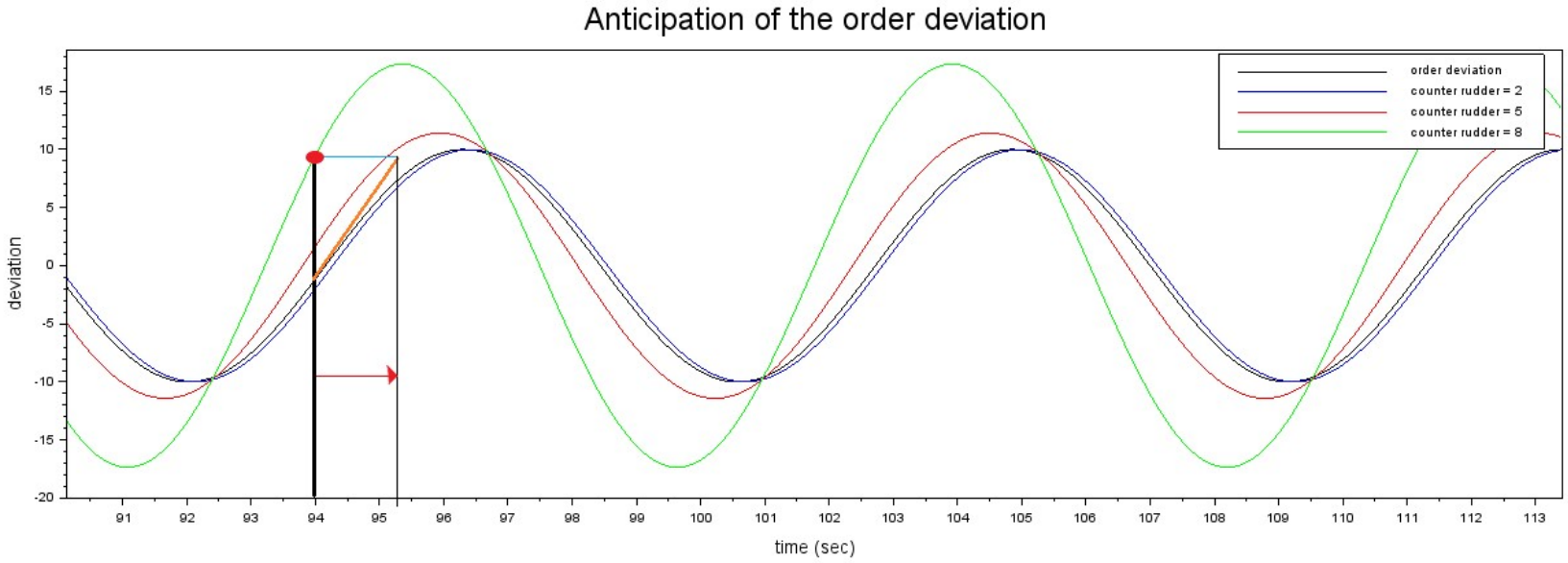
The Counter rudder

- The counter rudder controls the anticipation of order deviations.
  - Very useful during a shifted response from the boat: rough seas or for boats with high inertia
  - This setting affects all modes except rudder mode
  - Setting range : [1 to 9] + AUTO

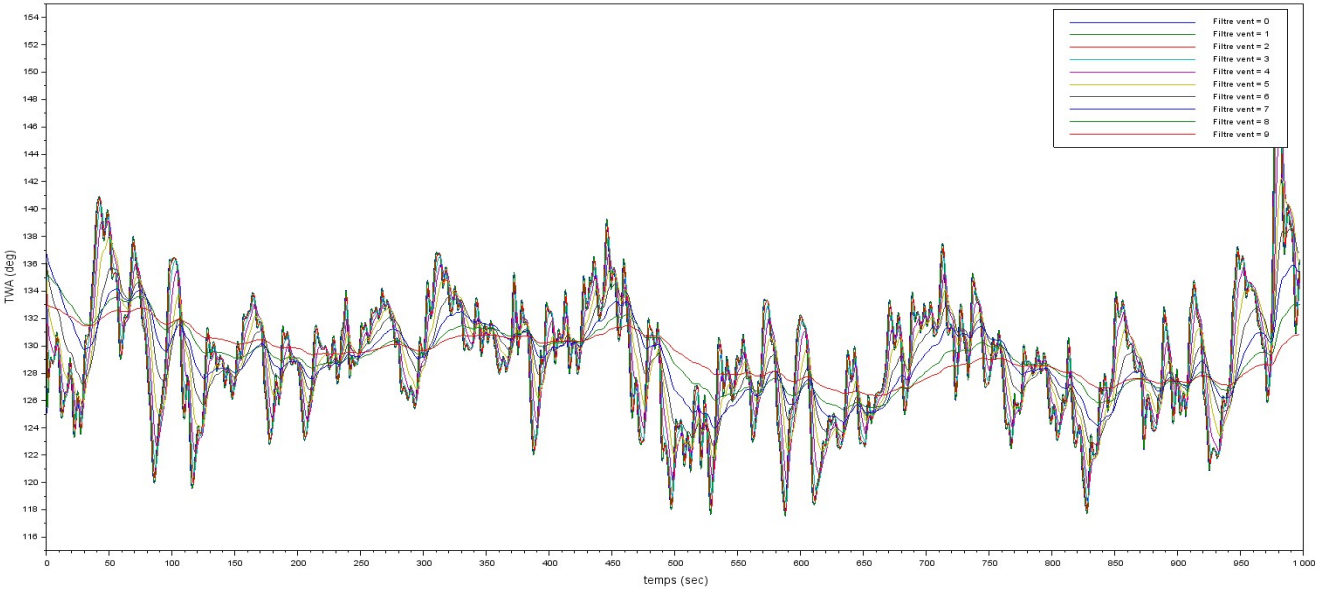
- Counter rudder too high result in:
  - Rudder swing
  - Rudder amplitude increases

- Counter rudder too low result in:
  - An autopilot that seems to react late
  - A boat that exceeds its order



WIND DAMPING

- Operation of the apparent wind / true wind modes: a compass mode that follows a TWD filtered according to the wind damping
- **Wind damping** controls the stability of the wind received by the autopilot.
  - This setting depends on the weather wind stability.
  - Setting range : [1 to 9] + AUTO
- Large wind damping ➔ Stable TWD, we are getting closer to a compass mode
- Weak wind damping ➔ Boat following the wind. If the wind is too unstable → oscillations too strong



Settings	Filtering range (sec)
0	0
1	0.2
2	0.4
3	1.6
4	3.2
5	**6.4**
6	12.8
7	25
8	51
9	102

SCENARIOS

POSSIBLE CASES

I'm going downwind in compass mode, my boat is making S's. It's relaunching hard and bearing down hard. He seems to be late. What to do?

❑ POSSIBILITY N°1 : my boat gives a feeling of late setpoint →I increase my counter rudder

❑POSSIBILITY N°2 : my rudder movements are too large, my actuator, limited in speed, is late. I lower my main gain and my rudder coef.

I'm going downwind in true wind mode, my boat is making S's. It's relaunching hard and it's bearing down hard, it seems to be late. In compass mode the boat works well. What to do?

❑ POSSIBILITY N°1 : I increase my wind damping, I'm going to get closer to a compass mode, I'm going to go straighter.

❑POSSIBILITY N°2 : if I mount my wind damping, my spinnaker blankets too much. I therefore keep a low wind damping to have reactivity in the wind, but I also reduce my rudder amplitudes and rudder reactivity (Gain, rudder coefficient)

I'm going downwind in true wind mode, I'm well trimmed in sail but I'm going too often to the heap. What to do?

❑ POSSIBILITY N°1 : I need to be responsive and to better anticipate the lost control. I mount my counter rudder and my rudder coef.

❑POSSIBILITY N°2 : If I raise my rudder coef, I do too much S. First of all, I need reactivity so I don't lower my rudder coef and my counter rudder but I increase my wind damping.

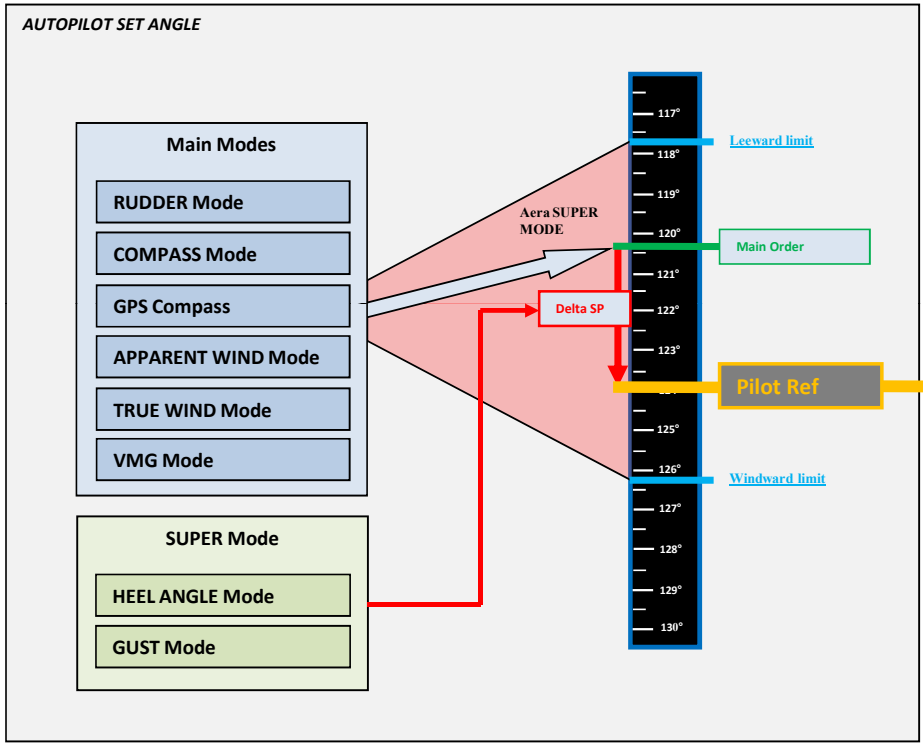
I'm going upwind, in apparent wind mode, my boat tacks on its own

❑ POSSIBILITY N°1 : I need to follow the wind better, I lower my wind damping.

❑POSSIBILITY N°2 : I lower my wind damping but the rudder moves too much so I can also lower my gain, rudder coef and counter rudder.

SUPER MODES

- The SUPER Modes are particular operating modes which intervene punctually according to a phenomenon or a particular situation. For example, Gust mode is a mode that activates after detecting a gust of wind
- SUPER Modes intervene in the construction of the autopilot's set angles. They calculate a set delta called "delta SP" to react to the detected situation.
- Two SUPER modes available as part of the GYOPILOT 3 :
  - GUST Mode
  - HEEL ANGLE Mode
- Activation Conditions :
  - MAIN MODE : COMPASS, APPARENT WIND,TRUE WIND, VMG
  - TWA available: navigation sector calculation
  - Availability of the variable
    - Heel Angle→Heel Angle Mode
    - TWS → Gust Mode
- Desactivation conditions :
  - Main mode change → reactivation with an "AUTO" command
  - Temporary suspension during tack, jibe, change of set angle

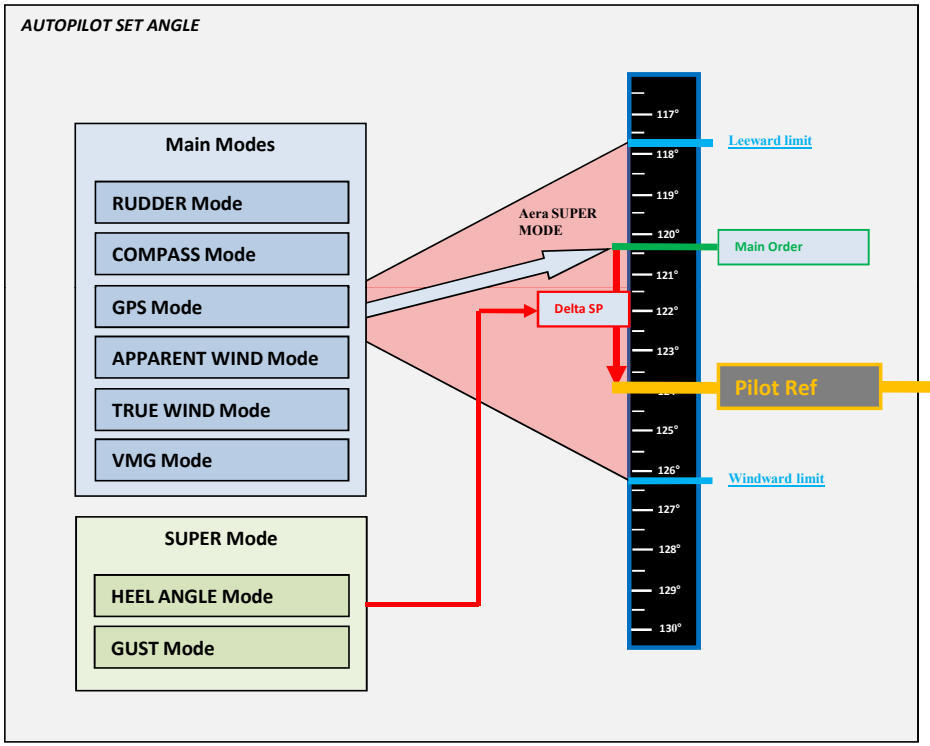


GUST MODE

- Mode that reacts to overselling
- **Gust gain** : setting range 1 to 9. Influence the way the boat will react in a gust

indicative table of the first stage of a response to a gust of 5 knots	
GUST GAIN	DELTA SP
1	0.25
2	0.5
3	1
4	1.75
5	2.5
6	3.5
7	4.5
8	5.5
9	7

- **Limit** : Maximum main set angle variation generated by gust mode.
  - Setting range : [0° to 60°]
- **Filter** : duration of the bursts taken into account by the mode.
  - Setting Range : [20s to 500s]



HEEL ANGLE MODE

- Mode that stabilizes the heel around a heel set angle
- Modification of the set heel angle with the autopilot commands: [arrow < or >] + ["ok"]
- **Heel angle gain** : setting range : 1 to 9. Influence in which the boat will react in a heel

indicative table of the first stage of a response to a heel of 5°	
HEEL GAIN	DELTA SP
1	0.5
2	1
3	1.5
4	2
5	2.5
6	3.5
7	4.5
8	5.5
9	7

- **Leeward limit** : Maximum main set heel angle variation upwind of the main setpoint generated by the heel angle mode.
  - Setting range : [0° to 60°]
- **Windward Limit** : Maximum main set heel angle variation downwind of the main setpoint generated by the heel angle mode.
  - Setting range : [0° to 60°]

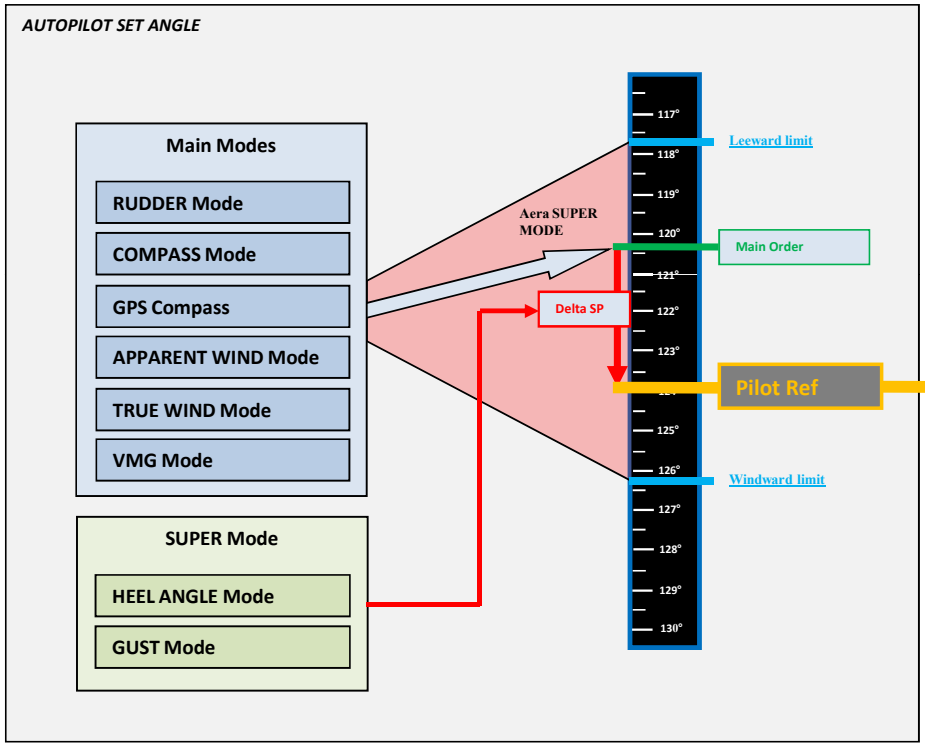


TABLE OF SETTINGS

34ft / 10m BOAT settings suggestion

	Upwind	Reaching	Down wind
Light Wind	**AWA Mode** **Gain : 1** **Rudder Coef: 6** **Counter rudder : 1** **Wind damping : 5**	**Compass Mode** **Gain : 1** **Rudder Coef : 6** **Counter rudder : 1** **Wind damping : 5**	**TWA Mode** **Gain : 2** **Rudder Coef : 15** **Counter rudder : 3** **Wind damping : 7**
Medium Wind	**AWA Mode** **Gain : 2** **Rudder Coef : 18** **Counter rudder : 2** **Wind damping : 4*** [Heel Angle Mode] : - Heel Gain : 5 - Limits : +/-4° max	**Compass Mode** **Gain : 3** **Rudder Coef : 20** **Counter rudder : 3** **Wind damping : 5*** [Gust Mode] : - Gust Gain : 5 - Limit : 7° - - upwind/downwind Limit : 60°	**TWA Mode** **Gain : 2** **Rudder Coef : 15** **Counter rudder : 3** **Wind damping : 7*** [Heel Angle Mode] : - Hell Gain : 5 - Leeward limit : 0 - Windwrd limit : 5°
Strong Wind	**AWA Mode** **Gain : 3** **Rudder Coef : 20** **Counter rudder : 3** **Wind damping : 4*** [Heel Angle Mode] : - Heel Gain : 7 - Limits : +/-4° max	**Compass Mode** **Gain : 5** **Rudder Coef : 28** **Counter rudder : 3** **Wind damping : 4*** [Gust Mode] : - Gust Gain : 7 - Limit : 7° - upwind/downwind Limit : 60°	**TWA Mode** **Gain : 6** **Rudder Coef : 35** **Counter rudder : 4** **Wind damping : 7*** [Heel Angle Mode] : - Heel Gain : 7 - Leeward limit : 4° - Windward limit : 2°

- (*) : wind damping +1 when you activate a SUPER mode

[Rule 1] : When you can't adjust yourself in wind mode, you start by adjusting yourself in compass mode

[Rule 2] : When we can't adjust, we remove the SUPER modes

[Rule 3] : When you activate a SUPER mode, you increase the wind damping by +1.

[Rule 4] : SUPER modes are not useful in all conditions

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FAILURE MANAGEMENT

breakdowns treated :

- Loss of Rudder Angle → Held rudder for duration of "Time before cut-off"
- Loss of compass in compass/GPS mode → switch to true wind mode
- Loss of compass in wind mode → no change of mode but degraded wind mode
- Loss of compass without wind → switch to pure inertia navigation for the duration of the "time to cut"
- Loss of wind vane in wind mode→ switch to compass mode
- Loss of pilot speed in true wind mode→ switch to apparent wind mode
- Detection of a faulty SPEEDO → switch to SOG as speed reference

SAFETY IMPROVEMENTS

PROCEDURE FOR DETECTING ANOMALIES AT SEA

ACTION 1
Detection of a problem!
NOTE THE TIME