**EUROCONTROL**

# TCAS II version 7.1

# Overview for air traffic controllers

Version 1.2 –  24 July  2014

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The European Organisation for the Safety of Air Navigation

*Note: This presentation material has been designed to support the training of people involved in the use of the Airborne Collision Avoidance System (ACAS). However, it is not, per se, designed for the complete training of controllers or pilots. The principal and essential technical and operational features of ACAS are introduced. For a deeper knowledge, the reader is advised to refer to documentation listed in the Resources section.*

*The information contained in this presentation and EUROCONTROL ACAS II Bulletins is considered to be accurate at the time of publishing and is subject to change.*

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| History of changes | | |
|---|---|---|
| Version 1.0 | 12 January 2012 | First release |
| Version 1.1 | 27 February 2013 | Updated Resources section. |
| Version 1.2 | 24 July 2014 | Updated hyperlinks |

# How to use this presentation?

- Use page up/page down keys to move from one slide to the other

- Jump directly to another section using the tabs at the top of the screen

- Check www.eurocontrol.int/acas to see if there is an updated version of this presentation available

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# Why version 7.1?

- TCAS II version 7.0 mandated in Europe since 2000

- Safety issues identified in version 7.0:
  - Unintentional opposite pilot response to "Adjust vertical speed, adjust" RAs
  - Level busts following "Adjust vertical speed, adjust" RAs
  - Flaws in the reversal logic

- TCAS II version 7.1 will address these safety issues
  - "Level off, level off" RA
  - Improvements to reversal logic
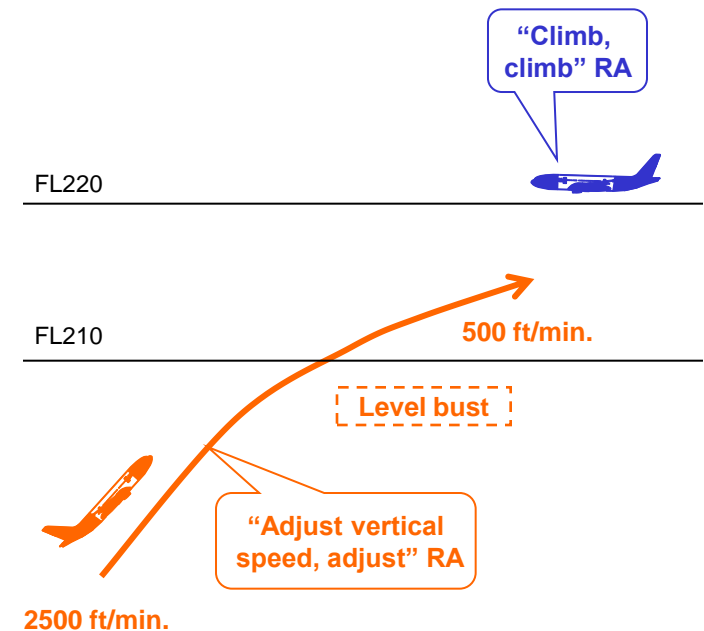
Note: TCAS versions are backwards compatible

# Unintentional opposite pilot response to "Adjust vertical speed, adjust" RAs

- "Adjust vertical speed, adjust" RAs always require reduction of vertical speed
  - The only RA that does not clearly communicate what exact manoeuvre is required
- Numerous cases reported when pilots unintentionally increased vertical speed responding to "Adjust vertical speed, adjust" RAs
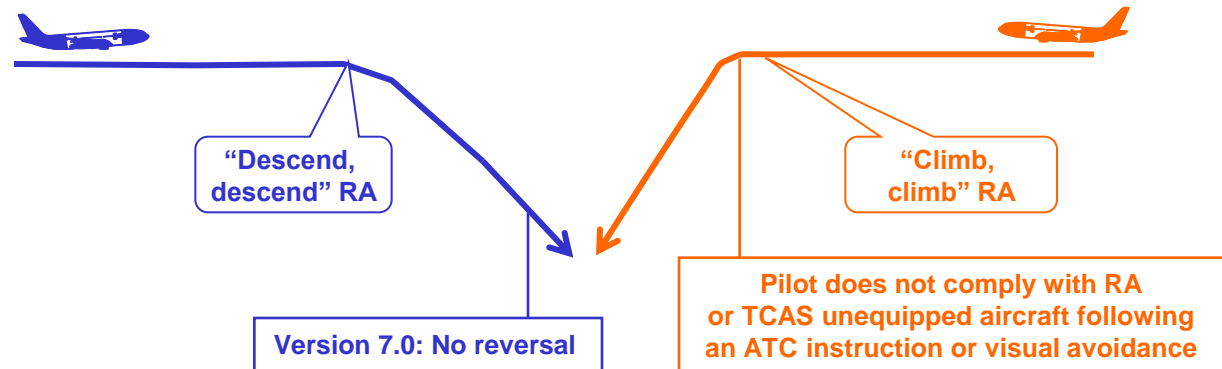  - Accidents avoided by chance
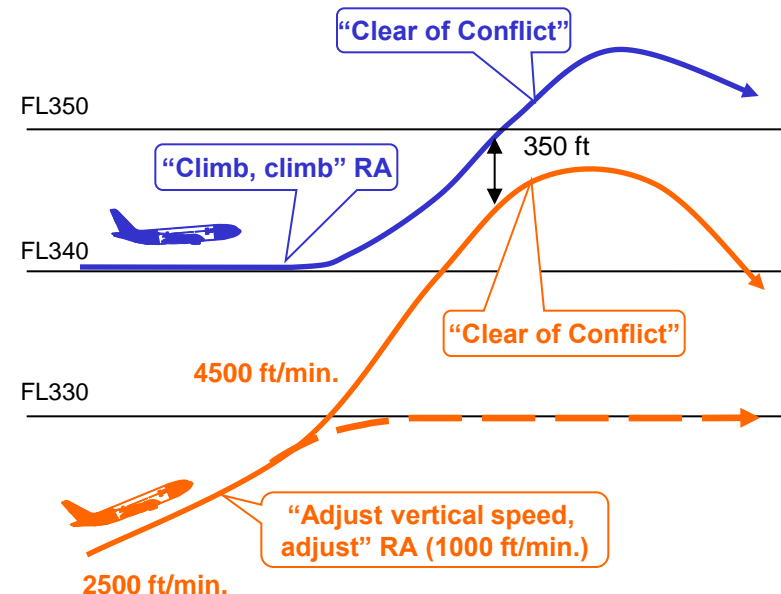
# Level busts following "Adjust vertical speed, adjust" RAs

- "Adjust vertical speed, adjust" RAs often unnecessarily affected ATC operations

  - Contribution to level busts (in situations where otherwise there would not have been a level bust)

  - Pilots following "green arc" not levelling off at the cleared level

  - Reason for RAs on the other aircraft



"Climb, climb" RA

FL220

FL210                                            500 ft/min.

Level bust

"Adjust vertical speed, adjust" RA

2500 ft/min.

# Flaws in reversal logic

- Version 7.0 will not reverse an RA if two aircraft converging in altitude remain within 100 feet
  - One aircraft is not responding to RA; or
  - One aircraft is not equipped and follows ATC instruction or visual avoidance
- Contributory factor in 2 accidents:
  - 2001 Yaizu accident
  - 2002 Überlingen midair collision
  - Several other serious events reported

"Descend, descend" RA

"Climb, climb" RA

Version 7.0: No reversal

Pilot does not comply with RA
or TCAS unequipped aircraft following
an ATC instruction or visual avoidance

# Who & When?

**Aircraft currently equipped** with version 7.0 will need to be upgraded to version 7.1 before **1 December 2015** in order to continue to operate in European Community airspace.

**All new aircraft**[1] above 5,700 kg Maximum Take-off Mass or with passenger seating capacity above 19 will have to be equipped from **1 March 2012**.

The above applies to European and foreign aircraft.

Note: The EU mandate sets an earlier equipage requirements than those published in ICAO Annex 10 (i.e. 1 January 2014 new installations, 1 January 2017 existing units).

[1] Aircraft with an individual certificate of airworthiness issued after 1 March 2012.
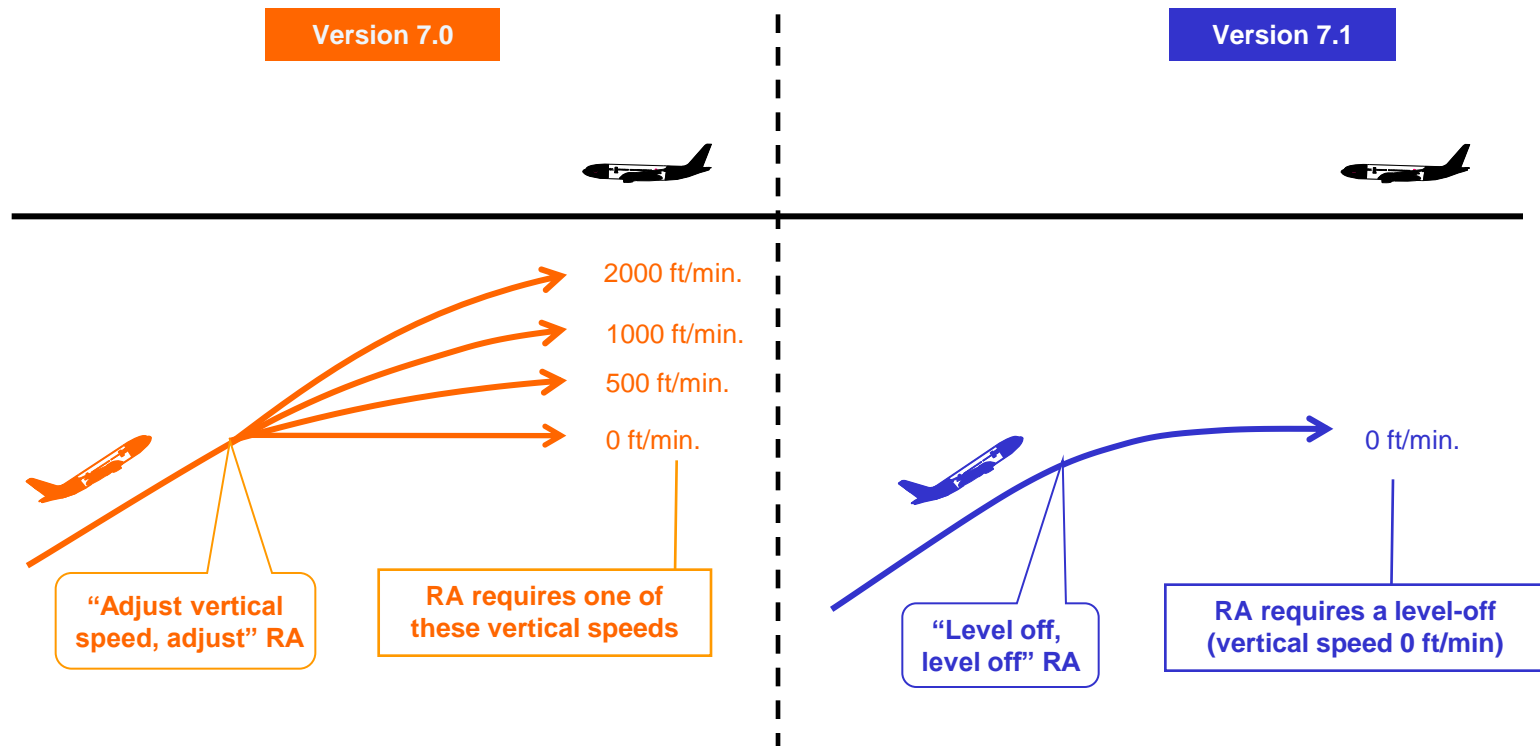
# What's new?

- [“Level off, level off” RA](#)
- [Improvements to the reversal logic](#)

# "Level off, level off" RA (1/5)

- New RA introduced in version 7.1: **"Level off, level off"**

- Pilots will reduce the vertical rate to 0 ft/min (i.e. level off)

- **The level off is to be achieved promptly**, <u>not</u> at the next flight level

- It replaces the existing "Adjust vertical speed, adjust" RA to address the issue of unintentional incorrect pilot responses

- Applies to both:

  - Initial RAs
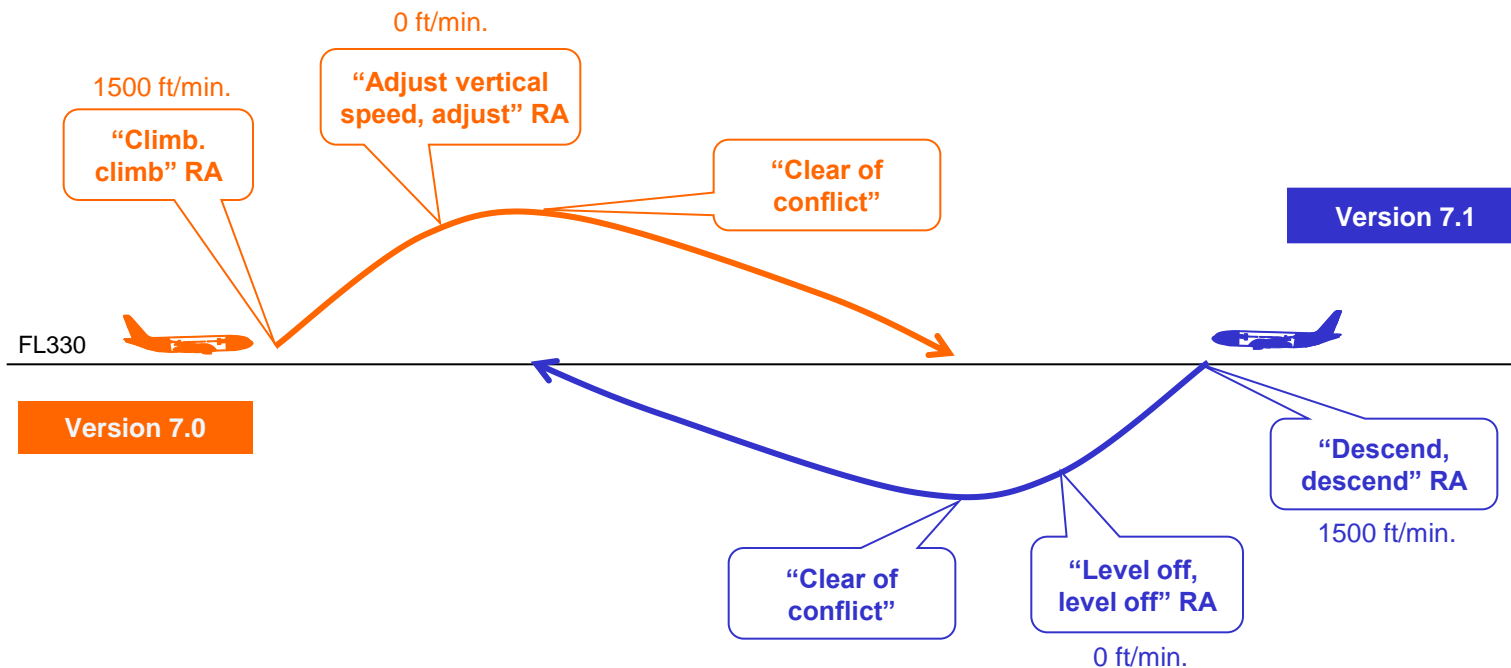
  - Weakening RAs

# "Level off, level off" RA (2/5)

## Initial RA



**Version 7.0**

**Version 7.1**

2000 ft/min.

1000 ft/min.

500 ft/min.

0 ft/min.

0 ft/min.

**"Adjust vertical speed, adjust" RA**

**RA requires one of these vertical speeds**

**"Level off, level off" RA**

**RA requires a level-off (vertical speed 0 ft/min)**
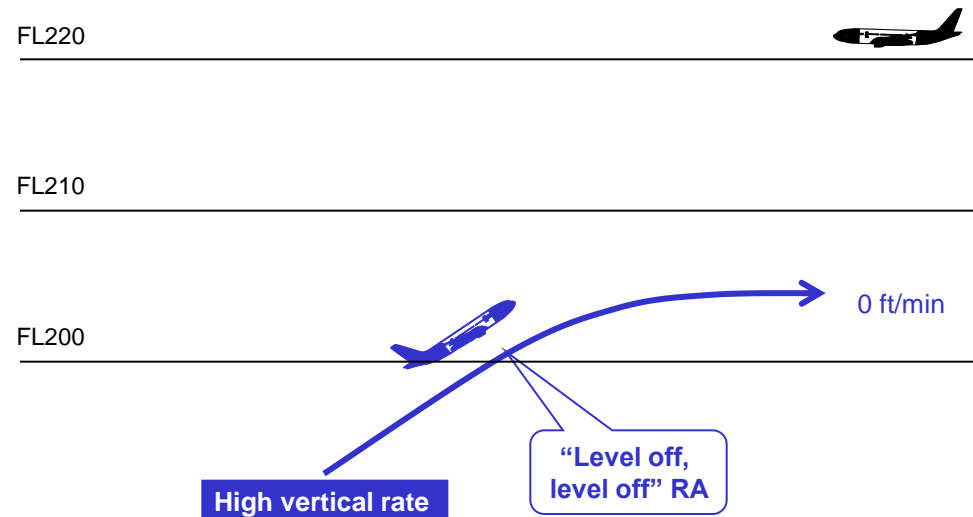
# "Level off, level off" RA (3/5)

## Weakening RA

- An RA will weaken when vertical spacing increases following the initial RA

  - In version 7.0 the weakening RA also always requires a level off



0 ft/min.

**"Adjust vertical speed, adjust" RA**

1500 ft/min.

**"Climb. climb" RA**

**"Clear of conflict"**

**Version 7.1**

FL330

**Version 7.0**

**"Descend, descend" RA**

1500 ft/min.

**"Clear of conflict"**

**"Level off, level off" RA**

0 ft/min.

Note: Versions 7.0 and 7.1 are compatible

# "Level off, level off" RA (4/5)

## Impact on ATC

- Prompt level off will result in some aircraft levelling off hundreds of feet before their cleared level while responding to this RA

- "Level off, level off" RA will not induce conflicts with third party aircraft more frequently than the current version of TCAS



FL220

FL210

FL200   0 ft/min

"Level off, level off" RA

**High vertical rate**

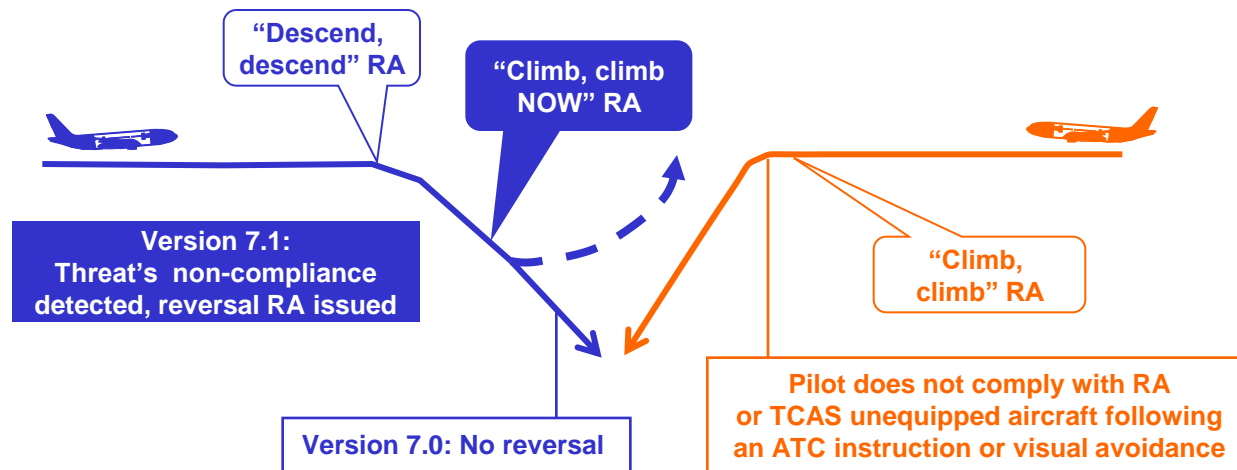# "Level off, level off" RA (5/5)

## Impact on ATC

- "Level off, level off" RA will reduce instances of:
  - RAs – as follow up RAs are less likely
  - Level busts as a result of RA
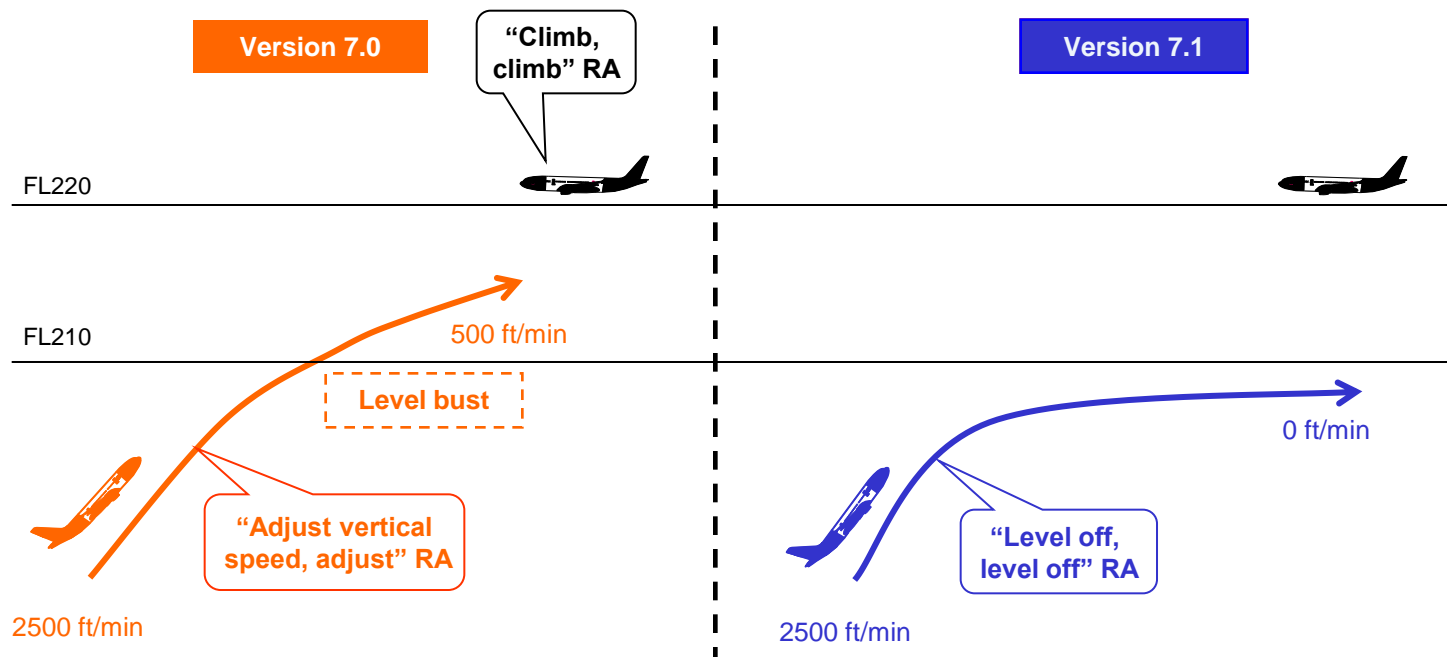
# Improvement to the reversal logic (1/2)

- Version 7.1's improved reversal logic recognizes situations when two aircraft:

  - remain within 100 feet and converge
  - one aircraft is not responding to the RA or is not equipped

- A reversal RA (i.e. "Climb, climb NOW" or "Descend, descend NOW") will be issued to the aircraft that is correctly responding to the previous RA

- Improvement to the reversal logic is transparent for pilots and controllers

# Improvement to the reversal logic (2/2)



"Descend, descend" RA

"Climb, climb NOW" RA

Version 7.1:
Threat's non-compliance detected, reversal RA issued

"Climb, climb" RA

Version 7.0: No reversal

Pilot does not comply with RA
or TCAS unequipped aircraft following
an ATC instruction or visual avoidance

# Frequently Asked Questions (FAQ)

1. [What controller training is required?](#)

2. [How do I know which version of TCAS the aircraft operates?](#)

3. [Can an aircraft operate without serviceable TCAS?](#)

4. [More Frequently Asked Questions…](#)

# What controller training is required?

Air Navigation Service Providers should ensure that air traffic controllers are:

- aware of the TCAS version upgrade
- understand the effect the new "Level off, level off" RA will have on ATC operations (i.e. there will be some instances of premature level-offs by aircraft following the RA)

Besides that there are no differences (visible to pilots and controllers) between version 7.0 and version 7.1.

# How do I know which version of TCAS the aircraft operates?

There is no need for ATC to know which version of TCAS the aircraft operates. In Europe there is no requirement to indicate in the flight plan which version of TCAS the aircraft operates.

TCAS versions are compatible, so proper TCAS-TCAS coordination will take place in coordinated encounters.

The provision of air traffic services to aircraft equipped with TCAS shall be identical to those that are not equipped.

# Can an aircraft operate without serviceable TCAS?

In Europe an aircraft may operate under the Minimum Equipment List (MEL) provisions with TCAS II inoperative for up to 10 calendar days.

In German airspace the time period during which TCAS II may be inoperative is reduced to 3 days. National regulators may impose more restrictive deadlines for some operators or parts of airspace.

In Europe, there is no requirement to notify ATC or to make a remark in the flight plan about TCAS II being inoperative.

# More Frequently Asked Questions…

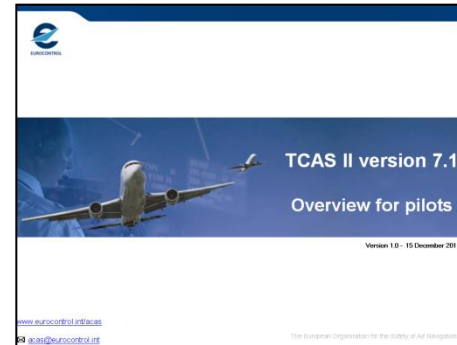Available on EUROCONTROL website:

[www.eurocontrol.int/acas](www.eurocontrol.int/acas)

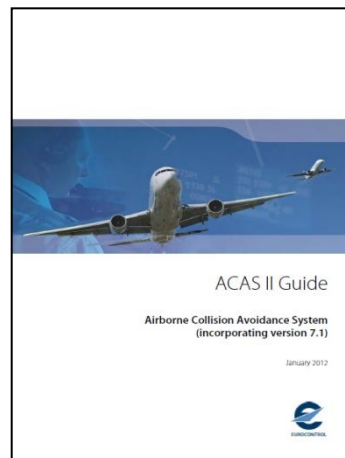# Additional training resources (1/2)

Available from www.eurocontrol.int/acas and www.skybrary.aero
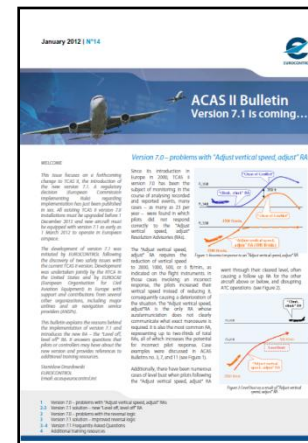


Overview of ACAS II
(presentation)



TCAS II version 7.1 for pilots
(presentation)



ACAS II Guide



ACAS II Bulletin no. 14
Version 7.1 is coming…

# Additional training resources (2/2)
## EUROCONTROL ACAS II Bulletins

| | |
|---|---|
| 1 - Follow the RA! (July 2002) | 9 - Frequently Asked Questions (July 2007) |
| 2 - RAs and 1000 ft level-off manoeuvres (March 2003) | 10 - When ATC meets TCAS II (November 2007) |
| 3 - Wrong reaction to "Adjust Vertical Speed" RAs (October 2003) | 11 - ACAS world is moving on (May 2010) |
| 4 - TCAS II and VFR traffic (May 2004) | 12 - Focus on pilot training (February 2011) |
| 5 - Controller and Pilot ACAS regulation and training (October 2004) | 13 - Reversing to resolve (September 2011) |
| 6 - Incorrect use of the TCAS traffic display (March 2005) | 14 - Version 7.1 is coming (January 2012) |
| 7 - The Dos and Don'ts of TCAS II Operations (March 2006) | 15 - Not so fast… (May 2012) |
| 8 - TCAS II Operations in European RVSM Airspace (May 2006) | 16 - "Traffic, traffic" - TCAS Traffic Advisories (December 2012) |

The information contained in the EUROCONTROL ACAS II Bulletins is accurate at the time of publishing but is subject to change.

All EUROCONTROL ACAS II Bulletins are available from:
www.eurocontrol.int/acas and www.skybrary.aero

# Questions?
# Need more information?

## www.eurocontrol.int/acas

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