

TCAS Transition Program (TTP) Industry Alert Bulletin
August 12, 2002

Background

Over the past several months, there have been several TCAS events in which the improper response to a TCAS resolution advisory (RA) resulted in the vertical miss distance between two aircraft being less than that which TCAS is designed to provide. In addition, the final report of a January 2001 near mid-air collision between two TCAS-equipped aircraft in Japan indicates that one of the contributing factors to this event was the improper response of one pilot to the RA received during the encounter.

With this in mind, the TTP believes it is essential for all operators to review the previously published guidance related to responding to RAs. The following material is taken from the Federal Aviation Administration Advisory Circular (AC) 120-55B, entitled *AIR CARRIER OPERATIONAL APPROVAL AND USE OF TCAS II*. Although the title refers to air carriers, the guidance contained in the AC is applicable to all TCAS operators.

1. Pilot Responsibilities. TCAS is intended to serve as a backup to visual collision avoidance, application of right-of-way rules, and air traffic separation service. ***For TCAS to work as designed, immediate and correct crew response to TCAS advisories is essential.*** Delayed crew response or reluctance of a flight crew to adjust the aircraft's flight path as advised by TCAS due to Air Traffic Control (ATC) clearance provisions, fear of later FAA scrutiny, or other factors could significantly decrease or negate the protection afforded by TCAS. Flight crews are expected to respond to TCAS RAs in accordance with the following guidelines:

(a) When an RA occurs, the pilot flying (PF) should respond immediately by direct attention to RA displays and maneuver as indicated, unless doing so would jeopardize the safe operation of the flight or the flight crew can assure separation with the help of definitive visual acquisition of the aircraft causing the RA. By not responding to an RA, the flight crew effectively takes responsibility for achieving safe separation. In so choosing, the following cautions should be considered:

(i) The traffic may also be equipped with TCAS and it may maneuver in response to an RA that has been coordinated with your own TCAS. *Note: If the traffic is TCAS-equipped, its RA will be in the opposite direction to that which you receive.*

(ii) The traffic acquired visually may not be the same traffic causing the RA.

(iii) Visual perception of the encounter may be misleading. Unless it is unequivocally clear that the target acquired visually is the one generating the RA and there are no complicating circumstances, ***the pilot's instinctive reaction should always be to respond to RAs in the direction and to the degree displayed.***

(b) Satisfy RAs by disconnecting the autopilot, if necessary, using prompt, positive control inputs in the direction and with the magnitude TCAS advises. To achieve the required vertical rate (normally 1,500 feet per minute (fpm) climb or descent), first adjust the pitch of the aircraft using the suggested guidelines shown in the table below. Then refer to the vertical speed indicator (VSI) and make all necessary pitch adjustments to place the VSI in the green arc. On aircraft with pitch guidance for TCAS RA displays, follow the RA pitch command for initial, increase, and weakening RAs.

Speed	Pitch Adjustment
.80 MACH	2°
250 KIAS below 10,000 feet	4°
APPROACH below 200 KIAS	5° to 7°

(c) For TCAS to provide safe vertical separation, the initial response is expected within 5 seconds of when the RA is first displayed. Vertical speed responses should be made to avoid red arcs or outlined pitch avoidance areas and, if applicable, to accurately fly to the green arc or outlined pitch guidance area. Excessive responses to TCAS RAs are inappropriate and may increase interference with other traffic and result in additional RAs.

(d) Respond immediately to any “increase” or “reversal” RA maneuver advisories. Initial vertical speed response to an increase or reversal RA is expected by TCAS within 2 1/2 seconds after issuance of the advisory. Again, avoid red arcs or outlined pitch avoidance areas and fly to the green arc or outlined pitch guidance area.

(e) If a TCAS RA response requires deviation from an ATC clearance, expeditiously return to the current ATC clearance when the traffic conflict is resolved, the TCAS “clear of conflict” message is heard, or follow any subsequent change to clearance as advised by ATC. *In responding to a TCAS RA that directs a deviation from assigned altitude, communicate with ATC as soon as practicable after responding to the RA.* AC 20-155B, Appendix 5, recommends that the following phraseology be used for notifying that an RA is in progress:

New York Center, Universal 602, TCAS Climb (Descent)

(f) If a TCAS RA maneuver is contrary to other critical cockpit warnings, then those other critical warnings are respected as defined by TCAS certification and training (that is, responses to stall warning, windshear, and Ground Proximity Warning System (GPWS) take precedence over a TCAS RA, particularly when the aircraft is less than 2,500 feet Above Ground Level (AGL)).

(g) The potential consequences of improperly maneuvering the aircraft in response to an RA include:

(i) An aircraft seen visually may not necessarily be the aircraft causing the RA or may not be the only aircraft that TCAS considers a threat.

(ii) It is difficult to visually determine the vertical displacement of other aircraft especially when ground reference information is unreliable or at cruise altitudes where the earth’s horizon is obscured. Therefore, disregarding RA information and maneuvering vertically based solely on visual acquisition may result in a loss of safe separation.

(iii) ATC may not know when TCAS issues RAs. It is possible for ATC to unknowingly issue instructions that are contrary to the TCAS RA indications. *Safe vertical separation may be lost during TCAS coordination when one aircraft maneuvers opposite the vertical direction indicated by TCAS and the other aircraft maneuvers as indicated by TCAS. Accordingly, during an RA, do not maneuver contrary to the RA based solely on ATC instructions.*

(iv) *Maneuvering in a direction opposite to a TCAS RA will negate safe separation as a TCAS-equipped intruder follows its RA, which has been coordinated to be in the opposite direction.*

2. ATC Responsibilities. ATC responsibilities relating to TCAS are contained in FAA Order 7110.65, Air Traffic Control. Excerpts of information contained in this Order are highlighted below.

(a) Controllers will not knowingly issue instructions that are contrary to RA guidance **when they are aware that a TCAS maneuver is in progress**. When an aircraft deviates from its clearance in response to an RA, ATC is still responsible for providing assistance to the deviating aircraft as requested until:

- (i) The pilot informs ATC that the RA conflict has cleared; and
- (ii) The aircraft has returned to the previously assigned altitude; or
- (iii) Alternate ATC instructions have been issued and acknowledged.

3. ICAO Guidance. The FAA guidance contained in AC 120-55B is similar to the guidance on ACAS provided by various ICAO documentation. The following ICAO documents contain references to ACAS and procedures for responding to ACAS advisories.

1. Annex 2 — *Rules of the Air*, Chapter 3, paragraph 3.2.2, Right-of-way.
2. Procedures for Air Navigation Services — Air Traffic Management (Doc 4444), Chapter 15, Procedures Related to Emergencies, Communication Failure, and Contingencies, Section 15.6.3, Procedures in regard to aircraft equipped with airborne collision avoidance systems (ACAS).
3. Procedures for Air Navigation Services — Aircraft Operations, Volume I — Flight Procedures (Doc 8168, PANS-OPS), Part VIII, Secondary Surveillance Radar (SSR) Transponder Operating Procedures, Chapter 3, Operation of ACAS equipment.
4. Annex 10 — Aeronautical Telecommunications, Volume IV — Surveillance Radar and Collision Avoidance Systems, Attachment A, paragraph 3.5.8.10.3, Contrary pilot response.
5. State letter AN 7/1.3.72-97/77, dated 8 August 1997, Attachment E, Proposed ACAS performance -based training objectives, page E-10, paragraph 12, which provides guidance in relation to pilot action when ATC instructions to maneuver conflict with an ACAS resolution advisory.

4. Summary. The safety benefits provided by TCAS are directly dependent on a pilot's correct response to an RA. The pilot's instinctive reaction to an RA should always be to respond to the RA in the direction and to the degree displayed.

5. Additional Information. Questions related to the information contained in this alert bulletin should be addressed to:

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