

virgin atlantic A340-600 <i>Flight crew operating manual</i>	NAVIGATION TCAS		1.34.80	P 1
			SEQ 100	REV 17

DESCRIPTION

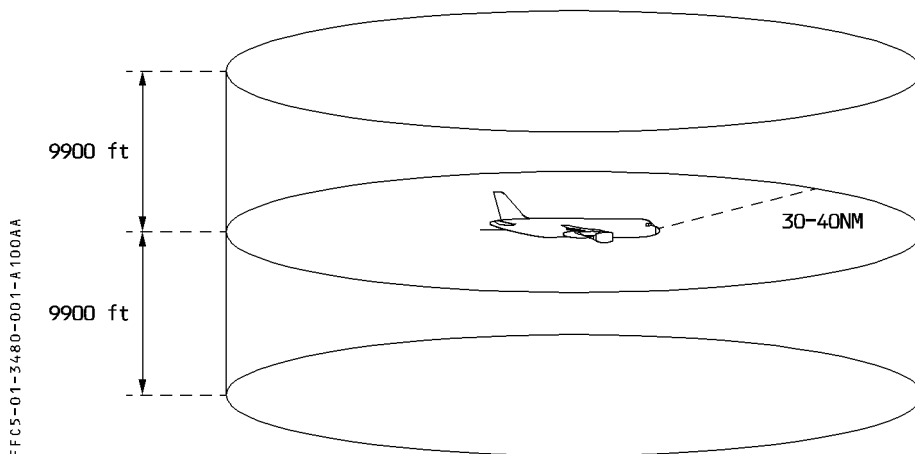
GENERAL

The TCAS (Traffic alert and Collision Avoidance System) :

- Detects any aircraft equipped with a transponder, flying in its vicinity ;
- Displays potential and predicted collision targets ;
- Issues vertical orders to avoid conflict.

The TCAS is normally independent of the ground-based air traffic control system.

The TCAS detection capability is limited to intruders flying within a maximum range of 30-40 NM (depending on aircraft configuration and external conditions), and within a maximum altitude of 9 900 feet above and below the threatened aircraft.



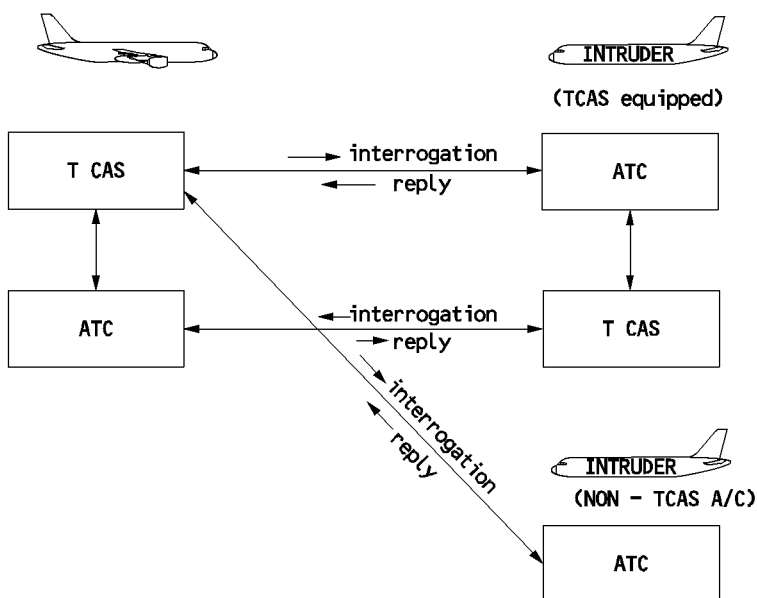
MAIN COMPONENTS

The system includes :

- a single channel TCAS computer
- two TCAS antennas
- two mode S ATC transponders, one active the other in standby.

These transponders allow :

- interface between the ATC/TCAS control panel and the TCAS computer
- communication between the aircraft and intruders equipped with a TCAS system
- an ATC/TCAS control panel



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PRINCIPLE

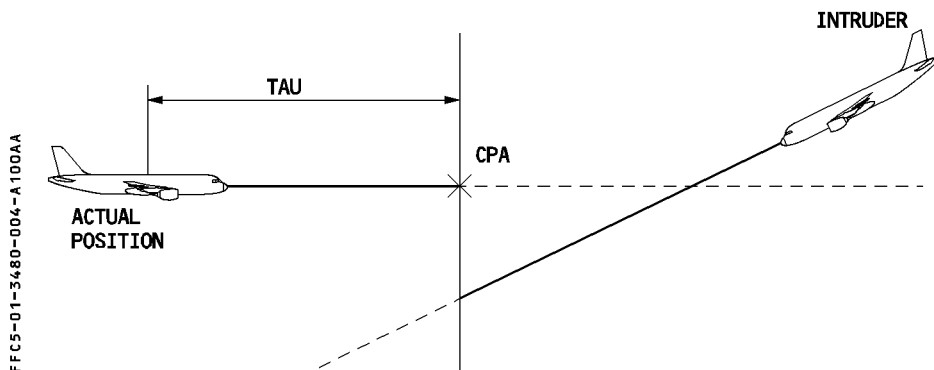
The TCAS interrogates transponder of intruders. From the transponder replies, the TCAS determines for each intruder:

- its relative bearing
- its range and closure rate
- its relative altitude if available (ATC mode C or S).

Then the TCAS computes the intruder trajectory, the Closest Point of Approach (CPA) and the estimated time (TAU) before reaching the CPA.

Each time the relative position of the intruder presents a collision threat, aural and visual advisories are triggered.

TCAS optimizes vertical orders to ensure a sufficient trajectory separation and a minimal vertical speed variation considering all intruders.



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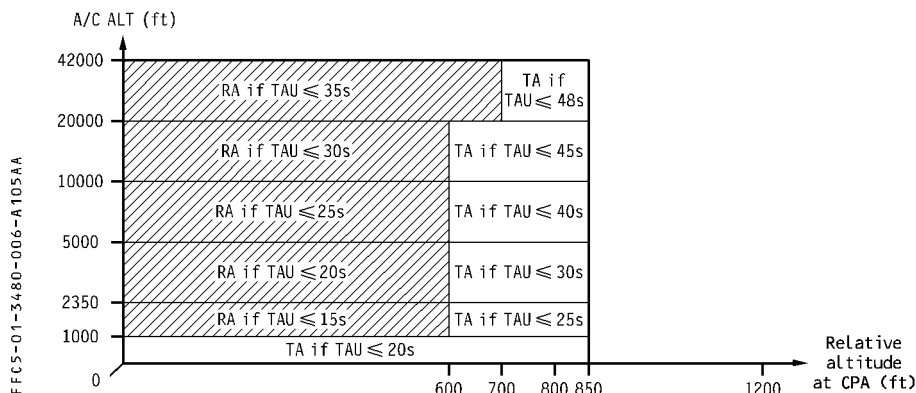
INTRUDER CLASSIFICATION

The intruders are classified in four levels :

LEVEL	INTRUDER POSITION	DISPLAYED INFORMATION
Proximate intruder	– no collision threat – intruder in vicinity to aircraft (closer than 6 NM in lateral and $\pm 1\ 200$ ft in vertical direction)	– ND : intruder position
Traffic Advisory (TA)	– potential collision threat – TAU is about 40 seconds	– ND : intruder position – Aural message
Resolution Advisory (RA)	– real collision threat – TAU is about 25 seconds	– ND : intruder position – Aural messages – PFD : vertical orders . Maintain actual V/S (Preventive Advisory) - or . Modify V/S (Corrective Advisory)
Other intruders	– no collision threat – intruder within a range greater than 6NM or above ± 1200 feet in vertical direction – any non proximate, TA, RA intruders within the surveillance envelope (lateral range : closer than 30 Nm vertical range : refer to 1-34-80 p 7)	– ND : intruder position

TA / RA THRESHOLDS

FOR INFO



TCAS MODES

The TCAS has 2 modes of operation :

TA/RA : Selected on the ATC/TCAS panel, this mode allows the display of all intruders.
 TA : Can be selected by :

- The crew, on the ATC/TCAS panel, in case of aircraft degraded performance (engine failure, landing gear extended) or when operating near closely spaced parallel runways, or
- The special equipped ground stations, via ATC transponder uplink command, or
- Automatically, when the following priority messages are triggered :
 - Windshear (⚠)
 - Stall
 - GPWS messages.

Consequently :

- All RAs are inhibited and converted into TA
- TA threshold is set to TAU ≤ 20 seconds independent of aircraft altitude.
- No vertical speed advisories on PFD
- "TA ONLY" is displayed on the NDs

In case of priority messages triggering, all the TCAS aural messages are suppressed.

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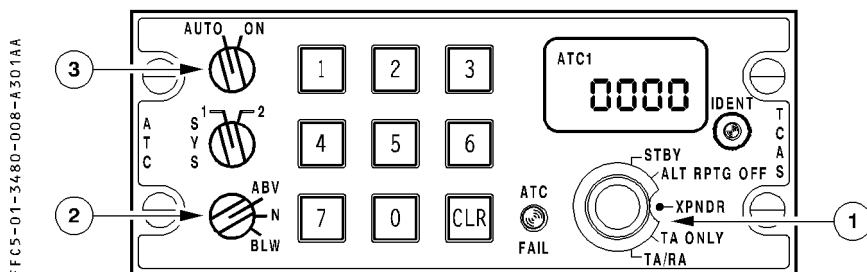
ADVISORY INHIBITION

Some advisories are inhibited, depending on the aircraft altitude :

- All intruders flying below 380 feet AGL, when the own aircraft altitude is below 1700 feet AGL.
- All RA aural messages below 1100 feet AGL in climb, and 900 feet AGL in descent. In this case, the RAs are converted into TAs.
- “Descend” type advisory below 1200 feet AGL in climb, or 1000 feet AGL in descent.
- “Increase Descent” RA below 1650 feet AGL in climb, or 1450 feet AGL in descent.
- All TA aural messages below 500 feet AGL.

CONTROLS AND INDICATORS

ATC/TCAS PANEL



① Mode sel

- TA/RA : Normal position.
Other and proximate intruders, TAs and RAs are displayed.
- TA : To be used in case of aircraft degraded performance (engine failure, landing gear extended or approach on parallel runways). All RAs are converted into TAs. TAs, other and proximate intruders are displayed.
- STBY : TCAS and ATC are in standby.

② TRAFFIC sel

Set the altitude range in which other intruders will be displayed on the NDs.

- ABV : Altitude range is set to + 7000 feet above the aircraft and – 2700 feet below.
- N : Altitude range is set to – 2700 feet below the aircraft and + 2700 feet above.
- BLW : Altitude range is set to – 7000 feet below the aircraft and + 2700 feet above.

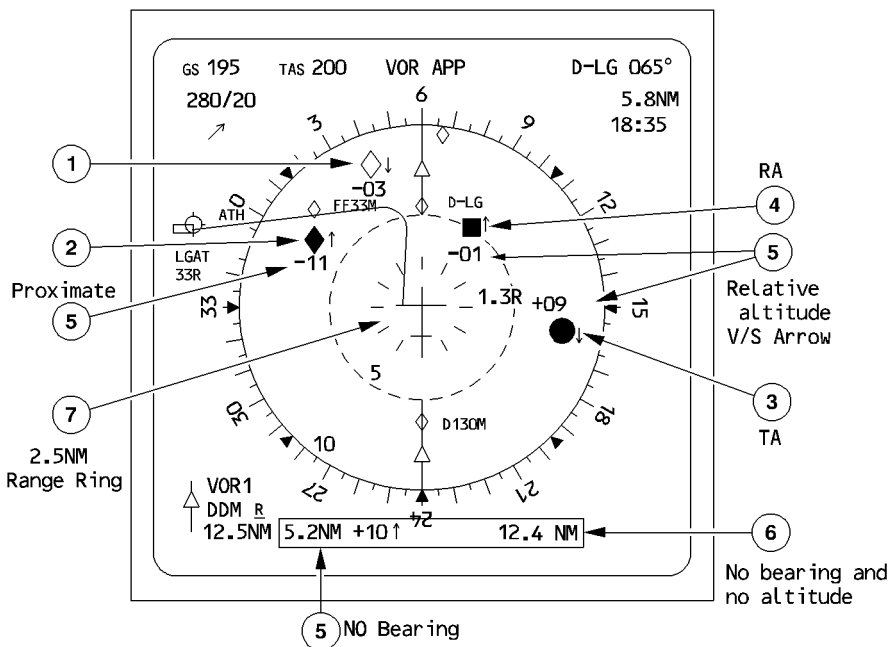
③ AUTO/ON sel or (THRT/ALL sel)

- ON (or ALL) : All intruders are displayed.
- AUTO (or THRT) : Proximate and other intruders are only displayed when a TA or a RA is already presented.

Note : Some TCAS control panels are equipped with a THRT/ALL selector instead of the AUTO/ON selector. The associated functions remain unchanged.

ND INDICATIONS

The traffic is displayed in all ROSE modes and ARC mode whatever NM range is selected. Only the eight most threatening intruders are displayed.



① Other intruder

Indicated by a white empty diamond.

② Proximate intruder

Indicated by a white filled diamond.

③ TA intruder

Indicated by an amber circle.

Associated with the "TRAFFIC-TRAFFIC" aural message.

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④ RA intruder

Indicated by a red square.

Associated with vertical orders displayed on the PFD and aural messages.

Note : *If the range of an intruder is not available, the intruder is not displayed.
An intruder may be partially displayed when its range is out of scale.*

⑤ Relative altitude/Vertical Speed arrow

Relative altitude : indicated in hundred of feet above or below the symbol depending on the intruder position.

Vertical speed arrow : displayed only if the intruder vertical speed is greater than ± 500 ft/min

Relative altitude and vertical speed arrow are displayed in the same color as the associated intruder symbol.

Note : *If the altitude of an intruder is not available, neither altitude nor vertical speed indications are displayed.*

⑥ No Bearing Intruder

If the bearing of TA or RA intruder is not available the following data is presented in digital form at the bottom of the ND :

- range
- relative altitude and vertical speed arrow if available.

Displayed amber or red according to threat level.

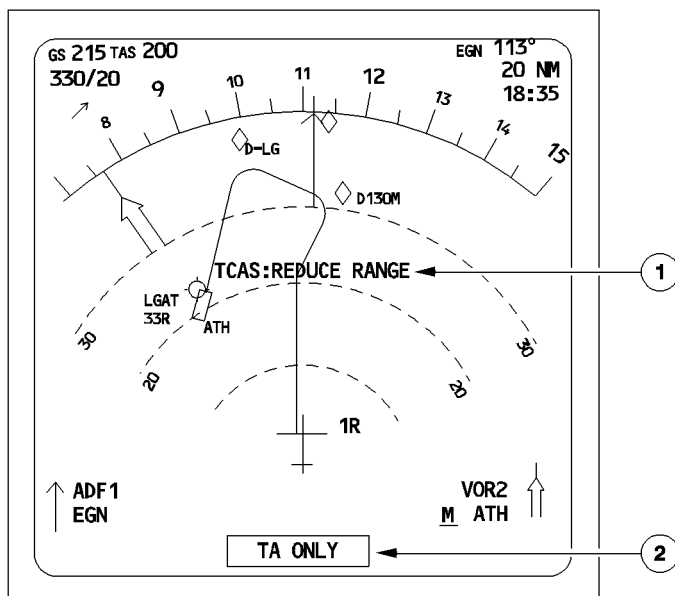
⑦ Range Ring

A 2.5 NM white range ring is displayed when a 10 or 20 NM range is selected.

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TCAS MESSAGES

FFC5-01-3480-011-A100AA



① Mode and range messages

Following messages can be displayed to draw pilot's attention :

TCAS : REDUCE RANGE : displayed when a TA or RA is detected and ND range is above 40 NM

TCAS : CHANGE MODE : displayed when a TA or RA is detected and ND mode is PLAN.

Displayed amber or red depending on the advisory level (TA or RA).

② TCAS operation messages

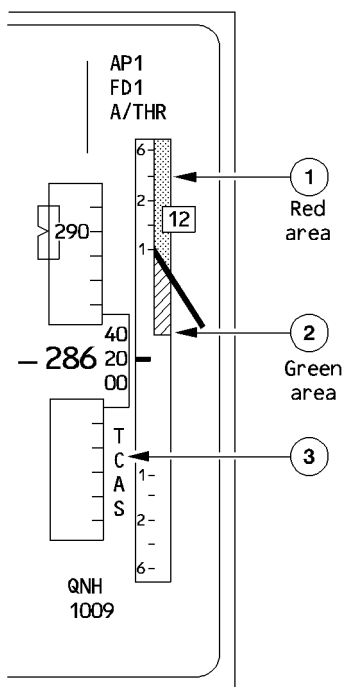
TCAS : displayed red in case of TCAS internal failure.

TA ONLY : displayed white when controlled by ground control or when selected by the crew.

PFD INDICATIONS

In case of RA detection, the PFD presents vertical orders on the vertical speed scale. The vertical speed scale background, which is normally grey, may be partially replaced by green and/or red areas.

Note : When TCAS information has to be displayed on the vertical speed scale, the grey background of the air speed and heading scales are removed.



① Red area

Indicates the vertical speed where the risk of conflict is high.

② Green area

Indicates the recommended vertical speed range ("FLY TO" sector).

Note : – The aircraft can also fly in the grey vertical speed range without risk of conflict (preventive RA).

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③TCAS message

Appears red when the TCAS cannot deliver RA data or ALT RPTG is switched OFF

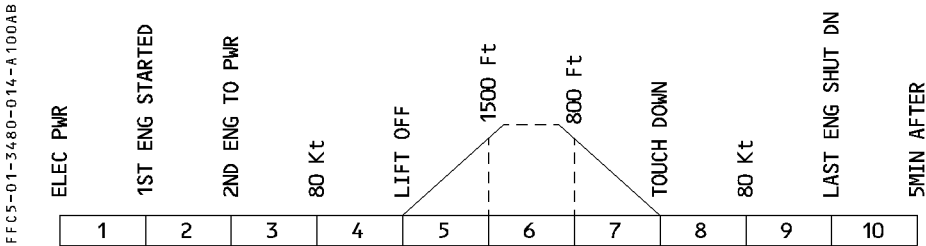
Note : When within the red area, the color of vertical speed needle and digits change to red too but in a different pattern so that it is possible to clearly distinguish them from the background.

AURAL MESSAGES

TA/RA detection is associated with the following messages :

TRAFFIC TRAFFIC	:	only in case of TA detection.
CLIMB CLIMB	:	climb at the vertical speed indicated by the green area on PFD.
CLIMB, CROSSING CLIMB (twice)	:	same as above. Indicates that you will cross through the intruder altitude.
INCREASE CLIMB (twice)	:	triggered after CLIMB message if vertical speed not sufficient to achieve safe vertical separation.
DESCEND DESCEND	:	descend at the vertical speed indicated by the green area on PFD.
DESCEND, CROSSING DESCEND (twice)	:	same as above. Indicates that you will cross through the intruder altitude.
INCREASE DESCEND (twice)	:	triggered after DESCEND message if vertical speed not sufficient to achieve safe vertical separation.
ADJUST VERTICAL SPEED ADJUST	:	adjust the vertical speed to that indicated on the PFD green area.
CLIMB, CLIMB NOW (twice)	:	triggered after DESCEND message if the intruder trajectory has changed.
DESCEND, DESCEND NOW (twice)	:	triggered after CLIMB message if the intruder trajectory has changed.
MONITOR VERTICAL SPEED	:	ensure that vertical speed remains outside the red area. Triggered only once in case of preventive RA.
MAINTAIN VERTICAL SPEED MAINTAIN	:	maintain the vertical speed indicated on the PFD green area
MAINTAIN VERTICAL SPEED ... CROSSING MAINTAIN	:	maintain the vertical speed indicated on the PFD green area. It further indicates that you will cross through the intruder altitude.
CLEAR OF CONFLICT	:	range is increasing and separation is adequate. Return to assigned clearance.

WARNINGS AND CAUTIONS



EWD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNINGS	FLT PHASE INHIB
TCAS FAULT	NIL	NIL	NIL	Flag on PFD and ND	3, 4, 5, 7, 8

MEMO DISPLAY

- TCAS STBY appears in green when :
- the crew selects TCAS STBY on ATC/TCAS panel, or
 - both ATC or RA fail, or
 - the crew turns OFF the ALT RPTG switch.