سلطنة عُمان
وزارة النقل والاتصالات وتقنية المعلومات
Sultanate of Oman
Ministry of Transport, Communications and Information Technology

# Oman Transport Safety Bureau (OTSB)

# - Final Report -

**OTSB Case File No: AIFN/003/05/2024**

# TCAS Resolution Advisory between Salam Air Aircraft A321-253N, A4O-OXD and A321-253NX, A4O-OXB Over OOMS

Operator: Salam Air
Make and Model: A321-253N
Nationality and Registration Marks: Sultanate of Oman, A4O-OXD

Operator: Salam Air
Make and Model: A321-253NX
Nationality and Registration Marks: Sultanate of Oman, A4O-OXB

Location of the Occurrence: Overhead Muscat TMA, 23°35′36″N 058°17′04″E
State of Occurrence: Sultanate of Oman
Date of Occurrence: 13th May 2024, 07:10 UTC
Date of Publication: 27th January 2025

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**Purpose of the Investigation**

The investigation was conducted by the Air Accident Investigation Section of the Oman Transport Safety Bureau (OTSB) pursuant to Civil Aviation Law 76/2019 Chapter 10, and in compliance with the Civil Aviation Regulation CAR-13.011 - Aircraft Accident & Incident Investigation & Reporting Procedures. The investigation was in conformance with the standards and recommended practices in Annex 13 - Aircraft Accident and Incident Investigation to the Convention on International Civil Aviation Organization (ICAO).

The sole objective of the investigation of an accident and incident is to prevent future aircraft accidents and incidents and not to apportion blame or liability.

Oman Transport Safety Bureau issues this Final Report in accordance with the national and international standards and industry best practice.

The Final Report will be publicly available at:

http://www.mtcit.gov.om

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| Abbreviation | Description |
|---|---|
| ° | Degrees |
| **C** | Celsius |
| **ACC** | Area Control Centre |
| **ADC** | Aerodrome Control |
| **AND** | Air Navigation Department |
| **AAI** | Air Accident Investigations |
| **AAIS** | Air Accident Investigation Section |
| **AFL** | Actual Flight Level |
| **AME** | Aviation Medicine Examiner |
| **AMSL** | Above Mean Sea level |
| **AFL** | Actual Flight Level |
| **AP** | Auto Pilot |
| **APCH** | Approach |
| **APP/SRV** | Approach Surveillance |
| **AIP** | Aeronautical Information Publication |
| **ALT** | Altitude |
| **ANSIC** | Air Navigation Service Incident Coordination |
| **AoR** | Area of Responsibility |
| **APW** | Area Proximity Warning |
| **ATC** | Air Traffic Control |
| **ATS** | Air Traffic Services |
| **ATSU** | Air Traffic Services Unit |
| **ATCO** | Air Traffic Controller |
| **AWY** | Airway |
| **BEA** | Bureau d'enquêtes et d'analyses pour la sécurité de l'aviation civile |
| **CA** | Conflict alert |
| **CAA** | Civil Aviation Authority |
| **CAL** | Civil Aviation Law |
| **CAS** | Controlled Airspace |
| **CDIS** | The Current Distance |
| **CFL** | Cleared Flight Level |
| **CLD** | Clearance Delivery |
| **CPA** | Closest Point of Approach |
| **CR** | Central Radar |
| **CTR** | Control Zone |
| **CVR** | Cockpit Voice Recorder |

| | |
|---|---|
| **ELP** | English Language Proficiency |
| **FD** | Flight Director |
| **FIR** | Flight information Region |
| **FL** | Flight level |
| **FMS** | Flight Management System |
| **FO** | First Officer |
| **FPL** | Flight Plan |
| **FPM** | Feet Per Minute |
| **FT** | Feet |
| **HDI** | Hand Down Item |
| **IAS** | Indicated Air Speed |
| **ICAO** | International Civil Aviation Organization |
| **IIC** | Investigator-in-Charge |
| **IL** | Interference limiting |
| **ILS** | Instrument Landing System |
| **LPC** | License Proficiency Check |
| **MATSOP** | Manual of Air Traffic Standard Operating Procedures |
| **MCT** | Muscat International Airport |
| **MDIS** | Minimum Predicted Distance |
| **ND** | Navigation Display |
| **NM** | Nautical Mile |
| **NOTAM** | Notice to Airmen |
| **OOMS** | Muscat International Airport |
| **OPC** | Operator Proficiency Check |
| **OTSB** | Oman Transport Safety Bureau |
| **PANS** | Procedures for Air Navigation Services |
| **PF** | Pilot Flying |
| **PFD** | Primary Flight Display |
| **PM** | Pilot Monitoring |
| **RA** | Resolution Advisory |
| **RCC** | Rescue Coordination Centre |
| **RDR** | Radar |
| **RNAV** | Area Navigation |
| **ROC** | Rate of climb |
| **ROD** | Rate of descent |

| | |
|---|---|
| **RVSM** | Reduced Vertical Separation Minima |
| **RWY** | Runway |
| **SA** | Situational Awareness |
| **SAR** | Search and Rescue |
| **SARP** | Standard and Recommended Practices |
| **SDD** | Surveillance Data Display |
| **SEP** | Separation |
| **SIC** | Specific regular medical examination(s) - contact licensing authority |
| **SOP** | Standard Operating Procedures |
| **SLL** | Salalah International Airport |
| **SRV** | Surveillance |
| **SSR** | Secondary Surveillance Radar |
| **STCA** | Short Term Conflict Alert |
| **SQK** | Squawk |
| **TA** | Traffic Advisory |
| **TAU** | Time to go to closest point of approach, or estimated time to collision |
| **TCAS** | Traffic Collision Avoidance system |
| **TMA** | Terminal Control Area |
| **TWR** | Control Tower |
| **VDL** | Correction for defective distant vision and carry a spare set of spectacles |
| **VIS** | Visibility |
| **VNL** | Correction for defective near vision and carry a spare set of Spectacles |
| **VMC** | Visual Meteorological Condition |
| **VOR** | Very High Frequency Omni-directional Range |
| **WSO** | Watch Supervisor Officer |

| Indra System Safety net Alert Abbreviation | | |
|---|---|---|
| STCA | Short Term Conflict Alert | "Yellow" Prediction<br>"Red" Violation |
| AW | Minimum Safe Altitude Warning (MSAW) | |
| W | RVSM | |
| LB | Level Burst | "Yellow" CFL not matching AFL<br>"Red" CFL not matching Mode-S flight level |
| HG | Heading conformance | |
| MC | Medium Term Conflict Detection | |
| RO | Route off | |
| SQ | SSR Code Conformance alert | |

**Synopsis**

Oman Transport Safety Bureau (OTSB) was notified of the occurrence by the operator through OTSB email on 14th May 2024 at 10:02 Local Time (LT) AM and by Sultanate of Oman Civil Aviation Authority (CAA) -Directorate General of Air Navigation (DGAN)- Air Navigation Service Incident Coordination (ANSIC) through OTSB email on 15th of May 2024 at 01:11 LT PM.

Following the review of the occurrence, the OTSB classified the it as a Serious Incident requiring investigation and the Director of OTSB appointed investigator in charge (IIC) and investigation team to institute and conduct investigation. The following parties were notified:

- State of Design and Manufacturer of Airbus, France-Bureau d'enquêtes et d'analyses pour la sécurité de l'aviation civile (BEA), French Safety Investigation Authority.
- International Civil Aviation Organization (ICAO).
- Oman Civil Aviation Authority (CAA).

An investigation team was appointed and the investigation was conducted in conformance with the ICAO Annex13, CAR 13 and OTSB Investigation procedures. The Sultanate of Oman is the State of Occurrence. The following party was involved in the investigation through their appointed accredited representatives and advisors:

- State of Design and Manufacturer of Airbus, France-Bureau d'enquêtes et d'analyses pour la sécurité de l'aviation civile (BEA), French Safety Investigation Authority

This is the Final Report issued on 27th January 2025 and it is made public at the below link:

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Unless otherwise mentioned, all times in this report are UTC. Local Time in The Sultanate of Oman is UTC plus +4 hours. Photos and figures used in this report were obtained from difference sources and adjusted from the original for the sole purpose of improving the clarity of the report. Modifications to images used in this report are limited to cropping, magnification, file compression, or enhancement of colour, brightness, contrast or insertion of text boxes, arrows or lines.

On the 13th May 2024 at 06:39 UTC, Salam Air aircraft OMS258 with registration marks A4O-OXD, an Airbus A321-253N departed from Fujairah International Airport (OMFJ) United Arab Emirates on an international scheduled flight with intended destination Muscat International Airport (OOMS), Oman, Muscat. While another Salam Air aircraft OMS134 with a registration marks A4O-OXB, an Airbus A321-253NX, departed from Duqm Airport (OODQ) 06:24 UTC on a domestic scheduled flight with intended destination Muscat International Airport (OOMS).

Aircraft OMS258 was coming from the North West, and after Air Traffic Controller (ATCO) issued a heading clearance to avoid R7 restricted area, aircraft OMS258 continued to MCT VOR approaching it from the North on a heading 150°. At the same time Aircraft OMS134 was coming from the south to MCT VOR and was cleared by the ATCO to expedite descent to Altitude (ALT) 8000FT. Once aircraft OMS258 was cleared from R7 restricted area, ATCO instructed it to descend from ALT 10000FT to 7000FT and to leave MCT VOR on a heading 290°. The ATCO reported that he expected the flight crew of aircraft OMS258 to make a left turn in order to intercept heading 290°.

When aircraft OMS258 was crossing overhead MCT descending from ALT 10000FT to ALT 7000FT, aircraft OMS258 maintained its heading of 290° for few seconds, then started turning right while confirming with the ATCO the turning direction. By the time the ATCO replied to the flight crew of aircraft OMS258 to turn left, and aircraft OMS134 to expedite decent to ALT 8000FT (which was coming from the south and descending to ALT 8000FT) just before reaching ALT 8000FT there was a loss of separation and Resolution Advisory (RA) was triggered on both aircraft OMS258 and aircraft OMS134. The minimum distance between the two aircraft OMS258 and OMS134 was 1.98NM which was less than the 5NM contained in the MUSCAT APPROACH MATSOP manual. The incident occurred overhead Muscat VOR. At the time of the incident, the ATCO reported that there were more than 12 aircraft on his frequency.

Both aircraft continued to OOMS and landed safely without any further incident.

The OTSB determines that the loss of separation was as a result of the ATCO issuing a late instruction and using the wrong callsign for the flight crew of aircraft OMS134 to expedite descent to ALT 8000FT. Both flight crews of aircraft OMS134 and aircraft OMS258 received TCAS RA alert. The flight crew of aircraft OMS258 received the RA alert while on the right turn and immediately commenced left turn to avoid traffic and the ATCO received STCA alert on the radar screen and requested the flight crew of aircraft OMS258 to expedite the left turn.

## 1. FACTUAL INFORMATION

### 1.1. History of Flight

1.1.1. On the 13th May 2024 at the time 06:39 UTC, Salam Air Airbus A321-253N with registration marks A4O-OXD, departed from Fujairah International Airport (OMFJ) on an international scheduled flight OMS258 with intended destination Muscat International Airport (OOMS), Oman. While another Salam Air Airbus A321-253NX with registration marks A4O-OXB, departed from Duqm Airport (OODQ) at 06:24 UTC on a domestic scheduled flight OMS134 with intended destination Muscat International Airport (OOMS) Oman.

1.1.2. At the time 06:55:50, the flight crew of aircraft OMS258 reported to Muscat approach Controller that they were routing to MCT VOR on descent to flight level (FL)160. The Muscat Approach Controller gave the QNH1008 to the crew of aircraft OMS258 and cleared them to descend to Altitude ALT 13000 feet (FT) direct to MUSANAH and the crew of aircraft OMS258 readback accordingly. At the time 06:56:05, APP ATCO contacted the flight crew of aircraft OMS258 and corrected the clearance from MUSANAH to MCT and to expect vectors for Instrument Landing System (ILS) RWY 08L. The flight crew of aircraft OMS258 read back and acknowledged.

1.1.3 Aircraft OMS134 was flying to MCT VOR from the South. At the time 07:00:31, the flight crew of aircraft OMS134 contacted MCT Approach Controller while descending to FL160. Aircraft OMS134 was 50NM from MCT descending to FL160 and aircraft OMS258 was 34NM from MCT maintaining ALT of 13000FT.

1.1.4 At the time 07:03:09, the flight crew of aircraft OMS134 requested to descend and the ATCO responded and issued a clearance to the crew of OMS134 to descend from FL160 to ALT 8000FT with QNH1008 and the crew of aircraft OMS134 read back accordingly.

1.1.5 At the time 07:03:28, APP ATCO instructed the flight crew of aircraft OMS258 to avoid restricted area Romeo 7 (R7), to turn left heading (HDG) 110°. The flight crew of aircraft OMS258 readback and avoided R7 while maintaining ALT13000FT.

1.1.6 At the time 07:05:00, ATCO instructed the flight crew of aircraft OMS258 to leave MCT VOR on HDG 290°. At the time 07:05:13 the flight crew of aircraft OMS258 replied that they are not proceeding to MCT. ATCO responded "I will give you shortly HDG standby". At the time 07:05:17, the flight crew of aircraft OMS258 informed ATCO that they were maintaining ALT 13000FT on HDG of 110°. At this time, aircraft OMS258 was 13NM north of MCT at 230kts indicated airspeed (IAS) and aircraft OMS134 was 24NM south of MCT at 277kts IAS descending through ALT 13500FT for 8000FT.

1.1.7 At the time 07:05:23, ATCO cleared the flight crew of aircraft OMS258 to route direct to MCT VOR and to expedite the descend through 13000FT to 10000FT and the flight crew of aircraft OMS258 readback. Aircraft OMS258 which was 11 NM to MCT VOR at ALT 13000FT started initiating a descent to MCT VOR at Rate of Descent (ROD) 2500 Feet Per Minute (FTM) and increased speed to 278kts IAS.

1.1.8 At the time 07:06:39, aircraft OMS258 was about 5.5NM to MCT VOR and the flight crew of aircraft OMS258 reported to ATCO that they were approaching MCT VOR.


Figure 1: aircraft OMS258 was observed on radar descending through ALT10600FT to ALT 10000FT with ROD of 1000FPM while aircraft OMS134 was descending through ALT 10200FT to ALT 8000FT with ROD of 700FPM (Source: DGAN).

1.1.9 At the time 07:06:43, ATCO responded and cleared the flight crew of aircraft OMS258 to descend through ALT 10000FT to ALT 7000FT at ROD 1000FPM and the flight crew of OMS258 readback. During this time, the yellow Short-Term Conflict Alert (STCA) was activated between aircraft OMS258 and aircraft OMS134 on the ATCO radar screen.

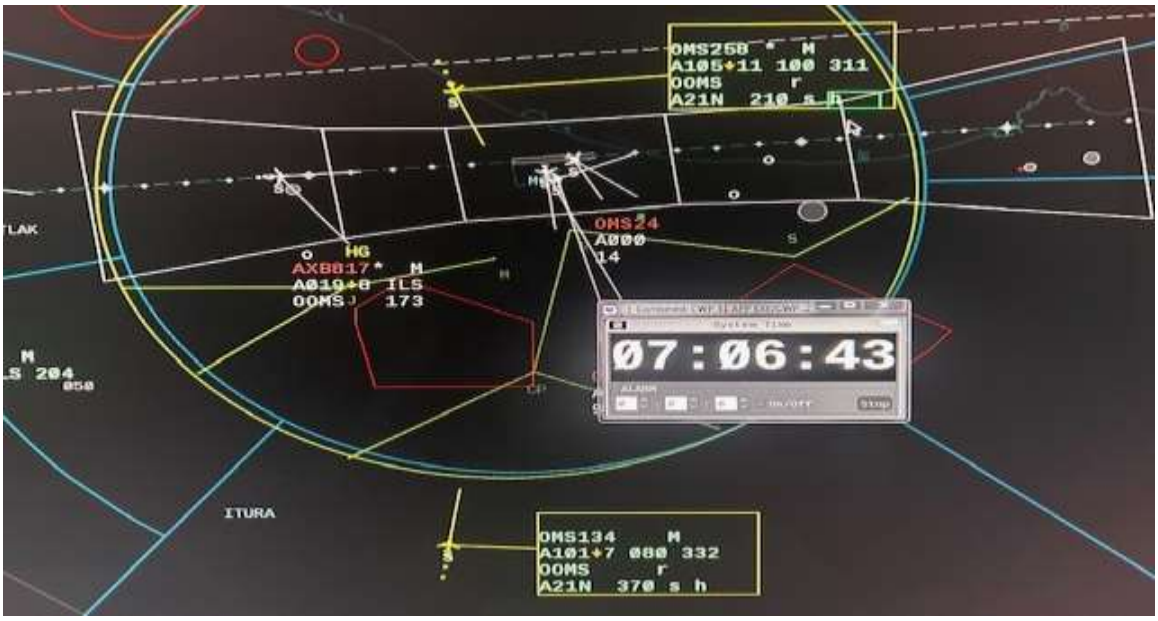



Figure 2: showing the yellow STCA was activated between aircraft OMS258 and aircraft OMS134 (Source: DGAN)

1.1.10 At the time 07:06:43, aircraft OMS258 was seen on ATCO radar screen descending through ALT 10500FT at a rate of descent of 1100FTM, and aircraft OMS134 was descending through ALT 10100FT at ROD of 700FPM with a distance of 1.9NM between both aircraft. At the time 07:06:45, the ATCO cleared the flight crew of aircraft OMS258 to descend to ALT 7000FT which the flight crew of aircraft OMS258 readback and continued descending to ALT 7000FT.

1.1.11 At the time 07:06:52, ATCO reported to the flight crew of aircraft OMS134 to expect to hold over MCT VOR and the flight crew of aircraft OMS134 acknowledged.

1.1.12 At the time 07:07:02, the flight crew of aircraft OMS258 called the ATCO stating “To expect left HDG after MCT OMS258” The ATCO replied:
“258 290° HDG” The flight crew of aircraft OMS258 readback:
“290° after MCT OMS258”.

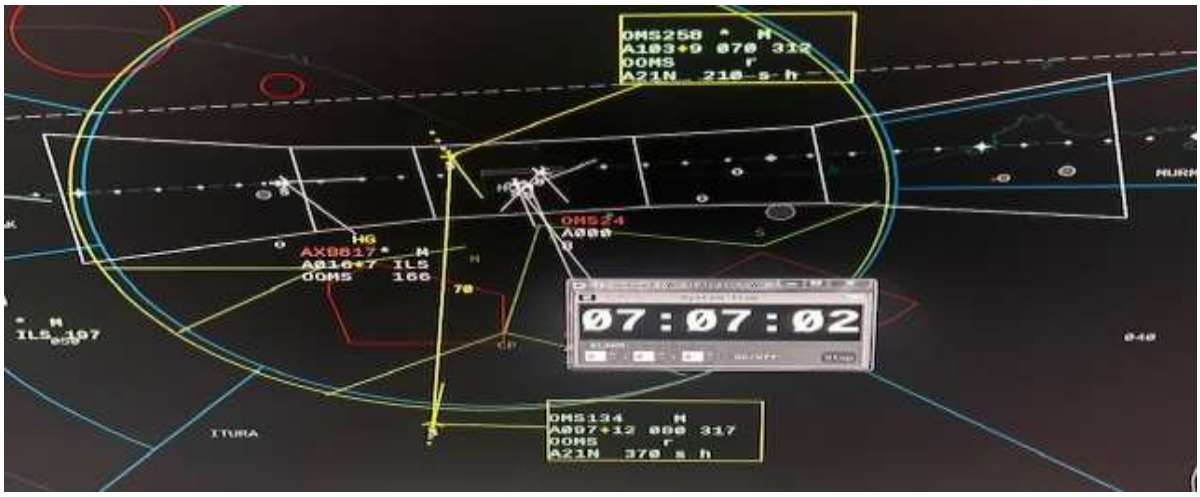



Figure 3: aircraft OMS258 was observed on radar on descend passing through ALT 10300FT descending to for ALT 7000FT with a rate of descent 900FPM while aircraft OMS134 was on descent passing through ALT 9700FT descending to 8000FT with a rate of descent 1200FPM with a distance of 70 seconds apart (Source: DGAN)

1.1.13 At the time 07:07:06, aircraft OMS258 was 1.5NM north of MCT VOR at ALT of 10200FT descending to ALT of 7000FT and at a ROD of 900FPM and a speed of around 250kts IAS. At the same time aircraft OMS134 was 11NM south of MCT VOR at ALT of 9600FT descending to ALT of 8000FT at a ROD of 1400 FPM and a speed of 250kts IAS.

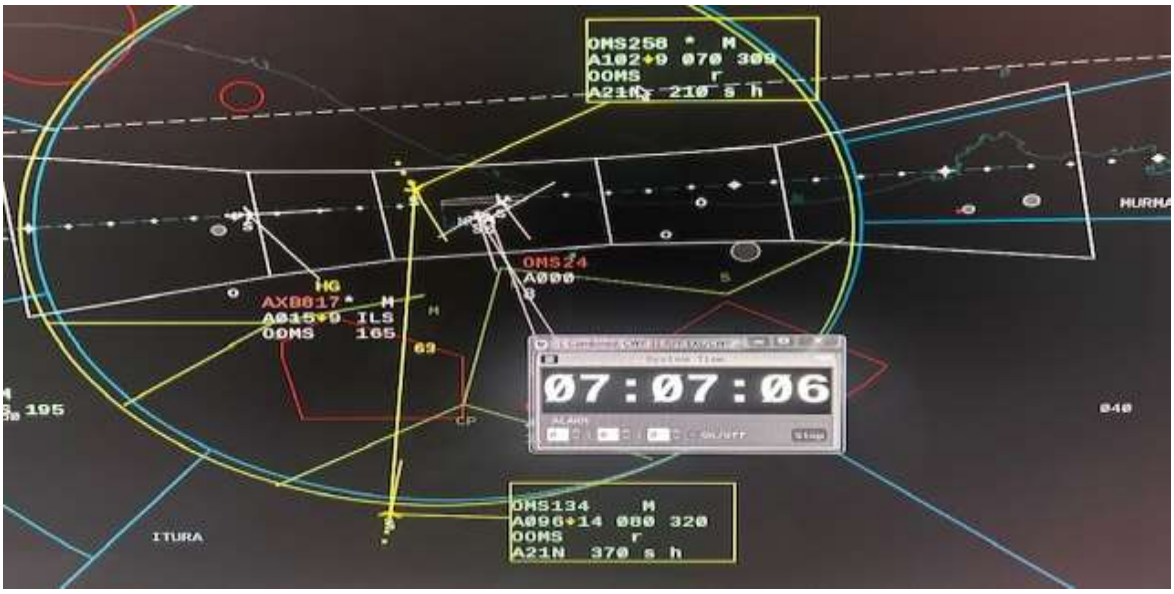



Figure 4: showing aircraft OMS258 1.5NM north of MCT at ALT 10200FT descending through ALT 7000FT at a speed of 320kts IAS (Source: DGAN)

1.1.14 At the time 07:07:24, the APP ATCO confirmed if OMA134 was descending through ALT of 8000FT but there was no reply as there was no aircraft on frequency with such callsign. At the same time aircraft OMS258 was overhead MCT VOR descending through ALT 9800FT to ALT of 7000FT at ROD 1400FPM and IAS 304kts while aircraft OMS134 was descending through ALT 9300FT to ALT 8000FT at ROD of 900FPM, air speed of 317kts IAS. The distance in time between the two aircraft was 46 seconds.

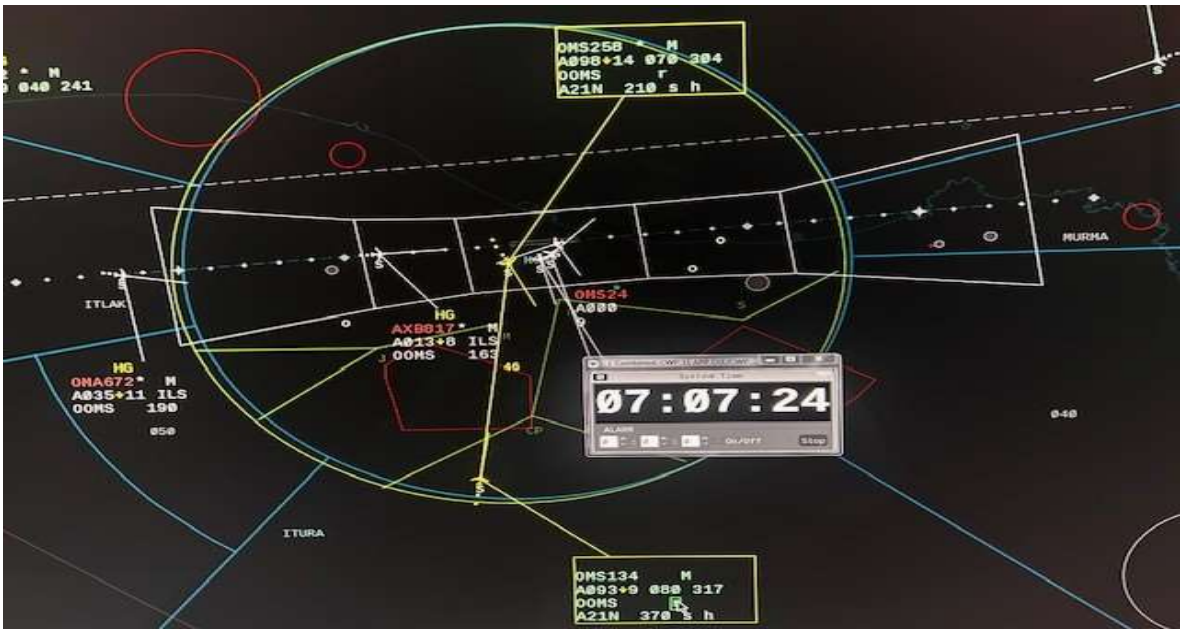



Figure 5: showing both aircraft OMS258 and aircraft OMS134 descending with distance in time between them 46 seconds (Source: DGAN)

1.1.15 During the radar playback, it was observed on radar screen that the flight crew of aircraft OMS258 maintained heading 150° for 8 seconds and then commenced a right turn aiming for heading 290°.

1.1.16 At the time 07:07:30, the flight crew of aircraft OMS258 contacted ATCO confirming turning direction of heading 290° by stating: "OMS258 confirm right HDG 290°". At the time 07:07:35, the ATCO replied by saying "258 make it to ahhh turn left please expedite turn left".

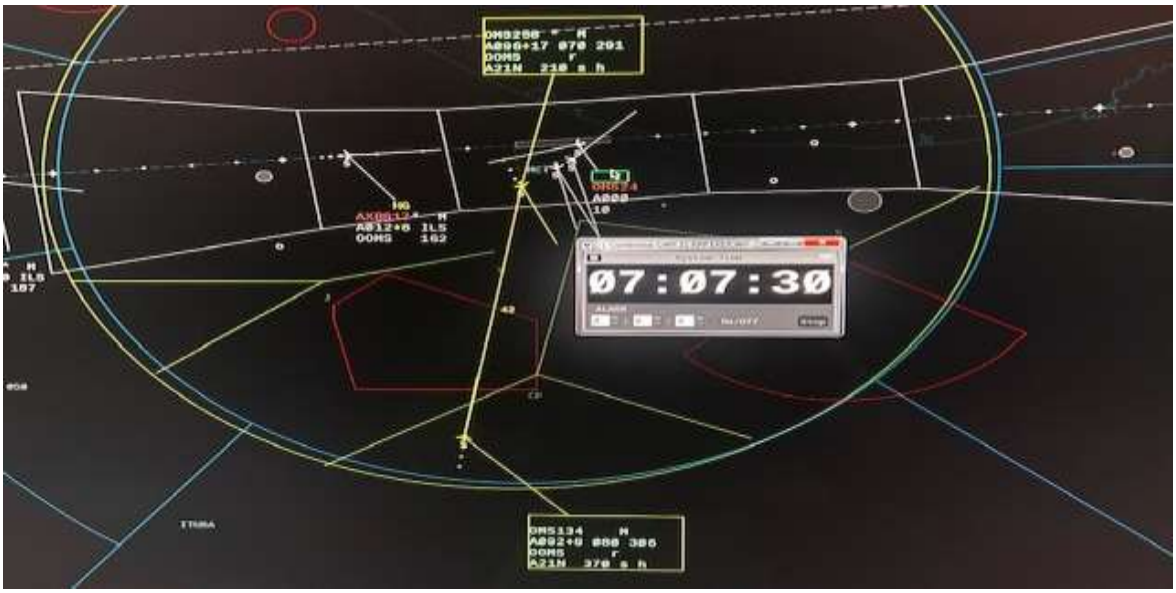



Figure 6: showing aircraft OMS258 descending through ALT 9600FT to ALT 7000FT at ROD of 1700FPM while aircraft OMS134 descending through ALT 9200FT to ALT 8000FTat ROD 800FPM and the distance in time between them was 39 seconds (Source: DGAN)

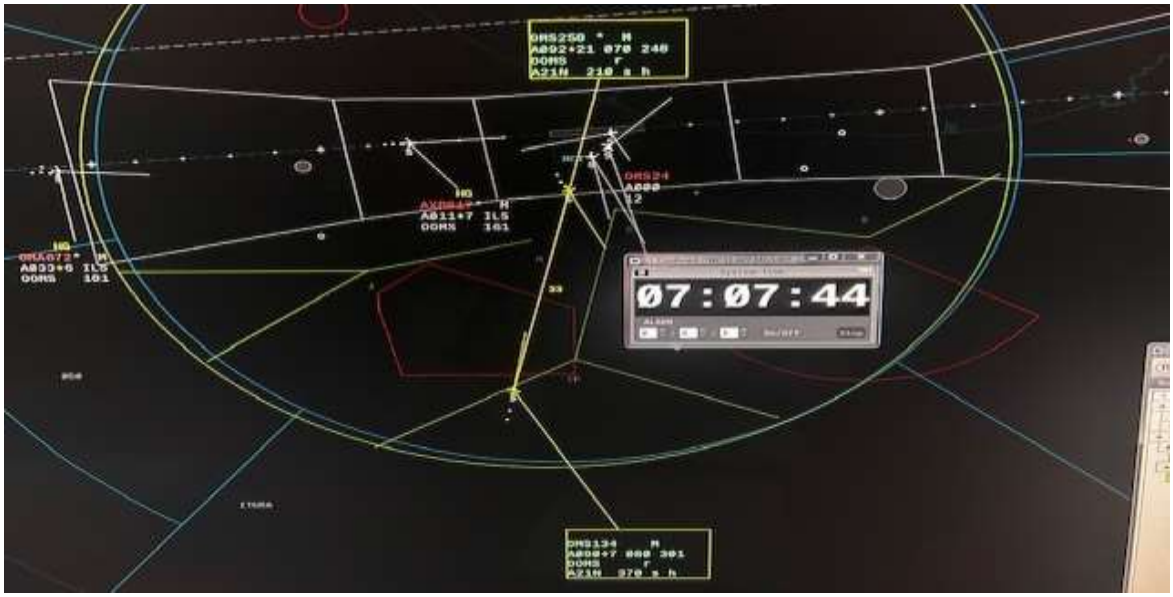



Figure 7: showing aircraft OMS258 descending through ALT 9200FT to ALT 7000FT at ROD 2100FPM while aircraft OMS134 descending through ALT 9000FT to 8000FT at ROD of 700FPMand the distance between the two aircraft in time was 33 seconds (Source: DGAN)

1.1.17 While aircraft OMS258 was changing its direction from right to left and at the time 07:07:44, aircraft OMS258 had Traffic Advisory (TA) and at the time 07:07:46 aircraft OMS134 also had TA. Both aircraft were at ALT of 9000FT and the distance between both aircraft was 1.98NM.

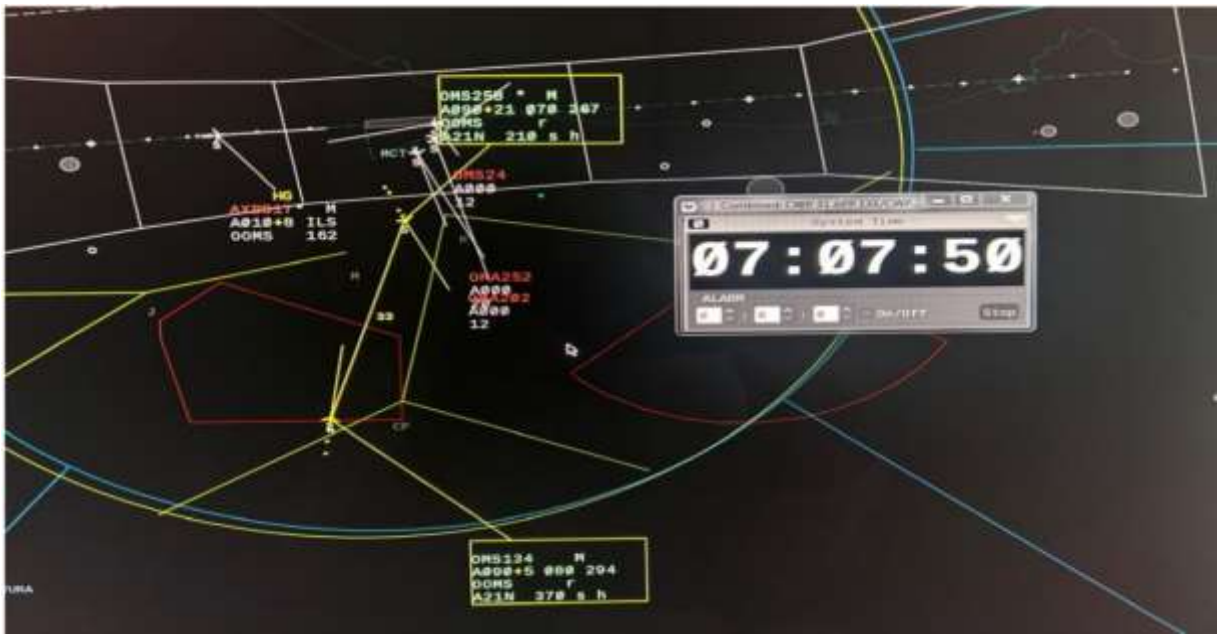



Figure 8: showing aircraft OMS258 was observed on radar descending through ALT 9000FTdescending to ALT 7000FT at ROD of 2100FPM while aircraft OMS134 was descending through ALT 9000FT to ALT 8000FT at ROD of 500FPM-Yellow STCA (Source: DGAN)

1.1.18 At the time 07:07:59, aircraft OMS258 was observed on the ATC radar screen turning to the right. At the time 07:08:00, ATCO called the flight crew of aircraft OMS134 to expedite the descent to ALT 8000FT.

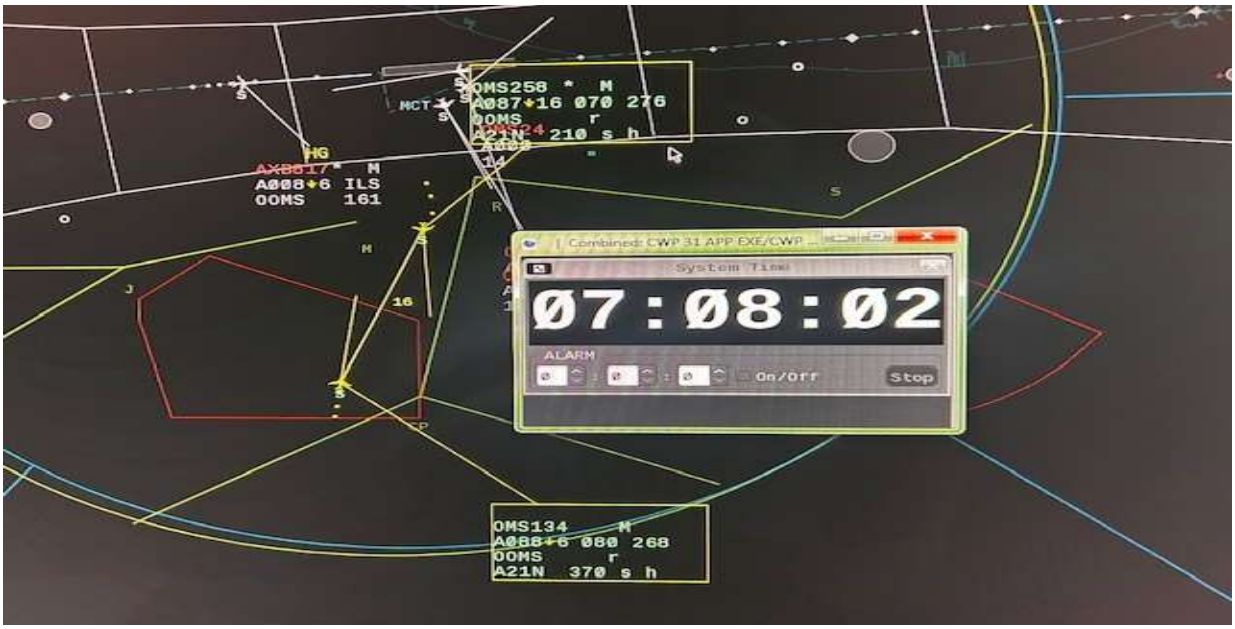



Figure 9 shows at 07:08:02 aircraft OMS258 and aircraft OMS134 had RA 2 seconds apart and the distance in time was 16 seconds (Source: DGAN)

1.1.19 At this time 07:08.05, the flight crew of aircraft OMS258 reported to ATCO that they have a conflict alert and 2 seconds later aircraft OMS134 had RA. The distance between the two aircraft in time was 16 seconds.


Figure 10: showing aircraft OMS258 was observed on radar descending through ALT 8700FT to ALT 7000Fat ROD of 1600FPM while aircraft OMS134 was descending through ALT 8800FT to ALT 8000FT at ROD of 600FPM (Source: DGAN)

1.1.20 The ATCO radar screen showed that at the time 07:08:11 aircraft OMS258 was descending through ALT 8500FT to 7000FT, with a ROD of 1100FPM and a ground speed of 286kts IAS. Meanwhile aircraft OMS134 was descending through ALT 8800FT to 8000FT with a ROD of 500FPM and a ground speed of 274kts IAS. The distance between both traffic in time was 1 seconds.

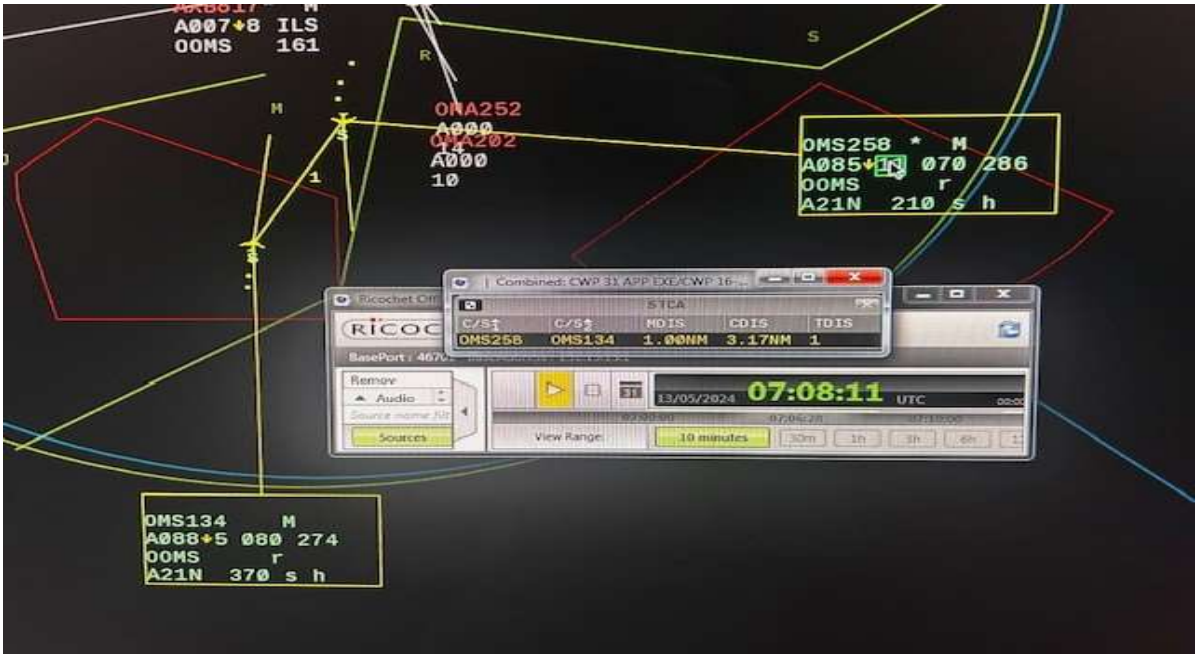



Figure 11 showing aircraft OMS258 was observed on radar descending through ALT 8500FT to 7000FT while aircraft OMS134 was descending through ALT 8800FT to 8000FT with a ROD of 500PFM (Source: DGAN)

1.1.21 At the time 07:08:12, aircraft OMS258 while descending through ALT 8500FT to 7000FT at ROD of 1100FPM was observed on radar screen turning to the left.


Figure 12 showing radar screen where aircraft OMS258 was turning left while descending through ALT 8500FT to 7000FT and aircraft OMS134 descending through ALT 8800FT to 8000FT after they were clear of TCAS conflict (Source: DGAN)

1.1.22 At the time 07:08:14, OMS134 while descending through ALT 8800FT to 8000FT reported they were clear of TCAS conflict. The red STCA alert was activated for 36 seconds from the time 07:08:14 to the time 07:08:50. The red STCA alert deactivated at the time 07:08:51, while aircraft OMS134 was descending through ALT 8500FT to 8300FT with ROD of 400FPM and aircraft OMS258 descending through 7700FT with ROD of 1100FPM.

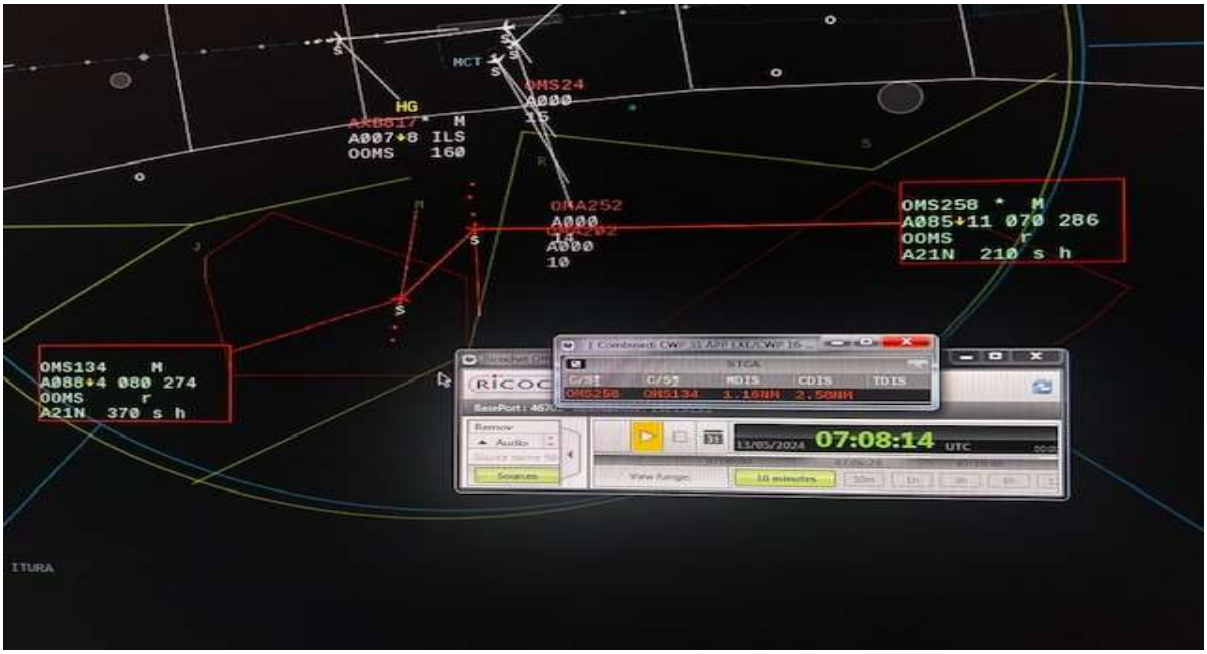



Figure 13 showing the RED STCA activated between aircraft OMS134 descending through ALT 8800FT to 8000FT at ROD of 400FPM and aircraft OMS258 was descending through ALT 8500FT to 7000FT at ROD of 1100FPM (Source: DGAN)


Figure 14 showing the RED STCA was deactivated between aircraft OMS134 and aircraft OMS258 while descending through ALT8300 at ROD of 1000FPM and ALT 7800FT to 7000FT at ROD of 800FPM respectively (Source: DGAN)

1.1.23 At the time 07:08:52, ATCO cleared the flight crew of aircraft OMS258 to continue descending to ALT 6000FT. Both aircraft OMS258 and aircraft OMS134 were radar vectored by the ATCO and landed safely in OOMS RWY08L with no further incident.


Figure 15 showing aircraft OMS258 descending through ALT 7700FT to 7000FT at ROD of 1100FPM and aircraft OMS134 descending through ALT 8300FT to 8000FT at ROD of 1000FPM and ATCO radar vectored after the RED STCA disappeared (Source: DGAN radar)

1.1.24 Following the incident and during the flight crew interview, the flight crew of aircraft OMS258 reported that they were proceeding to MCT VOR on heading 150° while descending from ALT 10000FT to 7000FT and no heading clearance was given by ATCO after 2 NM from MCT VOR. The flight crew of aircraft OMS258 were on heading 152°. The flight crew of aircraft OMS258 asked the ATCO about which heading to proceed. The instruction by ATCO was heading 290° without specifying left or right turn. The flight crew indicated that they were able to see the other aircraft below through the TCAS system. The flight crew of aircraft OMS258 then proceeded with the right hand turn as the right-hand turn was shorter to heading 290° even after they have been advised to expect left turn earlier and while descending the flight crew of aircraft OMS258 asked the ATCO to confirm if they should continue to the right turn or turn to the left.

1.1.25 The flight crew of aircraft OMS258, also indicated that it was for the first time using the route to come overhead MCT-VOR, coming from OMFJ as they normally join left downwind then left base for RWY 08L. They planned to come straight in to MCT on heading 152° South East. The flight crew of aircraft OMS258 indicated that they were approaching from the North West to MCT VOR, which was towards the high mountains. The flight crew of aircraft OMS258 indicated that before they received TCAS alert and while approaching MCT, focus was in the cockpit on aircraft instruments as the approach phase is critical and requires the crew attention and through TCAS system they were able to establish the position of the other aircraft.

1.1.26 The flight crew of aircraft OMS134, indicated during the interview that the flight from OODQ to MCT was uneventful. During the descent and a few NM from MCT VOR, ATCO cleared the flight crew of aircraft OMS134 to ALT 8000FT. The Captain of aircraft OMS134 stated that when passing ALT 8000FT to 7000FT, the Pilot Flying (PF) realized that the aircraft was closing in and the PF reduced the ROD to 300FPM.

The flight crew of aircraft OMS134 reported that they received TCAS TA followed by the TCAS RA which advised the flight crew of aircraft OMS134 to level off, the aircraft was automatically controlled by the Autopilot and Flight Directors (AP/FD). The aircraft leveled off by itself. The flight crew of aircraft OMS134 followed TCAS, the AP/FD procedures and called the ATCO after the incident.

1.1.27 The flight crew of aircraft OMS134 further indicated that they were approaching MCT VOR from the South to the North. The Captain of aircraft OMS134 was the Pilot Monitoring. The flight crew of aircraft OMS134, reported that during the incident they saw the other aircraft outside but due to the automation the crew focus was in the cockpit on the TCAS system. The PF could not remember the settings of the TCAS parameters, but the flight crew of aircraft OMS134 could see the other aircraft from the left when they were making the right turn. The PF could not remember what was the TCAS range as the display was lagging. When occurrence happened the automation took over, the flight crew of aircraft OMS134 followed the TCAS procedures.

1.1.28 The PF of aircraft OMS134, indicated that usually when coming from the south aiming for RWY 08L. Initially they take left turn proceeding outbound of MCT VOR, the flight crew of aircraft would take10° to 15° to the right to a execute teardrop. The reason to turn right was because there were high mountains on the left. The flight crew of aircraft OMS134 mentioned

that this flight was the first for the crew flying together, the relationship and communications were perfect throughout the flight.

1.1.29 The crew of aircraft OMS134 indicated that the incident happened very quick hence they couldn't see the other aircraft. The PF of aircraft OMS134 further indicated that the TCAS system worked as expected. After the incident the crew of aircraft OMS134 informed the ATCO that they were clear of the conflict.

1.1.30 Following the incident and during the interview, the ATCO reported that there were 12 aircraft within 25 NM in MCT Approach area and were under his control at the time of the incident. The ATCO took over from the second morning shift which was one of the busiest times on the day and at the time of the incident. The ATCO mentioned that although there was high density of traffic, it was not something unusual as ATCO has controlled the same traffic density before.

1.1.31 According to the ATCO, aircraft OMS258 was coming from the north which was on the heading 150° to avoid R7 restricted area and aircraft OMS134 was coming from the south to MCT VOR descending to ALT 8000FT. After aircraft OMS258 was cleared from R7, ATCO instructed the flight crew of aircraft OMS258 to descend to ALT 7000FT and to leave MCT VOR at heading 290°. The ATCO further indicated that he was expecting the flight crew of aircraft OMS258 to turn to the left of MCT VOR and back to HDG 290°, however the flight crew of aircraft OMS258 made a right turn instead. According to the interview, the ATCO thought the flight crew of aircraft OMS258 would leave MCT VOR to the left and would not cross it as other flight crews normally approach from the South they take MCT VOR and then, they would turn to the left descending to ALT 8000FT.

1.1.32 During the interview, the ATCO reported that the shift supervisor was not there when the alert activated and the shift supervisor was informed after the incident had happened. The supervisor asked the ATCO if ATCO wanted to continue working which the ATCO responded by saying "yes". The ATCO further indicated that was not supposed to let other colleague to go for tea break as the traffic was congested. The ATCO stated that the other colleague had asked ATCO if it is fine to handle the traffic density. The ATCO assured the other colleague that was fine to handle the traffic density alone.

1.1.33 During the interview, the aircraft OMS258 crossed MCT VOR heading south and asked ATCO to which direction they should turn, either left or right. The flight crew of aircraft OMS258 decided to turn right since they didn't receive a response from ATCO, while on right turn, the flight crew received TCAS RA and immediately commenced left turn. Before the ATCO could respond, the STCA was activated on the screen which was as a result of the conflict between aircraft OMS258 and aircraft OMS134. The ATCO then instructed the flight crew of aircraft OMS258 to expedite a left turn and the flight crew of aircraft OMS134 to expedite a descend to ALT 8000FT. At this time aircraft OMS258 had started the left turn during which the two aircraft came close to each other and both of them reported TCAS RA.

## 1.2. Injuries to Persons

1.2.1. No injuries were reported.

**Injuries to Persons OMS258**

| Injuries | Pilot | Cabin Crew | Passengers | **Total on Board** | Other |
|---|---|---|---|---|---|
| Fatal | - | - | - | - | - |
| Serious | - | - | - | - | - |
| Minor | - | - | - | - | - |
| No Injuries | 2 | 5 | 126 | **133** | - |
| **Total** | **2** | **5** | **126** | **133** | - |

Note: Other, means people on ground.

**Injuries to Persons OMS134**

| Injuries | Pilot | Cabin Crew | Passengers | **Total on Board** | Other |
|---|---|---|---|---|---|
| Fatal | - | - | - | - | - |
| Serious | - | - | - | - | - |
| Minor | - | - | - | - | - |
| No Injuries | 2 | 5 | 80 | **87** | - |
| **Total** | **2** | **5** | **80** | **87** | - |

Note: Other, means people on the ground.

## 1.3. Damage to Aircraft

1.3.1. No damage to aircraft was reported.

## 1.4. Other Damage

1.4.1. No other damages were reported.

## 1.5. Personnel Information

1.5.1 Pilot-in-command (PIC).

Captain (PF) OMS258

| | | | |
|---|---|---|---|
| Nationality | Tunisian | | |
| Medical validity | Expiry: 31/12/2024 | Licence type | Airline Transport Pilot Aeroplane |
| Licence validity | Expiry: 31/10/2025 | Type endorsed | Yes |
| Ratings | Instrument Rating, Multi-Engine, A320 | | |
| English Language Proficiency | Level 4. Expiry date: 20th January 2026. | | |
| Latest LPC Issue dates | 12/01/2024 | Latest OPC Issue dates | 25/12/2023 |

The Line Proficiency Checks (LPC) was conducted by a CAA Authorized Flight Examiner. The LPC validity is 12 months.

**Flying experience:**

| | |
|---|---|
| Total hours | 10409 |
| Last 24 hrs | 5:53 |
| Last 7 days | 17:43 |
| Last 30 days | 67.20 |
| Last 90 days | 169:25 |

1.5.2 First Officer (FO)
Pilot Monitoring (PM) OMS258.

| | | | |
|---|---|---|---|
| Nationality | Sudanese | | |
| Medical valid | Expiry: 13/07/2024 | Licence type | Commercial Pilot Aeroplane |
| Licence valid | Expiry: 13/08/ 2027 | Type endorsed | Yes |
| Ratings | Instrument Rating, Multi-Engine, A320 | | |
| English Language Proficiency | Level 4. Expiry date: 13th August 2025 | | |
| Latest LPC Issue Dates | 10/4/2023 | Latest OPC Issue Dates | 19/02/2024 |

The Line Proficiency Checks (LPC) was conducted by a CAA Authorized Flight Examiner. The LPC validity is 12 months.

**Flying experience:**

| | |
|---|---|
| Total hours | 1590 |
| Last 24 hrs | 06:43 |
| Last 7 days | 12:33 |
| Last 30 days | 69.40 |
| Last 90 days | 148:21 |

1.5.3 Pilot-in-command (PIC)
Captain (PF) OMS134):

| | | | |
|---|---|---|---|
| Nationality | New Zealand | | |
| Medical validity | Expiry: 29/11/2024 | Licence type | Airline Transport Pilot Aeroplane |
| Licence validity | Expiry: 31/01/2025 | Type endorsed | Yes |
| Ratings | Instrument Rating, Multi-Engine, A320 | | |
| English Language Proficiency | Level 5. Expiry date: 5th April 2029 | | |
| Latest LPC Issue Dates | 22/01/24 | Latest OPC Issue Dates | 23/01/24 |

The Line Proficiency Checks (LPC) was conducted by a CAA Authorized Flight Examiner. The LPC validity is 12 months.

**Flying experience:**

| | |
|---|---|
| Total hours | 5613 |
| Last 24 hrs | 6 |
| Last 7 days | 19 |
| Last 30 days | 69.12 |
| Last 90 days | 179 |

1.5.4. First Officer (FO):
Pilot Monitoring (PM) OMS134.

| | | | | | |
|---|---|---|---|---|---|
| Nationality | Pakistani | | | | |
| Medical validity | Expiry: 24/12/2024 | Licence type | Airline Transport Pilot Aeroplane | | |
| Licence validity | Expiry: 31/12/2024 | Type endorsed | Yes | | |
| Ratings | Instrument Rating, Multi-Engine, A320 | | | | |
| English Language Proficiency | Level 4. Expiry date: 15th May 2026 | | | | |
| Latest LPC Issue Dates | 22/06/2023 | Latest OPC Issue Dates | 12/06/2023 | | |

The Line Proficiency Checks (LPC) was conducted by a CAA Authorized Flight Examiner. The LPC validity is 12 months.

**Flying experience:**

| | |
|---|---|
| Total hours | 6563.08 |
| Last 24 hrs | 2.2 |
| Last 7 days | 2.2 |
| Last 30 days | 41.40 |
| Last 90 days | 138:42 |

1.5.5 **Air Traffic Controller:**

| | | | | | |
|---|---|---|---|---|---|
| Nationality | Omani | | | | |
| Medical valid | 14th May 2025 | Licence type | Air Traffic Controller | | |
| Licence valid | 4th May 2025 | Type endorsed | YES | | |
| Ratings | ADC, APP RDR | Language Proficiency Requirements (LPR) | | Level 5 | |

1.5.5.1 The ATCO was issued with ratings to allow operating as a controller at OOMM as ADC, APP, Area RDR/INDRA.

1.5.5.2 The ATCO medical assessment was conducted on 26th March 2024 and was not issued until on 15th May 2024 due to the ATCO medical condition. The medical certificate was only issued two days after the incident. The ATCO was issued a Class three (3) medical certificate with an expiry date of 14th May 2025. At the time of the incident, ATCO's medical certificate was expired on the 30th March 2024. The ATCO operated between the 31st March 2024 and the 14th May 2024 without a valid medical certificate.

1.5.5.3 Civil Aviation Regulation requirements (Date of Issue: 20 July 2023): CAR.ATCO.A.015
Exercise of the privileges of licenses and provisional inability:
(a) The exercise of the privileges granted by a licence shall be dependent on the validity of the licence, ratings, endorsements including English Language Proficiency (ELP) and the medical certificate.
(b) Licence holders shall not exercise the privileges of their licence when having doubts of being able to safely exercise the privileges of the licence and shall in such cases immediately notify the relevant air navigation service provider of the provisional inability to exercise the privileges of their licence.

1.5.5.4 CAR 10.005 Authority Empowered to Grant Exemptions (Source: CAR-10 EXEMPTIONS Effective 15th August 2021):

(a) The Director General of Civil Aviation Regulation (DGCAR) may grant exemptions from the specified requirements upon receipt of an application to that effect or on its own initiative if, in its estimation, the circumstances so warrant and the safety of civil aviation is considered not to be compromised by such action, subject to such terms and conditions to be specified by the Authority.

(b) An exemption must be in writing, it must be signed and approved by the DGCAR. It may be granted subject to such conditions as the Authority deems pertinent. In critical cases, DGCAR may seek the advice or approval of the President of the CAA or his designated delegate.

1.5.5.5 CAR 10.010 Non-Compliance without applicable Exemption

(a) Compliance with the regulatory requirements and provisions of the Civil Aviation Authority of Oman (CAA) is mandatory unless an exemption has been granted by DGCAR in accordance with the established procedures outlined in the Exemptions Procedure Manual. No person may take or cause to be taken any action not in compliance with the Specified requirements unless the DGCAR has issued an applicable exemption to the person.

(b) Any person, organization or entity, involved in civil aviation activities, who contravenes the provisions of this regulation commits an offence and upon conviction, shall be liable to a fine as stated in Article 68 of the Civil Aviation Law.

1.5.5.6 CAR 10.015 Conditions to Grant Exemption.

(a) Any exemption shall only be granted on the basis of a robust rationale.

(b) The request for issuance of exemptions that are not supported by safety risk assessments or aeronautical studies will not be accepted by the CAA.

## 1.6. Aircraft Information

1.6.1 The Airbus A321 is a narrow-body (single-aisle) aircraft with a retractable tricycle landing gear powered by two wing pylon-mounted turbofan engines type CFM/ LEAP-1A33. It is a low-wing cantilever monoplane with a conventional tail unit having a single vertical stabilizer and rudder. The Airbus A321 was the first derivative of the A320, also known as the Stretched A320, A320-500 and A325. Its launch came on 24 November 1988, around the same time as the A320 entered service, after commitments for 183 aircraft from 10 customers were secured.-The Airbus A321 is a commercial passenger twin engine jet airliner; it carries 185 to 236 passengers. It has a stretched fuselage which was the first derivative of the baseline A320 and entered service in 1994, about six years after the original A320. The aircraft shares a common type rating with all other Airbus A320-family variants, allowing A320-family pilots to fly the aircraft without the need for further training. The A321 is the largest variant of the A320 family.

Airframe Information (**OMS258**)

| | | |
|---|---|---|
| Manufacturer/Model | Airbus/A321-253N | |
| Serial Number | 7770 | |
| Year of Manufacture | 2017 | |
| Total Airframe Hours (At Time of Incident) | 10,974:27 | |
| Last Inspection (Date & Hours (TSN)) | 30-Mar-2024 | 10,544:54 |
| Last Inspection Airframe Cycles (CSN) | 7885 | |
| Hours Since Last Inspection | 430 | |
| Type of inspection preformed | 3A Check | |
| CRS Issue Date | 30-Mar-2024 | |
| C of A (First/initial Issue Date) | 06-Aug-2022 | |
| C of A (Expiry Date) | 05-Aug-2024 | |
| C of R (Issue Date) (Present Owner) | 28-Jul-2022 | |
| Type of Fuel Used | JET-1A | |
| Operating Category | Transport (passenger) | |
| Previous Accidents | None | |

**Engine 1:**

| | |
|---|---|
| Manufacturer/Model | CFM/ LEAP-1A33 |
| Serial Number | 59C184 |
| Part Number | LEAP-1A33 |
| Hours Since New | 456 |
| Hours Since Overhaul | N/A |
| Hours since last shop visit | N/A |
| Cycles Available Before Next Shop Visit | 9690 |
| Oil type | NYCO TURBONYCOIL 600 |

**Engine 2:**

| | |
|---|---|
| Manufacturer/Model | CFM/ LEAP-1A33 |
| Serial Number | 59C186 |
| Part Number | LEAP-1A33 |
| Hours Since New | 456 |
| Hours Since Overhaul | N/A |
| Hours since last shop visit | N/A |
| Cycles Available Before Next Shop Visit | 9690 |
| Oil type | NYCO TURBONYCOIL 600 |

Aircraft Information **(OMS134):**

| | |
|---|---|
| Manufacturer/Model | Airbus/A321-253NX |
| Serial Number | 10627 |
| Year of Manufacture | 2022 |
| Total Airframe Hours (At Time of Incident) | 10259:04 |
| Last Inspection (Date & Hours (TSN)) | 12-Apr-2024 |
| Last Inspection Airframe Cycles (CSN) | 3032 |
| Hours Since Last Inspection | 391 |
| Type of inspection preformed | 1C Check |
| CRS Issue Date | 12-Apr-2024 |
| C of A (First/initial Issue Date) | 24-Feb-2022 |
| C of A (Expiry Date) | 24-FEB-2025 |
| C of R (Issue Date) (Present Owner) | 24-Feb-2022 |
| Type of Fuel Used | JET-A1 |
| Operating Category | Commercial Air Transport Operation |
| Previous Occurrences | None |

**Engine 1:**

| | |
|---|---|
| Manufacturer/Model | CFM/ LEAP-1A33 |
| Serial Number | 599361 |
| Part Number | LEAP-1A33 |
| Hours Since New | 11190 |
| Hours Since Overhaul | 1841 |
| Hours since last shop visit | 1841 |
| Cycles Available Before Next Shop Visit | 4953 |
| Oil type | NYCO TURBONYCOIL 600 |

**Engine 2:**

| | |
|---|---|
| Manufacturer/Model | CFM/ LEAP-1A33 |
| Serial Number | 599618 |
| Part Number | LEAP-1A33 |
| Hours Since New | 12296 |
| Hours Since Overhaul | 4503 |
| Hours since last shop visit | 4503 |
| Cycles Available Before Next Shop Visit | 7266 |
| Oil type | NYCO TURBONYCOIL 600 |

### 1.7 Meteorological Information:

1.7.1 The weather information below is from the Meteorological Routine Aerodrome Report (METAR) at 06:50 UTC:

| | | | | | |
|---|---|---|---|---|---|
| Wind Direction | 040° | Wind Speed | 07 kts | Visibility | 9km |
| Temperature | 32°C | Cloud Cover | Sky Clear | Cloud Base | Sky Clear |
| Dew Point | 25°C | QNH | 1008 HPA | | |

### 1.8 Aids to Navigation.

1.8.1 Both aircraft were equipped with a standard navigational equipment and systems approved by the Oman CAA. There were no records or defects indicating that the navigation system was unserviceable prior to the incident flight.

### 1.9 Communications.

1.9.1 Both aircraft were equipped with a standard communication equipment and systems approved by the Oman CAA. There were no records or defects indicating that the communication system was unserviceable prior to the incident flight.

### 1.10 Aerodrome/Airport Information

1.10.1 Departure Aerodrome (OMS258):

| | |
|---|---|
| ICAO designation | Fujairah International Airport (OMFJ) |
| Aerodrome co-ordinates | 25°06′44″N 056°19′27″E |
| Aerodrome elevation | 153FT Mean Sea Level (MSL) |
| Runway designations | 11/29 |
| Runway dimensions | 12303 x 148 ft |
| Runway used | 11/29 |
| Category for Rescue Fire Fighting | CAT 10 |
| Approach facilities | ILS, RNP, GVA, Runway Lights, PAPI's |
| Aerodrome status | Licensed |

Destination Aerodrome:

| | | |
|---|---|---|
| ICAO designation | Muscat International Airport (OOMS) | |
| Aerodrome co-ordinates | 23°35′36″N 058°17′04″E | |
| Aerodrome elevation | 25FT Mean Sea Level (MSL) | |
| Runway designations | 08R/26L | 08L/26R |
| Runway dimensions | 4080 x 60 M | 4000 x60 M |
| Category for Rescue Fire Fighting | CAT 10 | |
| Approach facilities | ILS, RNP, VOR, Runway Lights, PAPI's | |
| Aerodrome status | Licensed Airport (Open) | |

1.10.2 Aerodrome Information (OMS134):

Departure Aerodrome:

| | |
|---|---|
| ICAO designation | Duqm Airport (OODQ) |
| Aerodrome Coordinates | 19°30′00″N 57°38′35″E |
| Aerodrome elevation | 383. Ft MSL |
| Runway designations | 04/022 |
| Runway dimensions | 13130 x 197 Feet |
| Runway used | 04 |
| Category for Rescue Fire Fighting | CAT 10 |
| Approach facilities | ILS, RNP, GVA, Runway Lights, PAPI's |
| Aerodrome status | Licensed |

Destination Aerodrome:

| | | |
|---|---|---|
| ICAO designation | Muscat International Airport (OOMS) | |
| Aerodrome co-ordinates | 23°35′36″N 058°17′04″E | |
| Aerodrome elevation | 25 Ft MSL | |
| Runway designations | 08R/26L | 08L/26R |
| Runway dimensions | 4080 x 60 M | 4000 x60 M |
| Runway used | 08L | |
| Category for Rescue Fire Fighting | 10 | |
| Approach facilities | ILS, RNP, VOR, Runway Lights, PAPI's | |
| Aerodrome status | Licensed | |

## 1.11 Flight Recorders.

1.11.1 Both aircraft were fitted with the Digital Flight Data Recorder (DFDR), FDM and the Cockpit Voice Recorder (CVR). Both recorders were never downloaded as a result were over-written, therefore OTSB will be relying on other flight information data sources such as Flight Data Management (FDM) and Air Traffic Services (ATS) communication records to assist in the investigation. Figures below indicate the flight overview of the aircraft parameters as per the FDM for both aircraft OMS258 and aircraft OMS134.


Figure 16 indicates flight ALT standard, pitch angle and the

status of the Auto pilot for aircraft (OMS258)

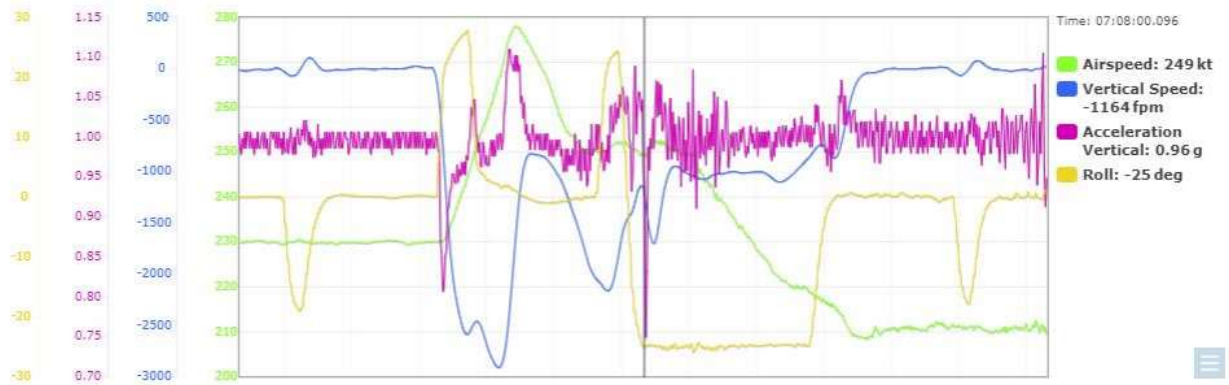



Figure 17 indicates the airspeed, vertical speed, acceleration and the roll angle for aircraft (OMS258)

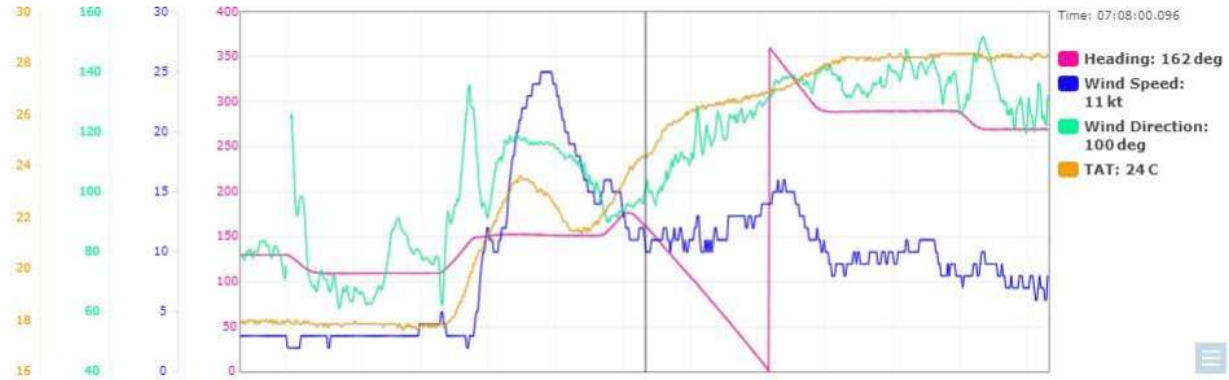



Figure18 indicates the aircraft heading, wind speed and direction and Total Air Temperature for aircraft (OMS258)

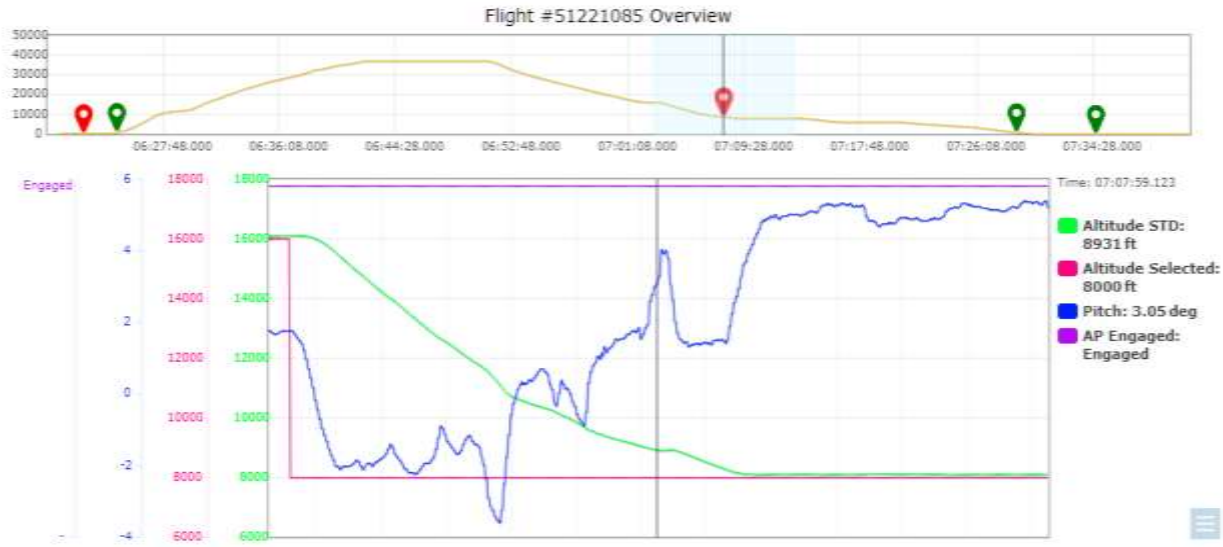



Figure 19 indicates flight ALT standard, pitch angle and the status of the Auto pilot for aircraft (OMS134)

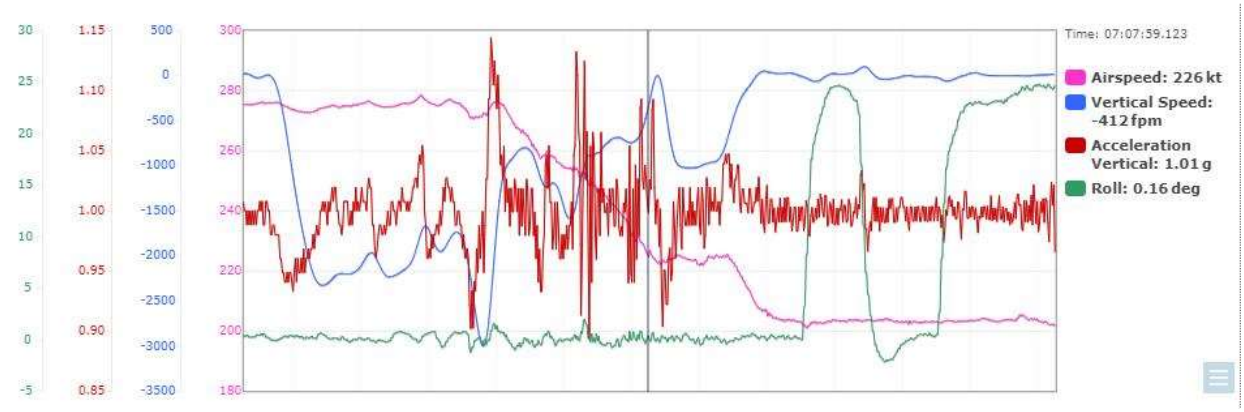



Figure 20 indicates the airspeed, vertical speed, acceleration and the roll angle for aircraft (OMS134)


Figure 21 indicates the aircraft heading, wind speed and wind direction and total air temperature aircraft (OMS134)

## 1.12 Wreckage and Impact Information.

1.12.1 Not relevant to the occurrence.

## 1.13 Medical and Pathological Information.

1.13.1 Not relevant to the serious incident.

## 1.14 Fire.

1.14.1 Not relevant to the serious incident.

## 1.15 Survival Aspects.

1.15.1 Not relevant to the serious incident.

## 1.16 Tests and Research.

1.16.1 Not relevant to the serious incident.

## 1.17 Organizational and Management Information.

### 1.17.1 Salam Air (Air Operator):

1.17.1.1Aircraft OMS258 was scheduled international passenger flight and aircraft OMS134 was scheduled domestic passenger flight.

1.17.1.2The operator, Salam Air was issued an Air Operating Certificate (AOC) by the State of Registry and State of Operator, the Sultanate of Oman CAA and revalidated on 29th January 2024. The Expiry date is as per applicable Sultanate of Oman Regulations, which states that the certificate is valid until suspended or revoked. The certificate certifies that the SALAM AIR (S.A.O.C) is authorized to perform commercial air operations as defined in the operations specifications, in accordance with all applicable manuals and all the applicable Sultanate of Oman Regulations. Both aircraft have valid certificates of Airworthiness at the time of the incident.

The Operator, Salam Air have implemented Safety Management System (SMS), whereby occurrences are reported to the relevant authorities as and when they occur and they are reviewed, categorized, classified and investigated to identify the need for any gaps, risk assessment and management, remedial action that are required to be taken by the organization.

1.17.2 **Directorate General Air Navigation (DGAN):**

The service provider (DGAN) have implemented Safety Management System (SMS) which includes all its ATS unit's, whereby occurrences are reported to the relevant authorities as and when they occur and they are reviewed, categorized, classified and investigated to identify the need for any gaps, risk assessment and management remedial action that are required to be taken by the organization.

1.17.2.1 MUSCAT APPROACH MATSOP procedures requires that when an STCA is generated and in the event that a separation minimum was infringed, APP/SRV controllers are required to complete an air traffic incident report using the AQD e-report system; only in the event that a separation minimum was infringed. After the incident and consultation with the approach supervisor, the ATCO completed the incident report as required by the DGAN SMS manual.

1.17.2.2 OTSB established that the ATCO was exercising the privileges of the license while the medical certificate had expired, which rendered the license invalid. There was no exemption granted for the ATCO to provide navigational services with expired medical certificate.

1.17.2.3 There has been a total of 3 occurrences (AIFN:002/02/2024, dated 10th February 2024, AIFN:003/05/2024, dated 13th May 2024 and AIFN:004/06/2024, dated 15th June 2024) that have been reported to OTSB, OTSB did open the investigation to establish the cause for loss of separations. Based on the above mentioned investigations, the cause(s) and contributory factors appear to be similar on all occurrences, pointing to the loss of situational awareness of ATCOs.

1.17.2.4 OTSB has also issued Loss of Separation safety study (dated 14 September 2022) report with safety recommendations which have since been implemented before the safety study final report was issued however the same causal factors are still reoccurring.

## 1.18. Additional Information

1.18.1 Salam Air A320/A321 Flight Crew Operating Manual (Source):
Aircraft Systems Surveillance-TCAS-Description
The Traffic alert and Collision Avoidance System (TCAS):
- Detects and displays surrounding aircraft that have a transponder
- Calculates and display possible collision threats
- Triggers vertical speed orders, in order to avoid collisions.

| **PRINCIPLE** |
|---|

1.18.1.1 The TCAS detection capability is limited to intruders flying within a maximum range of 30 NM on either sides and approximately 30 NM to 80 NM longitudinally (depending on aircraft configuration and external conditions), and within a maximum altitude range of 9 900 above and below the aircraft.

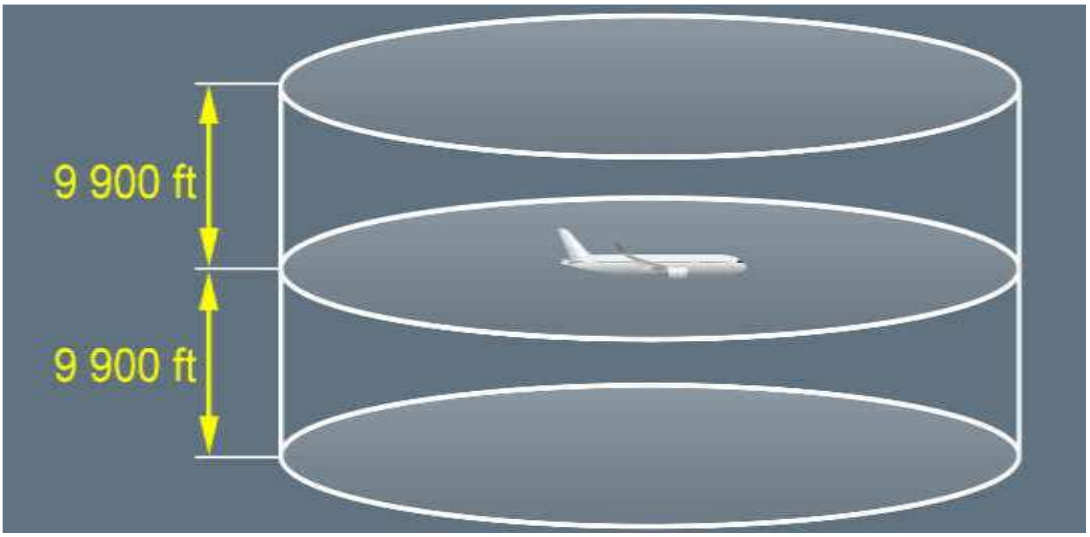



Figure 22 showing TCAS Range

1.18.1.2 The TCAS obtains data transmitted by the transponders of nearby aircraft, and uses this data to evaluate possible collision threats.
The TCAS determines:
- The bearing of intruders, in relation to the bearing of the aircraft.
- The distance between the aircraft and intruders, and the rate of separation or closure.
- The relative ALT of intruders, if intruders report their ALT via a Mode-C or Mode-S transponder.

The TCAS then calculates the intruder trajectory, the Closest Point of Approach (CPA), and the estimated time (TAU) before reaching the CPA.
The TAU is the ratio between the distance that separates both aircraft, and the sum of their speed.

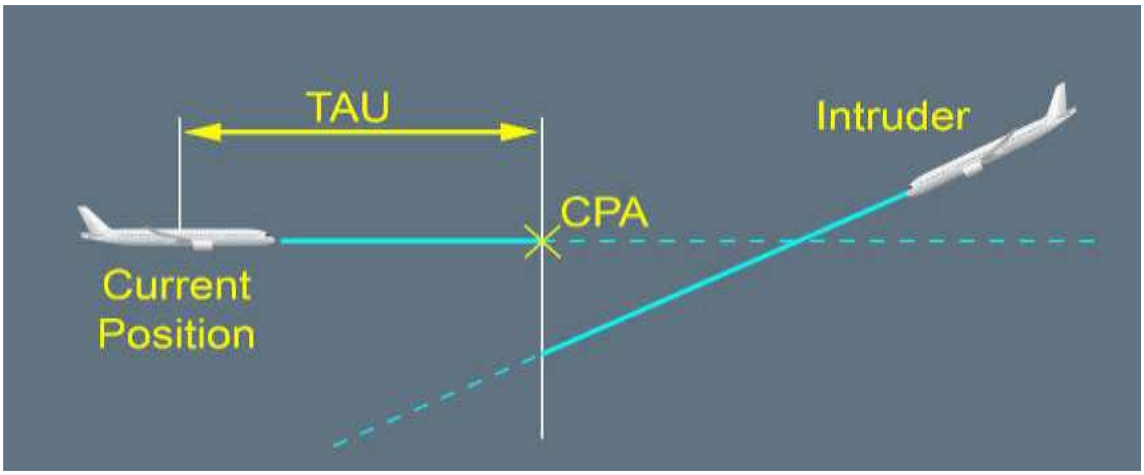



Figure 23 showing TAU Definition

1.18.1.3 If the TCAS detects that the trajectory of an intruder may be a collision threat, it triggers:

- Audio and visual indicators
- Vertical speed orders, to ensure a sufficient trajectory separation and a minimal vertical speed variation considering all intruders.

| **MAIN COMPONENTS** |
|---|

1.18.1.4 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.

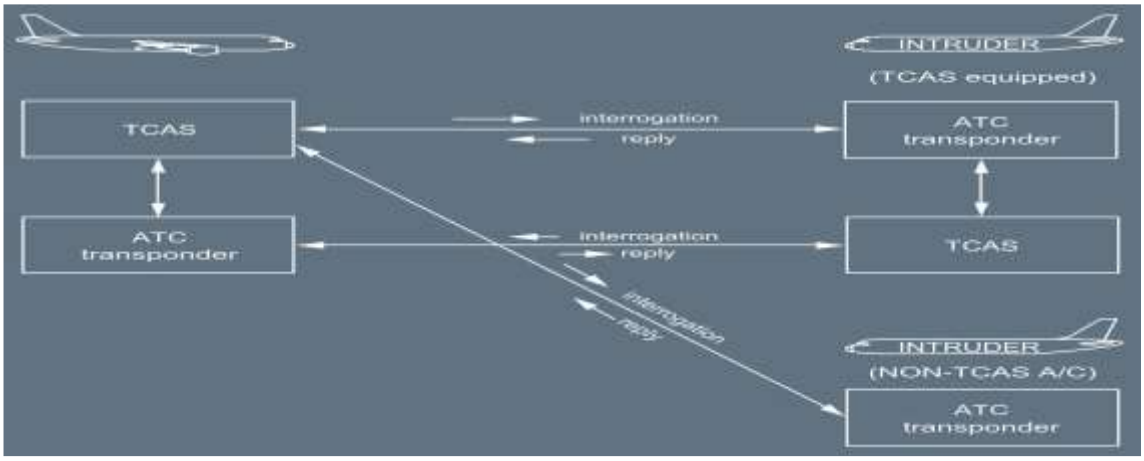



Figure 24 showing Aircraft Surveillance Systems

## INTRUDER DETECTION CATEGORIES

1.18.1.5 The TCAS divides the space surrounding the aircraft into the following four zones, in order to evaluate and categorize possible collision threats:

- Resolution Advisory (RA)
- Traffic Advisory (TA)
- Proximate intruders
- Other intruders.

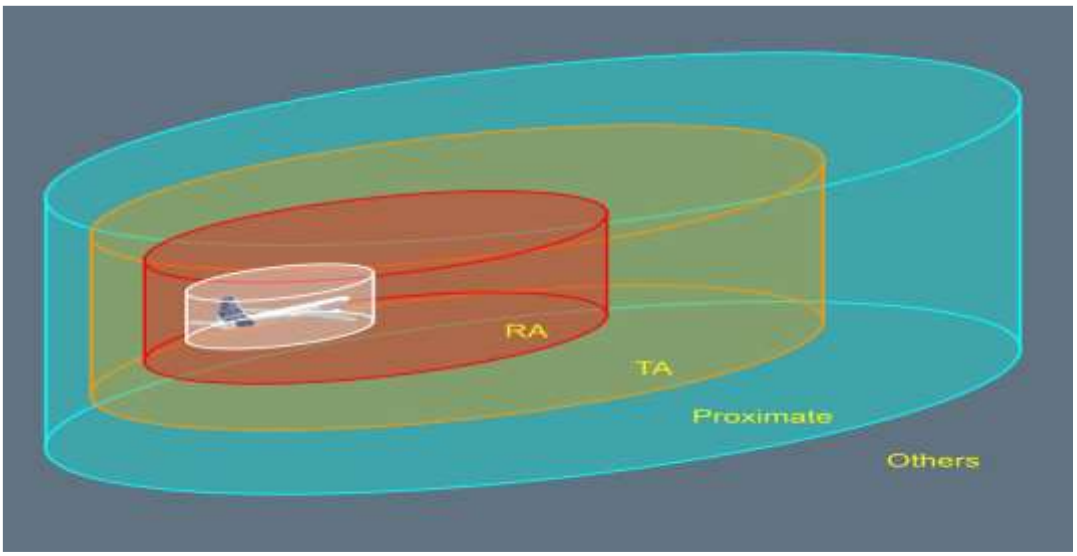
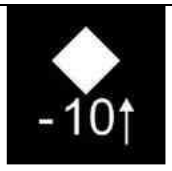



Figure 25 showing TCAS Envelopes

Depending on the level of the collision threat, the TCAS triggers audio and visual indicators:

| LEVEL | INTRUDER POSITION | DISPLAYED INFORMATION AND MESSAGE | |
|---|---|---|---|
| Proximate | - No collision threat<br>- Intruder in the vicinity of the A/C (closer than 6 NM laterally and ±1200 ft vertically) | - ND: Intruder position |  |
| Traffic Advisory (TA) | - Potential collision threat<br>- TAU is about 40 s | - ND: Intruder position<br>- Aural messages |  |
| Traffic Advisory (TA) | - Potential collision threat<br>- TAU is about 40 s | - ND: Intruder position<br>- Aural messages |  |

| | | | |
|---|---|---|---|
| Resolution Advisory (RA) | - Real collision threat<br>- TAU is about 25 s | - ND: Intruder position<br>- Aural messages<br>- PFD: Vertical orders<br>• Maintain actual V/S (Preventive Advisory)<br>or<br>• Modify V/S (Corrective Advisory) |  |

Figure 26 showing the level of the collision threat, the TCAS triggers audio and visual indicators

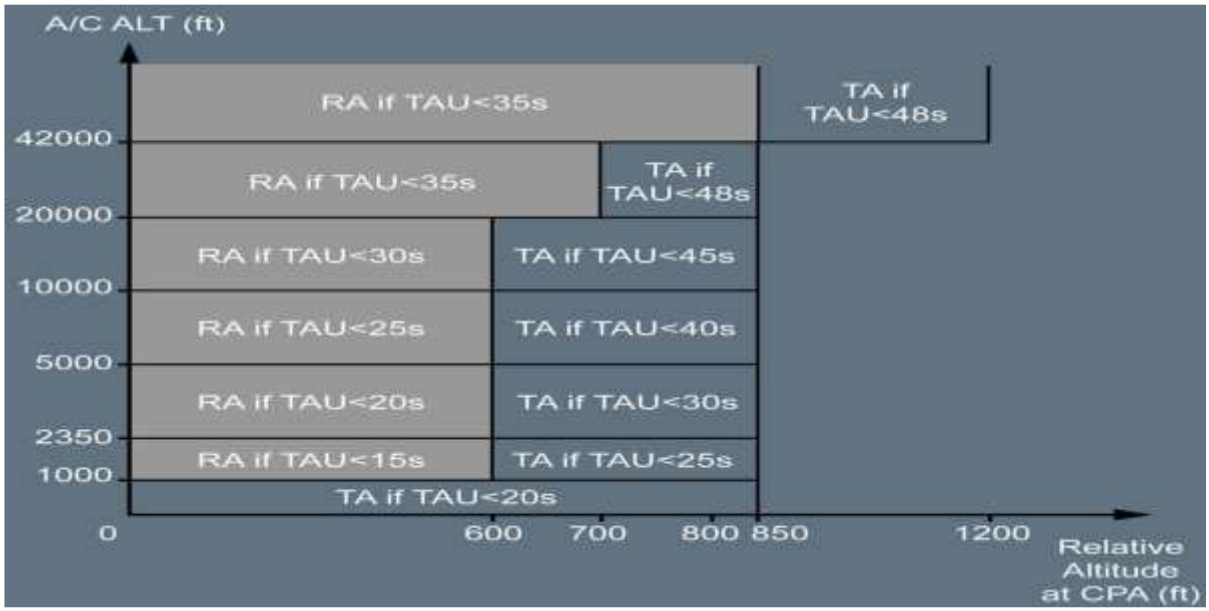



Figure 27 showing TA/RA thresholds

1.18.1.6 TCAS MODES

The TCAS has three different modes of operations that can be selected on the ATC / TCAS control panel:
- The Traffic Advisory/Resolution Advisory (TA/RA) mode
- The Traffic Advisory Only (TA ONLY) mode
- The standby (STBY) mode.

TRAFFIC ADVISORY/RESOLUTION ADVISORY (TA/RA) MODE

The TA/RA mode is the normal TCAS operating mode that enables:
- The ND to display all intruders
- The PFD to display the vertical speed orders that indicate the vertical direction that the aircraft should take, in order to avoid a collision.

TRAFFIC ADVISORY ONLY (TA ONLY) MODE

The TA ONLY mode can be selected:
- Manually in case of aircraft degraded performance (engine failure, landing gear extended), or in specific airports, and for specific procedures (identified by operators) that may provide RA that are neither wanted nor appropriate (e.g. Closely-spaced parallel or converging runways)
- Automatically, if TA/RA mode is previously selected and:
• The windshear alert is triggered
• The stall warning is triggered

• GPWS alerts are triggered
• Aircraft is below 1000 FT AGL.
When the TCAS is operating in TA ONLY mode:
- All RAs are inhibited and converted into TAs
- TA threshold is set to TAU ≤20 s, irrespective of the aircraft altitude
- No vertical speed advisories are indicated on the PFDs
- “TA ONLY” is displayed on the NDs

STANDBY MODE
In the standby mode, the advisory generation and surveillance functions are not active. The TCAS does not trigger any alert. No TCAS information can be displayed on the PFDs and NDs.
MODE
The AP/FD TCAS mode is a vertical guidance mode of the AP/FD. In the case the TCAS generates a Resolution Advisory (RA) alert, this mode automatically engages to assist the flight crew to follow the RA orders, and to revert toward initial trajectory:

- Automatically if the AP is engaged, or
- Manually with the guidance of the Flight Director (FD), if the AP is not engaged.
The AP/FD TCAS mode optimizes the vertical speed for a rapid and appropriate response to an RA, and minimizes the deviations from the latest ATC clearance.
When the TCAS is operating in TA ONLY mode, the AP/FD TCAS mode is inhibited.

INTRUDER DETECTION
Based on the received information from the intruders, the TCAS may generate the following sequence of alerts:
• If the TCAS considers the intruder to be a possible collision threat
- It generates a visual and aural Traffic Advisory (TA).
- In that case, the AP/FD TCAS mode automatically arms: TCAS appears on the FMA to inform the flight crew that the AP/FD TCAS mode will be available in the case a Resolution Advisory (RA) is subsequently triggered.

• If the TCAS considers the intruder to be a real collision threat:
- It generates a visual and aural Resolution Advisory (RA).
- The AP/FD TCAS mode automatically engages: TCAS appears on the FMA. The flight crew has vertical guidance to fly the RA orders, automatically with the AP/FD, or manually with the FDs only (if AP was not engaged).

- If the A/THR is disconnected, it automatically becomes armed or active, depending on the thrust lever position. When active, the speed/Mach mode engages, and the speed/Mach control becomes selected. For more information, Refer to DSC-22_30-40-100 Normal Operations - When a RA is triggered - Consequence on A/THR and Speed/Mach Control.
- The vertical speed scale on the PFD indicates the vertical speed range within which the aircraft should fly.

• When the TCAS considers that there is no more collision threat:
- It triggers the "CLEAR OF CONFLICT" aural alert.
- In most of the cases, the AP/FD TCAS mode automatically reverts to V/S mode: The vertical speed target leads the aircraft toward the FCU selected altitude.
If the altitude capture conditions are met at the clear of conflict, the AP/FD TCAS mode can revert to an altitude acquire, or an altitude hold mode. Refer to DSC-22_30-40-100 Normal Operations - When a RA is triggered - Consequence on AP/FD Vertical Mode.

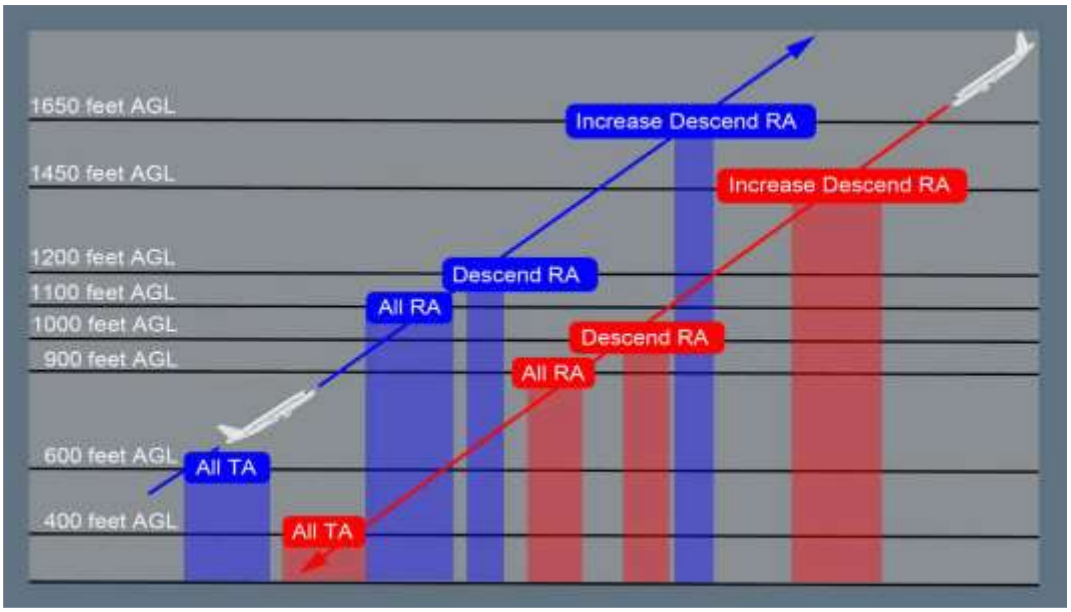



Figure 28 showing when a RA is triggered - Consequence on AP/FD Vertical Mode.

Some advisories are inhibited depending on the aircraft ALT:
- All intruders flying below 380 ft AGL when the own aircraft ALT is below 1 750 ft AGL in climb or 1 650 ft AGL in descent
- All TA aural messages below 600 ft AGL in climb or below 400 ft AGL in descent
- All RA aural messages below 1 100 ft AGL in climb or 900 ft AGL in descent. In this case, the RA are converted into TA
- “Descend” RA below 1 200 ft AGL in climb or 1 000 ft AGL in descent
- “Increase Descent” RA below 1 650 ft AGL in climb or 1 450 ft AGL in descent
- The AP/FD TCAS flight guidance mode is inhibited below 900 ft.

**TCAS INTRUDER WITH NO REPORTED ALT**

For intruders that do not report their ALT:
- The relative ALT does not appear on ND
- The TCAS never triggers any RA
- The TCAS inhibits the TA when own aircraft ALT is above 15500 ft.

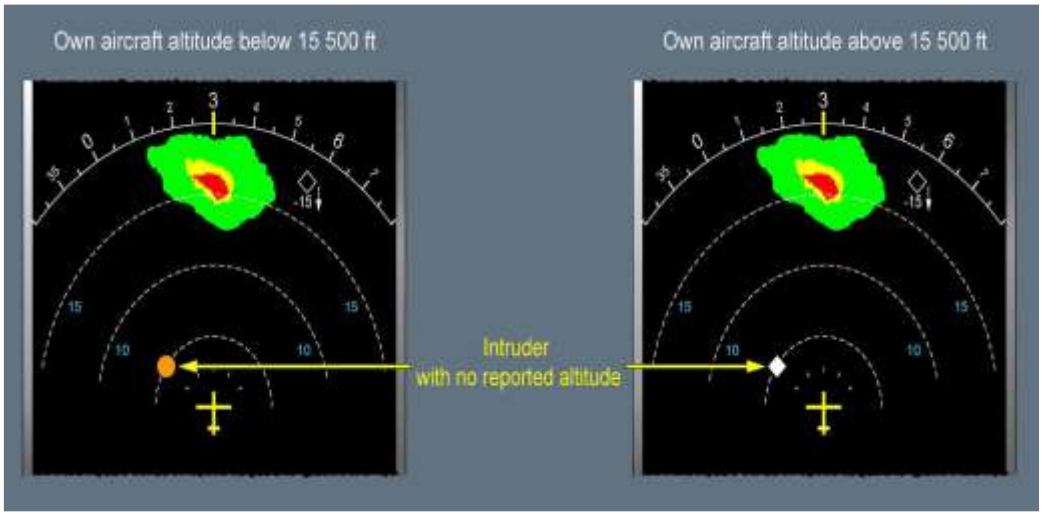



Figure 29 showing TCAS intruder with no reported AL

1.18.2 Salam Air: /A320/A321 Flight Crew Operating Manual: Procedures Abnormal And Emergency

Procedures

| (MEM) TCAS CAUTION-RESOLUTION ADVISORY |
|---|

L2

If the AP/FD TCAS mode is available, the TCAS mode arms on FMA.

L1

| TCAS mode ……CHECK ARMED |
|---|

L2
If the AP/FD TCAS mode does not arm, the flight crew must be prepared to disconnect the AP in the case of a RA, and manually follow the TCAS guidances.
L1
If the A/THR is off:
AUTOTHRUST.....ONL2

It is recommended to set the A/THR to ON in order to avoid the AUTO FLT A/THR LIMITED alert at the automatic A/THR activation that occurs in the case of a RA.

L1

Do not perform a maneuver based on a TA alone.

| [MEM] TCAS CAUTION - TRAFFIC ADVISORY |
|---|

Do not perform a maneuver based on a TA alone.

| | [MEM] TCAS WARNING - RESOLUTION ADVISORY | |
|---|---|---|

Always follow RA orders, even if this results in crossing the intruder ALT, because these orders ensure the best ALT separation.

| CAUTION | Be aware that the intruder may have a TCAS, and may maneuver in response to a coordinated RA order. Therefore, not following an RA order could compromise safe separation. |
|---|---|

- If the AP/FD TCAS mode is available:

L2 The flight crew applies this procedure, when a RA is triggered, and the AP/FD TCAS mode engages. The AP/FD TCAS mode follows the RA orders.

L1 All RA, except any CLIMB RA during approach in CONF 3 or FULL:

- If the AP is OFF:

| FD ORDERS.....FOLLOW<br>The AP can be engaged. |
|---|

| VERTICAL SPEED.....MONITOR |
|---|

L2 If a preventive RA was triggered: check that the vertical speed remains out of the red area of the vertical speed scale.
If a corrective RA was triggered: check that the vertical speed gets out of the red area, and remains in the green area of the vertical speed scale.

L1

| | |
|---|---|
| CAUTION | If for any reason during a RA, the aircraft vertical speed does not reach the green area of the vertical speed scale, the PF should disconnect the AP, and override the FD orders, in order to lead the aircraft vertical speed out of the red area of the vertical speed scale. If necessary, the PF must use the full speed range between Vαmax and VMAX. |

- Any CLIMB RA during approach in CONF 3 or FULL:

| |
|---|
| GO-AROUND.....PERFORM |

L2 The AP/FD TCAS mode disengages (the AP/FD does no longer follows the RA orders).

L1 Follow the SRS GA mode.

| |
|---|
| VERTICAL SPEED.....MONITOR |

L2 Check that the vertical speed remains out of the red area of the vertical speed scale and take over if necessary.

L1 Respect stall, GPWS or windshear warnings.

| |
|---|
| ATC.....NOTIFY |

- When the “CLEAR OF CONFLICT” aural alert sounds:

L2 The AP/FD TCAS mode, if engaged, disengages.

L1

| |
|---|
| AP/FD.....MONITOR/FOLLOW<br>ATC.....NOTIFY<br>LATERAL AND VERTICAL<br>GUIDANCE.....ADJUST |

L2 The flight crew should engage an appropriate vertical mode, or adjust the vertical speed target, in accordance with the latest ATC clearance.

L1

| |
|---|
| SPEED.....ADJUST |

L2 The flight crew should adjust the speed target, and revert to managed speed, as appropriate.

L1 If the AP/FD TCAS mode is not available:

L2 The flight crew applies this procedure, when a RA is triggered, and the AP/FD TCAS mode does not engage.

L1 All RA, except CLIMB RA during approach in CONF 3 or FULL:

| |
|---|
| AP (if engaged).....OFF<br>BOTH FDs.....OFF |

Respond promptly and smoothly.

| |
|---|
| VERTICAL SPEED.....ADJUST or MAINTAIN |

L2 Adjust or maintain the vertical speed as required, to reach the green area and/or avoid the red area of the vertical speed scale.

L1 Note: Avoid excessive maneuvers while attempting to maintain the vertical speed just outside the red area of the vertical speed scale, and within the green area. If necessary, use the full speed range between Vαmax and VMAX.

Any CLIMB RA during approach in CONF 3 or FULL:

| |
|---|
| GO-AROUND.....PERFORM |

Follow the SRS GA mode.

| |
|---|
| VERTICAL SPEED.....MONITOR |

L2 Check that the vertical speed remains out of the red area of the vertical speed scale and take over if necessary.

L1 Respect stall, GPWS or wind shear warnings.

| |
|---|
| ATC.....NOTIFY |

When the “CLEAR OF CONFLICT” aural alert sounds:

| |
|---|
| ATC.....NOTIFY<br>LATERAL AND VERTICAL GUIDANCE.....ADJUST |

L2 Adjust the lateral and vertical guidance to resume normal navigation, in accordance with ATC clearance.

L1

| |
|---|
| AP/FD.....AS RQRD |

L2 If necessary, reengage the AP/FD.

| |
|---|
| [MEM] TCAS WARNING - RESOLUTION ADVISORY |

Always follow RA orders, even if this results in crossing the intruder ALT, because these orders ensure the best ALT separation.

| | |
|---|---|
| CAUTION | Be aware that the intruder may have a TCAS, and may maneuver in response to a coordinated RA order. Therefore, not following an RA |

| | |
|---|---|
| | order could compromise safe separation. |

All RA, except any CLIMB RA during approach in CONF 3 or FULL:

| |
|---|
| AP (if engaged) .....OFF<br>BOTH FDs.....OFF |

Respond promptly and smoothly.

| |
|---|
| VERTICAL SPEED.....……ADJUST or MAINTAIN |

L2 Adjust or maintain the vertical speed as required, to reach the green area and/or avoid the red area of vertical speed scale.

L1 Note: Avoid excessive maneuvers while attempting to maintain the vertical speed just outside the red area of the vertical speed scale, and within the green area. If necessary, use the full speed range between Vαmax and VMAX.

Any CLIMB RA during approach in CONF 3 or FULL:

| |
|---|
| GO-AROUND.....PERFORM |

Follow the SRS GA mode.

| |
|---|
| VERTICAL SPEED.....MONITOR |

L2 Check that the vertical speed remains out of the red area of the vertical speed scale and take over if necessary.

L1 Respect stall, GPWS, or wind shear warnings.

| |
|---|
| ATC.....NOTIFY |

**When the "CLEAR OF CONFLICT" aural alert sounds:**

| |
|---|
| ATC.....NOTIFY<br>LATERAL AND VERTICAL GUIDANCE.....ADJUST |

L2 Adjust the lateral and vertical guidance to resume normal navigation, in accordance with ATC clearance.

L1

| |
|---|
| AP/FD.....AS RQRD |

L2 If necessary, reengage the AP/FD.

1.18.3 Surveillance Separation Minima: MISCELLANEOUS OPERATING INSTRUCTIONS Chapter 5 (APPROACH MUSCAT APPROACH MATSOP)

1.18.3.1The horizontal separation used within Muscat TMA/CTR is 5 NM

1.18.4 **Source: APPROACH MUSCAT APPROACH MATSOP, Chapter 10; RADIO COMMUNICATION PROCEDURES & CONTINGENCIES:**

1.18.4.1**Communications Technique & Standard Phraseology General**
Radiotelephony provides the means by which pilots and ground personnel communicate with each other. Used properly, the information and instructions transmitted are of vital importance

in assisting in the safe and expeditious operation of aircraft. However, the use of non-standard procedures and phraseology can cause misunderstanding.

**Transmitting Technique**
According to the ICAO Doc 9432 Manual of Radiotelephony the following transmitting techniques will assist in ensuring that transmitted speech is clearly and satisfactorily received:
(a) A slight pause before and after numbers will assist in making them easier to understand.
(b) Avoid introduction of hesitation syllables, such as 'er' or 'ah'.

**Standard Phraseology**
The need for clear and unambiguous communication between pilots and Air Traffic Control (ATC) is vital in assisting the safe and expeditious operation of aircraft. It is important, therefore, that due regard is given to the use of standard words and phrases and that all involved ensure that they maintain the highest professional standards when using radiotelephony (RTF). This is especially important when operating within busy sectors with congested frequencies where any time wasted with verbosity and non-standard, ambiguous phrases could lead to flight safety incidents.

Phraseology has been carefully developed to provide maximum clarity and brevity in communications while ensuring that phrases are unambiguous. However, while standard phraseology is available to cover most routine situations, not every conceivable scenario will be catered for, and radio-telephony (RTF) users should be prepared to use plain language when necessary following the principle of keeping phrases clear and concise. The phraseology detailed in this section has been established in accordance with ICAO PANS-ATM Doc.4444, Chapter 12 PHRASEOLOGIES.

The lists below are not exhaustive, and controllers may have to devise additional phrases for unusual situations. However, where a phrase does exist for a particular purpose, it must be used.

**TCAS RA**

| **Message** | **Phraseology** |
|---|---|
| After a flight crew starts to deviate from any ATC clearance or instruction to comply with an ACAS resolution advisory (RA). Controller answers ROGER (or alternative instructions) | CLEAR OF CONFLICT (assigned clearance) RESUMED |
| | CLEAR OF CONFLICT, RETURNING TO (assigned clearance) |
| | TCAS RA |
| | UNABLE, TCAS RA |

1.18.4.2 **Muscat APP/SRV unit Positions and functions:**
Muscat APP/SRV provide services appropriate for the Approach and Approach Radar control functions for IFR traffic within controlled airspace.

1.18.4.2.1 The APP/SRV executive controller Job Description:
a) Vector and sequence arrivals for Muscat Int'l Airport ILS, VOR, RNAV and/or visual approaches;
b) Coordinate with Muscat ADC as required for final approach spacing and landing or go-around clearances;

c) Coordinate with other ATSUs;
d) Coordinate planned and unplanned missed approaches and retaining control of such traffic when released by ADC;
e) Initiate control instructions;
f) Monitor and operate radio frequencies;
g) Accept and initiate hand offs;
h) Scan surveillance data display (SDD);
i) Ensure system entries are completed on instructions or clearances issued or received;
j) Adhere to reporting of any abnormal occurrence/situation to concerned personnel.

1.18.4.2.2 Safety Review:
An ATS provider shall conduct regular and systematic safety reviews by personnel qualified through training, experience, and expertise and having a full understanding of relevant Standards and Recommended Practices (SARPs), Procedures for Air Navigation Services (PANS), safe operating practices, and human factors principles.

1.18.4.2.3 The scope of ATS unit safety reviews should include at least the following issues:
a) Regulatory issues to ensure that:
1) ATS operation manuals, ATS unit instructions and air traffic control (ATC) coordination procedures are complete, concise, and up to date;
2) the ATS route structure, where applicable, provides for:
i. adequate route spacing; and
ii. crossing points for ATS routes located so as to reduce the need for controller intervention and for inter- and intra-unit coordination;
3) the separation minima used in the airspace or at the aerodrome are appropriate and all the provisions applicable to those minima are being complied with;

4) where applicable, provision is made for adequate observation of the manoeuvring area, and procedures and measures aimed at minimizing the potential for inadvertent RWY incursions are in place. This observation may be performed visually or by means of an ATS surveillance system;
5) appropriate procedures for low visibility aerodrome operations are in place;
6) traffic volumes and associated controller workloads do not exceed defined, safe levels and that procedures are in place for regulating traffic volumes whenever necessary; and
8) procedures for the reporting of incidents and other safety-related occurrences are implemented, that the reporting of incidents is encouraged and that such reports are reviewed to identify the need for any remedial action.

b) Operational and technical issues to ensure that:
2) automation systems generate and display flight plan, control, and coordination data in a timely, accurate and easily recognizable manner and in accordance with Human Factors principles;
c) Licensing and training issues to ensure that:

1) controllers are adequately trained and properly licensed with valid ratings;
2) controller competency is maintained by adequate and appropriate refresher training, including the handling of aircraft emergencies and operations under conditions with failed and degraded facilities and systems;
3) controllers, where the ATC unit/control sector is staffed by teams, are provided relevant and adequate training in order to ensure efficient teamwork;
6) standard phraseology is used.

1.18.4.3 **Source: Objectives of the Air Traffic Services (OPERATIONAL MANUAL (MUSCAT APPROACH MATSOP)):**

1.18.4.3.1 Muscat APP/SRV shall issue information and clearances to air traffic within, entering and leaving its area of responsibility with the objective of:
a. Preventing collisions between aircraft under its control;
b. Expediting and maintaining an orderly flow of air traffic;
c. Provide advice and information useful for the safe and efficient conduct of flights;
d. Notify SAR organization (RCC) regarding aircraft in need of search and rescue aid, and assist such organization as required.

**Note:** The objectives of the air traffic control service do not include prevention of collision with terrain. The procedures prescribed herein do not relieve pilots of their responsibility to ensure that any clearances issued by Muscat APP/SRV are safe in this respect. When an IFR flight is vectored or is given a direct routing which takes the aircraft off an ATS route, the APP/SRV shall issue clearances such that the prescribed obstacle clearance will exist at all times until the aircraft reaches the point where the pilot will resume own navigation.

1.18.4.3.2 Separation Standards:
The separation must be in accordance with the applicable criteria and minima prescribed by:
(1) Subpart E; or
(2) Document 4444; or
(3) Document 7030.

1.18.4.3.3 Air Traffic Control Clearances:
An ATC clearance authorises an aircraft to proceed under conditions specified by an ATC unit. Clearances are based solely on known traffic conditions and are required for any flight, or portion of a flight, which is provided with an air traffic control service.

1.18.4.3.3.1 Contents of Clearances Approach ATC clearances shall include:
a. Aircraft identification as shown in the flight plan;
b. Clearance limit;
c. Route of flight;
d. Level(s) of flight for the entire route or part thereof and changes of levels if required;
e. Any necessary instructions or information on other matters such as approach or departure manoeuvres, communications, and the time of expiry of the clearance.
**Note.** The time of expiry of the clearance indicates the time after which the clearance will be automatically cancelled if the flight has not been commenced. Standard departure and arrival routes and associated procedures should be established when

necessary to facilitate:
the safe, orderly, and expeditious flow of air traffic; the description of the route and procedure in air traffic control clearances.

1.18.4.3.4 Read-back of clearances and safety-related information:
Definition**:**

1.18.4.3.4.1 Read back is defined as a procedure whereby the receiving station repeats a received message or an appropriate part thereof back to the transmitting station so as to obtain confirmation of correct reception. (ICAO Annex 10 Vol II).
The flight crew shall read back to the air traffic controller safety-related parts of ATC clearances and instructions which are transmitted by voice.

1.18.4.3.4.2 Read-back of Air-Ground Voice Communications**:**
The APP/SRV ATCO shall:
(a) Listen to the read-back to ascertain that the clearance or instruction has been correctly acknowledged by the flight crew and shall take immediate action to correct any discrepancies revealed by the read-back;
(b) When issuing clearances, instructions, or information, ensure acknowledgment by the pilot. If no acknowledgment is received, attempt to re-establish contact;
(c) If read back is incorrect or incomplete, ATCOs shall take immediate action to correct any discrepancies revealed by the read-back;

(d) Read-back of a clearance should never be replaced by the use of terms such as “Roger”, "Wilco" or “Copied”. Likewise, ATCOS should not use similar terms to acknowledge a message requiring a definite answer (e.g. acknowledging a pilot’s statement that an ALT or speed restriction cannot be met).

1.18.4.3.4.3 APP/SRV ATCOs are to prompt a pilot if a read back is not immediately forthcoming. Errors in a read back must be corrected by the controller until the pilot gives an accurate read back.
**Note:** An uncorrected erroneous read-back (known as a hear-back error) may lead to a deviation from the intended clearance and may not be detected until the ATCOs observes the deviation on his/her situational display.

1.18.4.3.5 Short-term conflict alert (STCA) procedures:

1.18.4.3.5.1 The generation of short-term conflict alerts is a function based on surveillance data, integrated into INDRA ATM system. The objective of the STCA function is to assist the APP/SRV in preventing collision between aircraft by generating, in a timely manner, an alert of a potential or actual infringement of separation minima.

1.18.4.3.5.2 In the STCA function the current and predicted three-dimensional positions of aircraft with pressure-ALT reporting capability are monitored for proximity. If the distance between the three-dimensional positions of two aircraft is predicted to be reduced to less than the applicable separation minima within a specified time period, an acoustic and visual alert will be generated to the APP/SRV within whose jurisdiction area the aircraft is operating.

1.18.4.3.5.3 Surveillance data is used to predict conflicts; tracked Mode C data is used to predict conflicts in the vertical dimension.

1.18.4.3.5.4 When an STCA is generated, an alarm message is displayed in the SDD. Two main conflict statuses can occur when there is a pair of tracks PREDICTION AND VIOLATION.

a. STCA prediction: Tracks in STCA prediction present a yellow circle around concerned tracks symbol; track symbol and velocity vector also turn YELLOW, as well as a YELLOW square surrounding the track label.

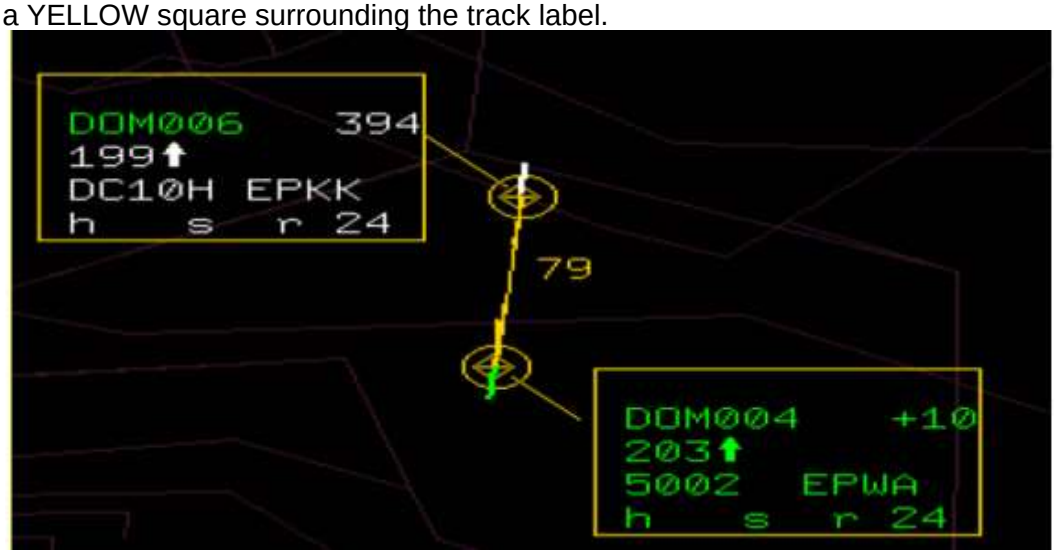



Figure 30 showing Tracks in STCA Warning

b. STCA violation: When the tracks enter in an actual violation phase, Conflict alert (CA) is displayed in RED color as in diagram below.

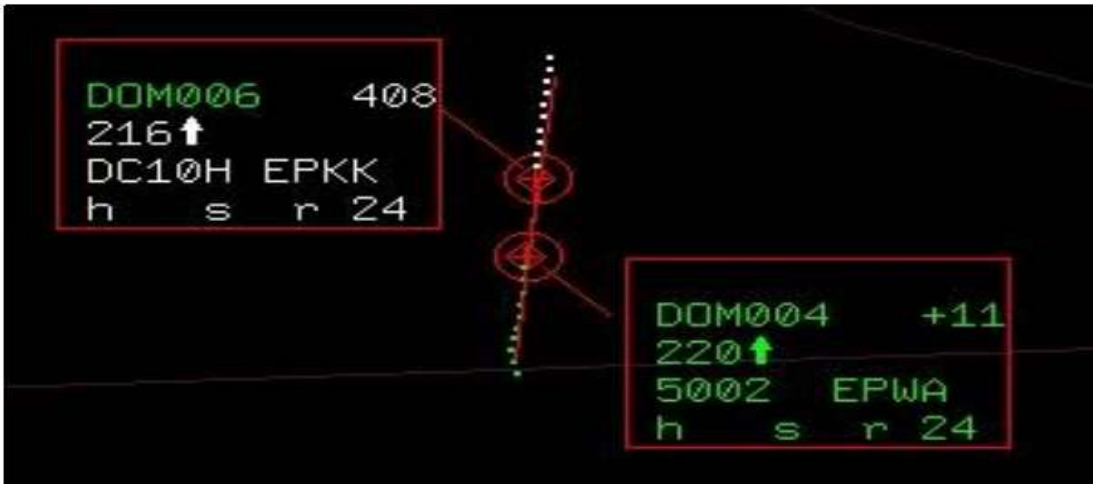



Figure 31 showing Tracks in STCA Alert – Violation phase

1.18.4.3.5.5 Any traffic involved in an STCA occurrence will be displayed in STCA Pop-Up list (sector defined). The list includes the minimum predicted distance (MDIS) between aircraft in conflict, the current distance (CDIS) between them and for STCA in prediction status, the predicted time to become an actual violation.

1.18.4.3.5.6 The STCA parameters between eligible radar plots are the following:

| Up to FL 150 | |
|---|---|
| alert warning time | 120 seconds |
| Vertical distance | 800 ft |
| Horizontal distance | 2.9 Nm |
| **above FL150** | |
| alert warning time | 120 seconds |
| Vertical distance | 800 ft |
| Horizontal distance | 4.9 Nm |

Figure 32 showing STCA parameters between eligible radar plots

Note: STCA separation parameters for horizontal conflict may differ for different sectors.

1.18.4.3.5.7 In the event an STCA is generated in respect of controlled flights, the APP/SRV shall without delay assess the situation and, if necessary, take action to ensure that the applicable separation minimum will not be infringed or will be restored.

1.18.4.3.5.8 STCA alert follow-up: Following the generation of an STCA and in the event that a separation minimum was infringed, APP/SRV controllers are required to complete an air traffic incident report using the AQD e-report system; only in the event that a separation minimum was infringed.

1.18.4.3.5.9 The ANSIC unit retains electronic records of all alerts generated. The data and circumstances pertaining to each alert are analyzed to determine whether an alert was justified or not. Non-justified alerts are ignored. A statistical analysis shall be made of justified alerts in order to identify possible shortcomings in airspace design and ATC procedures as well as to monitor overall safety levels.

1.18.4.3.6 Traffic Information:

1.18.4.3.6.1 ICAO Doc4444 (PANS-ATM) defines traffic information as:
“Information issued by an air traffic services unit to alert a pilot to other known or observed air traffic which may be in proximity to the position or intended route of flight and to help the pilot avoid a collision.”

1.18.4.3.6.2 Furthermore, ICAO Doc4444 Section 5.10.1.1 and 5.10.1.2 states:
“Essential traffic is that controlled traffic to which the provision of separation by ATC is applicable, but which, in relation to a particular controlled flight is not, or will not be, separated from other controlled traffic by the appropriate separation minimum.”
“Essential traffic information shall be given to controlled flights concerned whenever they constitute essential traffic to each other.”

## 1.19 Useful or Effective Investigation Techniques

1.19.1 None.

## 2. ANALYSIS:

### 2.1 General (Organization):

2.1.1 Both aircraft are owned by the operator Salam Air and the operator is properly licensed by Oman Civil Aviation Authorityy (CAA). The OTSB investigation team noted that the Operator (Airline) and the service provider (DGAN) have implemented Safety Management System (SMS), whereby occurrences are reported to the relevant authorities as and when they occur and they are reviewed, categorized, classified and investigated to identify the need for any remedial action that are required to be taken by the organization. There were no anomalies identified with the safety culture of reporting occurrences from the airline. OTSB investigation team concluded that the organization was not a factor into the incident. It was the operator who alerted the DGAN and OTSB of the potential risk following both flight crews receiving TCAS RA warning.

2.1.2 The ATCO medical certificate expired on the 30th March 2024, though the medical assessment was done on the 16th March 2024 and based on the medical assessment, the CAA couldn't renew the ATCO'S medical certificate until the 15th May 2024 where ATCO had to perform additional medical assessment due to the medical condition identified after the initial medical assessment. During the period 30th March 2024 until 14th May 2024, the ATCO continued to exercise the privileges of the License while the medical certificate was expired. The ATCO continued exercising the privileges of the license as he was of the opinion that the CAA have granted an exemption for ATCO to continue working with the expired medical certificate. OTSB investigation team established during the interviews, that there was no exemption granted by CAA for ATCO to continue exercising the privileges of the license with an expired medical certificate. ATCO's continuation of exercising the privileges of the license with expired medical certificate was in contravention of Oman Civil Aviation Regulation requirements (Date of Issue: 20 July 2023): CAR.ATCO.A.015 which state that for the ATCO "to exercise of the privileges of licence shall be dependent on the validity of the licence, ratings, endorsements including English Language Proficiency (ELP) and the medical certificate".

2.1.3 During the interview, the Chief Approach indicated that he communicated with the DGCAR-CAA through the email requesting the approval for the ATCO to be exempted and proceed working while waiting for his medical certificate to be signed off by the DGCAR-CAA AME. Although the email was sent to DGCAR-CAA requesting exemption for ATCO, the CAA never responded to the email which then rendered the exemption request not granted by DGCAR-CAA.

### 2.2 Flight operations:

2.2.1 Flight Crew:

2.2.1.1 The flight crew of both aircraft OMS258 and aircraft OMS134 were properly licensed to operate the aircraft and their medical records didn't show any limitations or restrictions. At the time of the incident, both flight crew medical certificates were valid for the flights conducted. There was no issue with regard to the rest period of both flight crew, the flight crew were well rested prior to undertaking the operation of the incident flight.

2.2.2 Operational procedures:

2.2.2.1 Both flight crew of the two aircraft followed established procedures when they received TCAS RA warning, there was no deviation from laid down procedures for TCAS RA. OTSB investigation team concluded that the flight crew's operation was not a factor to the incident as the crew followed the procedures during the flight operation. The TCAS RA procedures were followed by both crews and complied with effectively and ensuring that the conflict and any possibility of collision was avoided.

2.2.2.2 During the interview, the Captain of aircraft OMS258 indicated that they were coming from the North to the South and he was the Pilot Monitoring (PM). The Captain also stated that during the incident the crew saw aircraft OMS134 but due the automation procedures the crew focused on the TCAS recovery system which was followed successfully. The Captain stated that the crew could not remember the settings of the TCAS range setting however they could see the other aircraft from the left when they were making the right turn. The aircraft of OMS134 departed Duqm Airport (OODQ) on a domestic scheduled flight with intended destination Muscat International Airport (OOMS). Where there were 12 aircraft in the area. The flight crew of aircraft OMS258 requested to descend to ALT 8000FT and halt at 8000FT crossing through 9000FT, immediately received RA, approximately at 8600FT, which lasted for 25 seconds. The flight crew of aircraft OMS134, indicated that they saw the traffic flying below aircraft OMS258. The Captain could not remember what was the TCAS range setting as the display was lagging.

2.2.2.3 When the automation took over, the crew indicated that they followed the TCAS RA procedures and called the ATC after they were clear of conflict. The Captain indicated that usually when coming from the South and whenever runway in use is 08L, they usually cross overhead MCT VOR for the left hand downwind and establish RWY08L, turn left. The reason for executing the left turn was to avoid the high mountains on the right side.

2.2.2.4 Both the flight crews of aircraft OMS258 and aircraft OMS134 indicated that following the incident the crew followed the set procedures and the TCAS system worked as expected.

2.2.3 Weather:

2.2.3.1 Both the flight crew of aircraft OMS258 and aircraft OMS134 did not observe any cloud on the weather radar system, and or any deviation from flight plan. The outside air temperature indicated continuous fluctuations with a predominant drop of about 32°C, wind direction of 040° and wind speed of 7 knots and the visibility was 9 kilometers. The weather was good and clear (VMC). Weather was considered to be fine at the time of the incident and none of the flight crews reported severe weather or challenges with en-route weather, as a result, the OTSB investigation team concluded that weather was not a factor into the incident.

2.2.4 Air traffic control:

2.2.4.1 The ATCO held the license however his medical certificate was not valid at the time of the incident. ATCO provided pertinent information to the crew in relation to the flight and the track. The ATCO was not supposed to exercise the privileges of the ATCO license as required by CAR.ATCO.A.015 which states that, "the exercise of the privileges granted by a license

shall be dependent on the validity of the license, ratings, endorsements including English Language Proficiency (ELP) and the medical certificate."

2.2.5 Communications:

2.2.5.1 Although there were reported the frequency congestion and the blockage, there were no records or reported defects indicating that the communication system was unserviceable prior and during the incident flight, therefore communication equipment was not a factor on the serious incident. The communications between the flight crews and the ATCO was characterized by wrong call signs, non-readbacks or delayed responses, errors such as clearing the flight crew of OMS258 to descend to ALT13000FT direct to MUSANAH then corrected it to MCT. Also, using unapproved improper phraseology in response to the imminent loss of separation which had a potential to accident, therefore communication was a factor to the incident due to the following:

2.2.5.1.1 The aircraft OMS258 was operating from Fujairah International Airport (OMFJ) on an international scheduled flight and came in contact with MCT ATC.

2.2.5.1.2 At the time 06:55:50, the flight crew of aircraft OMS258 reported to ATCO that they were routing to MCT VOR approaching FL160. The Muscat radar controller then contacted Muscat approach controller and handed over the flight crew of aircraft OMS258 who reported the QNH1008 and cleared it to descend to ALT 13000FT direct to MUSANAH. At the time 06:56:05, ATCO contacted the flight crew of aircraft OMS258 and corrected the destination from MUSANAH to MCT.

2.2.5.1.3 At the time 07:05:00, ATCO requested the flight crew of aircraft OMS258 to leave MCT VOR on HDG 290°. At the time 07:05:13 the flight crew of aircraft OMS258 replied that they are not proceeding to MCT. ATCO responded "I will give you shortly HDG standby". At the time 07:05:17, the flight crew of aircraft OMS258 informed ATCO that they were maintaining ALT 13000FT on HDG 110°. At the time 07:05:23, ATCO cleared the flight crew of aircraft OMS258 to route direct to MCT VOR and to expedite the descent to ALT 10000FT.

2.2.5.1.4 At the time 07:06:39, aircraft OMS258 was 5.5NM to MCT VOR and the flight crew of aircraft OMS258 reported to ATCO that they were approaching MCT VOR. At the time 07:06:43, ATCO cleared the flight crew of OMS258 to descend to ALT 7000FT. At this time, the yellow STCA on the ATCO radar screen was activated between aircraft OMS258 descending through 10,500, ROD=1100, G/S=311 and aircraft OMS134 descending through 10,100, ROD=700, G/S=332. The distance between the two aircraft was 1.9NM. MUSCAT APPROACH MATSOP procedures requires that the eligible radar plots for STCA parameters up to FL150, the horizontal distance should be 5NM.

2.2.5.1.5 MUSCAT APPROACH MATSOP procedures requires that when an STCA is generated, an alarm message is displayed in the SDD. Two main conflict (STCA) statuses can occur when there is a pair of tracks prediction and violation. In the event an STCA is generated in respect of controlled flights, the ATCO shall without delay assess the situation and, if necessary, take action to ensure that the applicable separation minimum will not be infringed or will be restored. The investigation established that by the time the ATCO took corrective actions to separate the two aircraft as the last safety barrier it was too late as the flight crew of aircraft OMS258 reported conflict (TCAS RA) at the same time.

2.2.5.1.6 At the time 07:07:02, the flight crew of aircraft OMS258 called the ATCO by stating the intention after MCT VOR: “To expect left HDG after MCT OMS258” The ATCO replied: “258 290° HDG” The flight crew of aircraft OMS258 readback: “290° after MCT OMS258”. The investigation established that the ATCO did not use the full call sign and specify the direction of the turn.

2.2.5.1.7 At the time 07:07:30, the flight crew of aircraft OMS258 contacted ATCO confirming turning to heading 290° by stating: “OMS258 confirm right HDG 290°”. The ATCO replied after 5 seconds: “258° make it to ahhh turn left please expedite turn left”. In the APPROACH MUSCAT APPROACH MATSOP and ICAO Doc 9432 Manual of Radiotelephony, Transmitting Technique which state that both the crew and ATCO must not use of non-standard procedures and phraseology as it can cause misunderstanding and must also avoid introduction of hesitation syllables, such as 'er' or 'ah'. The ATCO used the phrase “258° make it to ahhh” which is not in line with the required procedures. The procedures require to use the complete callsign

2.2.5.1.8 The Crew of aircraft had initiated a right turn after MCT VOR due to get a shorter distance in their mind for their approach but at the time 07:07:44, while the flight crew of aircraft OMS258 was changing its turning direction from right to left, the TCAS Traffic Advisory (TA) activated and at 07:07:46 aircraft OMS134 had TCAS TA. Both aircraft were at 9000FT and the distance between them was 1.98NM.

2.2.5.1.9 At the time 07:07:59, aircraft OMS258 was observed on the ATC radar turning from right to left. At 07:08:00, ATCO called aircraft OMA134 and immediately corrected the callsign to OMS134 traffic to expedite descent to 8000FT. At this time aircraft OMS258 had Resolution Advisory RA and 2 seconds later aircraft OMS134 had RA. The distance between the two aircraft in time was 16 seconds.

2.2.5.1.10 At the time 07:08:05 the flight crew of aircraft OMS258 called that they have a conflict alert. At the time 07:08:11, the ATCO radar screen showed that aircraft OMS258 was descending through ALT 8500FT, with a ROD of 1100FPM and a ground speed of 280kts. Meanwhile aircraft OMS134 was descending through ALT 8800FT with ROD of 500FPM and a ground speed of 271kts. The distance between both traffic was 1 NM and in time was 5 seconds.

2.2.5.1.11 At the time 07:08:12, aircraft OMS258 while at ALT 8500FT descending to ALT 7000FT was observed on radar screen turning left. At the time 07:08:14, the flight crew of aircraft OMS134 while passing through ALT 8800FT descending to ALT 8000FT, reported they were clear of TCAS conflict. The vertical separation between the two aircraft was 300FT.

2.2.5.1.12 The red STCA was activated for 36 seconds from 07:08:14 to 07:08:50. When the STCA deactivated, aircraft OMS134 was descending from ALT 8800FT through 8300FT with rate of descent of 400FPM and aircraft OMS258 descending through ALT 7700FT with ROD of 1100FPM.

2.2.5.1.13 At the time 07:08:12, aircraft OMS258 while at ALT 8500FT descending to 7000FT was observed on radar screen turning to the left of MCT VOR. At the time 07:08:14, the flight crew of aircraft OMS134 reported they were clear of TCAS conflict while they were at ALT 8800FT descending to ALT 8000FT.

2.2.5.1.14 At the time 07:08:12, aircraft OMS258 while at ALT 8500FT descending to 7000FT was observed on radar screen turning left. At the time 07:08:14, the flight crew of aircraft OMS134 reported they were clear of TCAS conflict (the red STCA was activated between the two aircraft and the distance between the two aircraft was 1.16NM) while at ALT 8800FT descending through 8500FT with ROD of 1100FTM to 8000FT. The crew followed the AP/FD/TCAS and cleared from the conflict and informed the ATCO that they were clear of the conflict.

2.2.5.1.15 The OTSB investigation concluded that the wrong callsign, the delayed and hesitation in communication by the ATCO was a factor to the incident. ATCO only provided heading without turning direction to the flight crew of aircraft OMS258 2NM after they have passed MCT VOR as the heading direction turn was not given. At the time 07:07:30, the flight crew of flight OMS258 contacted ATCO to confirm the right HDG. At the time 07:07:30 to timing 07:07:35 which was 5 seconds after contacting ATCO without the response, the flight crew of aircraft OMS258 decided to take the right turn as it was shorter to heading 290° while descending through ALT 10000FT to 7000FT. By the time the ATCO responded to confirm the left turn, there was another traffic approaching which aircraft OMS134 and immediately TCAS TA alert was triggered which was followed by the TCAS RA resulting in loss a of separation and conflict.

2.2.6 Aids to navigation

The navigational system onboard both aircraft OMS258 and OMS134 was found to be serviceable and operated as required at the time of the incident. Therefore, OTSB investigation team determined that the navigational aid was not a factor to the incident.

2.2.7 Aerodrome

The incident happened in flight during decent, therefore, OTSB investigation team determined that the aerodrome was not a factor to the incident.

## 2.3 Aircraft:

2.3.1 Both aircraft OMS258 and OMS134 were issued with valid certificate of airworthiness (CoA) and certificate of registration (CoR), the maintenance records of both aircraft did not reveal any abnormality in the maintenance standard requirements. Both aircraft were certified and maintained in accordance with existing regulations and approved procedures. There were no pre-existing defects or conditions that contributed to the occurrence.

The OTSB investigation concluded that aircraft maintenance was not relevant to the occurrence and was not considered a factor to this incident.

## 2.4 Human Factors:

2.4.1 During the interview, both crews of OMS258 and OMS134 indicated that that the scenarios they practice during their simulator training doesn't include the scenarios where they have to operate in a busy airport with busy approaches and or changing of tower frequencies with the focus on the use of TCAS, effective monitoring of radio frequencies. The OTSB investigation team determined that both the flight crew of aircraft OMS258 and aircraft OMS134 were vigilant with situational awareness of the vicinity. There was no evidence that incapacitation or physiological factors affected the flight crew performance. There was no evidence that the crew suffered any sudden illness or incapacity which might have affected the crew's ability to control the aircraft.

2.4.2 During the interview the ATCO indicated that at the time of the incident, there were more than 12 aircraft in the vicinity and the ATCO was supposed to ask other colleague whom took over from, to assist as it was the busiest times. The ATCO also indicated that the ATCO that he took over from was also busy in handling more than 12 aircraft. The ATCO also indicated that this was not the first time managing the same number of the aircraft and hence the ATCO thought the traffic would be manageable which showed that the ATCO was comfortable that would be manageable to handle the number of the aircraft as ATCO used to do as per the experience dating back over 15 years.

The OTSB investigation determined that due to the increase in traffic on approach sector over Muscat TMA at the time of the incident, it is likely that the work overload lead ATCO loss of perception and situational awareness. There was no evidence that incapacitation or physiological factors affected the ATCO performance.

2.4.3 After aircraft OMS258 was clear from R7, ATCO instructed the flight crew of aircraft OMS258 to descend from ALT 10000FT to 7000FT and to leave MCT VOR on heading 290°. The ATCO further indicated to the flight crew of aircraft OMS258 that would be expecting to turn to the left however the flight crew of aircraft OMS258 made a right turn instead. The OTSB investigation team determined that the crew had a responsibility to verify and confirm the direction of turn with the ATCO after they were cleared to heading 290° and before making a right turn.

2.4.4 Following the incident during the interview, the crew of aircraft OMS258 reported that they were proceeding to MCT VOR on heading 150° while descending from ALT 10000FT to 7000FTand no heading clearance was given till 2 NM to MCT VOR. The flight crew of OMS258 asked the ATCO which heading to proceed to after passing MCT VOR. The instruction was heading 290° without specifying left or right turn. The flight crew of aircraft OMS258 then proceeded with the right turn as it was shorter to heading 290° and while descending the flight crew of aircraft OMS258 asked the ATCO to confirm if aircraft OMS258 should continue to the right turn or to the left.

2.4.5 The flight crew of aircraft OMS134 indicated that they were approaching from the South to MCT VOR, which was towards the high mountains hence they opted a turn to the left. The flight crew of aircraft OMS258 indicated that before the TCAS warnings was triggered while approaching MTC VOR, they are also not required to look out as they were focusing inside the aircraft as the landing approach is critical and need more focus.

2.4.6 The flight crew of aircraft OMS134, reported that during the descent and a few NM from MCT VOR, ATCO cleared aircraft OMS134 to ALT 8000FT. On approaching 8000FT, the flight crew of aircraft OMS134 reported that they received TCAS TA warning followed by TCAS RA, leveled off and then followed TCAS, autopilot and flight directors (AP/FD) procedures and then contacted the ATCO.

2.4.7 The ATCO indicated that prior to the yellow STCA conflict alert and the TCAS RA, the ATCOs plan was to give a descent to aircraft OMS258 to ALT 7000FT to leave MCT VOR and the aircraft OMS134 to be behind aircraft OMS258, however by the time the instruction to keep the two aircraft clear from each other was given, both aircraft were clear of conflict.

2.4.8 The ATCO indicated that the delay was as a result of the ATCO being busy with the other traffic and he thought that the flight crew of aircraft OMS258 would turn left as all other flight crews did previously. The ATCO also indicated that there was an alternative to separate the two aircraft by requesting the flight crew of aircraft OMS134 to descend and turn to the left as there was enough space to keep both aircraft clear from each other. However, the OTSB investigation team established that the reason why corrective actions to clear the conflict between the aircraft could not be made timeously following the yellow STCA conflict alert was due to the ATCO providing clearances to aircraft OMS134 with the vicinity. However, during the interview, the approach controller reported that the workload of 12 aircraft was assessed as high with normal complexity.

2.4.9 Loss of situational awareness by ATCO, when the Short-Term Conflict yellow Alert then red warning was displayed on radar about the conflicting aircraft, ATCO was busy with other aircraft within the vicinity hence less attention to issue the correct instructions without delay to the incident aircraft OMS258. The ATCO received the red STCA at the time 07:07:43 and the flight crew of aircraft OMS258 reported that they have a conflict at the times 07:08:05 and 07:08:10 respectively.

2.4.10 The OTSB determines that the loss of separation was as a result of the ATCO issuing a late instruction and using the wrong callsign for the flight crew of aircraft OMS134 to expedite descent to ALT 8000FT. Both flight crews of aircraft OMS134 and aircraft OMS258 received TCAS RA alert. The flight crew of aircraft OMS258 received the RA warning while turning from right to the left and the ATCO received STCA alert on the radar screen and requested the flight crew of aircraft OMS258 to expedite the left turn.

### 2.5 Survivability

2.5.1 Rescue fire service response: There was no services required of Rescue fire, therefore Rescue fire was not a factor to the incident as there was no fire during and after the incident.

## 3. CONCLUSION

### 3.1. General

From the available evidences, the following findings, causes and contributing factors are made with respect to this incident. These shall not be read as apportioning blame or liability to any organization or individual.

To serve the objective of this investigation, the following sections are included in the conclusion heading:

- **Findings —** are statements of all significant conditions, events, or circumstances in this incident. The findings are significant steps in this incident sequence, but they are not always causal or indicate deficiencies.

3.2. Findings

3.2.1 The PIC of aircraft OMS258 was initially issued Airline Transport Pilot license (ATPL) by Oman CAA on the 8th October 2020 and a validation was conducted on the 25th December 2023 with an expiry date of the 31st October 2025.

3.2.2 The PIC of aircraft OMS258 was issued a Class (one) 1 medical certificate by Oman CAA on the 16th July 2023 with an expiry date of 18th July 2024. The last medical assessment was conducted on the 13th July 2023 with no limitations.

3.2.3 The FO of aircraft OMS258 was initially issued with Commercial Pilot Aeroplane license by Oman CAA on the 18th August 2022 and a validation was conducted on the 19th February 2024 with an expiry date of the 31st August 2027.

3.2.4 The FO of aircraft OMS258 was issued a Class 1 medical certificate by Oman CAA on the 13th July 2023 with an expiry date of the 20th July 2024. The last medical assessment date was conducted on the 13th July 2023.

3.2.5 The PIC of aircraft OMS134 license was initially issued by Oman CAA on the 5th March 2019 and a validation was conducted on the 23rd January 2024 with an expiry date of the 31st March 2029.

3.2.6 The PIC of aircraft OMS134 was issued a Class 1 medical certificate by Oman CAA on the 29th October 2023 with an expiry date of the 29th November 2024. The last medical assessment was conducted on the 26th October 2023. The medical certificate had a no limitations.

3.2.7 The FO of aircraft OMS134 was issued with Airline Transport Pilot Aeroplane license by Oman CAA on the 4th July 2019 and a validation was conducted on the 12th June 2023 with an expiry date of the 31st December 2024.

3.2.8 The FO of aircraft OMS134 was issued a Class 1 medical certificate by Oman CAA on the 13th November 2023 with an expiry date of the 18th May 2024. The last medical assessment was conducted on the 18th May 2023 with no limitations.

3.2.9 The flight crew of aircraft OMS258 were properly licensed to conduct the flight. Their licenses were issued by Oman CAA.

3.2.10 The flight crew of OMS134 were properly licensed to conduct the flight. Their licenses were issued by Oman CAA.

3.2.11 Aircraft OMS258 was properly registered and issued with Certificate of Airworthiness by Oman CAA and was valid at the time of the incident.

3.2.12 Aircraft OMS134 was properly registered and issued with Certificate of Airworthiness by Oman CAA and was valid at the time of the incident.

3.2.13 The ATCO was issued with Air Traffic Controller license by Oman CAA on the 27th January 1992 and a validation was conducted on the 17th December 2023 with an expiry date of the 28th February 2027.

3.2.14 The ATCO medical assessment was conducted on 26th March 2024 and was not issued until on 15th May 2024 due to the ATCO medical condition. The medical certificate was only issued two days after the incident. The ATCO was issued a Class three (3) medical certificate with an expiry date of 14th May 2025 with limitations (VDL, VNL and SIC).

3.2.15 The ATCO medical certificate was not valid at the time of the incident as it had expired on the 30th March 2024. The ATCO operated between the 31st March 2024 and the 14th May 2024 without a valid medical certificate.

3.2.16 The ATCO was not properly licensed to provide navigational services as required by CAR.ATCO. A.015 which states that, “the exercise of the privileges granted by a license shall be dependent on the validity of the license, ratings, endorsements including ELP and the medical certificate.”

3.2.17 The ATCO was issued with ratings to allow him operating as a controller at OOMM as ADC, APP, Area RDR/INDRA.

3.2.18 The Approach controller`s actions and statements indicated that his knowledge and understanding of the radar systems was adequate.

3.2.19 There were no records or reported defects indicating that the communication system was unserviceable prior and during the incident flight.

3.2.20 At the time 06:55:50, the flight crew of aircraft OMS258 reported to Muscat approach Controller that they were routing to MCT VOR on descent to FL160. The Muscat Approach controller then contacted Muscat approach controller and handed over the flight crew of aircraft OMS258 who gave the QNH1008 and cleared aircraft OMS258 to descend to ALT 13000FT direct to MUSANAH and the crew of aircraft OMS258 readback accordingly. At the time 06:56:05, APP ATCO contacted the flight crew of aircraft OMS258 and corrected the clearance from MUSANAH to MCT.

3.2.21 At the time 07:06:43, ATCO responded and cleared the flight crew of aircraft OMS258 to descend through ALT 10000FT to ALT 7000FT at ROD 1000FPM and the flight crew of OMS258 readback. During this time, the yellow Short-Term Conflict Alert (STCA) alert was activated between aircraft OMS258 and aircraft OMS134 on the ATCO radar screen.

3.2.22 At the time 07:07:30, the flight of crew of aircraft OMS258 contacted ATCO confirming turning direction to heading 290° by stating: “OMS258 confirm right HDG 290°”. The ATCO replied after 5 seconds: “258 make it to ahhh turn left please expedite turn left”. MUSCAT APPROACH MATSOP and ICAO Doc 9432 Manual of Radiotelephony, Transmitting Technique which state that both the crews and ATCO must not use of non- standard procedures and phraseology as it can cause misunderstanding and must also avoid introduction of hesitation syllables, such as 'er' or 'ah'.

3.2.23 The ATCO received the red STCA alert at the time 07:07:43 and the flight crew of aircraft OMS258 reported that they have a conflict at the times 07:08:05 and 07:08:10 respectively.

3.2.24 At the time 07:08:12, aircraft OMS258 while at ALT 8500FT descending to 7000FT was observed on radar screen turning left. At the time 07:08:14, the flight crew of aircraft OMS134 while on descend passing through ALT 8800FT descending to 8000FT reported they were clear of TCAS conflict.

3.2.25 The vertical separation between the two aircraft was 300FT and the distance in time was16 seconds. After the incident both flights continued to their intended destination.

3.2.26 According to Miscellaneous Operating Instructions chapter 5, (MUSCAT APPROACH MATSOP) edition 03, APP/SRV Planner Controller job description is for the Planner Controller to assist the APP/SRV Executive Controller in conflict resolution depending on his/her workload and the nature of the problem and to also identify the potential conflicts and make suggestions about resolution of conflicts.

3.2.27 According to Miscellaneous Operating Instructions chapter 5, (MUSCAT APPROACH MATSOP) the generation of short-term conflict alerts is a function based on surveillance data, integrated into INDRA ATM system. The objective of the STCA function is to assist the APP/SRV in preventing collision between aircraft by generating, in a timely manner, an alert of a potential or actual infringement of separation minima.

3.2.28 There was no evidence that incapacitation or physiological factors affected the flight crew performance. There was no evidence that the crew suffered any sudden illness or incapacity which might have affected both of the aircraft crews' ability to control the aircraft.

### 3.3. Probable Cause

3.3.1 The OTSB determines that the loss of separation was as a result of the ATCO's loss of situational awareness and issuing of late instruction and using the wrong callsign for the flight crew of aircraft OMS134 to expedite descent to ALT 8000FT. The flight crew of aircraft OMS258 received the TCAS RA warning while on the right turn, and immediately the flight crew of aircraft OMS258 commenced left turn to avoid traffic. ATCO received STCA alert on the radar screen and requested the flight crew of aircraft OMS258 to expedite the left turn. The OTSB determines that ATCO lost situational awareness, due to high number of aircraft at the vicinity resulting in loss of separation between aircraft OMS258 and aircraft OMS134.

### 3.4. Contributing Factors

3.4.1 ATCO's assumption that aircraft OMS258 was going to take left turn to heading 290°.

3.4.2 ATCO called the wrong call sign by saying "OMA134 instead of OMS134, when ATCO wanted to provide the instruction for descent.

3.4.3 The flight crew of aircraft OMS258 commenced a right turn without confirming with ATCO for clearance.

3.4.4 Delayed instruction by ATCO for aircraft OMS134 to expedite descent.

## 4. SAFETY RECOMMENDATIONS

### 4.1. General

The safety recommendations listed in this report are proposed according to paragraph 6.8 of Annex 13 to the Convention on International Civil Aviation and are based on the conclusions listed in paragraph 3 of this report. The OTSB expect that all safety issues identified by the investigation team are addressed to the concerned States and Organizations/Entities.

### 4.2. Safety Recommendations

OTSB issued safety recommendations during the investigation, and the Directorate General Air Navigation (DGAN) has already responded and taken actions on some of the issued safety recommendations as per below:

4.2.1 **Sultanate of Oman Civil Aviation Authority, Directorate General Air Navigation (DGAN):**

4.2.1.1 OTSB recommends DGAN to put measures in place to ensure compliance with the existing regulations as required by CAR.ATCO.A.015 which states that, “the exercise of the privileges granted by a license shall be dependent on the validity of the license, ratings, endorsements including English language proficiency (ELP) and the medical certificate.”

**Action taken by DGAN on the issued safety recommendation:**
DGAN accepted OTSB recommendation to put measures in place to monitor all the ATCO licensing dates related to the validity of the licenses, including the medical certificates monitoring.

4.2.1.2 The DGAN is recommended to issue a notice to the ATCOs regarding the importance of using standard phraseology and using the correct callsigns in order to achieve the required results and to avoid confusion as the Approach controller at a critical situation called the flight crew of aircraft OMS258 in order to issue an avoiding heading without using the full callsign as a result the flight crew of aircraft OMS258 did not readback the clearance.

**Action taken by DGAN on the issued safety recommendation:**
DGAN accepted OTSB recommendation to issue a notice to all ATCOs regarding the importance of using standard phraseology and using the correct callsigns.

4.2.1.3 The DGAN is recommended to implement the Air Traffic Flow Management to determine the number of aircraft to be handled per ATCO at a given time.

**Action taken by DGAN on the issued safety recommendation:**
DGAN accepted OTSB recommendation to implement the Air Traffic Flow Management and Sector Capacity.

4.2.1.4 In the interest of safety and to help preventing incidents of callsigns similarity, OTSB recommends DGAN in collaboration with Directorate General Civil Aviation Regulation (DGCAR), to establish a methodology to prevent callsigns similarity issues.

## 5. APPENDICES

5.1. None.

**This report is issued by:**
Oman Transport Safety Bureau (OTSB)
Sultanate of Oman