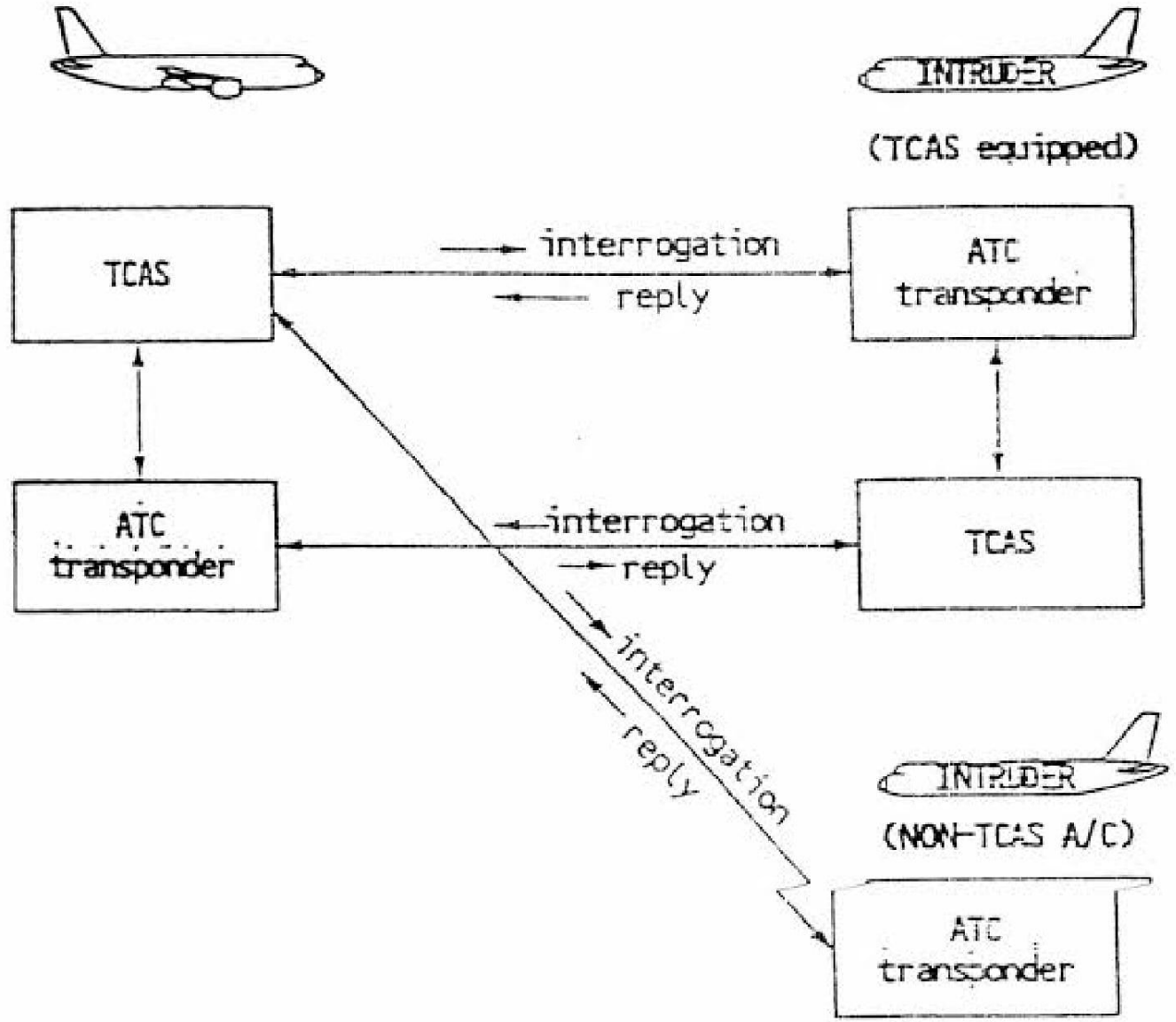
TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS)

A traffic collision avoidance system or traffic alert and collision avoidance system (both abbreviated as TCAS, and pronounced(*TEE-kas*) is an aircraft collision avoidance system designed to reduce the incidence of mid-air collisions between aircraft. It monitors the airspace around an aircraft for other aircraft equipped with a corresponding active transponder, independent of air traffic control, and warns pilots of the presence of other transponder-equipped aircraft which may present a threat of mid-air collision (MAC). It is a type of airborne collision avoidance system mandated by the International Civil Aviation Organization to be fitted to all aircraft with a maximum take-off mass (MTOM) of over 5,700 kg (12,600 lb) or authorized to carry more than 19 passengers.

➢ TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS)

- ✓ Traffic collision avoidance systems are transponder based air-to-air traffic monitoring and alerting systems.
- ✓ There are two classes of TCAS.
- ✓ TCAS I was developed to accommodate the general aviation community and regional airlines.
- ✓ This system identifies traffic in a 35 to 40 mile range of the aircraft and issues Traffic Advisories (TA) to assist pilots in visual acquisition of intruder aircraft.
- ✓ TCAS I is mandated on aircraft with 10 to 30 seats.
- ✓ TCAS II is a more sophisticated system.
- ✓ It is required internationally in aircraft with more than 30 seats or weighing more than 15 000 kg.

- **TRAFFIC ALERT AND COLLISION AVOIDANCE S**



- **TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS)**

- ✓ TCAS II provides the same information of TCAS I, but also analyzes the projected flight path of approaching aircraft.
- ✓ If a collision or near miss is imminent, the TCAS II computer issues a Resolution Advisory (RA).
- ✓ This is an aural and visual command to the pilot to take a specific evasive action.
- ✓ The computer is programmed such that the pilot in the encroaching aircraft receives an RA for evasive action in the opposite direction.
- ✓ TCAS issues an audible TA "TRAFFIC" alert when an intruder is 35-48 seconds away and issues an audible RA "CLIMB" or "DIVE" when an intruder is 20-30 seconds away.
- ✓ If vertical separation degrades to 850 feet, a TA warning

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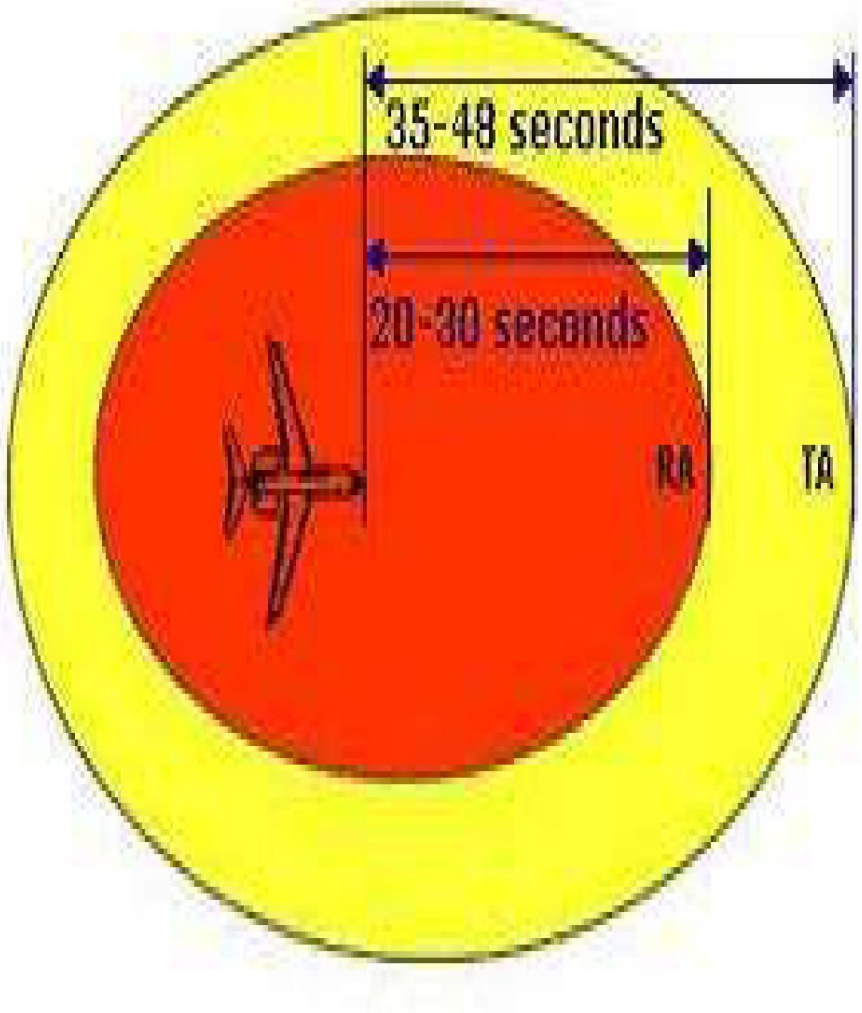

➢ TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS)

- ✓ An open diamond indicates a target; a solid diamond represents a target that is within 6 nautical miles or 1200 feet vertically.
- ✓ A yellow circle represents a target that generates a TA.
- ✓ A red square indicates a target that generates an RA.
- ✓ A plus sign indicates the target aircraft is above and a minus sign indicates that it is below.
- ✓ The arrows show if the target is climbing or descending.
- ✓ The Transponder (XPDR) of an aircraft equipped with TCAS is able to interrogate the Transponders of other aircraft nearby using Secondary Surveillance Radar (SSR) Modes C and S.
- ✓ This is done with a 1030 MHz signal.

- **TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS)**

➢ TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS)

- ✓ Interrogated aircraft transponders reply with an encoded 1090 MHz signal that allows the TCAS computer to display the position and altitude of each aircraft.
- ✓ It does this via a directional antenna mounted on the top of the aircraft that transmits interrogations on 1030 MHz at varying power levels in each of four 90 degree azimuth segments.
- ✓ Transponder replies are received on 1090 MHz and sent to the TCAS computer and compared with the range and altitude data obtained from the lower antenna.
- ✓ The TCAS unit typically receives inputs from the air data computer and radar altimeter as well.
- ✓ TCAS II equipped aircraft use continuous reply information to analyze the speed and trajectory of target aircraft in close proximity.

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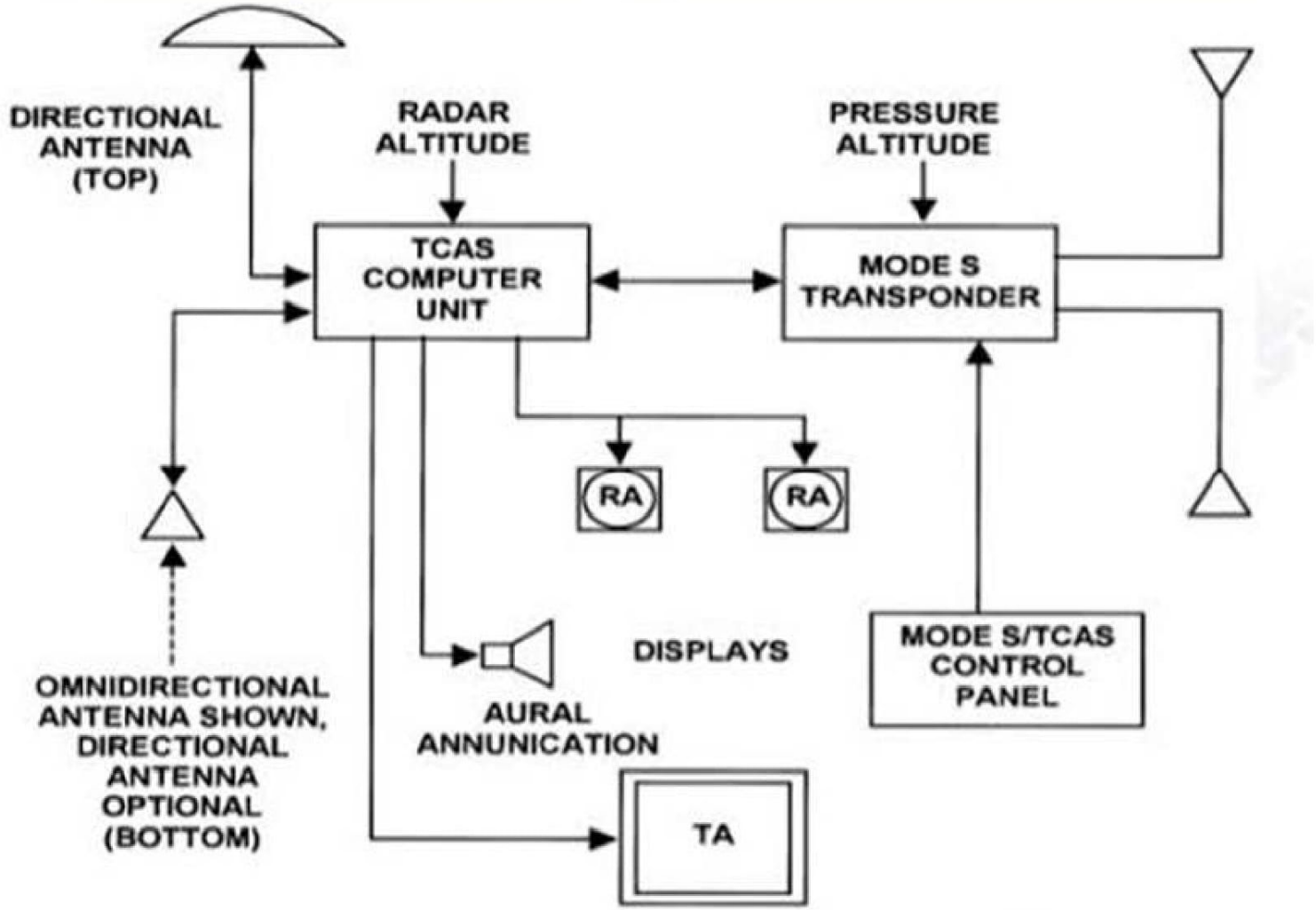
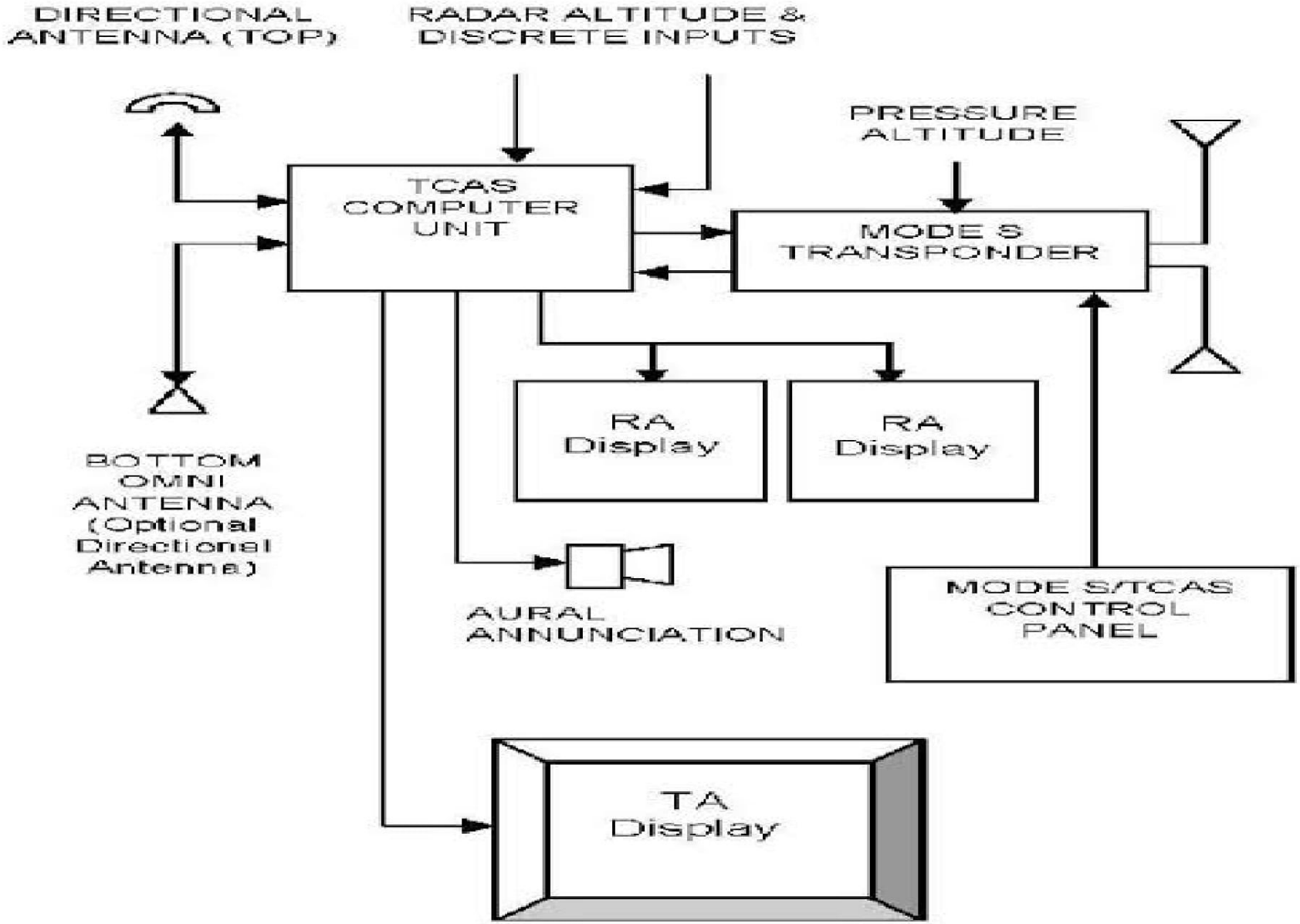


➢ TRAFFIC ALERT AND COLLISION AVOIDANCE



➢ TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS)

- ✓ If a collision is calculated to be imminent, an RA is issued.
- ✓ TCAS target aircraft are displayed on a screen on the light deck.
- ✓ Different colors and shapes are used on the display to depict approaching aircraft depending on the imminent threat level.
- ✓ Since RAs are currently limited to vertical evasive maneuvers, some stand-alone TCAS displays are electronic vertical speed indicators.

➢ WEATHER RADAR

- ✓ There are three common types of weather aids used in an aircraft flight deck that are often referred to as weather radar:

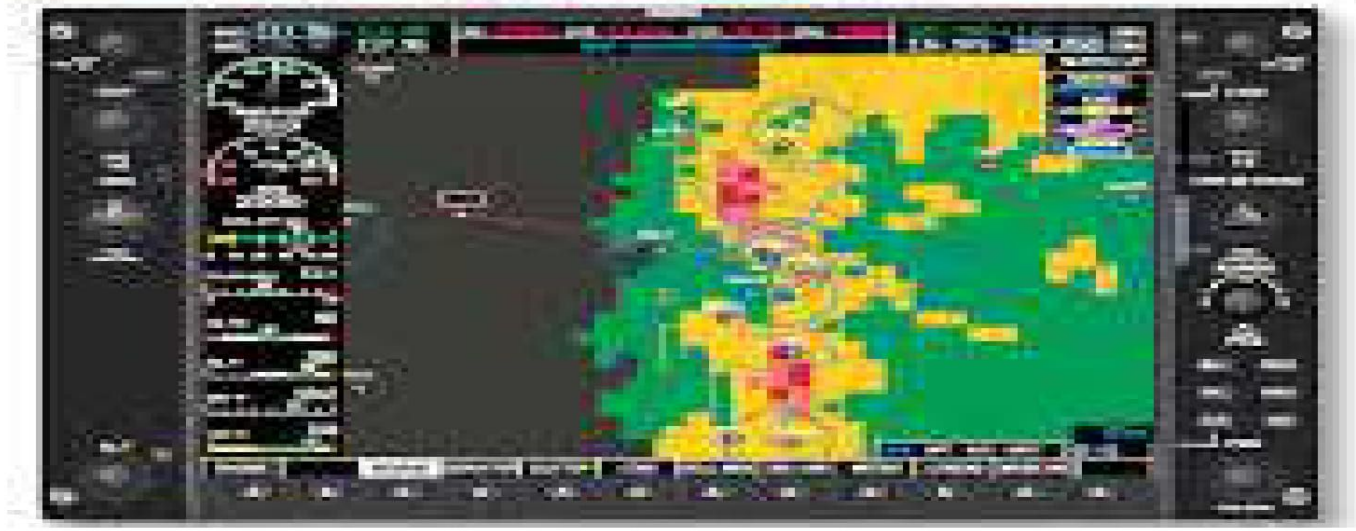
-Actual on-board radar for detecting and displaying weather activity

-Lightning detectors

-Satellite or other source weather radar information that is uploaded to aircraft from an outside source.

- ✓ On-board weather radar systems can be found in aircraft of all sizes.
- ✓ They function similar to ATC primary radar except the radio waves bounce off of precipitation instead of aircraft.
- ✓ Dense precipitation creates a stronger return than light precipitation.
- ✓ The on-board weather radar receiver is set up to depict

➢ WEATHER RADAR



➢ WEATHER RADAR

- ✓ Clouds do not create a return.
- ✓ Magenta is reserved to depict intense or extreme precipitation or turbulence. Some aircraft have a dedicated weather radar screen.
- ✓ Most modern aircraft integrate weather radar display into the navigation display(s).
- ✓ Radio waves used in weather radar systems are in the SHF range such as 5.44 GHz or 9.375 GHz.
- ✓ They are transmitted forward of the aircraft from a directional antenna usually located behind a non-metallic nose cone.
- ✓ Pulses of approximately 1 micro-second in length are transmitted.
- ✓ A duplexer in the radar transceiver switches the antenna to receive for about 2500 micro seconds after a pulse is transmitted to receive and process any returns.

➢ WEATHER RADAR

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- ✓ This cycle repeats and the receiver circuitry builds a two dimensional image of precipitation for display. Gain adjustments control the range of the radar.
- ✓ A control panel facilitates this and other adjustments.
- ✓ Severe turbulence, wind shear, and hail are of major concern to the pilot.
- ✓ While hail provides a return on weather radar, wind shear and turbulence must be interpreted from the movement of any precipitation that is detected.
- ✓ An alert is annunciated if this condition occurs on a weather radar system so equipped.
- ✓ Dry air turbulence is not detectable. Ground clutter must also be attenuated when the radar sweep includes any terrain features.
- ✓ The control panel facilitates this.
- ✓ Special precautions must be followed by the technician

➢ WEATHER RADAR

A receiver and antenna from a lightning detector system.

➢ WEATHER RADAR

- ✓ The Radome covering the antenna must only be painted with approved paint to allow the radio signals to pass unobstructed.
- ✓ Many radomes also contain grounding strips to conduct lightning strikes and static away from the dome.
- ✓ When operating the radar, it is important to follow all manufacturer instructions.
- ✓ Physical harm is possible from the high energy radiation emitted, especially to the eyes and testes.
- ✓ Do not look into the antenna of a transmitting radar.
- ✓ Operation of the radar should not occur in hangars unless special radio wave absorption material is used.
- ✓ Additionally, operation of radar should not take place while the radar is pointed toward a building or when refueling takes place.

➢ WEATHER RADAR

- ✓ Radar units should be maintained and operated only by qualified personnel.
- ✓ Lightning detection is a second reliable means for identifying potentially dangerous weather.
- ✓ Lightning gives off its own electromagnetic signal.
- ✓ The azimuth of a lightning strike can be calculated by a receiver using a loop type antenna such as that used in ADF.
- ✓ Some lightning detectors make use of the ADF antenna.
- ✓ The range of the lightning strike is closely associated with its intensity.
- ✓ Intense strikes are plotted as being close to the aircraft.
- ✓ Storm scope is a proprietary name often associated with lightning detectors.
- ✓ There are others that work in a similar manner.

➢ WEATHER RADAR