Digital Head Up Display **HUD** manufactured by Thales. Optional equipment, available for all Airbus aircraft.

Either single or dual installation.

LCD display giving a 1280 X 1024 high resolution and wide field of view (35° x 26°).


Fully integrated into the cockpit with automatic switching between modes (displays).
Benefits

HUD is considered as a tool to

- Increase the pilot **situational awareness**.
- Increase **approach stability** (NPA or VMC).
- Enable **seamless** IMC / VMC transition.
- Increase **landing accuracy**.
- Provide a flexible platform for growth using new technologies such as EVS, SVS and SGS to enhance surface operation and obstacle awareness.

HUD allows **to expand the operational capability** of the aeroplane.

- Lower take-off minimum RVR (from 125m down to 75m)).
- Lower approach minima on some dedicated runways. (CAT II approach minimum on CAT I type airfield)
Alerts are displayed on the HUD in case of surveillance warnings requiring an immediate reaction from the pilot, using PFD information:

• TCAS Resolution Advisory (RA)
• TAWS Terrain Warning (Pull Up)
• Reactive Windshear (WINDSHEAR)
The Installation consists of:

- **HUD projector and stowable combiner** mounted above the head of the pilot,
- **Crosswind, declutter and dimming controls** on the glareshield
- **HUD Computer** installed in the Avionics bay.

HUD installed in A340 (stowed)  
HUD installed in A340 (deployed)
HUD Computer installed in Avionics Bay
Installation

Glareshield controls (crosswind, dimming and declutter)
On first installation the HUD projector is accurately aligned by a boresighting process to ensure alignment of the symbology with the view of the real world.

In order to facilitate replacement of the HUD computer in service without the need to repeat the boresighting, the alignment settings are stored in a Personalized memory module (PMM).
- **Core symbology**: Horizon line, Bird, Accel/Decel chevrons, Approach reference flight path angle symbol, Delta Speed carrot

- **Comformal symbology flown referenced to outside world cues**
The chevrons “> <“ indicate the total flight path angle of the aircraft, which is the flight path angle that the aircraft is capable of, at constant speed. They enable the pilot to make thrust adjustments to control the aircraft speed on a given flight path angle.

The « Chevrons » angular position versus the Horizon Line is symptomatic of the Total Aircraft Energy (Potential + Kinetic).

The « Chevrons » relative position versus the Bird (FPV symbol) indicates the A/C acceleration/deceleration:

Chevrons above bird
Aircraft accelerates
Here aircraft is climbing

Chevrons in line with bird
A/C flies at constant speed
Here aircraft is in level flight

Chevrons below bird
Aircraft decelerates
Here aircraft is descending
Core Symbology

• HUD display modes:
  ‣ HUD symbology automatically adapts to the **current flight phase** and provides associated display modes
    
    – Taxi.
    
    – Take-Off
    
    – Flight.
    
    – Roll-Out / Rejected Take-Off
  
  ‣ Each display mode has various **Declutter levels** function of the flight phase in order to favour see through capability of the HUD.
  
  ‣ Only 3 dedicated HUD controls are provided (on the glare shield):
    - Brightness manual control
    - Crosswind Declutter
    - Display Declutter
Accurate **thrust settings** and **aircraft speed control** without reference to other instruments are possible through the indication of Ground Speed and of the Chevrons. The lateral deviation indication allows precise alignment on runway centreline.
Taxi Declutter Display
During Take off roll, lateral guidance commands to maintain runway centreline are given by the steering director display associated to Localizer lateral deviation information. This HUD lateral guidance allows to reduce T/O minimum RVR down to 75m.
On most Airbus A/C, the average T/O rotation pitch target is around 15°. While the A/C is on ground, only about 6° pitch range is provided above the horizon line in the HUD, making it difficult for the pilot to assess the pitch closure rate towards this target during rotation.

An Offset Pitch Rotation Symbol is provided during T/O roll, till lift off, to assist the pilot during rotation; this symbol is merely the A/C Pitch symbol offset down by the optimum rotation pitch target angle. During rotation, when this symbol closes the horizon line, this indicates to the pilot that the A/C pitch is close to the rotation pitch target.

Consequently, the pilot controls and monitors the initial rotation phase using the Offset Pitch Rotation Symbol; when it closes the horizon line (the A/C is actually lifting up), he then transitions to the Bird, which is above the horizon, and adjusts the A/C flight path angle using the flight director symbol related to the Bird (SRS mode).
In approach phase, with an ILS approach selected in the FMS, a conformal synthetic runway with its touchdown point and an extended runway centreline are provided when within HUD field of view, using natural rules of perspective. Flying an ILS or a VMC approach is therefore most similar
Interpretation of Lateral deviation

The **angle between the extended runway centre line and the horizon** indicates the lateral deviation of the A/C position with the runway centre line (90° means on centre line).

- Aircraft is **right** of track
- Aircraft is **on** of track
- Aircraft is **left** of track

The pilot flies the Bird to the **left** to correct to the runway centerline track.

Natural rules of perspective apply.
Interpretation of vertical deviation

The position of the **Approach Reference Flight Path symbol versus the touchdown point** indicates the A/C vertical position versus the ideal approach path.

- **Aircraft is below approach path**
  - The pilot flies the Bird *beyond* the touchdown point to correct

- **Aircraft is on approach path**
  - The pilot flies the Bird *to* the touchdown point

- **Aircraft is above approach path**
  - The pilot flies the Bird *before* the touchdown point to correct

**Natural rules of perspective apply**
When crosswind conditions occur, the airspeed or altitude tapes could obstruct the display of the core symbols.

**Cross-wind de-clutter** removes the airspeed and altitude tapes, thus open the lateral FOV; speed and altitude information are displayed in a compact format above horizon.
The first level of declutter is designed mostly once VMC conditions acquired. It removes from the HUD the Synthetic Runway and its external centre line in order to favor the see-through capability of the HUD. Since in VMC conditions, the pilot will get a clear view of the real runway and use it as “the” reference for the final approach and landing.

Optimized for VMC

N.B.: Cyclic selection of normal display, declutter1, declutter2, by pressing the declutter P/B on glareshield.
Normal display in approach with conformal synthetic runway and LOC axis
Declutter 1 display: conformal Synthetic Runway and LOC axis removed in order to favor the see-through capability of the HUD.
Declutter 2 display for short final in VMC: core conformal information provided in order to assist the pilot to stabilize final approach path down to the flare.
At 35ft Rad Alt, pulsing arrows on Bird as flare reminder.
The roll out display is shown after touch down. Lateral guidance commands and LOC lateral deviation are provided for roll out. A braking deceleration scale (referring to auto-brake deceleration settings) and a actual deceleration arrow allows to monitor the deceleration during roll out.
After landing roll out and braking information (if A/BRK ON, the selected deceleration level is boxed)
Tail Strike Protection

- Other features:
  - **Tailstrike prevention at landing**
    - Tail strike chevron symbol on pitch scale (as on PFD)

- Margin to tail strike displayed throughout the flare
- If the margin becomes less than 2 degrees, the tail strike symbol pulses as an attention getter
Video
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