Tishk International University
Engineering Faculty
Mechatronics Department

Avionics

TOPIC: Aircraft Cockpit and Display system

Week11_Lecture1

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Instructor: N. S. Sivakumar

Contents

Introduction

- This chapter introduces the electronic flight instrument systems available with advanced avionics. You will see how electronic flight instrument systems integrate many individual instruments into a single presentation called a primary flight display (PFD). Since all flight instruments are combined in one integrated electronic flight instrument system, a number of enhancements to conventional flight instruments are now possible. In addition to learning to interpret the primary flight and navigation instruments, you must learn to recognize failures of the underlying instrument systems based on the indications you see in the cockpit. You must also maintain proficiency in using the backup/standby instruments that are still part of every advanced cockpit.

Display Systems

➢ The cockpit display systems provide a visual presentation of the information and data from the aircraft sensors and systems to the pilot (and crew) to enable the pilot to fly the aircraft safely and carry out the mission.

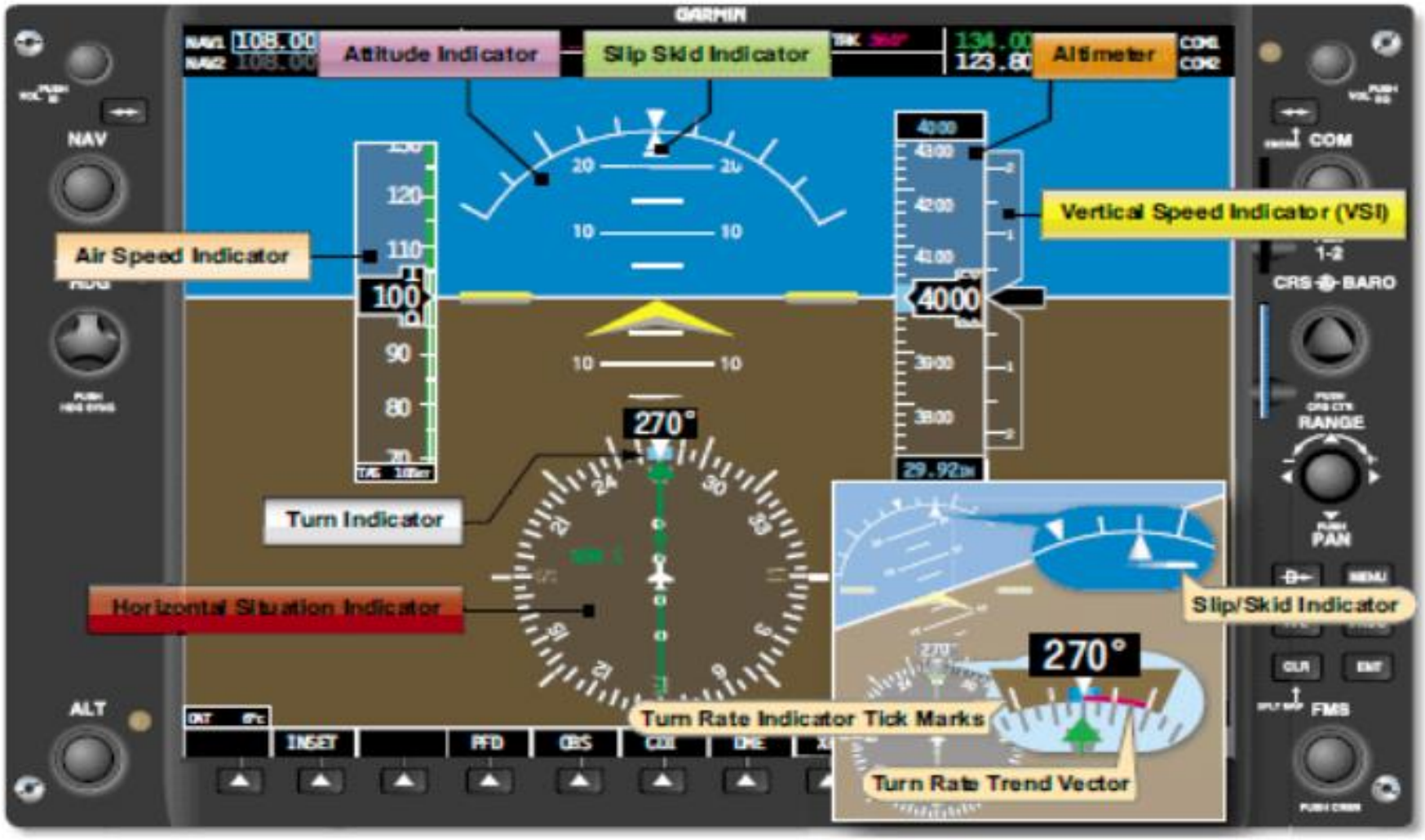
- ❑ Primary flight information
- ❑ Navigation information
- ❑ Engine data
- ❑ Airframe data
- ❑ Warning information

➢ The most important advance to date in the visual presentation of data to the pilot has been the introduction and progressive development of the **Head Up Display or HUD**. ***(First production of HUD in 1962 in the Buccaneer strike aircraft in the UK)***

Primary Flight Display

- A PFD presents information about primary flight instruments, navigation instruments, and the status of the flight in one integrated display. Some systems include powerplant information and other systems information in the same display. A typical primary flight display is shown in Figure

Primary Flight Display




Tape displays are used to depict airspeed and altitude.
A segmented triangle is used to show turn coordination.
An analog gauge is used to depict vertical speed.
A curvilinear display is used to show rate of turn.
Conventional symbology is used to depict heading and navigational information.
OAT 7°C
TAS 157 KTS
GS 140 KTS
VOR
113.10
BRG 323°
Hdg Bug
Alt Bug
VSI Bug
Baro Set
Bearing
Aux
Range
View
Range View
Hdg Sync

Display Systems

- It provides the visual interface between the pilot and the aircraft systems – HUD, HMD, HDD.

- HUD and HMD can project the display information into the pilot's field of view so that the pilot can be head up and can concentrate on the outside world. HUD can also display a **FLIR** (Forward Looking Infrared) video picture.

- The HMD enables the pilot to be presented with information while looking in any direction, as opposed to the limited forward field of view of the HUD.

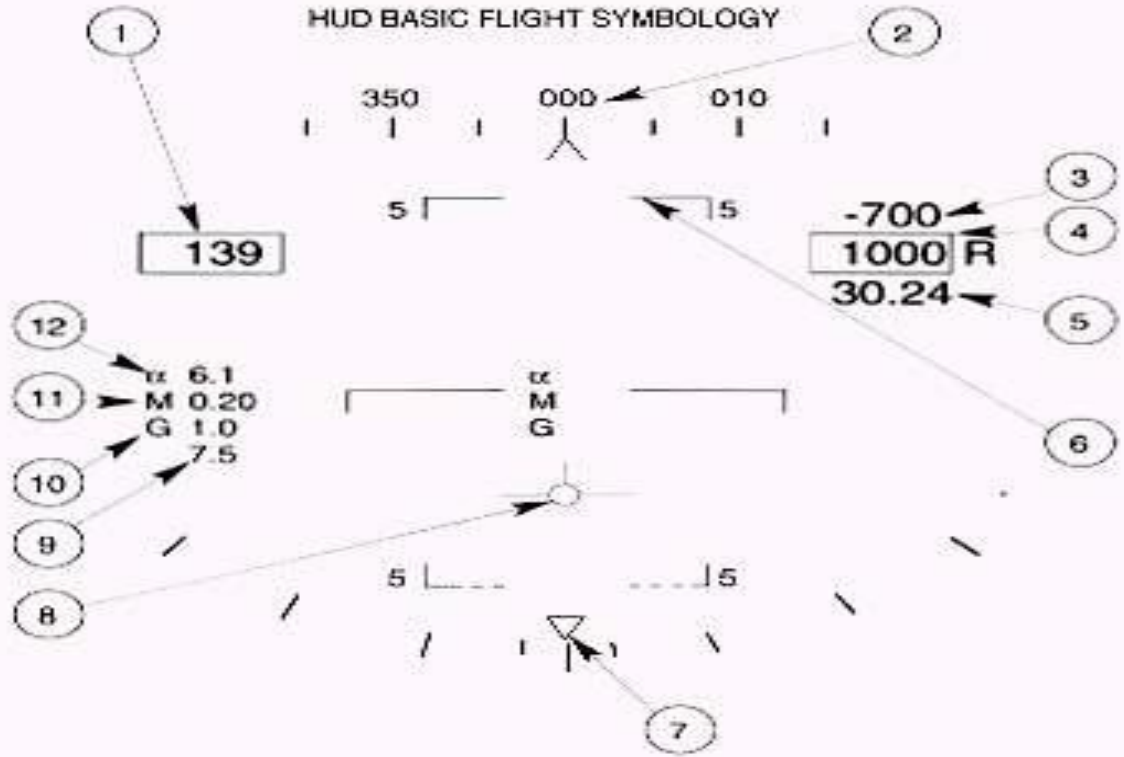
- Multi-function colour displays (HDD) provide the primary flight displays (PFDs) of height, airspeed, Mach number, vertical speed, artificial horizon, pitch angle, bank angle and heading, velocity vector and also engine data.

Head up display

- A **head-up display**,[1] also known as a **HUD** (/hʌd/), is any transparent display that presents data without requiring users to look away from their usual viewpoints. The origin of the name stems from a pilot being able to view information with the head positioned "up" and looking forward, instead of angled down looking at lower instruments. A HUD also has the advantage that the pilot's eyes do not need to refocus to view the outside after looking at the optically nearer instruments.

HEAD UP DISPLAY(HUDs)

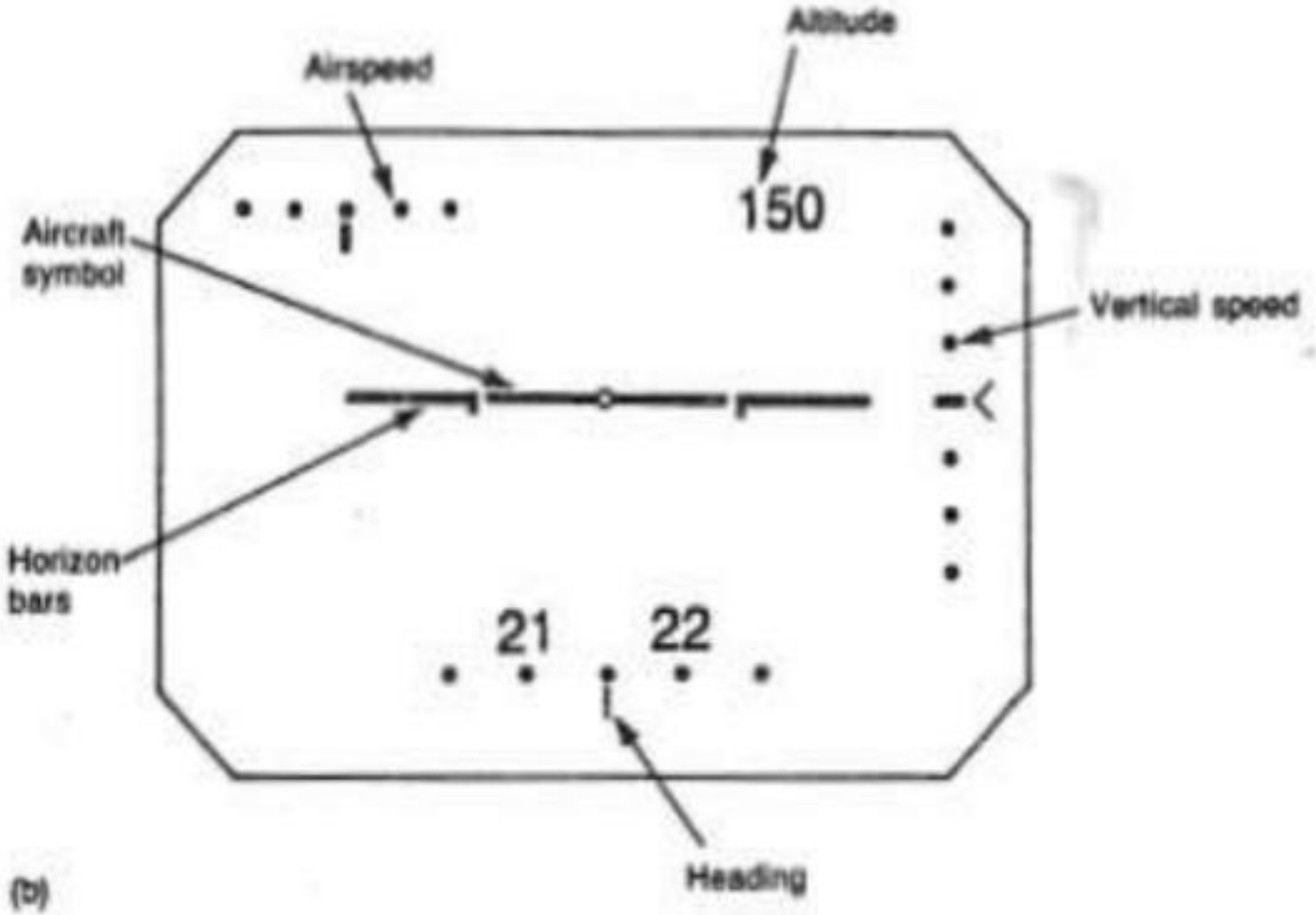
- HUDs present data at the same level as pilot's line of sight So he can also view outside scene.
- The data on the face of CRT is projected through collimating lens.
- A collimator is optical system of finite focal length with image source at focal plane .
- Rays of light emanating from a particular point on the focal plane exit from collimating system as parallel bunch of rays, as if they come from source at infinity.



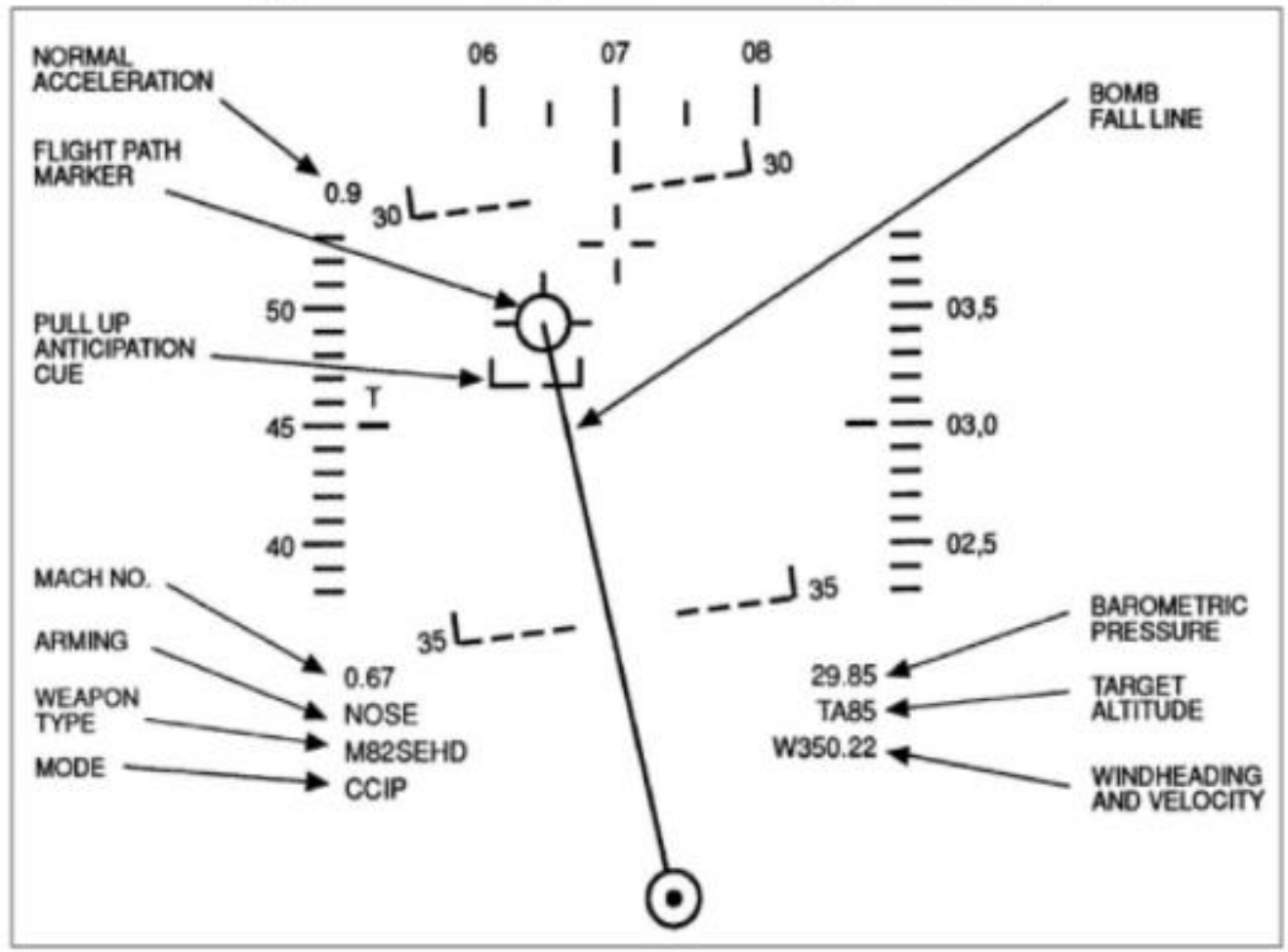
1. AIRSPEED
2. HEADING SCALE
3. CLIMB DESCENT RATE
4. ALTITUDE
5. BAROMETRIC SETTING
6. FLIGHT PATH/PITCH LADDER
7. BANK ANGLE SCALE POINTER
8. VELOCITY VECTOR
9. PEAK A/C G'S
10. CURRENT A/C G'S
11. MACH NUMBER
12. ANGLE OF ATTACK

TYPICAL HUD DISPLAY

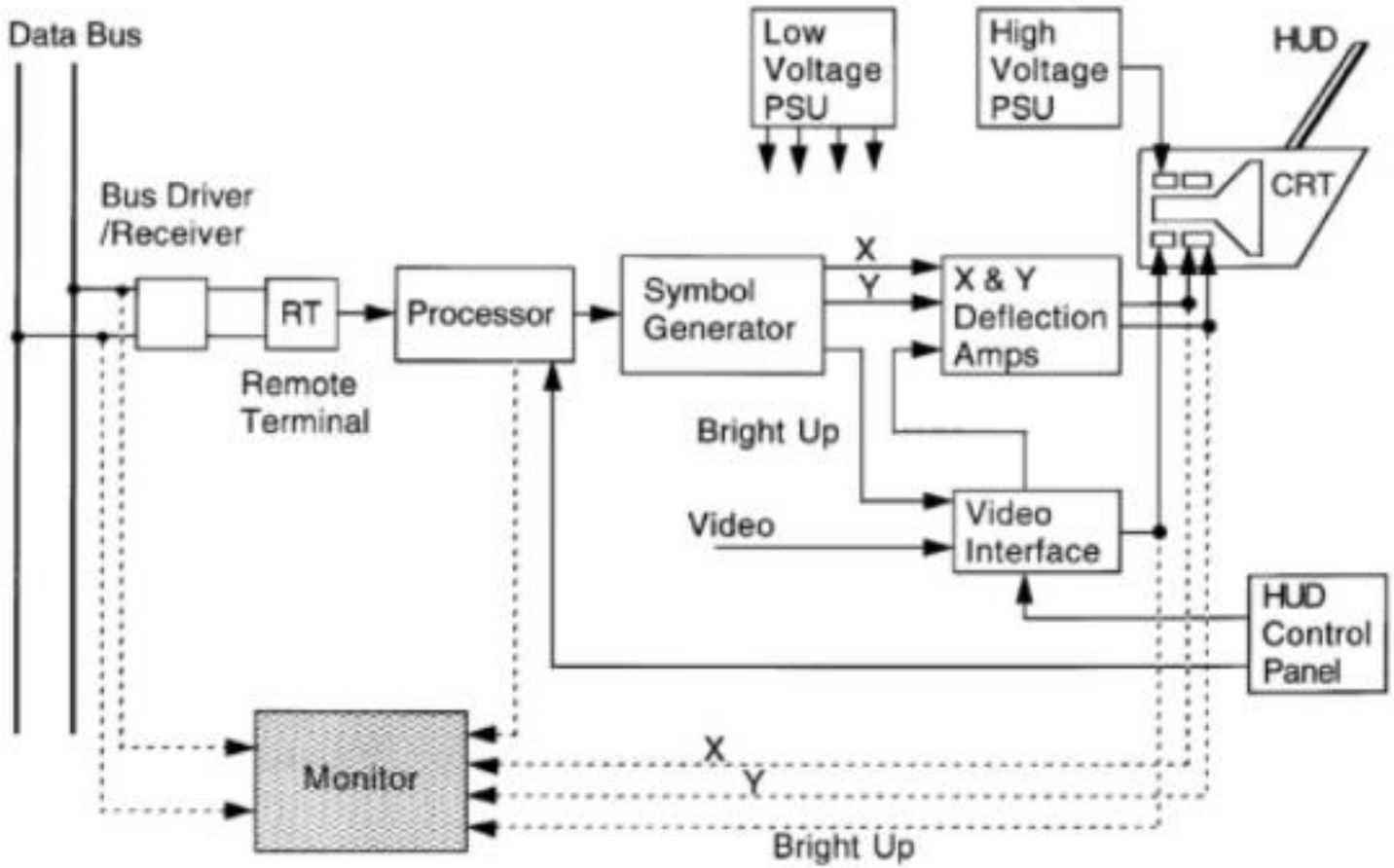
Primary information displayed on HUD



Typical Weapon Aiming Display



HUD Electronics



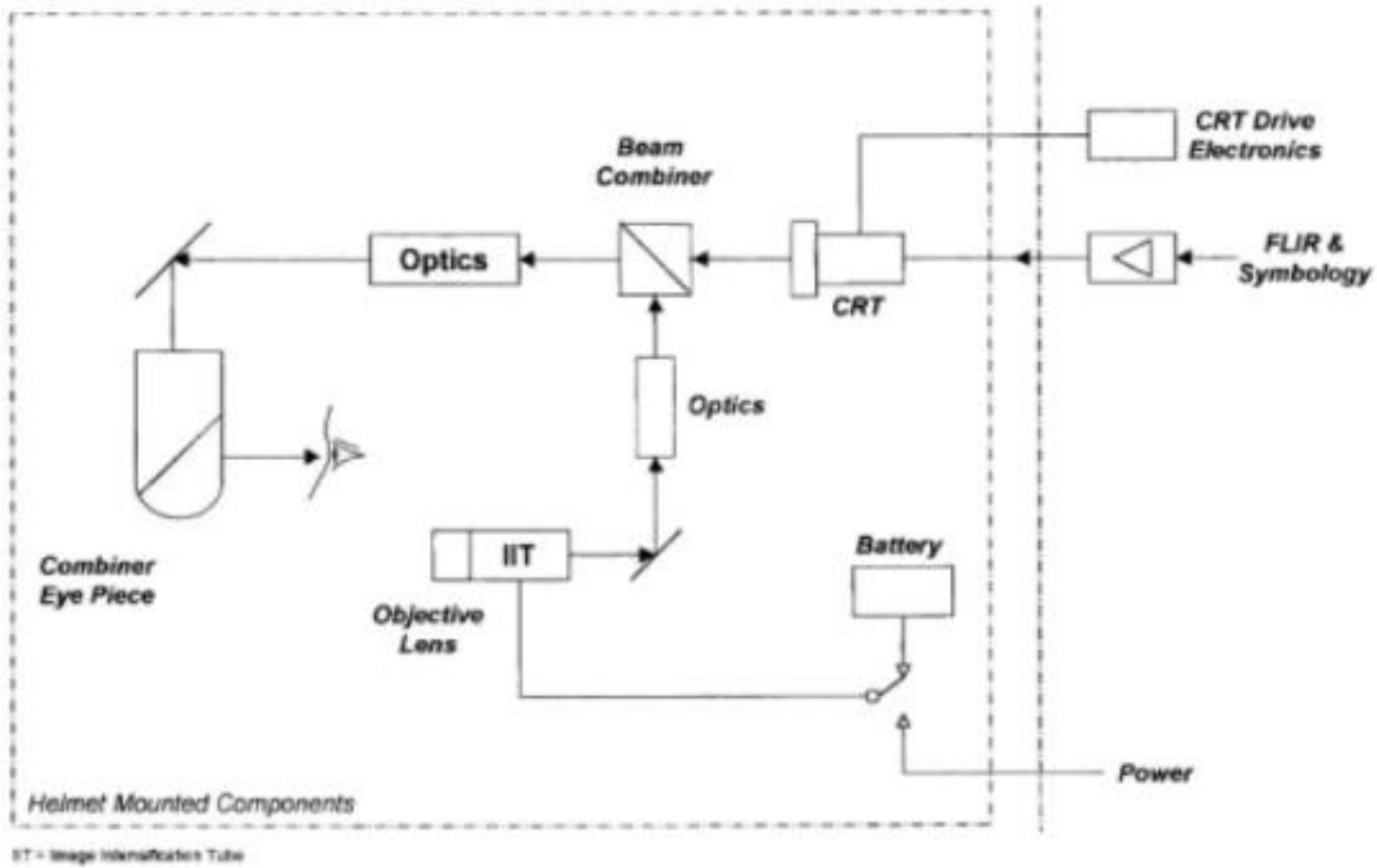
Helmet Mounted Display (HMD)

- HMD can comprise a simple helmet mounted sighting system which displays a collimated aiming cross or circle and some simple alphanumeric information. (typical FOV of 5°)

- **Helmet Design Factors**
  - Pilot's head and eyes
  - Oxygen mask
  - Aural and speech interface (headphones, throat microphone)
  - Cockpit background acoustic noise
  - Glare from sunlight
  - Compatible with NBC

- Integrating an HMD system into the helmet must thus consider the communications and breathing equipment requirement, the protection, comfort and cooling aspects as well as the visual performance of the display.

Helmet Mounted Display (HMD)



IIT = Image Intensification Tube

Optical mixing of IIT and CRT imagery

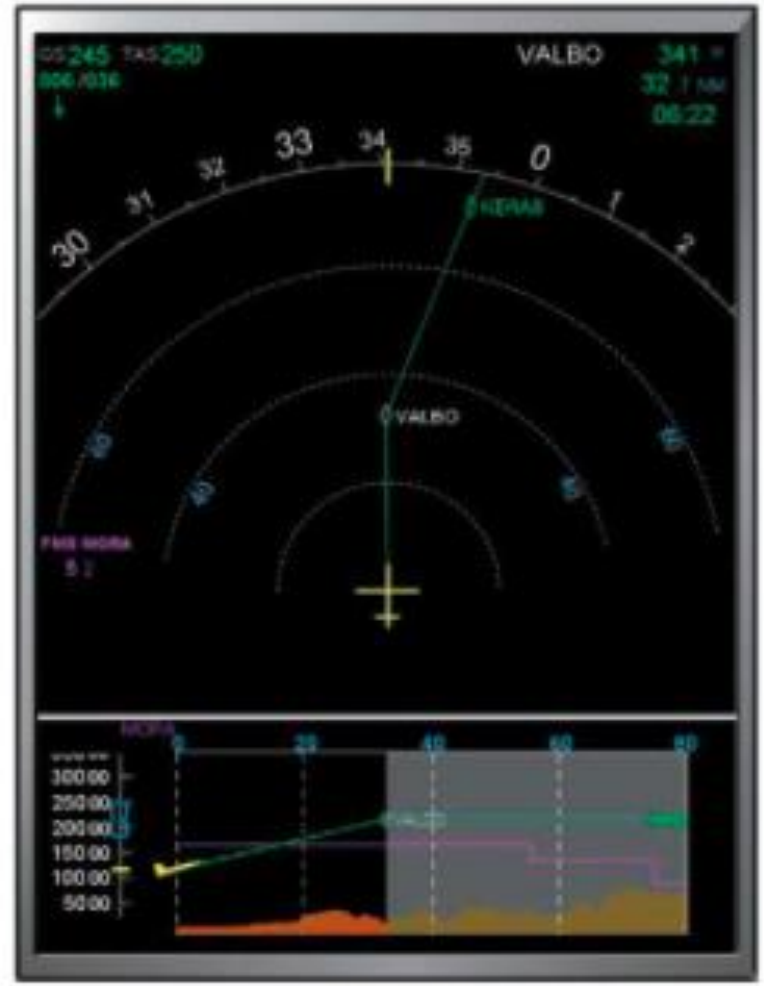
Head Down Displays (HDD)

➢ Traditional electro-mechanical instruments are now being replaced by all solid state equivalents with a **colour LCD** display presentation.

Actual Size

Civil Cockpit HDD

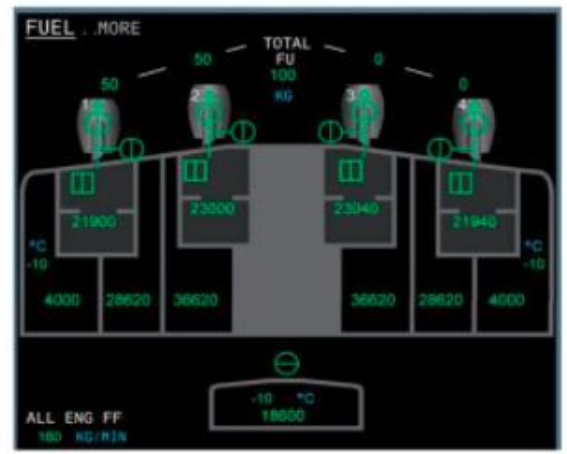
Primary flight Display (Airbus)



Navigation (or horizontal situation) displays (Airbus)

Civil Cockpit HDD

Engine/Warning display (Airbus)



Systems Display (Airbus)

Civil Cockpit HDD

Airbus A380 flight deck


GARMIN
NAV1 116.00 114.00
NAV2 113.90 114.80
GS 156kts DIS 38.2nm ETE 00:15 ETA 04:18
MAP - NAVIGATION MAP
125.900 121.600 COM1
123.850 119.000 COM2
TRACK UP
MAN IN HG
23.0
RPM
2300
FUEL QTY GAL
FFLOW GPH 13.7
OIL PSI 46
OIL °F 200
EGT °F 1652
CHT °F 338
30nm
MAP WPT AUX NRST
ENGINE
MAP
DCLTR
NAV
HDG
ALT
COM
CRS
BARO
RANGE
PAN
MENU
FPL
PROC
CLR
ENT
FMS

Video Slideshow

Multifunction Display (MFD)

Color Multifunction Displays(MFD’s) shows following data

Engine parameters

Hydraulic System status

Electrical System status

Flight Control System status

Flight Plans

Ground Maps

Radar displays(many pages)

Optical and other sensor displays

Weapon System status

Maintenance

Reference

- https://www.faa.gov/regulations_policies/handbooks_manuals/aviation/advanced_avionics_handbook/media/aah_ch05.pdf