



DOCUMENT  
**GSM-AUS-AASA-AFC**

DOCUMENT TITLE  
**AUTOMATIC FLIGHT CONTROL SYSTEMS (CASA ATPL)**  
**CHAPTER 3 – FLIGHT DIRECTORS**

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## INTRODUCTION

As aircraft developed over time with autopilots becoming more capable in controlling the aircraft in cruise conditions, a second system was developed to assist the pilot to manually fly the approach and landing at destination.

Called the Flight Director (FD), the system displays simple commands directing the pilot to fly up or down and left or right towards the correct approach profile. In an aircraft that is not fitted with a flight director system the pilot has to observe and respond to many inputs presented on multiple separate flight instruments.

A flight director accepts the same flight data input as the autopilot and processes this information in the same form so that it has similar modes to the autopilot.

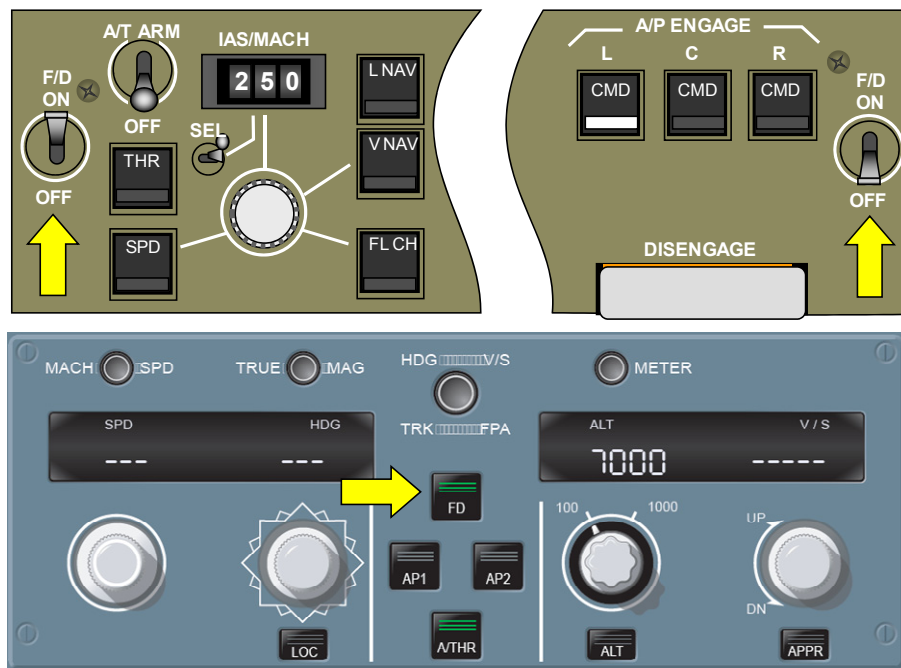
The Flight Director has become the primary guidance system. It cannot physically fly the aircraft but will provide its commands to the Pilot or Autopilot or both simultaneously.

The Flight director is considered to be a separate independent system from the autopilot and there is typically a flight director display for each pilot. The aircraft may be flown manually, without autopilot, using the flight director commands only.

Most large transport aircraft from the late 1960s operated the flight directors, autopilots and autothrottle simultaneously.

## FLIGHT DIRECTOR CONTROLS

The flight director control ON/OFF switch is typically located on the aircraft's Mode Control Panel (MCP). Most aircraft provide a switch for each pilot. Either switch when selected will turn the system on. Refer to Figure 3-1.



**Figure 3-1 Mode Control Panel**

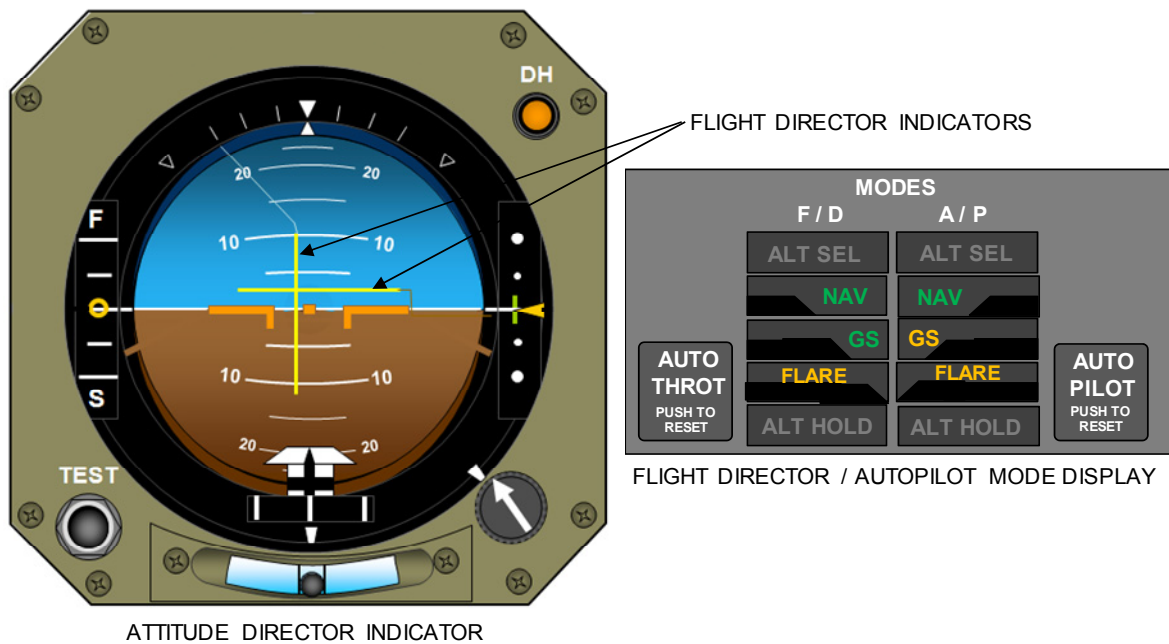
If the flight director switches are both OFF, in some aircraft initiating a go-around will activate the flight director.

## FLIGHT DIRECTOR DISPLAY

### Analog Instruments

In older analog aircraft the Flight Director commands presented to the pilot are physical indicators superimposed over the Attitude Indicator (AI).

Flight director modes are displayed along with the autopilot modes on separate indicators on the pilot's panel. Refer to Figure 3-2.

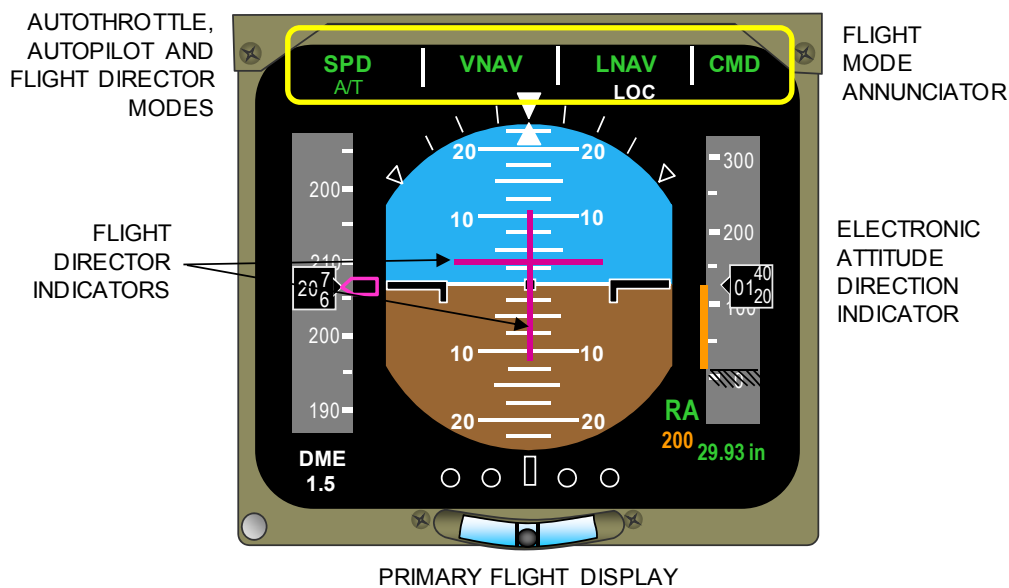


**Figure 3-2** Analog Flight Director Presentations

### Electronic Instruments

With the introduction of the Electronic Flight Instrument Systems (EFIS) in more modern aircraft, flight director commands and modes are displayed electronically on a Flight Mode Annunciator (FMA) integrated into the Electronic Attitude Direction Indicator (EADI).

Most modern aircraft refer to these displays as the Primary Flight Display (PFD). A component known as the symbol generator creates the information displayed electronically. Refer to Figure 3-3.



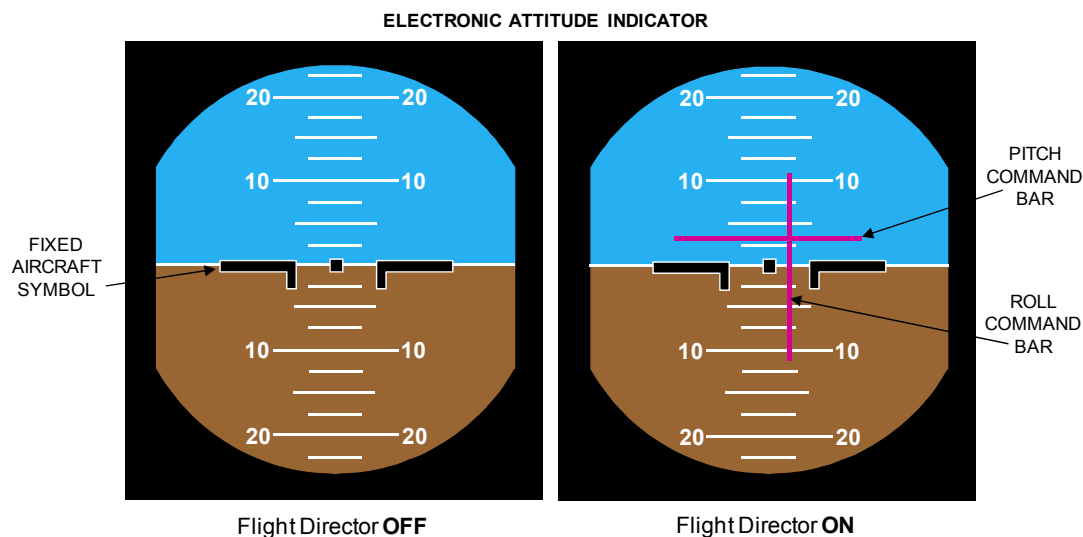
**Figure 3-3 Electronic Flight Director Presentations**

All flight directors, either analog or electronic, display the flying commands of pitch and roll in two formats.

## DISPLAY FORMATS

### Two Bar Display Format

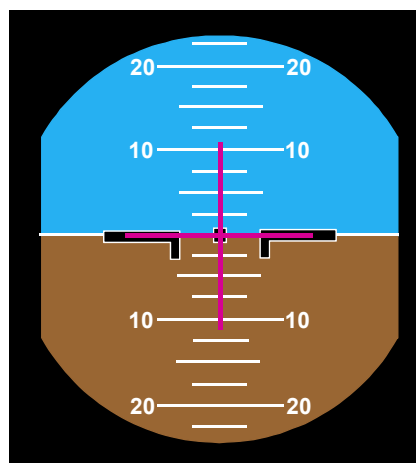
This is the most common presentation used in modern aircraft. The horizontal bar is the pitch bar and the vertical the roll bar. These bars move separately in fixed planes; that is to say that the pitch bar can only move up and down whilst remaining horizontal and the roll bar side to side whilst remaining vertical. Refer to Figure 3-4.



**Figure 3-4 Two Bar Flight Director Presentation**

The bars are showing the pilot what manoeuvres are required to regain the correct flight path. The pitch command bar displays the computed pitch correction which the aircraft must make to maintain a desired altitude, degree of pitch or to track a glideslope beam. The roll command bar displays computed roll correction which the aircraft must make to maintain a desired course or track.

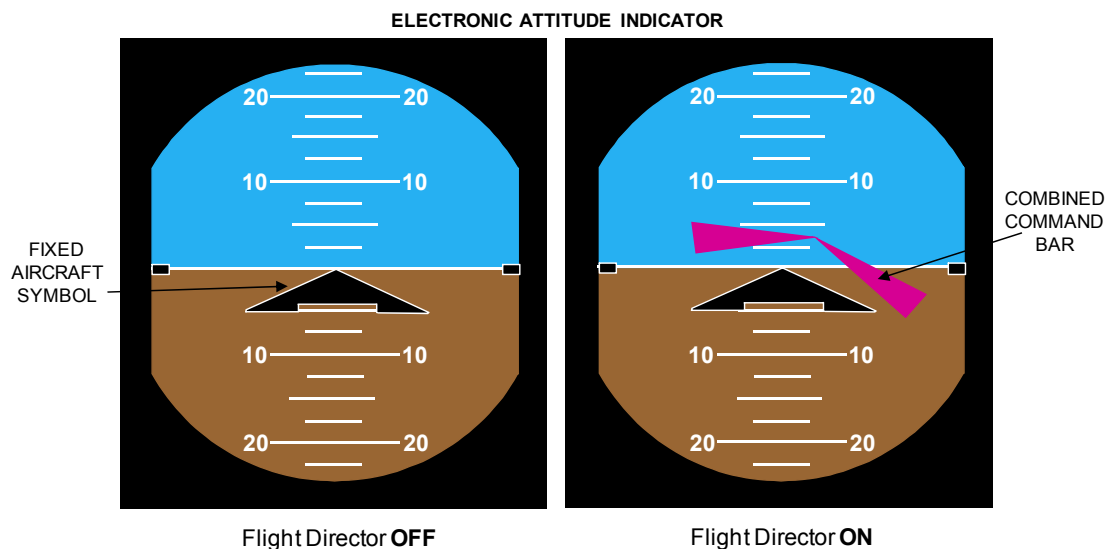
The figure above is showing the commands to pitch UP and roll RIGHT. By following the commands the pilot is attempting to get both bars in alignment with the aircraft symbol as shown in the figure below. Refer to Figure 3-5.



**Figure 3-5 Correctly following the Flight Director Command Bars**

### Combined Command Bar Display Format

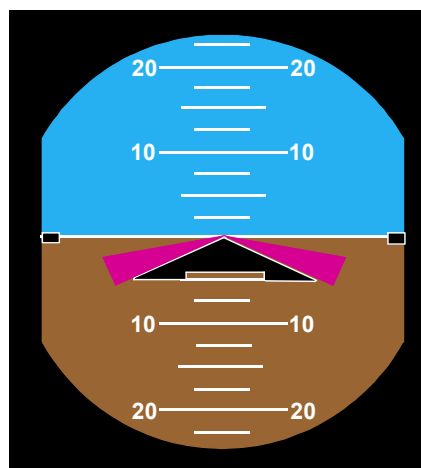
This presentation is also referred to as a “delta” or “V” format. Pitch and roll commands are made by one bar which can move in both planes and rotate giving a better representation of the actual manoeuvre to be performed. Refer to Figure 3-6.



**Figure 3-6 Combined Command Bar Presentation**

The single V bar is showing the Pilot what manoeuvres are required to regain the correct flight path as described in the two bar format.

The figure above is showing the command to pitch UP and roll RIGHT. By following the command the pilot is attempting to get the combined single V bar in alignment with the aircraft symbol as shown in the figure below. Refer to Figure 3-7.



**Figure 3-7 Correctly following the Flight Director Command Bar**

## INTERPRETING THE DISPLAY

To correctly interpret the command bars of the flight director one must understand what exactly is being displayed. The command bar position is the result of a computation made by the computer to direct the pilot towards the intended target.

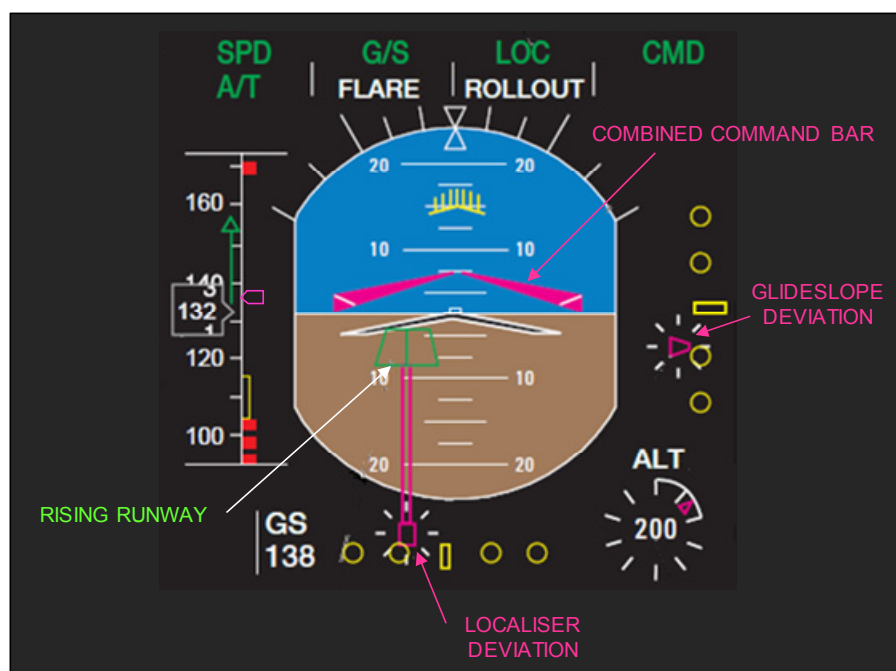
It is not the amount of deviation from the target.

There are no deviation scales for command bar movement, but the further the command bar is from the centered, aligned position, the greater the correction must be; small command bar deviations from the aircraft symbol only require small corrections.

For example, assume the aircraft is required to make a 90° right turn. The roll command bar will initially deflect to the maximum right position on the attitude indicator commanding the pilot to bank to the right.

A Flight Director roll command is limited to 30° of bank so as the aircraft approaches 30° of bank angle, the roll command bar will move to the centre, commanding the pilot to maintain the bank. As the aircraft approaches the target heading the roll command bar will command a left bank until wings level is achieved.

Usually the actual amount of deviation from the target is available on the EADI and on the EHSI when selected to approach mode. This information is not from the flight director but directly from the navigational aid such as the localizer, glideslope and radio altimeter. Refer to Figure 3-8.

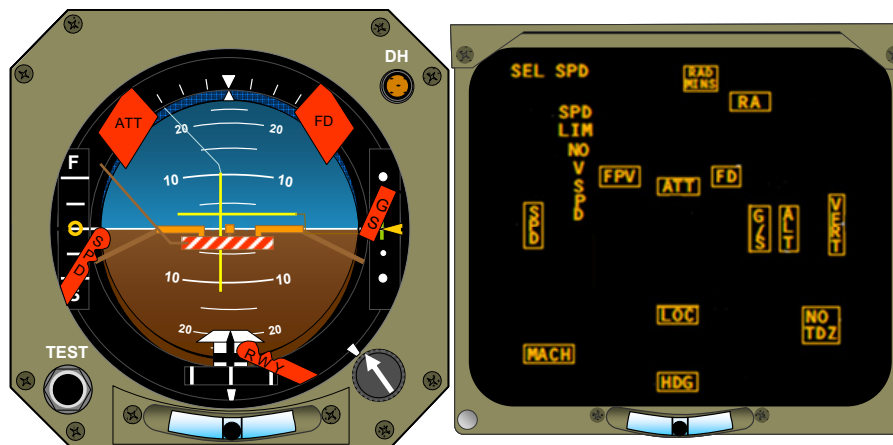


**Figure 3-8 Actual deviations displayed**



## DISPLAY FAILURES

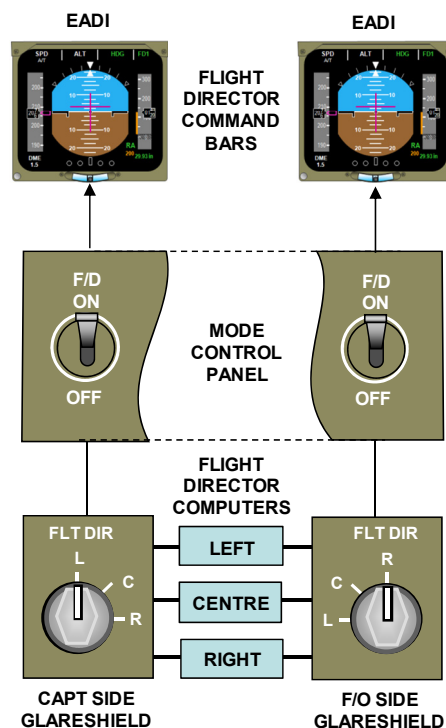
If the flight director computer fails or the raw information is invalid orange or red flags will appear. On an electronic display the command bars will disappear. Refer to Figure 3-9.



**Figure 3-9** Failure Flags

## REDUNDANCY

Modern aircraft normally have two or three flight director computers allowing each pilot an EFIS presentation from a separate source. Flight director sources can be selected by each pilot using a control on each side of the glareshield panel. Refer to Figure 3-10.



**Figure 3-10** Selection of Flight Director Computers

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