# MCDONNELL DOUGLAS MD-80 AUTOFLIGHT AND DFGS

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Note: This guide is not an FCOM and does not describe every single behavior of the system.

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https://github.com/Octal450/MD-80

## INTRODUCTION

The MD-80's Digital Flight Guidance System (DFGS) provides dual Autopilots (APs) and an Auto Thrust System (ATS). The system is capable of automatically flying the aircraft from shortly after liftoff, to touchdown and rollout.

The controls for the system are located on the Flight Guidance Control Panel (FGCP) on the glareshield. Outputs from the system are shown on both Flight Mode Annunciators, and the Flight Directors on each Primary Flight Display (PFD) or Attitude Indicator (AI).

The DFGS also provides a Yaw Damper and a Mach Trim Compensator.

## FLIGHT MODE ANNUNCIATOR

The Flight Mode Annunciator (FMA) shows the engaged and armed modes of the system. There is one FMA for the captain and one for the first officer. Sometimes referred to as the TARP, for Thrust, Arm, Roll, Pitch.



1) <u>THROTTLE Light</u>
   Flashes when the ATS is disengaged until the ATS disconnect button is pressed again.

2) <u>AP Light</u>
   Flashes when the AP is disengaged until the AP disconnect button is pressed again.

3) <u>Amber Comparator Lights</u>
   ILS, HORIZON, HEADING, NO AUTOLAND, AP TRIM, MONITOR indications, illuminate as a result of a comparator error between DFGS1/NAV1 and DFGS2/NAV2.

4) <u>RESET Button</u>
   Resets amber comparator status lights.

5) <u>Thrust Window</u>
   Displays the ATS mode when the ATS is engaged.

6) <u>Arm, Roll, and Pitch Windows</u>
   Displays the armed, roll, and pitch modes when the respective FD or either AP is engaged.

7) <u>FD, AP1/AP2 Lights</u>
   Illuminates to indicate the respective FD or either AP is engaged.

## AUTOFLIGHT MODES

### SPEED MODES

The Auto Thrust System (ATS) operates independently of the Autopilot. However, the AP and ATS will ensure that no mode conflicts occur.

If the AP is controlling the speed and the ATS is commanded to control the speed, the AP vertical mode will revert to VERT SPD or ALT HLD. If the ATS is controlling the speed, and the AP enters IAS or MACH mode, the ATS will revert to CLMP.

The ATS throttle command is constrained by the active Engine Pressure Ratio (EPR) limit selected on the Thrust Rating Indicator (TRI) and the DFGS computed idle limit.

Available modes are:

- SPD 250: FGCP selected airspeed is being held, in this case 250kts
- SPD ATL: ATS airspeed command exceeds the thrust limit
- MACH 780: FGCP selected mach number is being held, in this case .780
- MACH ATL: ATS mach command exceeds the thrust limit
- LOW LIM: ATS airspeed or mach command exceeds the idle limit
- ALFA SPD: FGCP selected speed too low, safe stall (alpha) margin speed being held
- VMO/MMO/FLAP/SLAT LIM: FGCP selected speed too high, safe speed being held
- EPR XXX: EPR limit being held (TO, MCT, GA, etc.)
- CLMP: Throttle servos are unpowered and the levers can be moved by the pilot
- RETD: Throttles are being retarded for touchdown

### LATERAL MODES

Available modes are:

- HDG HLD: Levelling out and holding current heading
- HDG SEL: FGCP selected heading is being captured and held
- NAV TRK: FMS lateral path is being captured and tracked
- VOR CAP: VOR localizer is being captured
- VOR TRK: VOR localizer is being tracked
- VOR CRS: VOR station crossing is occurring, holding existing heading
- LOC CAP: ILS localizer is being captured
- LOC TRK: ILS localizer is being tracked
- AUT LND: ILS localizer is being tracked in LAND mode
- ALN: Runway alignment is occurring
- ROL OUT: Runway centerline is being tracked
- TAK OFF: After liftoff, levelling out and holding current heading
- GO RND: Levelling out and holding current heading
- WNG LVL: Turbulence mode engaged, holding wings level

## VERTICAL MODES

Available modes are:

- ALT HLD: Altitude is being held
- ALT CAP: FGCP selected altitude is being captured
- VERT SPD: FGCP selected vertical speed is being tracked
- G/S CAP: ILS glideslope is being captured
- G/S TRK: ILS glideslope is being tracked
- AUT LND: ILS glideslope is being tracked in LAND mode
- FLAR: The flare maneuver is occurring
- ROL OUT: The nose is being lowered to the ground
- NO FLR (flashing): The AP is engaged under 100ft radio altitude but LAND is not engaged
- IAS: FGCP selected airspeed is being tracked by adjusting pitch angle
- MACH: FGCP selected mach number is being tracked by adjusting pitch angle
- TAK OFF: Takeoff guidance is being tracked to pitch for V2+10 (V2 for engine-out)
- GO RND: Go around guidance is being tracked
- TURB: Turbulence mode engaged, FGCP selected pitch angle is being tracked

## ARMED MODES

Armed modes are:

- VOR: VOR mode is armed
- LOC: LOC mode is armed
- NAV: NAV mode is armed
- LND: LAND mode is armed
- ALT: ALT CAP mode is armed
- ILS: LOC and G/S modes are armed
- AUT G/A: DFGS AP go around is armed
- FD G/A: DFGS FD go around is armed
- MAN G/A: DFGS go around is not armed

## FLIGHT GUIDANCE CONTROL PANEL

The Flight Guidance Control Panel (FGCP) is the location of most of the controls for the Digital Flight Guidance System (DFGS). It is located on the glareshield.



1) **Flight Director Switch**
   Toggles the Flight Director on the associated PFD or AI.

2) **Blank Button**
   Unused on PMS aircraft.

3) **SPD SEL Button**
   Sets the ATS to SPD mode. If the vertical mode is IAS, MACH, TAK OFF, or GO RND, it will revert to VERT SPD or ALT HLD. SPD mode will not engage if the TRI is set to TO or TO FLX.

4) **MACH SEL Button**
   Sets the ATS to MACH mode. If the vertical mode is IAS, MACH, TAK OFF, or GO RND, it will revert to VERT SPD or ALT HLD. MACH mode will not engage if the TRI is set to TO or TO FLX.

5) **EPR LIM Button**
   Sets the ATS to EPR mode. The vertical mode does not change.

6) **Speed Window**
   Displays the ATS selected speed.

7) **Speed Knob**
   Turn: Adjusts the selected ATS speed.
   Push: Switches the selected ATS speed between indicated airspeed (knots) and mach number.

8) **NAV Button**
   Arms or engages NAV mode (if available).

9) **ATS Switch (Auto Throt)**
   Engages or disengages the ATS. Switch will trip off automatically if the ATS disengages.

10) **VOR LOC Button**
    Arms or engages VOR localizer mode.

11) ILS Button
   Arms or engages ILS localizer and glideslope modes.

12) AUTO LAND Button
   If in ILS modes, arms or engages LAND modes.

13) Heading Window
   Displays the selected heading.

14) Bank Limit Selector
   Selects the maximum bank angle in HDG HLD, HDG SEL or VOR modes. No effect in other modes.

15) Heading Knob
   Turn: Adjusts the selected heading.
   Push: Engages HDG HLD mode. Cancels armed lateral modes.
   Pull: Engages HDG SEL mode. Cancels armed lateral modes.

16) Pitch Window
   When V is annunciated, displays the vertical speed select in feet-per-minute.
   When S is annunciated, displays the airspeed select for IAS vertical mode.
   When M is annunciated, displays the mach select for MACH vertical mode.
   When P is annunciated, displays the pitch angle select in degrees.

17) Pitch Knob
   Turning in VERT SPD mode adjusts the vertical speed select.
   Turning in IAS mode adjusts the airspeed select for IAS vertical mode.
   Turning in MACH mode adjusts the mach select for MACH vertical mode.
   Turning in TURB mode adjusts the pitch angle select.
   Turning in any other mode engages VERT SPD mode and disarms G/S and AUT LND.

18) VERT SPD Button
   Engages VERT SPD mode. Disarms G/S and AUT LND.

19) IAS MACH Button
   If below 27,000ft, engages IAS vertical mode. Disarms G/S and AUT LND.
   If above 27,000ft, engages MACH vertical mode. Disarms G/S and AUT LND.
   Pushing again toggles between IAS and MACH vertical modes. MACH mode is inhibited below mach 0.5.

20) PERF Button (Currently INOP)
   Engages PERF mode. Disarms G/S and AUT LND.

21) AP Switch
   Engages or disengages the AP. Switch will trip off automatically if the AP disengages.

22) ALT HOLD Button
    Engages ALT HLD mode and holds the current altitude. Disarms G/S and AUT LND.

23) Altitude Window
    Displays the altitude pre-select.

24) Altitude Knob
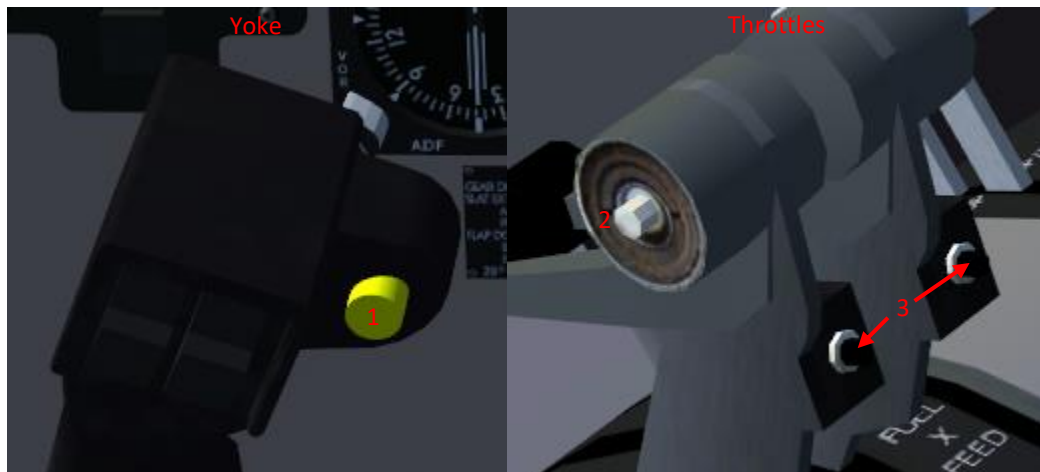    Turn: Adjusts the altitude pre-select by 1000ft.
    Push: Allows adjustment of the altitude pre-select by 100ft. Disarms ALT CAP.
    Pull: Arms ALT CAP for the pre-selected altitude.

25) TURB Button
    Engages the turbulence modes, WNG LVL and TURB. Disengages the ATS and disarms ALT CAP.


## OTHER CONTROLS



1) AP Disconnect Button (Both Yokes) (Shift + D)
   Disconnects both APs. Aural warning will sound and the AP light on the FMA will flash red. Second press silences the warning.

2) ATS Disconnect Button (Both Throttles) (Ctrl + D)
   Disconnects the ATS. The THROTTLE light on the FMA will flash red. Second press silences the warning.

3) Takeoff/Go Around (TOGA) Buttons (Shift + G)
   Engages GO RND modes. The Thrust Rating Indicator will switch to GA. The ATS will switch to EPR G/A and the throttles will be set to the Go Around Thrust limit. If the gear is on the ground and the AP is on, it will disconnect. Button has no effect above 1500ft radio altitude.

## MACH TRIM

A mach trim compensator is provided by the DFGS to cancel the mach tuck (nose down) effect at high mach numbers. An override is available to disable the system on the overhead panel.

At high mach numbers, commands from the DFGS push the first officers control column slightly backwards. This slews the neutral position of the elevators to counteract mach tuck.

## YAW DAMPER

A yaw damper is provided by the DFGS to damp Dutch roll and provide turn coordination. The yaw damper is active when above 50ft radio altitude. The rudder pedals do not move with yaw damper commands.

## PROCEDURES

### TAKEOFF AND CLIMB

1) Extend the flaps and ensure the TRI is set to TO or TO FLX mode, then push either of the TOGA buttons to engage TAK OFF mode.
2) Slowly spool the engines up to approximately 1.40 EPR and wait for them to stabilize.



3) Set the ATS switch to AUTO THROT.
4) Check that EPR mode appears on the FMA and the ATS drives the throttles to the takeoff limit.
5) At 60 knots, observe and crosscheck CLMP flashing and then becoming steady on the FMA and power is set.
6) At rotation speed, smoothly rotate the aircraft up and center the Flight Director bars. Do not chase the bars.
7) At 500ft radio altitude, the AP can be engaged. Center FD bars before engaging the AP.
8) At thrust reduction altitude, set the TRI to CL and observe EPR CL appearing on the FMA. The engines will roll back to the climb limit.
9) At acceleration altitude, push the IAS MACH button to engage the IAS vertical mode and use the pitch wheel to dial in the climb speed.

## ENGAGING THE AP OR ATS

1) Ensure the desired modes are active, and the Flight Director bars are centered.
2) Set the AP switch to AP ON.

## DISENGAGING THE AP OR ATS

1) Push the AP disconnect button on the yoke or the ATS disconnect button on the throttles.
2) Silence the disconnect warning and flashing red light by pressing the AP or ATS disconnect button again.

## CLIMBING TO A NEW ALTITUDE

1) Set desired altitude into the FGCP.
2) Push the IAS Mach button to engage the IAS or MACH vertical mode. Observe CLMP flashing on the FMA.
3) If the ATS is engaged, push the EPR LIM button to set power for climb.
4) If the aircraft is not equipped with auto altitude arm, pull the altitude knob to arm ALT CAP.
5) If engaged, observe the AP pitching for speed.

## DESCENDING TO A NEW ALTITUDE

1) Set desired altitude into the FGCP.
2) Push the IAS Mach button to engage the IAS or MACH vertical mode. Observe CLMP flashing on the FMA.
3) Manually idle the throttles to roughly 1.00 EPR to set power for descend.
4) If the aircraft is not equipped with auto altitude arm, pull the altitude knob to arm ALT CAP.
5) If engaged, observe the AP pitching for speed.

## PERFORMING AN ILS APPROACH OR AUTOLAND

1) Set the frequency and course into either NAV radio on the FGCP.
2) When on an intercept course (30 degrees or less recommended), push the ILS button.
3) Ensure ILS is displayed in the armed mode on the FMA.
4) When LOC CAP engages, ensure ILS remains displayed in the armed mode on the FMA.
5) When G/S CAP engages, ensure the missed approach altitude is set in FCP.
6) Ensure both LOC TRK and G/S TRK is displayed when established.
7) If performing an Autoland, push the AUTO LAND button.
8) Ensure either LND is displayed in the armed mode on the FMA, or AUT LND engages in both the lateral and vertical modes.
9) Monitor AP performance and be prepared to take over if system disconnects due to loss of ILS signal or malfunction. AP will disengage 5 seconds after nose wheel touchdown.

## TRACKING A VOR RADIAL OR ILS LOCALIZER

1) Set the frequency and course into either NAV radio on the FGCP.
2) When on an intercept course (30 degrees or less recommended), push the VOR/LOC button.
3) Ensure VOR or LOC is displayed in the armed mode on the FMA.
4) After VOR CAP or LOC CAP engages, ensure that VOR TRK or LOC TRK is displayed when established.