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The **McDonnell Douglas AV-8B Harrier II (Night Attack)** is a single-engine ground-attack aircraft that constitutes the second generation of the Harrier Jump Jet family. Capable of vertical or short takeoff and landing (V/STOL), the aircraft was designed in the late 1970s as an Anglo-American development of the British Hawker Siddeley Harrier, the first operational V/STOL aircraft.

The first-generation Harriers entered service with the Royal Air Force (RAF) and United States Marine Corps (USMC) in the late 1960s and early 1970s, but were handicapped in range and payload. In short takeoff and landing configuration, the AV-8A (American designation for the Harrier) carried less than half the 4,000 lb (1,800 kg) payload of the smaller A-4 Skyhawk, over a more limited radius. To address this issue, Hawker Siddeley and McDonnell Douglas began joint development of a more capable version of the Harrier in 1973.

The AV-8B Harrier II retains the basic layout of the Hawker Siddeley Harrier, with horizontal stabilizers and shoulder-mounted wings featuring prominent anhedral (downward slope). The aircraft is powered by a single Rolls-Royce Pegasus turbofan engine, which has two intakes and four synchronized vectorable nozzles close to its turbine. Two of these nozzles are located near the forward, cold end of the engine and two are near the rear, hot end of the engine. This arrangement contrasts with most fixed-wing aircraft, which have engine nozzles only at the rear. The Harrier II also has smaller valve-controlled nozzles in the nose, tail, and wingtips to provide control at low airspeeds.

Typically operated from small aircraft carriers, large amphibious assault ships and simple forward operating bases, AV-8Bs have participated in numerous military operations, proving themselves versatile assets. The aircraft took part in combat during the Gulf War and the Iraq War beginning in 2003. The Harrier II has served in Operation Enduring Freedom in Afghanistan since 2001, and was used in Operation Odyssey Dawn in Libya in 2011. Italian and Spanish Harrier IIs have taken part in overseas conflicts in conjunction with NATO coalitions. During its service history, the AV-8B has had a high accident rate, related to the percentage of time spent in critical take-off and landing phases.
The high accident rate I was mentioning before will very likely be applicable to the simulation world as well. Doing a vertical landing is much harder than meets the eye. The Harrier will test your skills as a pilot like never before.

The cockpit feels modern with its MPCDs (Multi-Purpose Color Displays) and Heads-Up Display and the AV-8B has a number of very powerful tools and sensors at its disposal like a Targeting Pod, a Jamming Pod and a Dual Mode Tracker. The Harrier seems to have been designed to be a Jack of all Trades that could be used in more or less any type of mission. You can operate from the cramped deck of the Tarawa, to remote FOBs (Forward Operating Base) where all you have to land is a small helipad. The Harrier will force you to manage your weight and make mental calculations if you need to perform difficult landings like a Vertical Landing. Aerodynamically speaking, the AV-8B is challenging since it is one of the few aircraft that can land pretty much anywhere. You’ll see: swivelling nozzles can be more difficult to use than you would think. I tried to explain the best practices in related sections, but I’m sure you’ll have a blast trying to figure out the best ways to fly this bird.

This makes it a very interesting experience since there are a lot of stuff to do in it. You will not feel like you are flying a next-gen fighter jet, but you will have a flexible aircraft that can give you lots of options. Think of an hybrid between an A-10 on steroids with a helicopter. This is why it is one of my favourite modules in DCS.

A lot of love was poured into this aircraft by RAZBAM, and it shows. The Harrier being currently in early access, some features are missing or simplified (RAZBAM said they were working on it, so please be patient), but despite that the Harrier feels very much like a proper study-level simulation that will have you learning ungodly amounts of cool things about the (very much) insane minds of the British engineers who first came up with the idea of the Harrier.
ASSIGNING PROPER AXIS IS IMPORTANT. HERE ARE A COUPLE OF TIPS.

NOTE: IN YOUR CONTROLS, MAKE SURE YOU CHECK YOUR "TRIM" CONTROLS SINCE THE DEFAULT VERSION OF THE GAME HAS YOUR TRIM HAT SET TO CHANGING YOUR VIEW RATHER THAN TRIM THE AIRCRAFT. SINCE MOST OF YOU ARE PROBABLY EQUIPPED WITH A TRACKIR ALREADY, I SUGGEST YOU MAKE SURE THE TRIM HAT SWITCH IS SET UP PROPERLY.

**PART 2 – CONTROLS SETUP**

TO ASSIGN AXIS, CLICK ON AXIS ASSIGN. YOU CAN ALSO SELECT “AXIS COMMANDS” IN THE UPPER SCROLLING MENU.

TO MODIFY CURVES AND SENSITIVITIES OF AXES, CLICK ON THE AXIS YOU WANT TO MODIFY AND THEN CLICK AXIS TUNE.
CONTROLS SETUP

BIND THE FOLLOWING AXES:

- PITCH (DEADZONE AT 0, SATURATION X AT 100, SATURATION Y AT 100, CURVATURE AT 15)
- ROLL (DEADZONE AT 0, SATURATION X AT 100, SATURATION Y AT 100, CURVATURE AT 15)
- RUDDER (DEADZONE AT 0, SATURATION X AT 100, SATURATION Y AT 100, CURVATURE AT 10)
- THRUST – CONTROLS ENGINE RPM
- NOZZLE – CONTROLS SWIVELLING NOZZLE ANGLE
- WHEEL BRAKE LEFT / RIGHT

NOTES:

1. The Airbrake key must be mapped to “AIRBRAKE TOGGLE” (B by default) and will act as a toggle switch.
2. I would personally not map anything to the flaps since they will be set in AUTO mode most of the time.
WHAT YOU NEED MAPPED

ECM DISPENSE RIGHT: ALL (Grey button on RHS)

Bomb Pickle

TRIM PITCH UP
TRIM PITCH DOWN
TRIM BANK LEFT
TRIM BANK RIGHT

ZOOM IN SLOW
TDC DOWN (ACTION)
ZOOM OUT SLOW
CAGE/UNCAGE (MAVERICK)

A/A Mode FWD: Sidewinder (Boresight)
A/A Mode DOWN: Gun
A/A Mode AFT: Sidewinder (SEAM)

AG Target
Undesignate/NWS/FOV Toggle
Emergency SAAHS Disconnect

Sensor Sel. FWD: INS, IRMV/EOMV
Sensor Sel. RIGHT: FLIR/HUD-BH/WH
Sensor Sel. AFT: DMT LST/TV
Sensor Sel. LEFT: MAP Center/Decenter
Sensor Sel. DOWN: HUD Reject

ECM DISPENSE AFT: CHAFF
ECM DISPENSE FWD: FLARES

+ TOE BRAKES (MAPPED ON PEDALS)

COMM FWD: Select COMM 1
COMM AFT: Select COMM 2

AIRBRAKE TOGGLE (B)

TDC FORWARD
TDC RIGHT
TDC AFT
TDC LEFT

Sensor Sel. FWD: INS, IRMV/EOMV
Sensor Sel. RIGHT: FLIR/HUD-BH/WH
Sensor Sel. AFT: DMT LST/TV
Sensor Sel. LEFT: MAP Center/Decenter
Sensor Sel. DOWN: HUD Reject

+ Sensor Sel. FWD: INS, IRMV/EOMV
+ Sensor Sel. RIGHT: FLIR/HUD-BH/WH
+ Sensor Sel. AFT: DMT LST/TV
+ Sensor Sel. LEFT: MAP Center/Decenter
+ Sensor Sel. DOWN: HUD Reject
PART 3 – COCKPIT & GAUGES
Canopy Detonation Cord
Detonates to shatter canopy to allow pilot ejection
**DECS (Digital Engine Control System) Switch**

UP = ON
DOWN = OFF

**Fuel Shutoff Lever**

UP = OFF (Fuel Valve Closed)
DOWN = ON (Fuel Valve Open)

*NOTE: The Fuel Lever will automatically lock in the DOWN position. To unlock the lever, use the “LWIN+F” key binding.*

**Fuel Shutoff Lever Lock Release Button**

Key Binding: LWin + F
### Engine RPM Selector Switch

**AFT = LOW**

**FWD = HIGH**

*Note: Selector switch will make the engine tachometer display either the low-pressure compressor speed (HIGH speed) or the bypass fan speed (LOW speed).*

### LIDS (Lift Improvement Devices System) Switch

**AFT = NORMAL**

**FWD = RETRACT**

### Oxygen Switch

**AFT = OFF**

**FWD = ON**

### EFC (Engine Fuel Control) Switch

**AFT = POS 2 (DECU 2)**

**FWD = POS 1 (DECU 1)**

*NOTE: This switch selects which engine DECU (Digital Engine Control Unit) is used to control fuel flow and engine parameters, as there are two DECUs available for redundancy.*

### Water Tank Dump Switch

**DUMP:** Dumps contents of water injection tank

**OFF:** Normal Operation
**Cockpit & Gauges**

- **External Lights Master Switch**
  - AFT = OFF
  - MIDDLE = NVG (Night Vision Goggles)
  - FWD = NORMAL

- **Seat Adjustment Switch**

- **Position Lights Switch**
  - AFT = OFF
  - FWD = BRIGHT

- **Anti-collision Lights Switch**
  - AFT = OFF
  - FWD = BRIGHT

- **Auxiliary Lights Switch**
  - AFT = OFF
  - FWD = BRIGHT

- **Formation Lights Brightness Knob**
  - OFF / BRIGHT

- **Air Refueling (A/R) Probe Switch**
  - AFT = FUEL PROBE IN/RETRACTED
  - MIDDLE = FUEL PROBE OUT/EXTENDED
  - FWD = Leaves probe extended and pressurizes fuel tank (no fuel transfer)

- **Formation Lights Brightness Knob**
  - OFF / BRIGHT

- **Fuel Proportioner Switch**
  - AFT = OFF
  - FWD = ON

- **Throttle Friction Switch**

- **Manual Fuel Switch**
  - AFT = OFF
  - FWD = ON

- **Rudder Trim Switch**

- **Fuel Booster Pump Switch (Left/Right)**
  - AFT = DC OPERATED (use if pump is failed)
  - MIDDLE = OFF
  - FWD = NORMAL

- **Wing Fuel Dump Switch (Left / Right)**
  - AFT = OFF
  - FWD = Dumps contents of selected fuel tank

- **Wing Fuel Dump Switch (Left / Right)**
  - AFT = OFF
  - FWD = Dumps contents of selected fuel tank

- **Flood Lamps**
  - Scroll mousewheel to change orientation

- **Seat Adjustment Switch**

- **External Lights Master Switch**
  - AFT = OFF
  - MIDDLE = NVG (Night Vision Goggles)
  - FWD = NORMAL

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  - AFT = OFF
  - MIDDLE = NVG (Night Vision Goggles)
  - FWD = NORMAL

- **Seat Adjustment Switch**
PART 3 – COCKPIT & GAUGES

Seat Checklist
• Remove three safety pins
• Emergency release handle down & locked
• Personal services connected
• Left hand & right hand risers connected
• Left hand & right hand lap belts connected
• Ground safety device on & locked

Emergency Handle – Canopy Fracture
• Rotate up to release
• Pull to fire
**Nozzle Angle Control Lever**
Controls angle of engine nozzles

**JPTL (Jet Pipe Temperature Limiter) Button**
AFT = ON  
FWD = OFF

**EMS (Engine Monitoring System) Pilot Record Button**
When depressed, EMU (Engine Monitoring Unit) records engine parameters, which will be available for the ground maintenance crews after flight.

**STO (Short Takeoff & Landing) Stop Lever**
Blocks Nozzle Angle Lever to selected position

**Nozzle Angle Control Lever Friction Knob**

**Nozzle Angle Control Lever**
Controls angle of engine nozzles
**Air-to-Air Programming Switch**
Not functional on AV-8B N/A variant

**ECM (Electronic Countermeasure) Dispense Switch**
AFT = Dispenses Chaff
FWD = Dispenses Flares
LEFT = Mini Jammer Engaged (Not Functional)
RIGHT = Dispenses all countermeasure types

**Weapon Cage/Uncage Switch**

**Antenna Elevation Switch**
Not functional on AV-8B N/A variant

**TDC (Target Designation Caret) Control Switch**
LEFT/RIGHT/FORWARD/AFT/DOWN (ACTION)

**Parking Brake Lever**
AFT = ON (ENGAGED)
FWD = OFF

**COMMS Switch**
UP = Selects COMM 1
DOWN = Selects COMM 2

**Airbrake (Speed Brake) Switch**

**Throttle Cutoff Lever**
Only clickable when throttle is at IDLE
PART 3 – COCKPIT & GAUGES

**Q-Feel Unit Switch**
- AFT = OFF
- FWD = ON

Note: Since the Harrier’s aircraft control surfaces are hydraulically-actuated, stick force is not felt by the pilot unless an artificial force feedback system, or “Q-Feel” system gives the pilot a force feedback based on the aircraft’s airspeed, or “q”, which is the dynamic pressure of the aircraft.

**SAAHS:**
STABILITY AUGMENTATION & ATTITUDE HOLD SYSTEM

**SAAHS Altitude Hold Mode Switch**
- AFT = OFF
- FWD = ON (ENGAGED)

**RPS (Rudder Pedal Shakers)/YAW Switch**
- AFT = OFF, RPS disabled
- MIDDLE = ON, RPS enabled
- FWD = TEST

**Landing/Taxi Lights Switch**
- AFT = OFF
- MIDDLE = HOVER
- FWD = APPROACH

**Aileron Trim Indicator**

**Rudder Trim Indicator**

**SAAHS AFC (Automatic Flight Controls) Mode Switch**
- AFT = RESET
- MIDDLE = OFF
- FWD = ON

**Yaw Stability Augmentation System Switch**
- AFT = OFF
- FWD = ON

**Roll Stability Augmentation System Switch**
- AFT = OFF
- FWD = ON

**Pitch Stability Augmentation System Switch**
- AFT = OFF
- FWD = ON
Magnetic Azimuth Detector Table

Landing Gear Position Indicator
GREEN = Deployed
AMBER = In Transition
EXTINGUISHED = Up & Locked
Note: M is for Main Landing Gear, N is for Nose Landing Gear, L is for Left Wing and R is for Right Wing Landing Gear

Flaps Mode Switch
UP = Cruise Mode
MIDDLE = Automatic Mode
DOWN = STOL (Short Takeoff & Landing) Mode

Flaps Power Switch
LEFT = TEST
MIDDLE = ON
RIGHT = OFF

Landing Gear Lever
DOWN = Gear Extended
UP = Gear Retracted

Emergency Jettison Button

Anti-skid Switch
UP = TEST
MIDDLE = ON
DOWN = Nosewheel Steering

Flaps BIT (Built-In Test) Button

Flaps Position Angle (degrees)
### PART 3 – COCKPIT & GAUGES

<table>
<thead>
<tr>
<th>System:</th>
<th>Magnetic Azimuth Detector</th>
</tr>
</thead>
<tbody>
<tr>
<td>To Fly</td>
<td>Steer</td>
</tr>
<tr>
<td>N</td>
<td>0</td>
</tr>
<tr>
<td>15</td>
<td>15</td>
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<td>135</td>
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<tr>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>165</td>
<td>165</td>
</tr>
</tbody>
</table>

**Clock**

**Water Injection Switch**
- UP = Takeoff Mode
- MIDDLE = OFF
- DOWN = Landing Mode

**CMBT (Combat Thrust) Activated Indicator**
Flashes after 2.5 minutes of CMBT usage
Armament Delivery Mode
AUT: Automatic
CIP: CCIP, Continuously Computed Impact Point
DSL: Depressed Sight Line
DIR: Direct

Weapon Manual Control
NORM: Normal
N/T: Nose & Tail Fuzing
N: Nose Fuzing
T: Tail Fuzing

Selective Jettison Control
STA: Selected stations
STOR: Selected stores
SAFE: Safety Position
CMBT: Combat
FUEL: External Fuel Tanks
PUSHBUTTON: Jettisons selected ordnance

Weapon Multiple Control

Weapon Quantity Control

Weapon Interval Control

Fuzing Control

Weapon Forward Control

Station Selection Button & Indication

IR (Infrared) Cooling Switch
Applies manual cooling to all sidewinder/sidewarm-equipped stations. You shouldn’t be turning it on at all unless you have a system failure that prevents the sidewinder seeker head from cooling or need to cool sidewinder’s while on the ground for preflight checks.
**PART 3 – COCKPIT & GAUGES**

- **Flood Lamps**: Scroll mousewheel to change orientation.
- **Canopy Handle**: Key Binding: LCTRL+R.
- **Standby Magnetic Compass**: Whiskey compass is used as a backup.
- **VSTOL (Vertical Short Takeoff & Landing) Master Mode Button**: (HUD, Heads-Up Display mode).
- **Master Arm Switch**:
  - UP = ON
  - DOWN = OFF
- **Navigation Master Mode Button**: (HUD, Heads-Up Display mode).
- **Air-to-Ground Master Mode Button**: (HUD, Heads-Up Display mode).
- **Flare Salvo Button**.
PART 3 – COCKPIT & GAUGES

MPCD (Multi-Purpose Color Displays)
Mode Switch
Day/Night

MPCD (Multi-Purpose Color Displays)
Symbology Brightness Control

MPCD (Multi-Purpose Color Displays) Gain Control

MPCD (Multi-Purpose Color Displays) Contrast Control
**MPCD Sub-Menus**

- FLIR: NAVFLIR (Navigation Forward-Looking Infrared) Display
- EHSD: Electronic Horizontal Situation Display
- DMT: Dual Mode Tracker display
- STRS: Stores Page
- HUD: Heads-Up Display repeater
- BIT: Built-In Test page
- VRST: VSTOL-REST (Vertical & Short Takeoff & Landing) calculator page
- ENG: Engine parameters page
- CONF: Software configuration page
- TPOD: Targeting Pod (LITENING II) page. Blank if no TPOD is loaded.
- IFF: Identify-Friend-or-Foe Data page.
- EW: Electronic Countermeasures/Warfare page. Displays RWR (Radar Warning Receiver)
- CARD: Pre-programmed kneeboard card display page.
- CAS: Close Air Support page.
- EMER: Emergency Checklist Cards page.
- SDAT: System Data page.
- COMM: Communication data page.

**MPCD Main Menu**

Accessible from every page
### MPCD

**EHSD (Electronic Horizontal Situation Display) MENU**

#### TACAN Data

<table>
<thead>
<tr>
<th>Bearing (degrees)</th>
<th>Distance (Nm)</th>
<th>Time-to-Go to TACAN Station (minutes:seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>290°</td>
<td></td>
<td></td>
</tr>
<tr>
<td>306°</td>
<td>468KTS</td>
<td></td>
</tr>
</tbody>
</table>

#### Waypoint Data

<table>
<thead>
<tr>
<th>Bearing (degrees)</th>
<th>Distance (Nm)</th>
<th>Time-to-Go to Waypoint (minutes:seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>083°</td>
<td>37.0</td>
<td>4:44</td>
</tr>
</tbody>
</table>

#### EHSD Map Scale

- Aircraft ground track pointer
- Waypoint Bearing Pointer
- Selected Course

#### Other Elements

- Heading and Airspeed (kts)
- TACAN bearing pointer
**LEFT Refuel Light**
- Flashing: internal left wing tank or left external tank is full.
- Illuminated (steady): both left wing and left external tanks are full.

**RIGHT Refuel Light**
- Flashing: internal right wing tank or right external tank is full.
- Illuminated (steady): both right wing and right external tanks are full.

**READY Refuel Light**
- Illuminates when you are cleared for air-to-air refueling.
- Extinguishes during contact.
Aircraft Pitch Ladder
Heading Scale
Indicated Airspeed (kts)
Bearing to Waypoint
Angle of Attack (AOA)
Mach Number
Current Acceleration (G)
Ground Speed (kts)
Max Gs attained

Indicated Altitude (ft)
VVM (Velocity Vector Marker)
Vertical Speed (feet per minute)
Clock (Zulu Time)
Waypoint Data (Distance in nm + Waypoint Number)
Auxiliary Heading Indicator (T is shown when True Heading is used)

Heads-Up Display (NAV Mode)
**TMR:** Timer
**TOO:** Target-of-Opportunity

**COM1 & COM2 Radio UFC:**
- Power/Volume Knob
- Radio Channel Display (M = Manual)
- Channel Selector (scroll mousewheel)

**Function Mode Keys**
- **ENT:** Enter (validates & saves entered values)
- **IFF:** Sets UFC for IFF system
- **TCN:** Sets UFC for TACAN
- **AWL:** Sets UFC for All Weather Landing System
- **WPN:** Sets UFC for Weapons delivery programming
- **WOF:** Waypoint Over Fly (INS position update)
- **BCN:** Radar Beacon Identification System ON/OFF
- **ALT:** Sets UFC to configure aircraft’s altimeter
- **EM CON:** Emission Control System ON/OFF

**Specialty Input Keys**
- **I/P:** Identification-of-Position (used by IFF)
- **SVE:** Save (not functional)
### Warning Lights
- **FIRE**: Engine fire detected
- **LAW**: Low Altitude Warning
- **FLAPS**: Flap system failure
- **L TANK**: Left fuel tank system overpressure or overtemperature
- **R TANK**: Right fuel tank system overpressure or overtemperature
- **HYD**: Both HYD1 and HYD2 hydraulic systems are failed
- **GEAR**: Landing Gear unsafe/fails to extend.
- **OT**: Overtemperature (Engine JPT limits exceeded)
- **JPTL**: Jet Pipe Temperature Limiter control inoperative
- **EFC**: Engine Fuel Control boxes DECU1 and DECU2 are both failed
- **GEN**: AC generator is offline

### Caution Lights
- **L FUEL**: Left fuel system level is low (steady when less than 750 lbs, flashing when less than 250 lbs)
- **R FUEL**: Right fuel system level is low (steady when less than 750 lbs, flashing when less than 250 lbs)
- **15 SEC**: JPT (Jet Pipe Temperature) above normal lift rating (flashes after 15 sec)
- **MFS**: Manual Fuel System ON
- **BINGO**: Fuel below bingo (return to base) setting
- **H₂O**: Less than 15 seconds of water injection remaining.
PART 3 – COCKPIT & GAUGES

FLIR Power Switch
UP = ON
DOWN = OFF

INS (Inertial Navigation System) Mode Selector
• OFF: No Power to INS
• TEST: INS BIT (Built-In Test)
• GB: Not used
• GYRO: Emergency mode
• IFA: Initiates INS In-Flight Alignment
• NAV: INS Navigation mode
• INS GND: INS Ground Align mode
• SEA: INS Sea Align mode

Video Recorder System (VRS) Switch
AUTO / RUN

Video Recorder System (VRS) Display Selector
MPCD / HUD

Dual Processor (DP) Mode Selector Switch
PRIMARY / AUTO / ALTERNATE

Mission Computer (MC) Mode Switch
OVERRIDE/AUTO/OFF

Probe (PRB) Heat Mode Switch
HEAT/AUTO

DMT (Dual Mode Tracker) Toggle Switch
ON / OFF
PART 3 – COCKPIT & GAUGES

Sensor Select Switch
AFT = DMT: LST/TV
FWD = INS: IRMV/EOMV
LEFT = MAP Center/Decenter
RIGHT = FLIR/HUD-BH/WH
DOWN (PUSHED) = HUD Scene Reject/TPOD

Trim Hat Switch
(Pitch & Bank)

Air-to-Ground Bomb Pickle Button
Releases bombs or launches rockets or Maverick air-to-ground missiles

Emergency SAAHS Disconnect Switch
Disengages SAAHS (Stability Augmentation and Attitude Hold System)

Trigger (front of stick)
Fires gun or launches Sidewinder or Sidearm missile

Waypoint Increment Button

Air-to-Air Weapon Select Switch
AFT = A/A Sidewinder SEAM Mode
FWD = A/A Sidewinder Boresight Mode
DOWN (PUSHED) = Gun Mode

Air-to-Ground Target Undesignate / Nosewheel Steering Button
**PART 3 – COCKPIT & GAUGES**

### Threat Lights
- **SAM**: SAM launch detected
- **CW**: Ground Tracking (Continuous Wave) radar is locked on aircraft
- **AI**: Air Intercept radar is locked on aircraft (flashes if launch is detected)
- **AAA**: Anti-Aircraft Artillery gun radar is locked on aircraft.

### Controls and Indicators

#### EDP (Engine Display Panel) BIT (Built-In Test) Button

- **RWR (Radar Warning Receiver) Control Knob**
  - OFF / ON / Volume

- **Expendables Dispenser Control Knob**
  - OFF: No Power
  - AUT: Dispenser selected automatically
  - UP: Dispensers on top of aft fuselage used first
  - DOWN: Dispensers on bottom of aft fuselage used first
  - RWR: Option not available

- **ECM (Electronic Countermeasure) Control Knob**
  - OFF: Removes power to DECM pod
  - STBY: Powers DECM pod but does not emit signal
  - BIT: DECM pod Built-In Test
  - RCV: Smart Standby (pod emits based on signal received)
  - RPT: Continuous jamming signal (repeat)

- **Engine Reaction Control System Duct Pressure Indicator (psi)**
- **Fuel Flow Indicator (lbs/min)**
- **Stabilator Position (Trim) Indicator**
  - Shown: nose down (↓) 2 deg
- **Tachometer**: Compressor (HI) or fan (LO) RPM
- **JPT (Jet Pipe Temperature) Indicator (deg C)**
- **Nozzle Angle Indicator (deg)**
- **EDP (Engine Display Panel) Brightness Control**
- **Water Quantity Indicator (lbs)**
- **Water Injection Flow Light**
- **Clock**
PART 3 – COCKPIT & GAUGES

Canopy Locking Lever
FWD: LOCKED
AFT: UNLOCKED

Canopy Handle
Key Binding: LCTRL+C

Flood Lamps
Scroll mousewheel to change orientation
PART 3 – COCKPIT & GAUGES

- Brake Pressure Indicator (psi)
- HYD 1 & 2 System Hydraulic Pressure (x10 psi)
- Accumulator Pressure (x1000 psi)
- Cabin Pressure (Pressure Altitude)
<table>
<thead>
<tr>
<th>PART 3 – COCKPIT &amp; GAUGES</th>
</tr>
</thead>
</table>

### CAUTION / ADVISORY LIGHT PANEL

<table>
<thead>
<tr>
<th>OXY</th>
<th>WSHLD</th>
</tr>
</thead>
<tbody>
<tr>
<td>OBOGS (On-Board Oxygen Generation System) malfunction</td>
<td>Windshield hot</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HYD 1</th>
<th>HYD 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydraulic System 1 pressure greater than 1400 psi</td>
<td>Hydraulic System 2 pressure greater than 1400 psi</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>L PUMP</th>
<th>R PUMP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left fuel boost pump pressure low</td>
<td>Right fuel boost pump pressure low</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>L TRANS</th>
<th>R TRANS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low air pressure to left feeder tank</td>
<td>Low air pressure to right feeder tank</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FLAPS 1</th>
<th>FLAPS 2</th>
<th>AUT FLP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flaps 1 channel failed</td>
<td>Flaps 2 channel failed</td>
<td>Auto-flap mode or ADC failed</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PROP</th>
<th>LIDS</th>
<th>OIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel proportioner off or failed</td>
<td>LIDS (Lift Improvement Device System) not in correct position</td>
<td>Oil pressure low</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>APU GEN</th>
<th>GPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>APU (Auxiliary Power Unit) selected and emergency generated failed</td>
<td>GPS not valid</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DEP RES</th>
<th>STBY TR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Departure Resistance reduced (aircraft more prone to depart from controlled flight)</td>
<td>Standby TRU (Transformer-Rectifier Unit) inoperative or offline</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CS COOL</th>
<th>LOAD</th>
<th>CANOPY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cockpit avionics cooling fan failed</td>
<td>Fuel asymmetry over Vickers (Vertical Landing) limit</td>
<td>Canopy not closed and locked</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>INS</th>
<th>SKID</th>
<th>EFC</th>
<th>NWS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inertial Navigation System aligning or failed</td>
<td>Anti-Skid system malfunction</td>
<td>DEC 1 or 2 (Digital Engine Control Unit) failed</td>
<td>Nosewheel steering malfunction</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>AFC</th>
<th>CIP AUT</th>
<th>H₂O SEL</th>
<th>APU</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACF (Automatic Flight Controls) malfunction or deselected</td>
<td>Computed delivery mode not available</td>
<td>Airspeed over 200 kts and water injection switch not set to OFF</td>
<td>APU (Auxiliary Power Unit) operating</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PITCH</th>
<th>IFF</th>
<th>SPD BRK</th>
<th>DROOP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pitch stabilization augmentation system off or failed</td>
<td>IFF (Identify-Friend-or-Foe) system off, not zeroized or not responding.</td>
<td>Gear up and speed brake extended or gear down and speed brake not 25 deg</td>
<td>Ailerons dropped</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ROLL</th>
<th>AFT BAY</th>
<th>CW NO GO</th>
<th>JMR HOT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roll stabilization augmentation system off or failed</td>
<td>Aft avionics bay ECS (Environmental Control System) failed</td>
<td>CW (continuous wave) radar jammer failure.</td>
<td>Jammer pod overtemperature</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>YAW</th>
<th>CW NO GO</th>
<th>P NO GO</th>
<th>CW JAM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yaw stabilization augmentation system off or failed</td>
<td>CW (continuous wave) radar jammer failure.</td>
<td>Pulse-Doppler radar jammer failure.</td>
<td>CW (continuous wave) radar jammer pod active</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ENG EXC</th>
<th>P NO GO</th>
<th>REPLY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine exceedance (overspeed, overtemperature or over-g) detected</td>
<td>Pulse-Doppler radar jammer failure.</td>
<td>IFF responding to Mode 4 interrogation.</td>
</tr>
</tbody>
</table>
PART 3 – COCKPIT & GAUGES

**Battery Switch**
- FWD: BATT/ON
- MIDDLE: OFF
- AFT: ALERT

**Generator Switch**
- FWD: GEN/ON
- MIDDLE: OFF
- AFT: TEST

**DC Test Switch**
- LEFT: MANUAL
- MIDDLE: OFF
- RIGHT: STANDBY

**DC Voltmeter (Volts)**

**APU (Auxiliary Power Unit) Generator Switch**
- FWD: Reset
- MIDDLE: ON (with battery set to BATT, GTS (Gas Turbine Starter) drives the APU provided it is not in the engine start mode)
- AFT: OFF

**Engine Start (ENG ST) Switch**
- FWD: Engine Start ON
- AFT: OFF

---

**APU (Auxiliary Power Unit) Generator Switch**
- FWD: Reset
- MIDDLE: ON (with battery set to BATT, GTS (Gas Turbine Starter) drives the APU provided it is not in the engine start mode)
- AFT: OFF
Compass Light/Test Lights Switch
FWD: Compass Light
MIDDLE: OFF
AFT: Lights Test

Flood Lights
Brightness Knob

Warning/Caution Annunciator
Lights Brightness Control Knob
BRT/RESET/DIM

Console Lights Brightness Knob

V/UHF Radio Set Control Panel
(Active when Radio in MANUAL mode)

ACNIP (Auxiliary Communication,
Navigation, Identification Panel)

Compass Light/Test Lights Switch
FWD: Compass Light
MIDDLE: OFF
AFT: Lights Test

Instruments Panel
Brightness Knob
PART 3 – COCKPIT & GAUGES

V/UHF RSC (Radio Set Control) Channel Frequency Mode Selector
- AJ/M: Not simulated
- AJ: Not simulated
- MAR: Selects one of 57 preset maritime channels. Not simulated
- PRST: CRS Switch changes selected preset channel.
- MAN: CRS Switch changes the frequency for the selected channel.
- 243: Turns on receivers for the 243.000 MHz emergency frequency.
- 121: Turns on receivers for the 121.000 MHz tactical frequency. Not simulated

V/UHF Ancillary Mode Switch
Positions cursor under various mode options. Used with ancillary mode pointer to select or deselect ancillary modes.

V/UHF Ancillary Mode Pointer
Positions pointer to select or deselect ancillary mode option defined by the – pushbutton.

V/UHF RSC Channel Frequency Tuner

V/UHF RSC Volume Control Knob
Turned: Volume
Pulled: Squelch OFF

V/UHF Network (Not simulated)

V/UHF Active Manual Frequency Selected

V/UHF Preset Channel Selected

V/UHF Time (Not simulated)
V/UHF Radio Control Mode Switch
- **MAN**: Manual Mode (radio is controlled by the Radio Control Set panel)
- **UFC**: Up-Front Controller Mode (radio is controlled by the UFC and ODU, Option Display Unit)

Radio Program 1/2 Switch
Selects which radio transmitter is active

KY58 Secure Speech System Unit 1
Diphasic/Baseband (DIPH/BB) Selector

KY58 Secure Speech System Unit 2
Diphasic/Baseband (DIPH/BB) Selector

Remote Variable Switch
With the switch in the RV1, the MASTER CAUTION Lights panel becomes invisible, allowing access to the LMPCD right buttons. When the switch is in the RV2 position, the MASTER WARNING Lights panel becomes invisible, allowing access to the RMPCD left buttons. The button position is in the middle, making both light panels visible.

KY58 Cipher Zero Norm Switch

IFF (Identify-Friend-or-Foe)
Zero/Hold Switch (Not Simulated)

IFF (Identify-Friend-or-Foe)
Emergency/Normal Switch (Not Simulated)

Console Lights Brightness Knob

ICS (Intercom System) Ground Volume Knob

ICS (Intercom System) Auxiliary Volume Knob
Can be used to tune volume of aural warnings (i.e. Bitchin’ Betty)

KY-58 Secure Speech System Unit #1 and Unit #2 Code and Mode Selected
The secure speech system is used for ciphering (coding) or deciphering (decoding) audio routed through the KY-58 cipher unit No. 1 (KY-1) or KY-58 unit No. 2 (KY-2).

KY-58 Unit #2
Code/Mode Switch (Not Simulated)

KY-58 Unit #1 Code/Mode Switch (Not Simulated)
Used to select a desired KY58 operating mode and code
**Defogging Switch**
FWD: Normal  
MIDDLE: Defog  
AFT: Maximum Defog

**Cockpit Pressure Switch**
FWD: Normal Pressure regulator  
MIDDLE: Dump cockpit pressure  
AFT: Ram air

**Forward Equipment Bay Cooling Switch**
FWD: Reset  
AFT: Normal

**ECS (Environmental Control System) Cabin Temperature Controller Knob**

**Aft Equipment Bay Cooling Switch**
FWD: Reset  
MIDDLE: ON  
AFT: OFF

**Flood Lamps**
Seat Ground Safety Lever
RETRACTED (DOWN): Safety OFF
EXTENDED (UP): Safety ON

NVG (Night Vision Goggle) and Video Recorder Stowage
## Ground Power Switches

<table>
<thead>
<tr>
<th>SWITCH</th>
<th>POSITION</th>
<th>EQUIPMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>STORES</td>
<td>ACP</td>
<td>ARMAMENT CONTROL PANEL</td>
</tr>
<tr>
<td>SMS</td>
<td>STORES MANAGEMENT COMPUTER</td>
<td>TACTS</td>
</tr>
<tr>
<td></td>
<td>ARMAMENT CONTROL PANEL</td>
<td>DECM/ASPJ</td>
</tr>
<tr>
<td>MISC</td>
<td>ON</td>
<td>TACAN</td>
</tr>
<tr>
<td></td>
<td>EXT LTS</td>
<td>RWR</td>
</tr>
<tr>
<td>DISP/FLT</td>
<td>ON</td>
<td>HUD</td>
</tr>
<tr>
<td></td>
<td></td>
<td>L/R MPCD</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VRX</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DSS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DVMS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ADC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SAAHS</td>
</tr>
<tr>
<td></td>
<td>INVERTER</td>
<td>TURN AND SLIP INDICATOR</td>
</tr>
<tr>
<td></td>
<td>UFC</td>
<td>STANDBY ATTITUDE INDICATOR</td>
</tr>
<tr>
<td></td>
<td>VRS</td>
<td>STANDBY ALTIMETER</td>
</tr>
<tr>
<td></td>
<td>FLIR</td>
<td>STANDBY REFERENCE</td>
</tr>
<tr>
<td></td>
<td>EDP</td>
<td>ALTIMETER VIBRATOR</td>
</tr>
<tr>
<td></td>
<td>VRX</td>
<td>DISPLAY PROCESSOR-GENERATOR</td>
</tr>
<tr>
<td>MC</td>
<td>MISSION COMPUTER</td>
<td></td>
</tr>
<tr>
<td>CNI</td>
<td>ON</td>
<td>MISSION COMPUTER</td>
</tr>
<tr>
<td></td>
<td>OFF</td>
<td>UHF/VHF NO.1</td>
</tr>
<tr>
<td></td>
<td>ON</td>
<td>INS</td>
</tr>
<tr>
<td></td>
<td>OFF</td>
<td>UHF/VHF NO.2</td>
</tr>
<tr>
<td></td>
<td>OFF</td>
<td>DVMS</td>
</tr>
<tr>
<td></td>
<td>OFF</td>
<td>ECM</td>
</tr>
<tr>
<td></td>
<td>OFF</td>
<td>RADAR</td>
</tr>
<tr>
<td></td>
<td>OFF</td>
<td>RWR</td>
</tr>
<tr>
<td></td>
<td>OFF</td>
<td>DECM/ASPJ</td>
</tr>
<tr>
<td>G/P B</td>
<td>OFF</td>
<td>KY-58</td>
</tr>
<tr>
<td>IGN ISO</td>
<td>MAX</td>
<td>REFER TO ENGINE FUEL SYSTEM, PARAGRAPH 2.3.6.2</td>
</tr>
<tr>
<td>JPTL TEST</td>
<td>OFF</td>
<td>REFER TO ENGINE CONTROLS, PARAGRAPH 2.4.6</td>
</tr>
<tr>
<td>JPTL TEST</td>
<td>AMPL</td>
<td></td>
</tr>
</tbody>
</table>

**PART 3 – COCKPIT & GAUGES**
PART 3 – COCKPIT & GAUGES

- Air Refueling Probe
- Engine Cold Air Outlet
- Zero Scarf Forward (Fan/Cold air) Nozzle
- Rear Swivelling Hot Stream Engine Exhaust Nozzle
Engine Intake Blow-In Doors
PART 3 – COCKPIT & GAUGES

Airbrake
Main Landing Gear
Twin-Wheels
Wing wheel
Nosewheel
Upper Countermeasure Dispensers (4 x 30 chaff or flares)
Bottom Countermeasure Dispensers (2 x 30 chaff or flares)
Tail Radome
Wing wheel
Airbrake
Main Landing Gear Twin-Wheels
Wing wheel
Nosewheel
Yaw Vane
Used to get direction of wind relative to you. When hovering, you should make sure to keep it straight to hover into the wind direction.
LIDS: Lift Improvement Device System

The LIDS itself can be seen as the small wing-like structures or "Strakes" on the underside, underneath the nozzles. The LIDS switch controls the "fence" panel, which is located just behind the main landing gear to prevent the recirculating air cushion from escaping out the front.

When the harrier is in hover at low altitude, the recirculating air from the exhaust is harnessed to essentially form a cushion to provide additional lift during vertical landing.

LIDS are also designed to reduce the effect of hot gas ingestion (HGI) through recirculation of exhaust gases into the engine intake when operating vertically, since an increase in inlet temperature can cause a significant loss of thrust. This reduces HGI substantially.
Aircraft Designation

The Tail Number you enter in the Mission Editor are actually the last three digits of the aircraft’s Bureau Number (BuNo), or the USN/USMC serial number. For tactical aircraft, the BuNo is unrelated to the aircraft’s “Side Number” (the one you see painted on the nose and flaps). The “Side Number” you see on the aircraft is the first the first BuNo digits reversed so that there is no obvious correlation.

As an example: “810” entered in the Tail # field of the mission editor will give “18” on the aircraft’s “Side Number”.

18: Side Number

VMA-231: Marine Attack Squadron 231

163810: Serial Number (BuNo)

Last 3 digits of Serial Number (BuNo)
Note 1: You must contact the ground crew to equip either the Helmet Visor or Night Vision Goggles (NVGs). Using "\", then F8 (Ground Crew), then F4 (Change helmet-mounted device) then either F1 or F2 for your desired helmet type.

Note 2: NVGs have to be equipped from the mission editor too for air spawns.
PART 3 – COCKPIT & GAUGES

NIGHT VISION GOGGLES
ON/OFF: LSHIFT + N
PRE-START-UP

1. Close and Lock Canopy
2. LIDS (Lift Improvement Device System) Switch – NORM (AFT)
3. Oxygen Switch – ON (FWD)
4. SAS (Stability Augmentation System) Pitch Switch – ON (FWD)
5. SAS (Stability Augmentation System) Roll Switch – ON (FWD)
6. SAS (Stability Augmentation System) Yaw Switch – ON (FWD)
7. Q-Feel switch – ON (FWD)
8. Rudder Pedal Shaker (RPS/YAW) Switch – ON (MIDDLE)
9. Anti-Skid Switch – ON (MIDDLE)
The Harrier is equipped with a GTS (Gas Turbine Starter), also referred to as APU (Auxiliary Power Unit). Many aircraft use the APU to provide pneumatic pressure for the engine starter, but the Harrier uses an electrical starter instead.

The GTS serves a dual purpose: to provide electrical power when the engine main generators are OFF and to provide a starting mechanism for the engine. The GTS/APU has two operation modes:

- **Mode 1: APU Generator Mode**
  This mode is used on ground to recharge the battery and supply electrical power to avionics systems. This is achieved when the APU GEN switch is turned on.

- **Mode 2: Starter Mode**
  This mode is used to spool the engine electrical starter and is automatically selected by the ENG ST switch.

**DIRECT ENGINE START:** If the ENG ST (START) switch is held and the GTS/APU is not running, the GTS starts and accelerates to operating speed within 25 seconds. When the engine attains self-sustaining speed, the GTS automatically disengages and the engine start switch returns to OFF. If the GTS does not match operating speed within 25 seconds or the main engine is not self-sustaining within 40 seconds, the GTS automatically shuts down and the engine start switch returns to OFF.

**TRANSLATION ENGINE START** If the ENG ST (START) is held and the GTS/APU is already running in APU GEN mode, the APU generator drops offine, the APU switch automatically returns to OFF, the 40-second GTS shutdown protection circuit is activated and the main engine is automatically engaged for start.

Take note that the GTS/APU cannot run both modes at the same time. Additionally, if the APU is turned on before takeoff and the main engine-driven generator is operating, the APU will automatically shut down when the aircraft reaches 325 kts.
PART 4 – START-UP PROCEDURE

1. Parking Brake Lever – ON (AFT)
2. Battery Switch – BATT (FWD)
3. Main Generator Switch – GEN (FWD)
4. Check that Voltmeter is at least 24.5 V
5. Engine RPM Switch – LOW
6. EFC (Engine Fuel Control) Switch – POS 1
7. Left/Right Boost Pump Switches – NORM (FWD)
8. Fuel Flow Proportioner – ON (FWD)
9. JPTL (Jet Pipe Temperature Limiter) Switch – ON (AFT)
11. Throttle – OFF (fully AFT)
12. Set Nozzle position lever – Between AFT and 10 deg
13. Fuel Shutoff Handle – ON (DOWN)
14. DECS (Digital Engine Control System) switch – ON
START-UP PROCEDURE

15. Optional: APU GENERATOR switch – ON
16. Optional: Confirm that APU advisory is ON
17. Optional: Confirm that APU GEN light is OUT
18. Press the Master Warning Reset switch to get rid of the aural warning messages
19. Set Left and Right MPCI brightness knobs
20. Click on « ENG » OSB (Option Select Button) to set right MPCI to the Engine Data page
START-UP PROCEDURE

21. Set Engine Start Switch – ENG ST
   • On a direct engine start (GTS/APU is OFF), the GTS normally lights off in about 5 seconds automatically, after which the engine begins to rotate.
   • On a translation engine start (GTS/APU is already started), there is a 10 second deceleration of the APU (Auxiliary Power Unit) before the GTS (Gas Turbine Starter) engages to start the engine.

22. Once engine RPM starts rising, move throttle lever forward to GROUND IDLE position. The throttle will mechanically stop at GROUND IDLE since the parking brake lever acts as a safety stopper.

23. Check that Engine Start switch automatically resets at OFF prior to 15 % RPM. If it doesn’t, set it to OFF manually to prevent damage to the GTS.

24. Check that RPM stabilizes at IDLE RPM (between 28.4 and 29 % RPM)

25. Check that JPT (Jet Pipe Temperature) does not exceed 545 deg C.

26. Check that HYD 1 and HYD 2 Pressure stabilize at 3000 +/- 200 psi.

27. Check that brake accumulator Pressure stabilizes at 3000 +/- 200 psi.

28. Set Nozzle position lever to 10 deg (will prevent excessive wear on the tail plane and flaps due to the heat and jet efflux acting on those control surfaces)
29. Set Seat Ground Safety Lever – DOWN
30. Set Flaps Power Switch – ON (MIDDLE)
31. Set Flaps Mode Switch – CRUISE (UP)
32. Set RWR (Radar Warning Receiver) Switch – ON
33. Set EXP (Expendables Decoy Dispenser) Switch – AUTOMATIC
34. Set DECM (Defensive Electronic Countermeasure) Switch – STBY
35. Set left MPCD Brightness knob and click on « EHSD » OSB (Option Select Button) to set left MPCD to the Electronic Horizontal Situation Display page
The ASN-139 INS (Inertial Navigation System) has four alignment modes:

- **SEA**: Alignment performed aboard a carrier by plugging in a SINS (Sea INS) cable. Uses the carrier’s own inertial navigation system to achieve INS precision.
- **GND**: Ground mode can only be performed with the aircraft on land.
- **IFA (GPS)**: In-Flight Alignment uses the aircraft’s built-in GPS (Global Positioning System). This alignment can be performed anywhere.
- **GYRO**: Degraded mode which provides a quick alignment process, but present position data is not available. This alignment can be performed anywhere.

Note: There are three INS alignment sub-modes:

- **SHDG**: (Stored heading alignment): Uses pre-existing heading for Ground & Sea modes, which accelerates alignment process.
- **Manual Sea Alignment**: performs a manual alignment without the carrier’s SINS (Sea INS).
- **GPS airborne alignment**: available for IFA

**INS ALIGNMENT OVERVIEW**

Before starting INS alignment, always make sure the INS Mode switch is set to OFF.
INS ALIGNMENT OVERVIEW

The difference between UNALIGNED, SAVED HEADING ONLY and PRE-ALIGNED is what data is already available in the INS when starting the alignment.

- **UNALIGNED**: You have to input IPP (Initial Present Position) data, magnetic variation and align the INS.
- **SAVED HEADING ONLY**: You still have to align the INS, but present position data is already in the system and you can bypass one of the steps. It has a faster alignment period.
- **PREALIGNED**: The INS is aligned from the get go.

Alignment options: unaligned, saved heading, or pre-aligned.

Unaligned (Requires alignment on IPP)

Saved Heading Only (Requires alignment on IPP)

Pre-Aligned (Does not require alignment on IPP)
36. Set IPP (Initial Present Position) if the aircraft is not pre-aligned, then start GND INS (Inertial Navigation System) alignment phase. Steps preceded by « * » are not required if the « PRE-ALIGNED » option is ticked in the Special Options tab.
   a) Make sure parking brake is engaged
   b) Set DISPLAY Brightness Knob
   c) * Select MENU->EHSD->DATA->A/C menu on the MPCD.
   d) * Press F10 and set your cursor on your aircraft. Alternatively, use F2. Write down your coordinates (i.e. 42°14’35” North 42°02’14” East in deg, min, sec). Keep in mind that the coordinate input to the Up-Front Controller is in deg, min, sec, while the displayed coordinate format on the EHSD is in deg, min decimals.
36. Set IPP (Initial Present Position) if the aircraft is not pre-aligned, then start GND INS (Inertial Navigation System) alignment phase. Steps preceded by « * » are not required if the « PRE-ALIGNED » option is ticked in the Special Options tab.

d) * Press F10 and set your cursor on your aircraft. Alternatively, use F2. Write down your coordinates (i.e. 42°14'35" North 42°02'14" East in deg, min, sec) Keep in mind that the coordinate input to the Up-Front Controller is in deg, min, sec, while the displayed coordinate format on the EHSD is in deg, min decimals.

e) * Press the POS (Position) ODU (Option Display Unit) to select the coordinate Latitude ("":"will appear next to it when selected).

f) * On the UFC, press « 2 » (N) to select North coordinates, type « 421435 », then « ENT » to enter them.

g) * Press on the POS ODU again to select the coordinate Longitude.

h) * On the UFC, press « 6 » (E) to select East coordinates, type « 0420214 », then « ENT » to enter them. Don’t forget to add the 0 at the beginning.

i) * Enter the correct MVAR (Magnetic Variation) based on where you are. Press the ODU next to MVAR ("":"will appear next to it when selected), press « 6 » (E) to select East coordinates, and then type « 6.0 », then « ENT » to enter the magnetic variation of 6.0 East deg.

- Caucasus = approx +6° (East)
- Nevada = approx +12° (East)
- Normandy = approx +8° (East)
- Persian Gulf = approx +1.6° (East)
INS ALIGNMENT (GROUND)

36. Set IPP (Initial Present Position) if the aircraft is not pre-aligned, then start GND INS (Inertial Navigation System) alignment phase. Steps preceded by « * » are not required if the « PRE-ALIGNED » option is ticked in the Special Options tab.

j) Set INS mode switch to ALIGN GND INS.

k) During the first 1 to 2 minutes of alignment, the indicator has ATT NOT OK displayed to the right of QUAL (Alignment Quality).

l) Once the message QUAL 0.7 OK appears, you can consider your alignment to be complete.

m) Set INS mode switch to IFA (In-Flight Alignment coupled with GPS).
36. Start INS (Inertial Navigation System) alignment phase by connecting the SINS (Sea INS) data cable to the aircraft. Then, start SEA INS (Inertial Navigation System) alignment phase.
   a) Make sure parking brake is engaged
   b) Set DISPLAY Brightness Knob
   c) Select MENU->EHSD->DATA->AC menu on the MPCD.
36. Start INS (Inertial Navigation System) alignment phase by connecting the SINS (Sea INS) data cable to the aircraft. Then, start SEA INS (Inertial Navigation System) alignment phase.

d) Contact ground crew and request electrical power by pressing « \ », then pressing F8 (Ground Crew), F2 (Ground Electric Power), then F1 (ON).
e) Electrical power will be applied and SINS (Sea INS) data cables will be connected from the carrier’s INS system to the aircraft.
f) Set INS mode switch to ALIGN SEA INS (SINS).
g) During the first 1 to 2 minutes of alignment, the indicator has ATT NOT OK displayed to the right of QUAL (Alignment Quality).
h) Once the message QUAL 0.7 OK appears, you can consider your alignment to be complete.
i) Set INS mode switch to IFA (In-Flight Alignment coupled with GPS).
j) Remove ground power / disconnect SINS cable.
**PART 4 – START-UP PROCEDURE**

37. Set ALT switch – RDR (Radar Altimeter ON)
38. Set Radio 1 & 2 Volume Knobs
39. Set COMM1 and COMM2 Radios to desired frequencies
40. Set HUD SYMBOLOGY Brightness Knob
41. Set HUD VIDEO Brightness Knob
42. Set HUD VIDEO Contrast Knob
43. On the EHSD menu, unselect the DATA menu.
44. Set FLIR Switch – ON (UP)
45. Set DMT (Dual Mode Tracker) Switch – ON (UP)
46. Set PROBE HEAT switch – AUTO
1. Ensure Anti-Skid Switch is set to ON (Middle Position), and flaps are ON (MIDDLE position) and at CRUISE (UP position), and Nozzle angle is at 10 deg
2. Select VSTOL (Vertical Short Takeoff & Landing) Master Mode Switch
3. Set trim to 0 deg rudder, 0 deg aileron, and 4 deg stabilator nose down.
4. Release Parking Brake Lever (FWD)
5. Throttle up to taxi
PART 5 – TAKEOFF

6. If you need to slow down, set Nozzle Control Lever between 45 and 60 degrees to better control taxi speed.

7. Press and hold the « AG Target Undesignate/NWS/FOV Toggle » HOTAS button (RWIN + N key binding by default) and use your rudder pedals to steer the aircraft.

Nosewheel Steering (NWS) Modes (NWS HOTAS Button):
- **CASTER**: Nose wheel is free to swivel, and rudder pedal movement is isolated from the NWS system.
- **LOW GAIN**: Rudder pedals are connected to the system, with a range of movement between +/- 14 deg.
- **HIGH GAIN**: Rudder pedals are connected to the system, with a range of movement between +/- 45 deg. HI GAIN is undesirable above 20 kts ground speed due to poor directional control characteristics. This is used mainly on very tight spaces like on a carrier.

Anti-Skid Modes (ANTSISKID Switch):
- **TEST**: Test Mode
- **ON**: Anti-Skid ON (NWS CASTER Mode by default, NWS LO GAIN when NWS HOTAS button is pressed)
- **NWS**: Anti-Skid OFF (NWS LO GAIN Mode by default, NWS HI GAIN when NWS HOTAS button is pressed)
TAKEOFF PRINCIPLES

Taking off and landing in the Harrier is one of the most interesting part of the aircraft: you can takeoff using a conventional method, but you can also takeoff vertically or perform a rolling takeoff depending on how much runway you have available or if you are operating on a FARP (Forward Arming & Refueling Point), an aircraft carrier or an amphibious assault ship like the LHA-1 USS Tarawa.

Taking off in real life requires performance charts to estimate various parameters like the Nozzle Rotation Airspeed (NRAS). The A1-AV8B-NFM-400 (NATOPS FLIGHT MANUAL PERFORMANCE CHARTS) document gives you charts and graphs to calculate everything you need.

Don’t gasp in horror like that, we won’t go as deep. I’ll just give you some ballpark figures to get you up to speed without having to do much performance calculations.
TAKEOFF PRINCIPLES

Flyco on the Eagle Dynamics forums graciously produced a data sheet giving representative data for takeoff. This is accurate only for Standard Temperature and Pressure (ISA, or 29.92 in Hg/1013.25 hPa and 15 degrees C).

Performance
Best Climb Speed 300 kts > 0.78M
Penetration 280 kts

Climb @ 300 kias to Cruise Ht shown Cruise @ MN shown Descend @ 230 kias
Fuel remaining at bottom of descent 800 lbs (200 lbs for Vert Ldg + 600 lbs reserve)

<table>
<thead>
<tr>
<th>Fuel Remaining</th>
<th>1000 lbs</th>
<th>1500 lbs</th>
<th>2000 lbs</th>
<th>3000 lbs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climbed to Height</td>
<td>5,000 ft</td>
<td>15,000 ft</td>
<td>20,000 ft</td>
<td>30,000 ft</td>
</tr>
<tr>
<td>Cruise at</td>
<td>0.40 M</td>
<td>0.62 M</td>
<td>0.78 M</td>
<td>0.75 M</td>
</tr>
<tr>
<td>Total Range</td>
<td>17 nm</td>
<td>84 nm</td>
<td>178 nm</td>
<td>357 nm</td>
</tr>
</tbody>
</table>

AV-8B – DATA & LIMITATIONS

<table>
<thead>
<tr>
<th>Aircraft Weights</th>
<th>ZFW – 13,537 lbs</th>
<th>Max Int Fuel &amp; Water – 21,737 lbs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max Wt – 31,086 lbs</td>
<td>Max Ldg Wt – 26,000 lbs</td>
<td></td>
</tr>
</tbody>
</table>

| Limiting Speeds | Max – 585 kias | 1.0 M | Gear – 250 kias | Flaps – 300 kias 0.87 M |

<table>
<thead>
<tr>
<th>Engine Limits</th>
<th>Max Continuous</th>
<th>102 % 645 °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wet</td>
<td>RPM</td>
<td>120 %</td>
</tr>
<tr>
<td>JPT</td>
<td>800 °C</td>
<td>780 °C</td>
</tr>
<tr>
<td>Dry</td>
<td>RPM</td>
<td>115.5 %</td>
</tr>
<tr>
<td>JPT</td>
<td>780 °C</td>
<td>765 °C</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Take-Off Data</th>
<th>All at Standard Temperature &amp; Pressure (STP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hover Power for Weight</td>
<td>14000</td>
</tr>
<tr>
<td>RPM</td>
<td>104.3 %</td>
</tr>
<tr>
<td>JPT</td>
<td>627 °C</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Short Take-Off</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
</tr>
<tr>
<td>NRAS</td>
</tr>
<tr>
<td>Nozzle</td>
</tr>
<tr>
<td>Distance</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Conventional Take-Off</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
</tr>
<tr>
<td>Lift-off Speed</td>
</tr>
<tr>
<td>Distance</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Landing Data</th>
<th>At STP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional Landing</td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>18,000</td>
</tr>
<tr>
<td>Threshold Speed</td>
<td>142 kts</td>
</tr>
<tr>
<td>Distance</td>
<td>5200 ft</td>
</tr>
</tbody>
</table>
1. Set STO STOP stopper fully AFT (CLEAR)
2. Set Nozzle Position Lever – 10 deg
3. Flaps Lever – AUTO
4. Set H2O Water Injection Switch – TAKEOFF (UP) (only if required in case of heavy payload)
5. Set Stabilator Trim to Takeoff Trim (2 deg nose down)
6. Check that Anti-Skid Switch is ON (very important!)
7. Hold Brakes
8. Throttle up and press the NWS HOTAS button to line up the aircraft with the center of the runway if need be
9. Rotate very gently at around 175 kts
10. During liftoff, ensure wings remain level and center the sideslip vane to takeoff into the wind
11. Set aircraft attitude: line up Witch Hat with the Pitch Carets (currently set to a fixed value of 14, or 6 deg elevation).
12. After liftoff, set landing gear lever UP
13. Gradually set Nozzles to 0 deg
14. Set Water H2O Water Injection Switch – OFF (MIDDLE)
CONVENTIONAL TAKEOFF (CTO)

9: Rotate at 175 kts

10

11 Pitch Carets

11 Witch Hat

CHECK THE ENGINES SECTION TO KNOW MORE ABOUT ENGINE OPERATION & LIMITS
SHORT TAKEOFF (STO)

1. Set STO STOP stopper at 55 or 50 deg based on your weight. For this tutorial, we will assume 95% gross weight.
2. Set Nozzle Position Lever – 10 deg
3. Flaps Lever – AUTO (or STOL if desired)
4. Set H2O Water Injection Switch – TAKEOFF (UP) (only if required in case of heavy payload)
5. Set Stabilator Trim to Takeoff Trim (2 deg nose down)
6. Check that Anti-Skid Switch is ON (very important!)
7. Hold Brakes
8. Throttle up and press the NWS HOTAS button to line up the aircraft with the center of the runway if needed
9. When reaching the Nozzle Rotation Speed (110 kts in our case), set Nozzle Position Lever AFT to the STO position set in step 1), which is 55 deg in our case. The STO STOP lever will act as a mechanical stopper to your Nozzle lever.
10. You should start ascending vertically
11. During liftoff, ensure wings remain level and center the sideslip vane to takeoff into the wind

**Recommended Rotation Speed (NRS) & Nozzle Setting Parameters for STO (by Nealius)**

<table>
<thead>
<tr>
<th>Aircraft Weight (Max Gross Weight = 31000 lbs)</th>
<th>NRS (kts)</th>
<th>Nozzle Setting (deg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>70% Max Gross Weight (21700 lbs)</td>
<td>60</td>
<td>55</td>
</tr>
<tr>
<td>81% Max Gross Weight (25100 lbs)</td>
<td>80</td>
<td>55</td>
</tr>
<tr>
<td>85% Max Gross Weight (26350 lbs)</td>
<td>90</td>
<td>50</td>
</tr>
<tr>
<td>88% Max Gross Weight (27300 lbs)</td>
<td>95</td>
<td>50</td>
</tr>
<tr>
<td>90% Max Gross Weight (27900 lbs)</td>
<td>100</td>
<td>50</td>
</tr>
<tr>
<td>95% Max Gross Weight (29450 lbs)</td>
<td>110</td>
<td>50</td>
</tr>
</tbody>
</table>
PART 5 – TAKEOFF

SHORT TAKEOFF (STO)

12. Set aircraft attitude: line up Witch Hat with the Pitch Carets (currently set to a fixed value of 14, or 6 deg elevation).
13. After liftoff, set landing gear lever UP
14. Gradually set Nozzles to 0 deg (maintain nozzles at 25 deg while flaps are still in STOL at 25 deg)
15. Set Water H2O Water Injection Switch – OFF

CHECK THE ENGINES SECTION TO KNOW MORE ABOUT ENGINE OPERATION & LIMITS
VERTICAL TAKEOFF (VTO)

Note: Check beforehand that your aircraft weight is below 20500 lbs or you may never leave the ground. Vertical takeoffs are very restrictive in terms of what payload you can carry.

1. Set STO STOP stopper fully AFT (CLEAR)
2. Set Nozzle Position Lever – 82 deg
3. Flaps Lever – STOL
4. Set H2O Water Injection Switch – TAKEOFF (UP) (only if required in case of heavy payload)
5. Set Stabilator Trim to Takeoff Trim (2 deg nose down)
6. Check that Anti-Skid Switch is ON
7. Hold Brakes
8. Throttle up gradually until liftoff
9. During liftoff, ensure wings remain level and center the sideslip vane to takeoff into the wind. Adjust attitude to prevent fore/aft drift.
PART 5 – TAKEOFF

10. When clear of ground effect (20-25 ft), gradually reduce power to establish hover.
11. When passing 50 ft and clear of obstacles, begin transition to forward flight by gradually setting Nozzles to 0 deg.
12. After liftoff, set landing gear lever UP.
13. Set Flaps switch to AUTO.
14. Set Water H2O Water Injection Switch – OFF (MIDDLE)

CHECK THE ENGINES SECTION TO KNOW MORE ABOUT ENGINE OPERATION & LIMITS.

Monitor climb and descent rate closely.

Altitude

Ground Speed

CHECK THE ENGINES SECTION TO KNOW MORE ABOUT ENGINE OPERATION & LIMITS.
Note: You need at least 100 ft of runway to perform a RVTO. Keep in mind that vertical takeoffs are restrictive in terms of what payload you can carry. Typically, RVTOs in the Harrier are not performed on carriers. There is a proper carrier STO takeoff procedure available in the NAVAIR 00-80T-106. This example is purely for illustrative purposes only.

1. Set STO STOP stopper at 70 deg
2. Set Nozzle Position Lever – 70 deg
3. Flaps Lever – STOL
4. Set H2O Water Injection Switch – TAKEOFF (UP) (only if required in case of heavy payload)
5. Set Stabilator Trim to Takeoff Trim (2 deg nose down)
6. Check that Anti-Skid Switch is ON
7. Hold Brakes
8. Throttle up and press the NWS HOTAS button to line up the aircraft with the center of the runway if need be
9. You should start ascending vertically
10. During liftoff, ensure wings remain level and center the sideslip vane to takeoff into the wind
11. As you start ascending, gradually reduce throttle and set Nozzles to 0 deg
12. After liftoff, set landing gear lever UP
13. Set Flaps switch to AUTO
14. Set Water H2O Water Injection Switch – OFF (MIDDLE)

CHECK THE ENGINES SECTION TO KNOW MORE ABOUT ENGINE OPERATION & LIMITS
Vertical landing on a ship needs some preparation. You cannot land vertically in any configuration: you need to make sure that you are light enough to be able to hover without smashing yourself against the ship’s deck.

To land successfully on a ship, your weight must not exceed 20500 lbs. This is why you’ll have to calculate your weight on landing. Redkite prepared some nice sheets to help you do it.

**Example of Weight Calculation:**

You approach the Tarawa loaded with the following weight:
- Airframe (14000 lbs) + Water Tank (500 lbs)
- Gunpod (1313 lbs)
- 2 x Sidearms (2 x 200 lbs)
- 2 x Mavericks AGM-65F (2 x 485 lbs)
- A targeting pod (445 lbs)
- 4100 lbs fuel
- A pilot + Equipment (300 lbs approx.)

Your total weight is 22028 lbs, which is roughly 1500 lbs over the limit.
WEIGHT CALCULATIONS

Note: the VREST page also has the BAW (Basic Aircraft Weight) value available in lbs.
In order to see what you have loaded, you can consult the STORES page on your MPCD:
1. Click the OSB next to MENU
2. Click the OSB next to STRS (Stores)
3. You will have the STORES page open. As an example, you can see the Targeting Pod (TPOD), the Maverick (IRMV) and the Sidearm (SA) missiles on their respective pylons.
If we take an example where we are 1500 lbs overweight, we can either:
• Fly until we burn the excess fuel
• Dump the excess fuel
• Jettison our weapons

Jettisoning expensive missiles may not be the best idea for the taxpayer... I'm just saying. Still, it's a simulator, so I'll show you how to dump fuel and jettison ordnance.

**Jettison Ordnance**
1. Set the Jettison Control white knob to STA (Selected Stations)
2. Press the « SEL » buttons at the stations you wish to jettison (try to avoid having an asymmetric configuration)
3. Alternatively, you can set the Selective Jettison Control Knob to specific preset positions like FUEL to select automatically external fuel tanks.
4. Press the JETT red button to jettison.

---

**Dump Fuel**

a. Calculate the Bingo Fuel you need to land: 4100 lbs – 1500 lbs = **2500 lbs**
b. Set Bingo Fuel knob to 2500 lbs
c. Set the Left and Right Fuel Dump switches FWD (DUMP)
d. The fuel tanks will dump fuel until either BINGO FUEL target is reached or 2800 lbs remains (whichever comes first).
e. Once d) is completed, Left and Right Fuel Dump Switches will automatically reset.
1. Set Anti-Skid Switch to ON (Middle Position)
2. Select VSTOL (Vertical Short Takeoff & Landing) Master Mode Switch
3. STO STOP lever – CLEAR
4. Set Nozzle Position lever – 60 deg
5. Set flaps to STOL for a vertical landing
6. Set Water Injection switch – LANDING (DOWN)
7. Set Stabilator Trim – 4 degrees nose down
8. Set landing gear lever down when flying below 250 kts
9. As you slow down at 130-140 kts, level off at 150 ft to avoid sinking and set Nozzle Position lever – 82 deg

10. Control your Flight Path Vector with your throttle and your witch hat with your stick pitch. Monitor constantly your variometer (sink rate in feet per minute), your Jet Pipe Temperature (J) and your engine RPM (R) in order to not exceed limitations.

11. Set Flight Path Vector on ship deck on the yellow line as you approach

12. As you slow down below 50 kts (carrier speed in our case is 20 kts), set witch hat 4 deg above horizon to set yourself in a hover attitude

13. Set Witch Hat 2 deg above horizon and stabilize descent with throttle. Nose up/down to maintain enough airspeed to follow the carrier.

14. Touchdown gently by monitoring variometer and hit the brakes once landed.

Demonstration by Redkite: https://www.youtube.com/watch?v=mWad6tuZXFg&index=10&list=PLml_c09ciucv3CIsWImCEqY5XIdbfPux
VERTICAL LANDING (VL)
PART 6 – LANDING

SLOW LANDING (SL) VARIABLE NOZZLE

SLOW LANDING (SL) FIXED NOZZLE
1. Set Anti-Skid Switch to ON (Middle Position)
2. Select VSTOL (Vertical Short Takeoff & Landing) Master Mode Switch
3. STO STOP lever – CLEAR
4. Set Nozzle Position lever – 0 deg
5. Set flaps to AUTO (25 deg)
6. Set Water Injection switch – OFF (MIDDLE)
7. Set landing gear lever down when flying below 180 kts
8. Set Flight Path Vector on end of runway
9. Set an AoA (Angle of Attack) of 10 to 12 degrees by using throttle to control the AoA.
10. At 30 to 50 ft AGL: Set Witches Hat 2 degrees above the horizon and control rate of descent with throttle
11. Touchdown when reaching runway threshold and cut throttle to slow down.
12. Engage Nosewheel Steering HOTAS button when rolling straight and pedals are neutralized
CONVENTIONAL LANDING (CL)

Pitch Scale

Witch Hat
The AV-8B N/A also fields an updated version of the **Rolls-Royce Pegasus 11-61** (F402-RR-408) vectored-thrust turbofan engine.

In the 1950’s, there was a perceived need for combat runways for takeoff and landing, and which could, if required, be dispersed for operation from unprepared and concealed sites. Naval interest focused on a similar objective to enable shipborne combat aircraft to operate from helicopter-size platforms and small ships, because of the high cost and expected vulnerability of large aircraft carriers. During the 1950s, numerous projects and research programs were initiated in the United States and Western Europe to study and validate alternative means of achieving the required short or vertical takeoff (VTO) and landing characteristics. One of the answers of the industry to this concern for short runway requirements resulted in the Pegasus.

Originally designed by Bristol Siddeley, the Pegasus was manufactured by Rolls-Royce plc and was not only able to power a jet aircraft forward, but also to direct thrust downwards via four swivelling nozzles. Lightly loaded aircraft equipped with this engine can manoeuvre like a helicopter. In particular, they can perform vertical takeoffs and landings. The Pegasus features three low pressure (LP) and eight high pressure (HP) compressor stages driven by two LP and two HP turbine stages respectively. The Pegasus 11-61 (MK.107, aka -408) is the latest and most powerful version of the Pegasus, providing 23,800 lbf (406 kN).

Unusually, the LP and HP spools rotate in opposite directions to greatly reduce the gyroscopic effects which would otherwise hamper low speed handling. LP and HP fan blading is made of titanium, and the LP fan blades operate in the partly supersonic region. Engine starting is done by a top-mounted packaged combined gas turbine starter/APU.
The Pegasus engine has multiple engine parameters. Engine RPM and Jet Pipe Temperature (JPT) can be monitored on the Heads-Up Display if the VSTOL Master Mode is ON.

- SORTIE JPT: Engine Outlet Jet Pipe Temperature
- Max JPT: Maximum Jet Pipe Temperature allowable
- OT TIME: Time available while in overtemperature
- IGV: Inlet Guide Vane Position (deg). IGVs may be visualized as a valve controlling corrected air mass flow into the high pressure compressor.
- COMP RPM: Low Pressure Compressor Speed
- FAN RPM: Bypass Fan Speed
- JPT: Jet Pipe Temperature
- COR COMP: High Pressure Compressor Speed (Engine Core)
- COR FAN: High Pressure Fan Speed (Engine Core)
- FUEL WT: Fuel Weight (lbs)
You will often hear “Dry Thrust” and “Wet Thrust” when reading about the Harrier. Is it related to water? Sort of. Is it related to flying over water? Umm... no.

Dry thrust usually refers to « non-augmented” thrust. This means thrust produced without the use of afterburners or liquid injection. The maximum thrust produced by jet engines without afterburner is sometimes called MIL (Military) thrust.

Wet thrust, on the other hand, refers to « augmented » thrust. The thrust of a jet engine can be increased by using methods like water/methanol injection (mostly in older turbojet engines) or by using afterburners (reheaters).

Keep in mind that thrust in the Harrier can create a very unstable flight in certain conditions. Consult the pictures to the right and test out the behaviour of the harrier in vertical flight while hovering.
The Pegasus engine of the Harrier requires constant monitoring. The Pegasus is prone to overheating, especially in phases of flight like takeoff and hover.

RPM and JPT (Jet Pipe Temperature) are the primary parameters that you will have to keep an eye on.

If you use the “VSTOL” Master Mode, your engine parameters can be monitored directly on the HUD (Heads-Up Display) with their power margins.

The “Combat Thrust” rating can be selected by pressing the CMBT switch/light, which will give you additional thrust. A side-effect of this rating is that your JPT will increase to a point where you can’t use this rating more than a few minutes (about 10 minutes).

**Engine Limits**

<table>
<thead>
<tr>
<th>RATING</th>
<th>Notes</th>
<th>MAXIMUM % RPM</th>
<th>MAXIMUM °C JPT</th>
<th>COMBINED TIME LIMITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHORT LIFT WET</td>
<td>1</td>
<td>120.0</td>
<td>800</td>
<td></td>
</tr>
<tr>
<td>SHORT LIFT DRY</td>
<td></td>
<td>113.5</td>
<td>780</td>
<td></td>
</tr>
<tr>
<td>NORMAL LIFT WET</td>
<td>1, 2</td>
<td>116.0</td>
<td>780</td>
<td></td>
</tr>
<tr>
<td>NORMAL LIFT DRY</td>
<td>2</td>
<td>111.0</td>
<td>765</td>
<td></td>
</tr>
<tr>
<td>COMBAT</td>
<td></td>
<td>110.0</td>
<td>750</td>
<td></td>
</tr>
<tr>
<td>MAXIMUM THRUST</td>
<td></td>
<td>109.0</td>
<td>710</td>
<td></td>
</tr>
<tr>
<td>MAXIMUM CONTINUOUS</td>
<td>2</td>
<td>102.0</td>
<td>645</td>
<td>UNLIMITED</td>
</tr>
<tr>
<td>IDLE</td>
<td>5</td>
<td>28.4 – 29.0</td>
<td>545</td>
<td>UNLIMITED</td>
</tr>
<tr>
<td>STARTING</td>
<td>2, 4</td>
<td>475</td>
<td></td>
<td>MOMENTARILY</td>
</tr>
</tbody>
</table>

1. Do not use water injection below ambient temperatures of -5°C or at altitude above 10,000 feet.
2. Requires pilot action to maintain limit.
3. Each 2.5 or 10.0 minute period of operation at the lift or combat ratings respectively must be separated by a minimum of 1 minute at maximum thrust or below.
4. Slow or abortive starting attempts should be discontinued without waiting for JPT to reach 475°C.
5. The minimum allowable sub-idle RPM is 22%
The Power Margin Indicator indicates the limiting engine parameter, either R (RPM) or J (Jet Pipe Temperature). The Hexagon gradually fills up as JPT/RPM increases. The last leg of the hexagon continues in a straight line and indicates an exceedance: avoid to remain in that engine setting for too long.

<table>
<thead>
<tr>
<th>RPM - %</th>
<th>JPT - °C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DRY</td>
</tr>
<tr>
<td>107.0</td>
<td>715</td>
</tr>
<tr>
<td>108.0</td>
<td>725</td>
</tr>
<tr>
<td>109.0</td>
<td>735</td>
</tr>
<tr>
<td>110.0</td>
<td>745</td>
</tr>
<tr>
<td>111.0</td>
<td>755</td>
</tr>
<tr>
<td>112.0</td>
<td>765</td>
</tr>
<tr>
<td>113.0</td>
<td>775</td>
</tr>
<tr>
<td>113.5</td>
<td>780</td>
</tr>
</tbody>
</table>
The Harrier uses a Water Injection system. This system injects water in order to cool the JPT (Jet Pipe Temperature) by about 20 deg C. The practical effect of water injection is that it allows the engine to reach higher power settings (i.e. engine RPM by 6 to 7 %) without exceeding JPT limits. Adding water increases the mass being accelerated out of the engine, increasing thrust, but it also serves to cool the turbines.

Keep in mind:
1. Operating the engine within these higher limits can seriously reduce engine life and can cause premature engine failure if overused
2. Water Injection will consume water from the water tank while it is used. When you run out of water, it’s gone for good. If you are too heavy and need water injection to land and you have no more water in reserve, you should dump fuel to reduce your weight.
3. Water injection is really used during takeoff and landing. There is no practical use for it in other phases of flight.
4. Do not use water injection below ambient temperatures of 5 deg C, or at altitude above 10,000 ft.
5. Water injection will only be active if the Water Injection Switch is either TO or LDG, and the engine is in a power setting that exceeds limitations listed on the Engine Limitations page.
6. Water flow is stopped by reducing the throttle below 103 to 105 % RPM or by setting the Water Injection Switch to OFF.
The Harrier engine can be troublesome for the uninitiated. Here are some tips:

- **Hot Gas Ingestion (HGI)** is a serious hazard to consider when flying vertically. Avoid doing hover flights and descending too quickly: this can lead hot gas to enter the engine intake and seriously reduce your power, which can be very dangerous when landing or descending.
- Constantly monitor your engine parameters once in a while. The Pegasus CAN break and WILL break if you don’t take good care of it.
- Always make mental calculations for your weight. Aircraft weight limitation exceedance is a critical factor when doing a short or vertical landing, and it is one of the main causes for botched vertical landings in DCS.
ENGINE RELIGHT

In case of an engine flameout, you can attempt to restart it by using the engine start procedure listed in the PART 4 – START-UP PROCEDURE section. The airstart envelope includes manual and normal fuel control.

Notes:
• Corrected fan speed is limited to 116.8 % below 10,000 ft MSL and 110.5 % above 30,000 ft.
• When manual fuel is selected, pilot action is required to maintain all engine limits since engine limiters will be overridden by the pilot.
• Maximum engine overspeed is 122 % for 15 seconds or 124 %

Manual Fuel Switch
AFT = OFF
FWD = ON
**PART 8 – FLIGHT & AERODYNAMICS**

**Airspeed Limitations**
- Flaps – STOL: 300 kts
- Flaps – CRUISE: 0.87 Mach
- Landing Gear – OPERATION/LOCKED DOWN: 250 kts
- Landing Gear – EMERGENCY EXTENSION: 210 kts
- Q-feel disengaged: 500 kts
- One Hydraulics system inop: 500 kts
- Canopy open: 40 kts
- Wheel in contact with ground: 180 kts ground speed
- LIDS fence extended: 200 kts
- Air Refueling Probe extended: 300 kts

**Angle of Attack Limits**

**Prohibited Maneuvers**
1. VTO with asymmetric load/stores greater than 45,000 inch-pounds.
2. STO with asymmetric load/stores greater than 85,000 inch-pounds.
3. CTO with asymmetric load/stores greater than 100,000 inch-pounds.
4. AUTO Flaps SL with asymmetric load/stores greater than 148,000 inch-pounds.
5. STOL Flaps SL with asymmetric load/stores greater than 85,000 inch-pounds.
6. FL with asymmetric load/stores greater than 80,000 inch-pounds.
7. Takeoff with less than 10° nozzles until wingborne.
8. Spin
9. Under 1g for more than 15 seconds.
10. Overtaking aileron high speed stop.
11. Roll over 360°.
12. In accelerating or decelerating transition:
   a. Over 15° AOA above 50 knots with landing gear down.
   b. Between 30 to 100 knots, sideslip requiring more than ½ lateral stick or with RPS on.
13. Rearward or downward translation above 30 knots.
14. Thrust Vector Control (TVC) above 30,000 feet at AOA above onset of stall warning/maneuvering tone.
15. Flight above onset of stall warning/maneuvering tone with more than 60,000 inch-pounds asymmetry.
16. Abrupt simultaneous stabilator, rudder or aileron inputs with more than 90,000 inch-pounds asymmetry.
17. Wingborne flight at any speed with more than 148,000 inch-pounds asymmetry.
18. Flight above 0.68 Mach with more than 90,000 inch-pounds asymmetry. (see note)
19. Departure above 250 knots.
20. Rudder deflection above 0.80 Mach.

**Airspeed Limits Diagram**

**Angle of Attack Limits Diagram**
LIMITS

ACCELERATION LIMITATIONS NOTE
• Maximum permissible acceleration in the takeoff and landing configuration is 0.0 g to 2.0 g.

Acceleration Limits (G)
SYMMETRICAL MANOEUVERS

Acceleration Limits (G)
ASYMMETRICAL MANOEUVERS

NOTE
Air-to-air load is two AIM-9 Sidewinders on pylons 1 and 7 and the GAU-12 gunpod.
THE VIFF CONCEPT

VIFF (Vectoring In Forward Flight) basically involves pilots rotating the nozzles forward from the usual in-flight horizontal position. In doing so, pilots can quickly deplete their airspeed and bleed energy, causing their surprised pursuer(s) to overshoot, suddenly finding their windscreen devoid of any prey they might have previously been chasing. After dropping altitude as a result of VIFFing, the Harrier can now be free to turn the tables on the predator, making the hunter the hunted. In a turning fight, this is an immense advantage for the Harrier’s pilot. But as soon as the pilot VIFFs his opponent, he has to have had a plan for dealing with the bandit, or else he can be in for a world of hurt; that’s not a trick any combat pilot will fall for twice.

On paper, VIFFing sounds like a great idea. However, among VIFF’s disadvantages is the fact that it can only really be used effectively in turning fights. If the pursuing aircraft is flying with a wingman, or as part of a larger attack flight, the odds would be stacked fairly high against the Harrier. Additionally, after VIFFing, any other enemy fighters that are not engaged in the melee between the Harrier and the first jet are placed in a prime position to take a shot at the jumpjet, which takes time to rebuild energy from the very-taxing VIFF maneuver (i.e. regain airspeed).
The Harrier comes equipped with the following sensors:

- **INS** (Inertial Navigation System): the built-in INS can be used for target designation with coordinate position (waypoint, mark points, mark offset points) and other parameters (inertial velocities, line of sight angles, etc.) to determine weapon release solution.

- **ARBS** (Hughes Angle Rate Bombing System): Built-in passive system designed to improve day and night bombing accuracy when operating in the close support role using unguided weapons
  - **DMT** (Dual Mode Tracker): Sub-system of the ARBS, the DMT tracks both TV (reflected light images) and laser-designated (LST) targets.

- **NAVFLIR** (Navigation Forward-Looking Infrared): Built-in FLIR system fixed on the aircraft’s waterline, which is mainly used for navigation and target infrared spotting. It does NOT have any target designation capability.

- **AN/AAQ-28 V Litening II Targeting Pod (TPOD)**: Targeting system developed to provide precision strike capability. Target designation is achieved by using a laser designator/range finder or an infrared laser marker, which can be created by the pod itself. It is also capable of displaying a FLIR thermal imagery.

- **AMG-65F Maverick** Seeker Head feed: Maverick air-to-ground missiles have seeker heads that have video capability and that can be used as supplemental sensors.

Now... why would the Harrier need all these sensors? It seems a bit overkill, no? Well, not really. Each sensor is useful in specific cases with specific weaponry for specific missions. The Harrier being operated by the United States Marine Corps, mission versatility is one of the main reasons this aircraft was so relevant to the types of operations conducted by the USMC.
INTRODUCTION

The sensors will make more sense to you once you start using them in the Weapons Tutorial section.

Sensor Select Switch

AFT = DMT: LST/TV
FWD = INS: IRMV/EOMV
LEFT = MAP Center/Decenter
RIGHT = FLIR/HUD-BH/WH
DOWN (PUSHED) = HUD Scene Reject/TPOD

TDC (Target Designation Caret) Control Switch

LEFT/RIGHT/FORWARD/AFT/DOWN (ACTION)
MY SENSORS CONTROL SETUP

Sensor Sel. FWD: INS, IRMV/EOMV
Sensor Sel. RIGHT: FLIR/HUD-BH/WH
Sensor Sel. AFT: DMT LST/TV
Sensor Sel. LEFT: MAP Center/Decenter
Sensor Sel. DOWN: HUD Reject

AG Target Undesignate/NWS/FOV Toggle

↑ TDC FORWARD
↓ TDC RIGHT
↑ TDC AFT
↓ TDC LEFT

↑ Sensor Sel. FWD: INS, IRMV/EOMV
↓ Sensor Sel. RIGHT: FLIR/HUD-BH/WH
↑ Sensor Sel. AFT: DMT LST/TV
↓ Sensor Sel. LEFT: MAP Center/Decenter
P Sensor Sel. DOWN: HUD Reject
NAVFLIR

1. NAVFLIR is powered by the FLIR switch (UP). The FLIR requires a cooldown time of approx. 5 minutes: NOT RDY legend on either MPCD will be shown as long as cooldown process is not complete.
2. You can consult the FLIR page on either MPCD by going in the main menu and pressing the OSB next to FLIR.
3. You can toggle BLACK/WHITE (BLK) modes using the BLK option.
4. During night operations, you can display the FLIR feed on your Heads-Up Display directly.
   a) Set HUD Mode switch to NIGHT (down position)
   b) Press the « Sensor Select » switch DOWN (HUD Scene Reject)

Sensor Select Switch
AFT = DMT: LST/TV
FWD = INS: IRMV/EOMV
LEFT = MAP Center/Decenter
RIGHT = FLIR/HUD-BH/WH
DOWN (PUSHED) = HUD Scene Reject/TPOD
ARBS & DMT IN A NUTSHELL

The ARBS's Dual Mode Tracker (DMT) has two main functions: TV and LST (Laser).

The TV function will allow you to set manually a target point by pointing your nose at the target and then designating it. Then, the DMT is able to keep track of this position.

The LST (Laser) function will allow you to slave your DMT to a laser-designated point by troops on the ground or friendly aircraft equipped with a laser designator (which can be done with the TGP).
**ARBS & DMT – TV MODE**

1. The DMT Power Switch powers up the Dual Mode Tracker.
2. Press the Sensor Select Switch AFT to toggle LST/TV Mode of the DMT to TV. DMT feed will appear on your MPCD displays.
3. At first, TV Mode tracks your aircraft’s flight path vector (where your nose is pointing).
4. Press the « TDC DOWN Action Position » button to slave the DMT to a designated target.
5. Once target is designated, you can slew the DMT.
6. Press the « AG Target Undesignate/NWS/FOV Toggle » to un-designate a target.
**ARBS & DMT – LST MODE**

1. The DMT Power Switch powers up the Dual Mode Tracker.
2. Press the Sensor Select Switch AFT to toggle LST/TV Mode of the DMT to LST (Laser). DMT feed will not yet appear on your MPCI displays if no laser is within range (SAFE LST).
3. Press the OSB (Option Select Button) next to CODE, then set required laser code on the keypad (1688 by default), then press ENT.
4. At first, LST Mode tracks your aircraft’s flight path vector (where your nose is pointing).
5. Once you have contacted the JTAC (Joint Terminal Attack Controller) and a friendly unit is lasing a target (LASER ON), fly towards the target and set your DMT Laser Tracking Point in the target area.
6. Laser will automatically be locked on once you are within range of laser, designating the target.
7. Press the « AG Target Undesignate/NWS/FOV Toggle » to undesignate a target.

**DMT Power Switch (ON = UP)**

**Sensor Select Switch**
- AFT = DMT: LST/TV
- FWD = INS: IRMV/EOMV
- LEFT = MAP Center/Decenter
- RIGHT = FLIR/HUD-BH/WH
- DOWN (PUSHED) = HUD Scene Reject/TPOD

**DMT LASER Target Tracking Point**
(Slaved & Locked)

**Flight Path Vector**

**DMT LST Display**

**SAFE LST**

**CODE MENU**

**LASER CODE**

**DMT: LST Mode Slaved & Locked**

**AG Target Undesignate/NWS/FOV Toggle Switch**
The TPOD (Targeting Pod) is used as an alternate sensor to the DMT (Dual Mode Tracker). It provides more options to properly monitor a target area.

1. The Targeting Pod can be powered up by:
   a) Clicking on the OSB next to the “TPOD” page in the main MPCD MENU
   b) Clicking the OSB next to STBY
   c) The Targeting Pod will start its initialization for 3 minutes.
   d) After initialization, the pod starts FLIR cooling, which takes approximately 6 to 8 minutes. Pod will display F-NOTRDY (FLIR Not Ready) indication when FLIR cooling is incomplete.
2. In order to use the TDC (Target Designation Caret), you must click on the OSB next to TDC to make it active/underlined.
3. You can slew your TDC using the TDC LEFT/RIGHT/FWD/AFT controls.
4. Select desired Laser Mode, Laser Options, Arm Laser
5. Fire Laser
6. Press the « AG Target Undesignate/NWS/FOV Toggle » to undesignate a target.
LASER CODES

1. Each time the aircraft is on the ground (Weight on Wheels ON), the Laser Code resets to 1111 automatically.
2. To change your laser code, you need to do it through the DMT (Dual Mode Tracker) page regardless of the TPOD mode.
3. Go in MPCD « DMT » page, then click OSB next to CODE.
4. Enter laser code on the keypad, then press ENT.
5. New laser code will be visible on scratchpad.
## INTRODUCTION

### MISSILES

<table>
<thead>
<tr>
<th>WEAPON</th>
<th>TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIM-9M Sidewinder</td>
<td>Infrared guided air-to-air missile</td>
</tr>
<tr>
<td>AGM-65F/G Maverick (IRMV)</td>
<td>Air-to-Ground missile guided by imaging infrared system (IRMV) and used at night and during bad weather.</td>
</tr>
<tr>
<td>AGM-65E Maverick (LMAV)</td>
<td>Air-to-Ground missile guided by laser designator guidance system (LMAV) optimized for fortified installations and heavier penetrating blast-fragmentation warhead</td>
</tr>
<tr>
<td>AGM-122 Sidearm</td>
<td>Air-to-Surface Anti-Radiation Missile</td>
</tr>
</tbody>
</table>

### BOMBS

<table>
<thead>
<tr>
<th>WEAPON</th>
<th>TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MK-82 LD</td>
<td>500 lbs unguided low-drag bomb</td>
</tr>
<tr>
<td>MK-82SE (Snake Eye)</td>
<td>500 lbs unguided low-drag retarded bomb</td>
</tr>
<tr>
<td>MK-82 AIR</td>
<td>500 lbs unguided low-drag ballute equipped bomb</td>
</tr>
<tr>
<td>MK-20 Rockeye</td>
<td>Unguided cluster bomb</td>
</tr>
<tr>
<td>GBU-12</td>
<td>500 lbs laser guided bomb</td>
</tr>
<tr>
<td>GBU-16</td>
<td>1,000 lbs laser guided bomb</td>
</tr>
<tr>
<td>BDU-33</td>
<td>25 lbs unguided training bomb</td>
</tr>
</tbody>
</table>

### GUN POD

<table>
<thead>
<tr>
<th>WEAPON</th>
<th>TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>GAU-12</td>
<td>Five-barrel 25 mm Gatling-type rotary cannon (300 rounds)</td>
</tr>
</tbody>
</table>

### ROCKETS

<table>
<thead>
<tr>
<th>WEAPON</th>
<th>TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZUNI MK-71</td>
<td>130 mm (5 inches) unguided rockets</td>
</tr>
<tr>
<td>FFAR</td>
<td>Folding-Fin Aerial Rocket, used as anti-bomber rockets</td>
</tr>
<tr>
<td>2.75 in</td>
<td>2.75 inches rocket, used for general purpose</td>
</tr>
</tbody>
</table>

Note: GBU stands for Guided Bomb Unit.
MY WEAPONS CONTROLS SETUP

- Sensor Sel. FWD: INS, IRMV/EOMV
- Sensor Sel. RIGHT: FLIR/HUD-BH/WH
- Sensor Sel. AFT: DMT LST/TV
- Sensor Sel. LEFT: MAP Center/Decenter
- Sensor Sel. DOWN: HUD Reject

- AG Target Undesignate/NWS/FOV Toggle

- Trigger: Fire Gun/Launch Sidewinder, Sidearm

- Bomb Pickle

- TDC UP
- TDC DOWN (ACTION)
- CAGE/UNCAGE (MAVERICK)

- A/A Mode FWD: Sidewinder (Boresight)
- A/A Mode DOWN: Gun
- A/A Mode AFT: Sidewinder (SEAM)

- TDC FORWARD
- TDC RIGHT
- TDC AFT
- TDC LEFT
There are 2 ways to deliver a bomb: CCRP or CCIP modes.

CCIP mode is the traditional dive bombing approach: you dive on target and the reticle will tell you where the bomb will impact.

However, dive bombing is a risky business, especially if anti-air defences are surrounding your target. The lower you go, the more vulnerable you are. This is why CCRP release mode was invented.

CCRP mode allows you to fly straight and level without having to dive down. The HUD will tell you when to release your bomb for the target you have designated with your radar. It is a much safer way to release a bomb, but as you may have guessed already, it is less precise. CCRP mode is also referred to the AUTO mode.
1. Set HUD Master Mode to A/G (Air-to-Ground)
2. Go in MPCD main MENU
3. Select STRS (Stores) Page
4. Select desired MK82 bombs by either selecting them with the upper OSB (Option Select Button) or by pressing the pylon SEL buttons on the ACP (Armament Control Panel).
5. Select CIP (CCIP) Armament Mode
6. Set Fuzing to desired mode (N IN for this tutorial)
7. Set desired Bomb Quantity (total bombs to be dropped)
8. Set Multiple parameter to the number of pylons used (how many bombs dropped at a time; we will use 2 in order to avoid asymmetrical loadouts).
9. Set desired Interval (distance between bombs dropped).
10. Set Master Arm Switch - ON (UP)
11. Perform a 45 degree dive on the target and fly to align the vertical CCIP line with the target.
12. At first, the CCIP cross will be dashed: this means your aircraft is not yet stabilized and ready to drop its bombs.
13. When CCIP cross becomes a solid cross, you can drop your bombs when the CCIP cross is aligned on your target.
14. Press the Bomb Pickle button (RALT+SPACE) to drop your bombs.
PART 10 – OFFENCE
WEAPONS & ARMAMENT

UNGUIDED BOMB - CCIP

12 Target

CCIP Vertical Line

13 Full CCIP Cross
In range: This is where your bombs will drop

Dashed CCIP Cross
Not in range
1. Set HUD Master Mode to A/G (Air-to-Ground)
2. Go in MPCD main MENU
3. Select STRS (Stores) Page
4. Select desired MK82 bombs by either selecting them with the upper OSB (Option Select Button) or by pressing the pylon SEL buttons on the ACP (Armament Control Panel).
5. Select AUTO (CCRP) Armament Mode
6. Set Fuzing to desired mode (N IN for this tutorial)
7. Set desired Bomb Quantity (total bombs to be dropped)
8. Set Multiple parameter to the number of pylons used (how many bombs dropped at a time; we will use 2 in order to avoid asymmetrical loadouts).
9. Set desired Interval (distance between bombs dropped).
10. Set Master Arm Switch - ON (UP)
UNGUIDED BOMB - CCRP

11. Set DMT (Dual Mode Tracker) Power Switch ON (UP)
12. Press the Sensor Select Switch AFT twice to toggle LST/TV Mode of the DMT to TV. DMT feed will appear on your MPCD displays.
13. At first, TV Mode tracks your aircraft’s flight path vector (where your nose is pointing).
14. Press the « TDC DOWN Action Position » button to slave the DMT to a designated target.
15. Once target is designated, you can slew the DMT more precisely using the TDC LEFT/RIGHT/FORWARD/AFT controls. You will be tracking the ground, NOT the target.
16. Fly level and manoeuvre to align the vertical CCRP line with your flight path vector as much as possible.
17. The time to release is indicated on the HUD.
18. When time is about 10 seconds before release, hold down the Bomb Pickle button (RALT+SPACE).
19. As you fly over Release Point cue (will be indicated by a green horizontal line descending from top to bottom), your bombs will drop automatically provided that you are holding the Bomb Pickle button.
20. Press the « AG Target Undesignate/NWS/FOV Toggle » to un-designate target once target is destroyed.
21. As you will see, CCRP is not a very precise bombing method with unguided bombs.
LASER-GUIDED BOMBS (GBU)

The TPOD (Targeting Pod) is used as an alternate sensor to the DMT (Dual Mode Tracker). We will use it to lase the target. Laser-guided bombing can also be done by buddy-lasing or by using a JTAC.

1. Set HUD Master Mode to A/G (Air-to-Ground)
2. Go in MPCD main MENU
3. Select STRS (Stores) Page
4. Select desired GBU12 bombs by either selecting them with the upper OSB (Option Select Button) or by pressing the pylon SEL buttons on the ACP (Armament Control Panel).
5. Select AUTO (CCRP) Armament Mode
6. Set Fuzing to desired mode (T IN for this tutorial)
7. Set desired Bomb Quantity (total bombs to be dropped)
8. Set Multiple parameter to the number of pylons used (how many bombs dropped at a time; we will use 2 in order to avoid asymmetrical loadouts).
9. Set desired Interval (distance between bombs dropped).
10. Set Master Arm Switch - ON (UP)
11. Set laser code to 1688: Press the Sensor Select Switch AFT to toggle LST/TV Mode of the DMT to LST (Laser) and press the OSB (Option Select Button) next to CODE, then set required laser code on the keypad (standard code is 1688), then press ENT. Default laser code 1111 is an initialization code and will not work.

12. Power up the Targeting Pod:
   a) Click on the OSB next to the “TPOD” page in the main MPCD MENU
   b) Clicking the OSB next to STBY
   c) The Targeting Pod will start its initialization for 3 minutes.
   d) After initialization, the pod starts FLIR cooling, which takes approximately 6 to 8 minutes. Pod will display F-NOTRDY (FLIR Not Ready) indication when FLIR cooling is incomplete.

13. In order to use the TDC (Target Designation Caret), you must click on the OSB next to TDC to make it active/underlined.

14. Select desired Laser Mode (CCD/FLIR)

15. Select desired Laser Options (LASR)

16. Arm Laser (ARMED) and slew your TDC over the target using the TDC LEFT/RIGHT/FWD/AFT controls.

17. Fire Laser to lock targeting pod on target and lase it.
LASER-GUIDED BOMBS (GBU)

18. Fly level and manoeuvre to align the vertical CCRP line with your flight path vector as much as possible.
19. The time to release is indicated on the HUD.
20. When time is about 10 seconds before release, hold down the Bomb Pickle button (RALT+SPACE).
21. As you fly over Release Point cue (will be indicated by a green horizontal line descending from top to bottom), your bombs will drop automatically provided that you are holding the Bomb Pickle button and guide themselves to the laser spot targeted by the Targeting Pod.
22. Press the « AG Target Undesignate/NWS/FOV Toggle » to un-designate target once target is destroyed.
23. As you will see, guided bombs are very precise and very effective.
AIM-9M SIDEWINDER
AIR-TO-AIR MISSILE

1. Set Master Arm switch ON (UP)
2. Set either Air-to-Air Weapon Select switch to AFT (A/A Sidewinder SEAM Mode) or to FWD (A/A Sidewinder Boresight Mode) to power on IR missile seeker. Sidewinder will start a low-pitch growl when seeking.
   - SEAM mode (Sidewinder Expanded Acquisition Mode) will rotate its seeker head around to have a greater field of view.
   - Boresight mode will make the seeker head look straight in front of you with a reduced field of view.
3. When within firing range, the seeker growling will become high-pitched and seeker circle will become full.
4. Press the Trigger (Fire Gun - SPACE) button to fire missile.
AIM-9M SIDEWINDER
AIR-TO-AIR MISSILE
GAU-12 GUN POD (AIR-TO-AIR)

1. Set Master Arm Switch – ON (UP)
2. Press the A/A Mode DOWN: Gun switch on your HOTAS (C key binding by default)
3. Set gun pipper on target. It is a pure boresight mode.
4. Press the Trigger (Fire Gun - SPACE) button to fire gun.
5. Keep in mind that the gun pod is located to the left and will induce a yaw moment when firing. You will have to compensate it with your rudder.

Air-to-Air Weapon Select Switch
AFT = A/A Sidewinder SEAM Mode
FWD = A/A Sidewinder Boresight Mode
DOWN (PUSHED) = Gun Mode
PART 10 – OFFENCE

WEAPONS & ARMAMENT

GAU-12 GUN POD (AIR-TO-AIR)

Gun Air-to-Air Mode Pipper

Rounds Remaining

3
GAU-12 GUN POD (AIR-TO-GROUND)

1. Set HUD Master Mode to A/G (Air-to-Ground)
2. Go in MPCD main MENU
3. Select STRS (Stores) Page
4. Select Gun Pod with the upper OSB.
5. Set Master Arm switch ON (UP)
6. Start a 45-degree descent towards the target
7. Set pipper on target and wait for the pipper to unwind.
8. You will be within firing range once the pipper starts unwinding
9. Press the Trigger (Fire Gun - SPACE) button to fire gun.
10. Keep in mind that the gun pod is located to the left and will induce a yaw moment when firing. You will have to compensate it with your rudder.
PART 10 – OFFENCE
WEAPONS & ARMAMENT

GAU-12 GUN POD (AIR-TO-GROUND)

Gun Pipper

CCIP Mode
Gun Selected

Pipper unwind
IN FIRING RANGE

Pipper not yet unwound
NOT IN FIRING RANGE
ROCKETS (+ GAU12 GUN POD)

1. Set HUD Master Mode to A/G (Air-to-Ground)
2. Go in MPCD main MENU
3. Select STRS (Stores) Page
4. Select desired Ground Rockets by either selecting them with the upper OSB (Option Select Button) or by pressing the pylon SEL buttons on the ACP (Armament Control Panel).
5. Set desired Rocket Quantity (number of rockets fired per pod per trigger press)
6. Set Multiple parameter to the number of pylons used.
7. Select Gun Pod with the upper OSB. You will be able to use it in addition to rockets. This step is optional.
8. Set Master Arm switch ON (UP)
9. Start a 45-degree descent towards the target
10. Set pipper on target and wait for the pipper to unwind.
11. You will be within firing range once the pipper starts unwinding
12. Press the Bomb Pickle button (RALT+SPACE) to fire rockets.
13. Press the Trigger (Fire Gun - SPACE) button to fire gun on the gun pipper cross.
ROCKETS (+ GAU12 GUN POD)

PART 10 – OFFENCE
WEAPONS & ARMAMENT

Rocket Pipper

CCIP Mode
38 Rockets Selected

Gun pod Pipper
Gun rounds will land there

Pipper not yet unwound
NOT IN FIRING RANGE

10

Pipper unwound
IN FIRING RANGE

11

4 rockets fired x 2 pods

12
1. Set HUD Master Mode to A/G (Air-to-Ground).
2. Set the EW (Electronic Warfare) page on one of your MPCDs, and the STRS (Stores) page on the other MPCD.
3. For SEAD (Suppression of Enemy Air Defenses) missions, I suggest that you make sure your RWR (Radar Warning Receiver) is set to ON, your EXP (Expendable) countermeasures are set to AUTO and your ECM (Electronic Countermeasures) switch is set in the appropriate position if a DECM pod is equipped.
4. Click on the SEL buttons to select your Sidearm missiles (SA)
5. Set Master Arm switch – ON (UP)
6. Find radar emitters using the RWR on the EW page and on your HUD.
7. When the low-pitch tone switches to a high-pitch tone and your seeker reticle locks onto the source of radiation emission, your Sidearm has locked on the target.
8. Press the Trigger (Fire Gun - SPACE) button to fire Sidearm missile.
AGM-122 SIDEARM
AIR-TO-SURFACE ANTI-RADIATION MISSILE
AGM-65F/G MAVERICK (IRMV)
AIR-TO-GROUND MISSILE

1. Set HUD Master Mode to A/G (Air-to-Ground)
2. You should prepare your Maverick missiles as soon as possible. Cooldown and preparation take a while.
3. Go in Mppard main MENU
4. Select STRS (Stores) Page
5. Select IRMV (Infrared Maverick) missile by either selecting them with the upper OSI (Option Select Button) or by pressing the pylon SEL buttons on the ACP (Armament Control Panel).
6. As soon as the Maverick missile is selected, it will begin its cooldown phase, which will last 3 minutes. STBY indicates the cooldown phase in in progress, while RDY indicates that the Maverick is warmed-up and ready for use.
7. Set Master Arm Switch - ON (UP) and set FUZ (fusing) switch to either IN, D1 or D2.
AGM-65F/G MAVERICK (IRMV)
AIR-TO-GROUND MISSILE

The steps on this page are optional.

8. Set DMT (Dual Mode Tracker) Power Switch ON (UP)
9. Press the Sensor Select Switch AFT twice to toggle LST/TV Mode of the DMT to TV. DMT feed will appear on your MPCD displays.
10. At first, TV Mode tracks your aircraft’s flight path vector (where your nose is pointing).
11. Press the « TDC DOWN Action Position » button to slave the DMT to a designated target.
12. Once target is designated, you can slew the DMT more precisely using the TDC LEFT/RIGHT/FORWARD/AFT controls. You will be tracking the ground, NOT the target.

Note:
Steps 8 through 12 are optional. You can simply skip to step 13 and uncage the Maverick and find your target using the IRMV sensor, which is independent from the DMT. In other words, you do not absolutely need the DMT to use the Maverick. It is simply a way to have a better view of the target with the DMT TV.
13. Press the CAGE/UNCAGE button to uncage the Maverick.
14. Press the Sensor Select Switch FWD (INS: IRMV/EOMV) to select the IRMV feed.
15. Press the OSB next to FOV to narrow the field of view.
16. Periodically press the TDC DOWN (ACTION) button to acquire a lock on the target. The Maverick is most likely going to acquire a good lock from a distance of 7.5 miles.
17. When lock is acquired by Maverick, press the Bomb Pickle button (RALT+SPACE).
AGM-65F/G MAVERICK (IRMV)
AIR-TO-GROUND MISSILE

**Note:** IR Mavericks have a Gimbal Limit warning. If the gimbal limits are reached, a "GIMBAL LIMITS" warning will flash on the MPCD screen and then the missile’s seeker will cage itself. You will have to uncage the missile again. If you attempt to uncage while the seeker is at gimbal limits, the warning will appear and the missile will cage itself again. Gimbal Limits may be reached when the missile is slaved to the DMT.

Maverick Uncaged and Locked on Target

Target

Distance to Target (nm)
AGM-65E MAVERICK (LMAV)  
AIR-TO-GROUND MISSILE

Note: We will have to use a Targeting Pod (TPOD) to obtain a laser for the LMAV Maverick to track.
1. Set HUD Master Mode to A/G (Air-to-Ground)
2. Go in MPCI main MENU
3. Select STRS (Stores) Page
4. Select LMAV (Laser-Guided Maverick) missile by either selecting them with the upper OSB (Option Select Button) or by pressing the pylon SEL buttons on the ACP (Armament Control Panel).
5. As soon as the Maverick missile is selected, the CAGED maverick page will appear with its laser code.
6. Set Master Arm Switch - ON (UP) and set FUZ (fusing) switch to IN
7. Set laser code to 1688: Press the Sensor Select Switch AFT to toggle LST/TV Mode of the DMT to LST (Laser) and press the OSB (Option Select Button) next to CODE, then set required laser code on the keypad (standard code is 1688), then press ENT. Default laser code 1111 is an initialization code and will not work.

8. Power up the Targeting Pod:
   a) Click on the OSB next to the “TPOD” page in the main MPCD MENU
   b) Clicking the OSB next to STBY
   c) The Targeting Pod will start its initialization for 3 minutes.
   d) After initialization, the pod starts FLIR cooling, which takes approximately 6 to 8 minutes. Pod will display F-NOTRDY (FLIR Not Ready) indication when FLIR cooling is incomplete.

9. In order to use the TDC (Target Designation Caret), you must click on the OSB next to TDC to make it active/underlined.

10. Select desired Laser Mode (CCD/FLIR)

11. Select desired Laser Options (LASR)

12. Arm Laser (ARMED) and slew your TDC over the target using the TDC LEFT/RIGHT/FWD/AFT controls.

13. Fire Laser to lock targeting pod on target and lase it.
14. Press the CAGE/UNCAGE button to uncage the Maverick.
15. The seeker head will automatically scan for the laser.
16. Once the Maverick seeker has found the laser and you are in range to fire, the Maverick feed will be filled with a full square and “INRNG” (In Range) will appear on the HUD. A diamond will appear over the target.
17. When lock is acquired by Maverick, press the Bomb Pickle button (RALT+SPACE)
AGM-65E MAVERICK (LMAV) AIR-TO-GROUND MISSILE
Countermeasures are very simple to use. You have three countermeasure types at your disposal: flares, chaff and an ECM (Electronic Countermeasure) jammer. We will explore together what is used against what, and how.

Missiles can generally track you using 2 things: radar signature (radar waves are sent on you and you reflect them, which is called a “radar signature”) and heat signature (like the exhaust of your engines). Countermeasures will only be effective against the kind of weapon it was meant to counter; a heat-seeking missile will not care if you deploy electronic countermeasures against it since it tracks heat, not radar signatures. This is why it is important to know what is attacking you in order to counter it properly. This is what the RWR (Radar Warning Receiver) is for: to help you know what is firing at you so you can take the adequate action to counter it. Keep in mind that the Harrier does not have a MLWS (Missile Launch Warning System), so you cannot know when a missile has been fired at you and is actively tracking you.

**Flares** are used against missiles that track heat (infrared or IR) signatures. Instead of going for the heat signature generated by your engines, a missile will go for a hotter heat source like flares.

**Chaff** is a form of “passive” jamming. Passive (reflected) jamming is when a deceptive object or device reflects radar waves. Chaff is simply a bundle of small pieces of metal foil with reflective coating, which creates clusters of radar signatures that prevent a radar to get a solid lock on the aircraft itself.

The **AN/ALQ-164 DECM jammer pod** is a form of “continuous” jamming, also called “active” or “transmitted” jamming. This device transmits its own synchronized radar waves back at your enemy’s radar receiver to simulate erroneous radar wave returns. Simply put, active jamming will try to drown a radar in white noise.

In order to use these three forms of countermeasures, you can use “countermeasure programs”, routines that will deploy a number of flares/chaff for a number of cycles at a given interval.
COUNTERMEASURES CONTROL SETUP

ECM Dispense Switch
AFT = Dispenses Chaff
FWD = Dispenses Flares
LEFT = Mini Jammer Engaged (Not Functional)
RIGHT = Dispenses all countermeasure types

Actual Cockpit

Thrustmaster Wart Hog
Your RWR will tell you what is around you with a top-down view, both friendly and enemy contacts. The closer the symbol to the center of the circle, the stronger the radar signal strength.

The RWR display consists of 4 concentric circles at predetermined intervals. The circles do not represent range but signal strength and priority. Each detected signal displayed consists of two parts: an alphanumeric code that identifies signal type, and a symbol that indicates emitter platform and priority. The RWR is also displayed on your Heads-Up Display in a top-down view (up is forward, down is aft).

To power up the RWR, just set the RWR selector to ON. You can access the RWR by going in the main MPCD menu and clicking “EW”.

**Threat Lights**
- **SAM**: SAM launch detected
- **CW**: Ground Tracking (Continuous Wave) radar is locked on aircraft
- **AI**: Air Intercept radar is locked on aircraft (flashes if launch is detected)
- **AAA**: Anti-Aircraft Artillery gun radar is locked on aircraft.
AN/ALR-67(v) RWR
(RADAR WARNING RECEIVER)

The "lollypops" indicate threat level for each signal:
- Short stem: Non-Lethal
- Dashed: Lethal
- Long Stem: Critical
- Long Stem with Arrow: Radar Lock
- Flashing long stem with arrow: Missile Launch

LETHAL BAND:
Threats that are attacking the aircraft.

CRITICAL BAND:
Threats that are safe for the moment

RWR Status Indicator:
1. N = Current Operational filter.
   (Filters are: N = Normal (All), P = Priority only.
2. L = Limited display (6 contacts max)
3. B = BIT fail
   (T is shown if RWR is overheated)

NON-CRITICAL (SAFE) BAND:
Emitters that cannot harm the aircraft.
Friendly emitters.
Unknown emitters (unless they are threatening)
AN/ALR-67(v) RWR (RADAR WARNING RECEIVER)

A steady symbol means that the radar is in search mode (in other words: not tracking you yet).

A flashing symbol indicates that the radar is supporting a missile that has been launched at you. You are about to receive a missile right up the arse. This is where you pop chaff, flares, ECM and start your evasive manoeuvres.

Note: “U” symbol stands for “Unknown”, which is sometimes attributed to ships.

List made by .408-X~RAY
COUNTERMEASURES – CHAFF & FLARES (EXPENDABLES)

1. Set Expendables Dispenser Control Knob to desired mode (preferably AUTO)
2. Set CHF and FLR release parameters to P (Program) or S (Single) by clicking the OSB next to their quantity in the EW (Electronic Warfare) page.
3. To dispense chaff or flares, use the ECM DISPENSE AFT/FWD/RIGHT switches (8, 7 and 0 key bindings)
4. Flare & Chaff counters are available on the EW RWR page.

ECM (Electronic Countermeasure) Dispense Switch
AFT = Dispenses Chaff
FWD = Dispenses Flares
LEFT = Mini Jammer Engaged (Not Functional)
RIGHT = Dispenses all countermeasure types

Expendables Dispenser Control Knob
OFF: No Power
AUT: Dispenser selected automatically
UP: Dispensers on top of aft fuselage used first
DOWN: Dispensers on bottom of aft fuselage used first
RWR: Option not available

P = Program, S = Single

Chaff (CHF) and Flare (FLR) Quantity
The DECM Jammer pod needs to be equipped on the ground and is externally mounted on the aircraft. It uses the ALQ-126B Charger Blue to counter pulse threats and the ALQ-162 Compass Sail to counter CW (Continuous Wave threats) like SARH (Semi-Active Radar Homing) missiles like the AIM-7 Sparrow.

The **Charger Blue** provides deceptive jamming against pulse-doppler threats in the E-J bands (2-18 GHz frequency range), which includes most radars on fighter aircraft from the 1960's. However, the Charger Blue does not have any capability against CW threats, therefore it is paired with a **Compass Sail**, which jams radar waves in the H-J bands (6-20 GHz frequency range) in a 120-degree beam width.

To use DECM, set the ECM Control Knob in the desired position (STBY when not needed, RCV if you want to avoid detection, and RPT when being actively tracked by a radar).

**ECM (Electronic Countermeasure) Dispense Switch**
- AFT = Dispenses Chaff
- FWD = Dispenses Flares
- LEFT = Mini Jammer Engaged (Not Functional)
- RIGHT = Dispenses all countermeasure types

**ECM (Electronic Countermeasure) Control Knob**
- OFF: Removes power to DECM pod
- STBY: Powers DECM pod but does not emit signal
- BIT: DECM pod Built-In Test
- RCV: Smart Standby (pod emits based on signal received)
- RPT: Continuous jamming signal (repeat)

**DECM Status Messages**
- **CW NO GO**: DECM Compass Sail Continuous Wave jammer is nonfunctional
- **P NO GO**: DECM Charger Blue pulse jammer is not functional
- **P JAM**: DECM Charger Blue pulse jammer is active and emitting
- **CW JAM**: DECM Compass Sail continuous wave jammer is active and emitting
The ARC-210 radio provides transmission and reception of amplitude and frequency modulated (AM & FM) on frequencies ranging from 30 MHz to 399.975 MHz.

The Harrier has two radios installed: COM1 and COM2. They are independent and have 26 preset channels each. The preset frequencies are set in the mission editor.

You can control the radio through two interfaces: the Up-Front Control (UFC) and through the ACNIP and V/UHF Radio Set Control (RCS). The radio has 2 operating modes: through UFC (Upfront Control) or MANUAL (through the ACNIP and RCS). You can toggle between UFC and MANUAL mode with the MODE switch on the ACNIP panel. Take note that the MANUAL mode is primarily used as an emergency mode for in-flight failures of the UFC.
KY-58 Secure Speech System Unit #1 and Unit #2 Code and Mode Selected

The secure speech system is used for ciphering (coding) or deciphering (decoding) audio routed through the KY-58 cipher unit No. 1 (KY-1) or KY-58 unit No. 2 (KY-2).

Remote Variable Switch

With the switch in the RV1, the MASTER CAUTION Lights panel become invisible, allowing access to the LMPCD right buttons. When the switch is in the RV2 position, the MASTER WARNING Lights panel becomes invisible, allowing access to the RMPCD left buttons. The button position is in the middle, making both light panels visible.

KY58 Cipher Zero Norm Switch

IFF (Identify-Friend-or-Foe) Zero/Hold Switch (Not Simulated)

IFF (Identify-Friend-or-Foe) Emergency/Normal Switch (Not Simulated)

Console Lights Brightness Knob

ICS (Intercom System) Auxiliary Volume Knob

Can be used to tune volume of aural warnings (i.e. Bitchin’ Betty)

Radio Program 1/2 Switch

Selects which radio transmitter is active

KY58 Secure Speech System Unit 1 Diphase/Baseband (DIPH/BB) Selector

KY58 Secure Speech System Unit 2 Diphase/Baseband (DIPH/BB) Selector

V/UHF Radio Control Mode Switch

- MAN: Manual Mode (radio is controlled by the Radio Control Set panel)
- UFC: Up-Front Controller Mode (radio is controlled by the UFC and ODU, Option Display Unit)

KY-58 Unit #2 Code/Mode Switch (Not Simulated)

Used to select a desired KY58 operating mode and code

KY-58 Unit #1 Code/Mode Switch (Not Simulated)

Used to select a desired KY58 operating mode and code

ICS (Intercom System) Ground Volume Knob

PART 12 – RADIO TUTORIAL

ARC-210 RADIO – ACNIP

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The UFC gives you access to the 26 preset channels of COMM 1 and COMM 2 radios.

To turn on radios, rotate the VOL knobs of COMM1 and COMM 2.

To change preset frequency, rotate the COMM1 or COMM2 Channel selector knobs.

To set a radio frequency manually on an existing preset frequency:
1. Left click on the desired COMM1 or COMM2 Channel Selector button to select it
2. Scroll mousewheel on desired COMM Channel Selector button to select desired Channel
3. Press the CLR (CLEAR) button on the UFC
4. Enter the desired frequency on the scratchpad
5. Press the ENT (ENTER) to overwrite the frequency.

To set radio options, press the ODU buttons (Option Display Unit) to toggle parameters for each option.

To transmit to either COMM1 or COMM2, use the “COMM AFT: Select COMM2” and the “COMM FWD: Select COMM1” bindings.

**Option Display Unit (ODU) 1**
- T/R: Transmit/Receive
- TR+G: Transmit/Receive + Guard
- G: Guard

**Option Display Unit (ODU) 2**
- Only avail when freq. between 225.000 to 400.000. Toggles AM or FM modulation.

**Option Display Unit (ODU) 3**
- Toggles Squelch. “.” means Squelch is active.

**Option Display Unit (ODU) 4**
- Toggles cipher modes: PLN (plain), CIPH (cipher) and DLY (delay). Not simulated.

**Option Display Unit (ODU) 5**
- Cipher code index to use when not in PLN (plain) mode. Not simulated since DCS does not have encrypted communications.
The autopilot of the Harrier is not very complicated to use.

1. Make sure you have all your Yaw, Pitch and Roll SAS switches ON
2. Set aircraft in desired altitude/attitude and make sure that the following conditions are respected or the autopilot will automatically disengage
   - You are not in a steep climb/descent (+/- 2000 ft per minute)
   - Airspeed must be greater than 160 kts
   - Your bank angle must be lesser than +/- 20 deg
   - Your pitch angle must be between -15 deg to +20 deg
3. Engage desired AFC Mode using the AFC switch (and the ALT HOLD switch if required)
4. You can use your trim controls while the autopilot is engaged to fine-tune your aircraft attitude.
5. You can disengage the SAAHS using the Emergency SAAHS Disconnect Switch or by simply setting the ALT HOLD & AFC switches OFF (AFT).

**AFC Modes**

**AFC Switch Only - Engaged**
AFC mode provides pitch attitude hold, roll attitude hold, and heading hold. You can see this as an “Attitude Hold”.

**AFC Switch + ALT HOLD Switch - Engaged**
ALT HOLD mode is pretty self-explanatory: the aircraft will provide an altitude hold. Keep in mind that you need to put yourself in level flight first, then engage the AFC switch, and finally set the ALT HOLD switch afterwards.
Navigation in the Harrier is mostly done through the EHSD (Electronic Horizontal Situation Display), which is a top-down view that displays your heading and navigation aids such as TACAN (Tactical Air Navigation) beacons and waypoints entered before flight in the mission editor.
The Moving Map can be used to help you navigate. To turn it on:
1. Select the EHSD page on either MPCD
2. Press the OSB next to MAPM to select the Moving Map menu.
3. Press the OSB next to MAP to activate the Moving Map.
4. And that’s it! Easy as pie.
5. Take note that the MAP-specific menus that appeared in step 3) will automatically revert back to the EHSD-specific menus after a short delay as shown in step 2).
MAPM: MOVING MAP

MOVING MAP (MAP MENU SELECTED, MOMENTARY)

SEQ option will display waypoints and their numbers

TRUE option will display True Track instead of Magnetic Track

TRAK option will display Ground Track Line

SCL option will change map scaling (100, 25, 13, 5, AUTO)

ZOOM option magnifies map scaling by 2

EHSI option shows/hides the EHSD overlay

MAP option shows/hides moving map

N-UP option selects the NORTH IS UP or the TRACK IS UP (up is aligned with the aircraft heading) map orientation
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PART 14 – NAVIGATION & ILS LANDING

MAPM: MOVING MAP

MOVING MAP (AUTOMATICALLY REVERTED BACK TO EHSD MENU)

NSEQ option enables non-sequential waypoint navigation

TCN selects the TACAN tracking mode

AWLS selects the All-Weather Landing System tracking mode

MAPM selects the MOVING MAP menu

DATA selects the Data display mode (information about tracked aircraft/waypoint/TACAN)

DESG is used for Steer to Point Designation

Ground Track

Ground Speed (kts)

Aircraft (top down view)
MAPM: MOVING MAP

MOVING MAP (DATA MENU)

- GPS coordinates for tracked waypoint/TACAN/aircraft
- UTM coordinates for tracked waypoint/TACAN/aircraft
- DECL: Declination Angle
- MVAR: Magnetic Variation
- Ground elevation for tracked waypoint/TACAN/aircraft
- Aircraft (top down view)
- WYPT Centers Map on Selected Waypoint
- A/C Centers Map on aircraft
- TCN Centers Map on selected TACAN
- Range for tracked waypoint/TACAN/aircraft
- Bearing for tracked waypoint/TACAN/aircraft
- DATA selects the Data display mode (information about tracked aircraft/waypoint/TACAN)
WAYPOINT NAVIGATION

1. Select the EHSD page on either MPCD
2. Press the OSB next to WYPT to set tracking mode to WAYPOINT.
3. To select a waypoint, press the OSB (Option Select Button) to increment or decrement the waypoint number.
4. Make sure the HUD Master Mode is set to NAV to be able to track your waypoint directly from your HUD.
5. Check the previous MOVING MAP section to see how to display multiple waypoint symbols.
WAYPOINT NAVIGATION

- Selected Waypoint Heading (to your left)
- Your current heading
- Tracking Waypoint 3 29.4 nautical miles away
- Clock
- Waypoint Heading
- Distance to waypoint (nm)
- Time to waypoint

Waypoint Heading (vertical bar) and your current heading (triangle) are now aligned. You are on course!

Waypoint Heading (triangle) and your current heading (bar) are now aligned. You are on course!
HOW TO ADD WAYPOINTS

1. We want to create Waypoint 4 after Waypoint 3.
2. Select the EHSD page on either MPCD
3. Click on the OSB next to “DATA” to select the EHSD data sub-menu (will become boxed when selected)
4. Make sure WYPT ODU (Option Display Unit) is selected (‘.’ next to it)
5. On the UFC (Up-Front Controller) scratchpad, press “3”, then “4”, then “ENT” to enter Waypoint Number 4 after Waypoint Number 3.
6. “* 4” should appear on the UFC, meaning a new waypoint numbered “4” has been created.

NOTE: Waypoint 4 has been created but has no coordinates yet.
HOW TO EDIT WAYPOINTS

1. We will want to edit Waypoint 4, which has been created but does not have any coordinates associated with it yet.
2. Select the EHSD page on either MPCD.
3. Click on the OSB next to “DATA” to select the EHSD data sub-menu (will become boxed when selected).
4. Make sure WYPT ODU (Option Display Unit) is selected (“:” next to it).
5. On the UFC (Up-Front Controller), press “4”, then “ENT” to select Waypoint 4 to edit it.
HOW TO EDIT WAYPOINTS

6. We will add for Waypoint 4 the coordinates of the Fujairah International Airport, which are in (deg, minutes, sec):
   **25°06'20” North 56°20'25” East**

7. Press the POS (Position) ODU (Option Display Unit) to select the coordinate Latitude (":" will appear next to it when selected).

8. On the UFC, press « 2 » (N) to select North coordinates, type « 250620 », then « ENT » to enter them.

9. Press on the POS ODU again to select the coordinate Longitude.

10. On the UFC, press « 6 » (E) to select East coordinates, type « 0562025 », then « ENT » to enter them. Don’t forget to add the 0 at the beginning.

11. And that’s it! You have edited Waypoint 4’s coordinates. If you click on the OSB next to DATA to de-selected it (not boxed), you can see that Waypoint 4 is now visible in the sequence if the SEQ option is enabled.
HOW TO EDIT WAYPOINTS

Coordinate format you input in the UFC is Degree, Minute, Seconds. Coordinate format displayed on the DATA page is Degree, Minute, Decimal.

INPUT 25 deg 06 minutes 20 seconds = OUTPUT 25 deg 06.333 minutes
HOW TO EDIT WAYPOINT WITH MOVING MAP & TDC

What if you already have a waypoint with coordinates and want to move it quickly to somewhere else? There’s a neat trick that allows you to do it quite simply with the TDC.

1. Select the EHSD page on either MPCD
2. Make sure the Moving Map is activated (see the AMAP: Moving Map Tutorial).
3. Click on the OSB next to “DATA” to select the EHSD data sub-menu (will become boxed when selected)
4. Press the WYPT ODU (Option Display Unit) is selected (“,” next to it)
5. On the UFC (Up-Front Controller), press “4”, then “ENT” to select Waypoint 4 to edit it.
6. Press the POS (Position) ODU (Option Display Unit)
1. Press the Sensor Select Switch – FWD (INS) to slave the TDC (Target Designation Caret) to the Inertial Navigation System.
2. Press on the OSB next to SCL (scale) to choose desired scale. This can be useful to zoom out if you need to move the waypoint a long distance since the TDC is automatically scaled with the Moving Map scale.
3. Use the TDC controls to move the waypoint on the moving map.
4. Once you are satisfied with its location, click on the OSB next to DATA to de-select the data sub-menu.

Sensor Select Switch
AFT = DMT: LST/TV
FWD = INS: IRMV/EOMV
LEFT = MAP Center/Decenter
RIGHT = FLIR/HUD-BH/WH
DOWN (PUSHED) = HUD Scene Reject/TPOD

TDC (Target Designation Caret) Control Switch
LEFT/RIGHT/FORWARD/AFT/DOWN (ACTION)
TACAN NAVIGATION

1. Determine the TACAN frequency you want to track by opening the map with F10 and by clicking on the airport you want to track. The frequency of the TACAN beacon for Senaki-Kolkhi is 31X.

2. Select the EHSD page on either MPCD.

3. On the UFC (Up-Front Control) Panel, press the TCN button and press the ON/OFF button if the ON indication is extinguished.

4. Press the T/R ODU (Option Display Unit) button to set it to Transmit/Receive. The “:” symbol indicates that it is selected.

5. Press “31” on the scratchpad and press “ENT” to enter frequency.

6. Press the X/Y ODU to toggle the right letter of the TACAN frequency (31X in our case).

7. If you are tracking an aerial TACAN beacon (i.e., on a tanker), press the A/A ODU button to select air-to-air mode. The “:” symbol indicates that the mode is selected. Otherwise, make sure A/A is not selected (no “:” symbol).

8. Press the OSB next to TACAN to select tracking mode to TACAN. Once selected, TCN should be boxed.

9. Set the HUD Master Mode switch to NAV.

10. Once frequency is set and options are set, you can track the TACAN beacon via the EHSD (Electronic Horizontal Situation Display) page and the HUD (Heads-Up Display).
**TACAN NAVIGATION**

- **Selected TACAN Heading** (to your left)
- **Your current heading**
- **Distance to TACAN (nm)**
- **Time to TACAN**
- **TACAN Heading**
- **TACAN Selected**
- **TACAN Heading**
- **Your current heading**

**TACAN Heading (vertical bar) and your current heading (triangle) are now aligned. You are on course!**

**TACAN Heading (triangle with a T) and your current heading (bar) are now aligned. You are on course!**
The AWLS (All-Weather Landing System) is a similar system to the ILS (Instrumented Landing System) in concept. You have a guidance system that will help you to land in bad weather conditions. The AWLS channels are preset; you need to use the ones associated to each airfield using the table to the right. The AWLS can be used with a TACAN station to provide you additional information about range and time to arrival, but the AWLS can also be used as is.

**DEFAULT AWLS CHANNEL LIST**

<table>
<thead>
<tr>
<th>CHANNEL</th>
<th>AIRPORT/AIRBASE</th>
<th>RUNWAY</th>
<th>TACAN FREQUENCY</th>
<th>GLIDE SLOPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Kobuleti</td>
<td>07</td>
<td>67X</td>
<td>3.0</td>
</tr>
<tr>
<td>02</td>
<td>Vaziani</td>
<td>14-32</td>
<td>22X</td>
<td>3.0</td>
</tr>
<tr>
<td>03</td>
<td>Kutaisi-Kopitnari</td>
<td>08</td>
<td>44X</td>
<td>3.0</td>
</tr>
<tr>
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**AWLS CONTROLS & INDICATORS**

RADAR AND NIGHT ATTACK AIRCRAFT
The AWLS tutorial will be set to Senaki-Kolkhi, which is set Channel 4 to runway 09 (course: 095) with a glide slope of 3.0. We will use the TACAN station 31X too even if it is optional.

1. On UFC (Up-Front Control) scratchpad, press the AWL button and the ON/OFF button to turn on the ALWS system.
2. Press the ODU (Option Display Unit) button CH01 (it is selected when the “:” symbol is shown) to select your AWLS channel option.
3. Press “4” on the UFC scratchpad, then “ENT” to set channel 04.
4. Press the ODU button GS (Glide Slope) and verify that “3.00” is entered correctly. If not, set it as shown in step 3.
5. Press the ODU button AZ (Azimuth) and input desired offset (in feet) to the runway centerline. Negative values are to the left of centerline, positive values are to the right of the centerline. In this tutorial, we will leave it as is with an offset of 0.
6. Press the ODU button TCN and input desired TACAN frequency one is available in the airfield (31X in our case) as shown in step 3.
7. Press the ODU button EL (Elevation) and input desired offset from runway elevation. In our case, we will leave it at 0.
8. Set HUD Master Mode to either NAV or VSTOL.
9. Set the runway course to 095.
10. Set appropriate scale (SCL) and press the OSB next to AWLS on the EHSD page to track the AWLS station.
AWLS ILS Tutorial

**AWLS Beacon Heading**

**AWLS Heading (vertical bar)** aligned with current heading. You are on course!

**Distance to AWLS Beacon (nm)**

**Time to AWLS Beacon**

**AWLS Azimuth Steering Bar**

**AWLS Azimuth Steering bar** aligned with center of velocity vector. You are horizontally aligned with the runway.

**AWLS Elevation Steering Bar (Horizontal, Glide Slope reference)**

**AWLS Elevation Steering Bar**

**Velocity vector**

Steer aircraft to set the elevation steering bar on the center of the velocity vector.

**Velocity vector**

Steer aircraft to set the azimuth steering bar on the center of the velocity vector.

**TACAN beacon**

**AWLS Tracking DME**

**Heading Tape**

**AWLS Azimuth Steering Bar (Vertical, Localizer reference)**

Once you are close enough to the AWLS beacon, the horizontal AWLS elevation steering bar (glide slope) will appear. Change aircraft pitch to set this glide slope bar lined up with the center of the velocity vector.
AWLS Azimuth Steering Bar (Vertical) and Elevation Steering Bar (Horizontal) both on the center of the velocity vector. You have caught the localizer and are on a glide slope of 3.0. You are good to land!
AIR-TO-AIR REFUELING – WHY WE ALL HATE IT

Air-to-air refueling is one of the hardest, most hated, and most frustrating tasks in DCS. Ever. Of all time.

Why? Well, one of the main reasons for the difficulty behind refueling is the skill required to do formation flying. Flying in formation with another aircraft requires much more practice than you would initially think. Another reason is pure physics: there is this thing called “wake turbulence”. An aircraft flies through a fluid: air. Just like with any fluid, if you have something that displaces itself through it at a certain speed, the fluid will become disrupted (turbulence). Wingtip vortices and jetwash are both effects of this simple concept. Wake turbulence is the reason why airliners need to wait a minimum time between takeoffs: flying through disrupted air will destabilize the aircraft and it is unsafe, especially during critical phases of flight like takeoff and landing.

Unfortunately, wake turbulence is something a pilot has to deal with during air-to-air refueling. This is why the aircraft will fly just fine when approaching the tanker, but start wobbling around when flying in close proximity of the refueling basket/drogue and tanker engines.
TYPES OF AIR-TO-AIR REFUELING

- There are four main air-to-air refueling techniques used in military aviation:
  - Probe-and-drogue (refueling probe must be inserted in the tanker’s drogue basket)
  - Flying Refueling Boom (guided by boom operator aboard the tanker)
  - Buddy Refueling (two fighters can refuel one another independently without a tanker)
  - Nose-Probe refueling

- The refueling aircraft available in DCS are:
  - The Ilyushin Il-78M “Midas”, a Russian probe-and-drogue tanker, which was developed from the Il-76
  - The Boeing KC-135 “Stratotanker”, a US Air Force flying boom tanker, which was developed from the Boeing 367-80
  - The Lockheed S-3B “Viking”, a US Navy probe-and-drogue tanker
  - The Lockheed KC-130 “Hercules”, a USMC probe-and-drogue tanker, which was developed from the C-130.

The Harrier is equipped with a Probe-and-Drogue system, so air-to-air refueling will only be performed from either an Il-78M, a KC-130 or a S-3B tanker.
1. Consult mission briefing to know on which radio frequency you need to contact the tanker. In our case, we will use the frequency 250 MHz on the V/UHF radio.

2. Find tanker using TACAN frequency as shown in the NAVIGATION - TACAN section.

3. Set your radio to 250 MHz and turn radio VOL knobs ON, and press “/” to communicate with TEXACO (tanker callsign).

4. Select Tanker – Texaco (F6) communication menu, and then select “Intent to Refuel”

5. TEXACO should give you a pre-contact altitude (in our case 18,000 ft).

6. Set Master Arm Switch – OFF (DOWN)

7. Set Flaps to CRUISE

8. Set A/R switch to OUT. READY light should illuminate.

Note: Some tankers like the KC-130 are equipped with a TACAN beacon, which can give you a direction to find it easily. Just make sure you have the correct TACAN frequency set in the A/A (Air-to-Air) Mode. Set TACAN using the NAVIGATION TACAN tutorial.

Pre-contact information: rendez-vous at 18,000 ft
9. Make sure refueling probe has deployed correctly.
10. When you are less than 0.1 nm away from tanker, position yourself as shown on picture.
11. When in position, use your radio menu to select “Ready Pre-Contact” (F1).
12. The tanker’s pilot should answer you with “Cleared Contact” and should deploy his drogue basket and start to accelerate to cruising speed.
13. Fly formation with the tanker (between 190-300 KIAS) and approach the drogue basket very slowly (make sure you remain about 2-3 kts faster than the tanker) with gentle inputs. Make sure AOA (Angle of Attack) is within safe operating limits (13 deg max)
14. Keep the aircraft trimmed at ALL TIMES. Approaching untrimmed is living hell.
15. Insert your probe into the drogue basket by using your reference points.
16. Additional drag should be generated by the drogue once you have contact with the drogue: your aircraft will slightly decelerate. Once the probe is taking fuel, the tanker pilot should tell you “You’re taking fuel”.
17. Keep formation with the tanker until your refueling is complete. Refueling should be complete when the RIGHT and LEFT Refuel lights are flashing or steady.
18. Detach your probe form the basket by throttling down and set A/R switch to IN. READY light should extinguish.

**RIGHT Refuel Light**
- Flashing: internal right wing tank or right external tank is full.
- Illuminated (steady): both right wing and right external tanks are full.

**READY Refuel Light**
- Illuminates when you are cleared for air-to-air refueling.
- Extinguishes during contact.

**LEFT Refuel Light**
- Flashing: internal left wing tank or left external tank is full.
- Illuminated (steady): both left wing and left external tanks are full.
Of course, all of this seems much easier said than done. You will very likely do following mistakes:

- Approach too fast and miss the basket
- Oscillate vertically without being able to line up with the basket
- Keep going either too fast or too slow
- Drift left or right
- Overcompensate control inputs
- Forget the airbrake on
- Forget to set the flaps at CRUISE, not AUTO

Here are various demos of air-to-air refueling.
- [https://www.youtube.com/watch?v=oLxQ9_4vtu](https://www.youtube.com/watch?v=oLxQ9_4vtu)
- [https://www.youtube.com/watch?v=JB7qUDBN3Y](https://www.youtube.com/watch?v=JB7qUDBN3Y)
- [https://www.youtube.com/watch?v=Tdj2qXYdzw](https://www.youtube.com/watch?v=Tdj2qXYdzw)

The next slide will give you a couple of tips to help you catch that basket and slurp that delicious jet fuel like a crack addict.
**TIPS AND TRICKS**

- Remaining **CALM is key** for a successful refueling. If you lose your cool, take a break and try again once you are relaxed. Silk hands and a clear head are needed for that part.
- If you overshoot (or are about to fly past) the tanker, you can bleed speed very fast by deploying your airbrakes. You can go from 400 kts to 300 kts in a matter of seconds.
- **Avoid rolling** your aircraft when you are tracking the basket: you will change the orientation of your lift vector and it will make you drift vertically and horizontally, which doesn’t help at all. Try to stay in the same horizontal plane as much as possible.
- It is easier if you try to “break down” your control inputs in **separate movements**. I try to avoid gunning my throttle, pitching up/down and using my rudder at the same time. The aircraft reacts in a way that makes it all very difficult for your brain to predict and process. I tend to make sure my plane is **straight and level at first** and that I am more or less lined up with the basket.
- Once I have a satisfying attitude and that the basket is placed approximately as shown on the picture below, I **gradually throttle up** and increase speed to **match the tanker’s speed**. In this case, the tanker’s speed is 335 kts. Make sure that you keep a constant speed.
- Once my speed matches the tanker’s, I can gradually accelerate to a speed that is 2-3 kts faster (338 in our case), **approaching the basket very slowly**. At that part, the ONLY two things I am watching are my **Airspeed** and the **REFERENCE POINT (NOT THE BASKET)**. Nothing else matters.
- Once I am approaching the basket, I make sure to avoid inducing rolling motions while displacing myself with the rudder and the vertical stick input ONLY. This way, your aircraft stays straight and delicately drifts left or right based on the **rudder input**, while you can **fine-tune your vertical attitude** with your stick.
If you go in the main Menu page, then select the VREST (Vertical/Short Takeoff & Landing, Range, Endurance, Speed & Time) page, which allows you to determine the operational capability of the aircraft. The VREST mission computer performs vertical takeoff, vertical landing, range endurance, speed and time calculations that can be consulted on the five sub-pages:

- **VL**: Vertical Landing Parameters
- **VTO**: Vertical Takeoff Parameters
- **STO**: Short Takeoff Parameters
- **CRUS**: Cruise Parameters
- **BNGO**: Bingo Fuel Parameters
VL & VTO (VERTICAL LANDING & TAKEOFF) Pages

- **TEMC**: Selects Celsius or Fahrenheit Degrees
- **OATC**: Outside Air Temperature (deg C)
- **ALTM**: Altimeter Barometric Pressure Setting (in Hg)
- **FELV**: Field Elevation (ft)
- **GWT**: Gross Weight (lbs)

Note: All these parameters are calculated for VERTICAL TAKEOFF & LANDING ONLY.

**F+W**: Maximum Weight of fuel and water (F+W) that permits a vertical takeoff or landing

**DRY vs WET parameter**: without (dry) or with (wet) water injection

**Note**: Data in certain field parameters can be modified manually via the UFC and the OSBs (Option Select Buttons).
Note: All these parameters are calculated for SHORT TAKEOFF & LANDING ONLY.
CRUS (CRUISE) Page

- **CAS**: Calibrated Airspeed (kts)
- **Mach Number**
- **CALT**: Cruise Altitude (ft)
- **Range (nm)**
- **RFUL**: Remaining Fuel (lbs)
- **MRNG**: Max Range reached if altitude, airspeed and Mach are followed
- **WIND**: Heading / Wind Speed (kts)
- **GWT**: Gross Weight (lbs)

**Note**: All these parameters are calculated for the CRUISE phase of flight.

**ACR**: Altitude Cruise (Max Cruise Performance at existing altitude).
**OPCR**: Optimum Cruise (Max Cruise Performance at optimal altitude)

**CAS**: Calibrated Airspeed (kts)

**Mach Number**

**CALT**: Cruise Altitude (ft)

**Range (nm)**

**RFUL**: Remaining Fuel (lbs)

**MRNG**: Max Range reached if altitude, airspeed and Mach are followed

**WIND**: Heading / Wind Speed (kts)

**GWT**: Gross Weight (lbs)

**Note**: * means that existing altitude is greater than optimum altitude.

**OPCR**: Optimum Cruise (Max Cruise Performance at optimal altitude)

**CAS**: Calibrated Airspeed (kts)

**Mach Number**

**CALT**: Cruise Altitude (ft)

**Range (nm)**

**RFUL**: Remaining Fuel (lbs)

**MRNG**: Max Range reached if altitude, airspeed and Mach are followed

**WIND**: Heading / Wind Speed (kts)

**GWT**: Gross Weight (lbs)

**Note**: All these parameters are calculated for the CRUISE phase of flight.
VREST SUB-MENUS

BNGO (BINGO) Page

ABNG: Altitude Bingo (Max Bingo Fuel Performance at existing altitude).
Note: * means that existing altitude is greater than optimum altitude.

BNGO Page – Interface with UFC (Up-Front Controller)

CAS: Calibrated Airspeed (kts)

Mach Number

CALT: Cruise Altitude (ft)

Range (nm)

RFUL: Remaining Fuel (lbs)

MRNG: Max Range reached if altitude, airspeed and Mach are followed

WIND: Heading / Wind Speed (kts)

DCRG: Descent Range (nm)

GWT: Gross Weight (lbs)

DI: Drag Index

Note: All these parameters are calculated for the BINGO flight profile. BINGO is “an order to proceed and land at the field specified, utilizing a bingo profile. Aircraft is considered to be in an emergency/fuel critical situation. Bearing, distance, and destination shall be provided.”
USEFUL RESOURCES

A1-AV8BB-NFM-000
NATOPS Flight Manual

A1-AV8BB-NFM-400
NATOPS Flight Manual Performance Charts

476th vFG AV-8B Flight Crew Checklist

RAZBAM (Official Developer) Work-In-Progress Pocket Guide
https://forums.eagle.ru/showthread.php?t=193603

Redkite’s Youtube Tutorials
https://www.youtube.com/watch?v=WJBPRZMM-8U&list=PLml_c09ciucvv3CIsWlmCEqY5XIdbfPxu

Jabbers’ Youtube Tutorials
https://www.youtube.com/channel/UCvXXUrGCF3wV3bbZ6pFQ00g/videos

Maverick’s Air-to-Air Refueling Tutorial
https://www.youtube.com/watch?v=oLx-Q9_4VTU