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COCKPIT

In this chapter, all keys are referred to by their names as they appear on the Custom Mapping screen. Key names are in all caps and bold — **VIEW_PILOT_FWD**, for example. If a keyboard key is given, that is the key in the default map; some of these you may have to add yourself.

The phrase "Multi-Purpose Display" and the abbreviation "MPD" are used collectively to refer to the F-15's four monochrome MPDs and three Multi-Purpose Color Displays (MPCDs), unless otherwise noted.

The buttons surrounding the MPDs and UFC are called pushbuttons, or PBs. They are numbered for reference in this chapter starting in the upper left and moving counterclockwise — "PB 5,"for instance, would be the fifth pushbutton from the left. For illustrations of this numbering convention, see **Multi-Purpose Displays (MPDs)**, p. 2.24 and **Up Front Controls (UFC)**, p. 2.64.

FRONT SEAT VS. BACK SEAT

The F-15 has two cockpits — the front seat where the pilot sits, and the rear seat where the WSO (Weapons Systems Officer, pronounced "wizzo") sits. In real combat, the pilot has control of the aircraft and flight and deals with air opposition, while the WSO finds, designates and engages ground targets. Both officers are in constant communication with one another, and each can take over most of the functions of the other, should one of them become incapacitated.

In the game, you will perform most of the functions of both officers. You can "jump" from cockpit to cockpit using VIEW_PILOT_FWD F1 (default pilot's cockpit view and VIEW_WSO_FWD F3 (WSO's cockpit view). Almost all flight, targeting and weapons information is available in both cockpits; however, each of the Multi-Purpose Displays (MPDs) and Multi-Purpose Color Displays (MPCDs) in both cockpits can have a different page displayed. By setting up different pages in the MPDs and jumping back and forth between cockpits, you can keep a total of seven pages open at once.

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FRONT SEAT (PILOT)

The pilot's cockpit features a Head-Up Display (see Head-Up Display (HUD), p. 2.5), Up Front Controls (see Up Front Controls (UFC), p. 2.64) two monochrome MPDs, an MPCD and several conventional standby instruments in case of main systems failure (see Standby Instruments, p. 2.77).

In the *default pilot seat view* (VIEW_PILOT_FWD F1) you can only see the two MPDs.



Switch to the *look-down pilot seat view* (<u>VIEW PILOT MPD</u>; F2) to see the bottom MPCD and your standby instruments.



MPD and MPCD pages are described under Multi-Purpose Displays (MPDs), p. 2.24.

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BACK SEAT (WSO)

Most notably, the WSO's cockpit lacks a HUD. It features two MPDs and two MPCDs, however. MPD and MPCD pages are described under Multi-Purpose Displays (MPDs), p. 2.24.



MASTER MODES

Master modes tailor the F-15's avionics for a specific function. Buttons below the UFC indicate which master mode you are in. You can click on these buttons to switch modes, or use the following hot keys:

MASTER_MODE_CYCLE M	Cycle through master modes — A/A, A/G, NAV and INST.
MASTER_MODE_AA [<u>AShift]</u> 4]	Switch to A/A (air-to-air combat) master mode. Required for air-to-air missile launches.
MASTER_MODE_AG (Switch to A/G (air-to-ground combat) master mode. Required for air-to- ground weapons release.
MASTER_MODE_NAV [Switch to NAV (navigation) master mode. Used for navigational reference on ingress and egress.
MASTER_MODE_INST [1]7]	Switch to INST (instrument) master mode. Provides HUD data, can be used if HUD damaged.

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MASTER MODE MPD CONFIGURATION

The table below lists the MPD configuration for each master mode and any other limits or features adjusted by that mode.

MPDs are numbered from 1-7: 1 and 2 are the pilot's MPDs, numbered from left to right, and 3 is the pilot's MPCD. MPDs 4 and 7 are the WSO's MPCDs and 5 and 6 his MPDs, numbered from left to right.

Master Mode	Pilot pages	WSO pages	Other
A/A	1. A/A Radar 2. TEWS 3. A/A Arm	4. A/A Arm 5. A/A Radar 6. TEWS 7. TSD	Removes steering data block from HUD (see p. 2.7).
A/G	1. A/G Radar 2. A/G Arm 3. TSD	4. A/G Arm 5. A/G Radar 6. TEWS 7. TSD	You can't fire A/A missiles.
NAV	1. A/A Radar 2. HSI 3. TSD	4. ADI 5. A/A Radar 6. HSI 7. TSD	Adds bank scale and vertical velocity to HUD (see p. XX). ILS symbology can appear (see p. XX).
INST	1. A/A Radar 2. HSI 3. ADI	4. ADI 5. A/A Radar 6. HSI 7. TSD	Adds bank scale and vertical velocity to HUD (see p. XX). ILS symbology can appear (see p. XX).

You can reset which pages appear in which MPDs for the A/A, A/G and NAV master modes — see **6. Master Mode Programming**, p. 2.37. The INST master mode is not reconfigurable.

HEAD-UP DISPLAY (HUD)

The HUD consists of computerized flight, targeting and weapon information that is projected onto a sheet of specially coated glass at the front of the cockpit. It is designed to keep the pilot from having to constantly look down at his instruments for flight information during a dogfight.

BASIC HUD SYMBOLOGY



Angle-of-Attack. Lists your current angle of attack. It will flash when you are above 28.4 units. For a more detailed explanation of angle-of-attack, see Flight: Angle-of-Attack, p. 3.2.

Barometric altitude. Indicates your altitude above sea level the front cockpit standby altimeter provides the ADC (air data computer) with barometric pressure information, which is then used to compute barometric altitude.

CAUTION: This is your altitude above sea level (ASL), NOT your altitude above the ground (AGL). AGL depends on the height above the terrain you are flying over, which is not taken into account in barometric altitude computations. For AGL information, see Customizable Basic Symbology: Radar Altitude, p. 2.9.

Command heading bug. This small bar on the *heading scale* indicates the heading to the currently selected steer point. When this heading cannot be displayed onscreen, the bug moves to the edge of the heading scale closest to the steer point (i.e., the far left or right edge) and the correct heading is numerically displayed below it.

Current Gs. The number of Gs you are currently pulling. See **Flight:** 2.7 **G-Forces**, p. 3.5, for an explanation of G-force.

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Velocity Vector. (Also called a *Flight Path Indicator.*) Indicates the direction of your current flight path. In some situations — with heavy use of the rudder, for example — the nose of the aircraft (marked by the waterline) may be pointed in one direction, while the aircraft is actually side-slipping in another direction. In this case, the flight path indicator would mark the direction of side-slippage, which is the actual direction in which the aircraft is traveling.

+ Gun cross. Displayed on the HUD whenever master arm is on (see Standby Instruments, p. 2.77), regardless of HUD mode or weapon chosen. Marks the point through which bullets will pass at a range of 2250ft.

Heading scale. The heading scale is essentially a compass. North is 360°

(abbreviated to 36), east is 90° (9), south is 180° (18) and west is 270° (27). The caret in the center of the scale remains fixed, marking your current heading.

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02

532 Indicated airspeed. Displays your current *indicated airspeed* in knots. Indicated airspeed is the speed your aircraft would be traveling given your engine output if you were flying at sea level in still air. Changes in air pressure and wind affect your speed, so your *true airspeed* can be faster or slower than the speed listed here (see *Customizable Basic Symbology:* **True Airspeed** (T), p. 2.9). See **Flight: Airspeed**, p. 3.3, for a more detailed comparison of true and indicated airspeed.

Mach ratio. The mach ratio is your aircraft's speed in relation to the speed of sound *at the same altitude* — a mach number of 1 indicates that your aircraft is flying at the speed of sound. A mach number of .850 indicates your aircraft is flying at 85% the speed of sound.

Air density is less at higher altitudes, and thus your indicated airspeed will continue to decrease as you climb. The table below lists the indicated airspeed of aircraft traveling at Mach 1 at different altitudes. It gives an indication of just how much indicated airspeed may vary with altitude.

Altitude	Indicated airspeed
Sea level	661 knots
10,000ft	548
20,000	450
30,000	360
40,000	312
50,000	251
60,000	198

Above 30,000ft, pilots rely on the Mach number for speed information.

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- The lines of the pitch ladder are tilted to half of
- the pitch angle they indicate the 10° pitch line is angled 5°, the 60° pitch line is angled 30°.
- Positive pitch lines (i.e., those that mark pitch angles above 0°) are solid; negative pitch lines are dashed.
- The pitch ladder always remains perpendicular to the ground.

Steering data block. Displays navigational (NAV) or TACAN station (TCN) data if you are in NAV or INST master mode, depending on which option you choose with PB 6 of the UFC (see **Steering Data** (NAV/TCN/TGT STR), p. 2.68). If you are in A/G master mode and have a target designated, target information is displayed here. If you are in A/A master mode, this information disappears altogether.

Available Gs. The maximum number of Gs you can pull without potentially damaging the aircraft. See **Flight: G-Forces**, p. 3.5.

Pitch ladder. The pitch ladder is a series of paired, short lines in the center

NAV Lists the currently selected sequence point (e.g. NAV 0A), nautical range (N)

NAV Data Block

to this sequence point (distance to the sequence point in nm) and your *ETA or ETE* * (in hours:minutes:seconds).

MRV 26 — Currently selected steer point N 2.7 — Range to steer point 00 00 5 E – ETE or ETA

TCN Lists the currently selected TACAN channel (e.g. TCN XXX), nautical range

(*N*) to the corresponding TACAN station (distance to the station in nm), and your *ETA or ETE* * (in hours:minutes:seconds).

TACAN Data Block
ICN 207 — CurrentTACAN channel
N866_9 Range to station
0 53 59 E-ETE (or ETA) for station

* Time displays can be toggled between Estimated Time of Arrival (ETA — time at which you will reach the steer point or station) and Estimated Time Enroute (ETE — amount of time you will be enroute to a steer point or station) via the UFC data menu. See **UFC Data Menu**, p. 2.72.

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TGT Lists the ground range (G), in nm, current bomb mode (CDIP, AUTO OF AUTO LOFT) and one of the times below, depending on where you are in the launch sequence:

TARGET Data Block IGT 6 58.8 ---- Ground range to target 03:05 TREL- Time to release AUTO . Bomb mode

- *Time-to-target (TTGT)*. Counts down the time until you reach the area designated as your target. When this is displayed, your ground range is the range to this target point.
- *Time-to-pull (TPULL)*. Counts down the time until you need to pull up in an auto loft bombing sequence. (See Combat: Auto Loft Bombing Mode, p. 4.63.) Ground range lists the distance to the point on the ground over which this will occur.
- *Time-to-release (TREL)*. Counts down the time until the time the weapon should or will be released. Ground range indicates the distance to the point on the ground over which this will occur.

All times are displayed in minutes:seconds.

Waterline. Indicates where the aircraft's nose is pointed.

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CUSTOMIZABLE BASIC SYMBOLOGY

You can add and remove this information from your HUD display by using the HUD options submenu of the UFC (see **HUD Options Submenu**, p. 2.69).

True airspeed (T). This is your velocity relative to the ground, taking into account additions and subtractions to your indicated airspeed due to altitude, temperature, head winds, tail winds, side slippage, etc. See **Flight: Airspeed**, p. 3.3, for a comparison of true and indicated airspeed.

Radar altitude scale. Graphically displays your altitude above ground level (AGL). Appears when you drop below 1500ft AGL. Numbers on the scale represent hundreds of feet — 5 = 500ft, 10 = 1000ft, 15=1500ft. The caret indicates the current LAW setting (See 1. Low Altitude Warning (LAW) Submenu, p. 2.66). The top of the heavy vertical bar on the scale indicates your current altitude above the ground.

The radar altimeter measures the time it takes for a radar pulse to travel from the aircraft to the ground and back, and using this measurement calculates your altitude above the ground. Its antenna are located underneath the aircraft, and it can only function when pitch angle is $\pm 20^{\circ}$ and bank angle is less than $\pm 60^{\circ}$. At all other times, the radar altitude scale is removed from the HUD.

Thrust XXX. Appears when you do not have a throttle wheel on your joystick or a seperate throttle device. When thrust is displayed, it appears underneath the current/available G's indicators on the HUD. It appears as follows: THRUST 60%. The number indicates the percentage of maximum thrust you are currently using. You can increase and decrease thrust with a throttle device or by using the following key commands:

THROTTLE_UP (+=)	Increase throttle setting
THROTTLE_DOWN ()	Reduce throttle setting
THROTTLE_IDLE (①Shift)-)	Set throttle to idle
THROTTLE_MIL (☆Shift) ⁺ =)	Set throttle to full military power
THROTTLE_AB	Toggle afterburner on/off

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Selecting different master modes and weapons adds different symbology to the HUD. This additional symbology is described on the following pages.

A/A MASTER MODE SYMBOLOGY

Selecting A/A master mode removes the steering data block from the HUD (See **Basic HUD Symbology: Steering Data** (NAV/TCN/TGT STR), p. 2.68). Additional symbology is added to the HUD, depending on what radar acquisition mode you choose and which weapon is currently in priority. The following sections give an overview of this symbology. For more detailed, step-by-step instructions on finding, designating and engaging air targets, see **Combat: Getting In**, p. 4.11.

AUTO-ACQUISITION (ACQ) MODE SYMBOLOGY

In addition to manual acquisition (i.e., you click on a contact on your radar screen to designate it as your target) there are five target acquisition functions that the radar can run for you — Supersearch, Boresight, Long-Range Boresight, Vertical Scan and GUNS. (See also **Combat: A/A Auto-Acquisition Modes**, p. 4.28.) The symbology displayed on the HUD in these modes is explained here.

There is no mouse equivalent to these auto-acquisition mode functions. All but GUNS Acquisition must be assigned to a joystick button or key. GUNS Acquisition is activated automatically when you choose your gun while in A/A master mode and there is no current primary radar target.

Boresight and Long-Range Boresight Symbology

Boresight slaves the radar antenna to the radar boresight line (RBL), which is cued to the position of the waterline on your HUD. When you press either the boresight (ACQ_BST (6)) or longrange boresight (ACQ_LRBST (7)) key, a 4° circle (i.e., a circle with a diameter



of 4° — see note on next page) is drawn on your HUD. In boresight mode, the radar locks up the first target within 10nm to pass inside the circle. In long-range boresight mode, the radar locks up the first target within 40nm to pass inside the circle.

Acquisition scan areas cover a cone of area — the farther away from your plane, the larger the area covered. Therefore, the size of each scan area is expressed in degrees (4° or 20°), to specify the angular width of the scan area cone.



Supersearch Symbology

Supersearch (ACQ SS ; 5) is similar to boresight, except the circle is 20° in diameter. The radar designates the first target within 10nm to pass inside this circle.



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Vertical Scan Symbology



In vertical scan acquisition mode (ACQ_VTS (8)), the radar searches for its target 5° to 55° above the RBL, but only 7.5° in azimuth (3.75° to the left and right of your aircraft's nose). The radar locks up the first target within 10nm to pass inside this area. This is

the best mode to use if you are trying to acquire a target, you are tailing in a turning fight. A vertical line appears on the HUD to help you align your target in the radar's *field-of-view* (FOV).

GUNS Acquisition

GUNS acquisition is activated automatically when you choose your gun while in A/A master mode and there is no current primary radar target. It covers 60° of azimuth (30° to either side of aircraft's nose) and 20° of elevation (10° above nose, 10° down), out to a range of 5nm. No additional symbology appears on the HUD, however.

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MISSILE LAUNCH MODE SYMBOLOGY



The F-15 can carriy two types of missiles — short-range (AIM-9s) and medium-range (AIM-7s and AIM-120s). Different parameters and symbology are required for the successful launch of each, so the system has two air-to-air missile launch modes — short-range missile (SRM) and medium range missile (MRM). Press **SRM_SELECT** [2] to select SRM launch mode and **MRM_SELECT** [3] to select MRM launch mode.

The following two sections give an overview of missile launch mode symbology; step-by-step instructions for firing air-to-air missiles are listed under **Combat: Engage with Missiles**, p. 4.33.

Medium-Range Missile (MRM) Launch Mode Symbology

The F-15 can carry two types of medium-range air-to-air missiles — AIM-7s and AIM-120s. The HUD symbology is almost identical for the two missiles, exceptions are noted below.

ASE circle and steering dot. The Allowable Steering Error circle and dot provide a steering reference when you are tracking your target with radar. This circle and dot indicate Lead Angle Error (LAE) — the circle represents the maximum steering error that is normally acceptable for missile launch, and you should steer to place the dot inside the circle before launching. The size of the ASE is a function of target range relative to R_{acro} , target altitude and target aspect angle. As you close in on your target, the ASE will increase in size to a certain point, then may decrease depending on target aspect.

The ASE is displayed on the HUD at all times, but is only for reference purposes if you do not have a currently designated radar target.





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Break X. Appears in the center of the HUD when you are inside the priority missile's minimum range.

Degrees before break-lock. The number of degrees remaining before the radar lock on the currently designated target is broken. It appears directly over the waterline whenever the target's angle off the boresight reaches 50°. (Degrees before break-lock is also displayed in NAV master mode.) Break lock occurs beyond 60°.

Missile count cue. Appears as soon as you select MRM launch mode.

MRM	Indicates medium-range missile mode.
120A or 7F/M	Indicates which type of missile is in priority.
1 - 8	Number of this type of missiles remaining onboard

Prelaunch TTA or TTI. Lists the time-to-activate (A) or time-to-impact for the missile currently in priority. TTA is displayed if the missile is an AIM-120 and target range is between R_{opt} and the range at which the AIM-120's seeker head will switch to an active radar search (missile active range or MAR). If the target is within missile active range, TTI will be displayed. TTI is always displayed for an AIM-7.

Postlaunch min/max, TTA or TTI. Describes time-to-activate and time to impact for the missile in flight.

AXX/XX	AIM-120 only — lists min/max TTA. (Min TTA would be for the missile hitting first, max for the missile hitting last. If only one missile is in flight, only one number is listed.)
XX/XX	AIM-120 only — lists min/max TTI, as above.
TXX/XX	AIM-7 only — lists min/max TTI, as above.
LSG/LSG	Appears if the predicted TTI exceeds the time it would take the missile to travel its R_{aero} (see <i>Radar range scale</i> , next page), indicating a losing missile status.
XXX/XXX	Appears when the missile's actual time-of-flight exceeds the predicted TTI, indicating a lost missile status.

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Radar range scale. Appears as soon as you switch to MRM or designate a target, whichever comes last. The currently selected radar range, in nautical miles, is listed at the top of the scale — each tick mark represents 25% of that range. The following markers move up and down the bar.



R _{arro} bar	(Not visible.) Maximum aerodynamic range of the missile (always above the $\rm R_{opt}$ bar). Only useful against totally non-maneuvering targets — i.e., targets that maintain straight and level flight during the missile's entire time of flight.
$R_{_{opt}}bar$	Optimum range of the missile against a target that flies straight and level until the missile has almost reached it, then performs a 4G terminal escape maneuver (always below the R_{aero} bar).
R _w bar	Maximum range of the missile against a target that turns and runs as soon as the missile is launched (always below the R_{opt} bar). This is the range inside which a target can't escape (at least, not by running away).
R _{min} bar	Minimum range of the missile (always below the R_{opt} bar). The missile will not be able to hit a target inside this range.
Target range	This caret points to your target's current range.
Closure rate	The number beside the caret indicates your target's clo- sure rate in knots. A positive closure rate indicates the speed with which the distance between you is decreas- ing, a negative closure rate indicates the speed with which the distance between you is increasing.
MAR dot	(AIM-120 only.) Missile activation range — range at which AIM-120 active seeker attempts to acquire the target.

Range to target (R). Lists distance to your target in nm.

Shoot cue. This flashing symbol appears beneath the TD box when your target is within weapon range. The AIM-7 cue is a triangle, the AIM-120 cue is a six-pointed star.

Target altitude. Lists target's altitude (ASL) in ft — for example, 10-0 means 10,000ft and 16-2 means 16,200ft.

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Target aspect line. A radial line is displayed outward from the ASE circle to indicate target aspect. A line at 12:00 o'clock indicates tail aspect; 6:00 o'clock indicates nose aspect. The line is displayed in MRM and SRM modes whenever the HUD ASE is displayed.

Target aspect angle. Indicates which aspect of the target is facing you, measured in degrees (the final zero has been dropped for brevity). An aspect of т indicates you're facing your target's tail (0°) ; н indicates you're facing his nose (180°). An aspect of 16R indicates you're facing a point between the aircraft's nose and its right wing. 9L indicates you're facing the pilot's left wing. See Combat: Aspect Angle, p. 4.71.

Target locator line. When the TD box is limited by the HUD FOV, a dashed target locator line is displayed. The target locator line extends from the water line symbol and points to the limited TD box.

TD box. Appears around the current target, as soon as it is designated. When your target moves off of the HUD, the box is half-displayed at the edge of the HUD and marks the point you should turn toward to bring the target back in view. If you have IFF set to AUTO (or NORM and you send out a query), an X appears within the box if your target is friendly. (See Identification Friend or Foe (IFF), p. 2.67.)



Short-Range Missile (SRM) Launch Mode Symbology

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SRM symbology appears on the HUD when you press SRM_SELECT [2]. Different symbols may appear, depending on whether an AIM-9L/M or an AIM-9P is in priority (i.e., next in line to be fired), whether you are tracking your target with radar, whether the missile seeker head is caged or uncaged (i.e., locked to the boresight or free to move around — see Air-to-Air Armament Page (A/A ARM), p. 2.26) and whether the seeker head is currently locked on to its target.

The following features only appear in SRM launch mode when you are tracking your target with radar, but function in the same way as they do in MRM launch mode. See pp. 2.12-2.15.

Break X	TD box
Degrees before break-lock	Target altitude
Range to target	Target aspect angle
Shoot cue (triangle)	Target locator line

The following symbology is unique to SRM launch mode or behaves differently in SRM launch mode.

ASE circle and steering dot. Only appears when an AIM-9L/M is in priority *and* you are tracking a target with radar. Otherwise, it functions in the same way as the MRM launch mode ASE circle. See p. 2.12 for details.

Missile FOV. Appears whenever an AIM-9P is in priority or when an AIM 9L/M is in priority and you have no designated radar targets. When the missile seeker head is uncaged (i.e., free to move around and look for targets — see **Air-to-Air Armament (**A/A ARM**) Page**, p. 2.26) the missile FOV circle disappears and the missile FOV becomes roughly the size of the HUD FOV.

When the missile seeker head is caged, its FOV circle (field of view circle) also called the "missile boresight" — remains locked on the aircraft's waterline. This circle indicates where the missile seeker head is aimed and what it can "see" while it is caged.

An AIM-9 may end up tracking the sun if it falls within the missile's FOV!

Seeker head position. Appears whenever a AIM-9L/M is in priority, and indicates the direction the weapon's seeker head is currently "looking." It is smaller than the FOV circle. It remains on the HUD even when the AIM-9 seeker head is uncaged.

Missile count cue.Appears as soon as you select SRM mode.SRMIndicates you're in short-range missile mode.9L, 9M or 9PIndicates which type of AIM-9 the missile in priority is.1-4Number of SRM missiles remaining onboard.

Radar range scale. Appears if you are tracking your target with radar. It's the same as in MRM mode, but the following markers move up and down the bar: R_{max} bar, R_{min} bar, target range and closure rate. R_{max} indicates the missile'smaximum range. All others function as they do in MRM mode. See p. 2.13. Uncage cue (UNC). When scan is selected on the A/A Arm page (see A/A Arm Pushbuttons, p. 2.27), the missile seeker head is uncaged and will attempt to lock on to your currently designated target. This target must be within the missile seeker head field of view (40° from the nose of the missile).

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A/A GUN SIGHT SYMBOLOGY

A/A FNL Sight Symbology

If you are in A/A master mode but do not have a designated target, Lead-Computing Optical Sight (LCOS) funnel symbology appears on the HUD when you press GUN_SELECT 1. The radar will also automatically switch to Gun auto-acquisition mode and attempt to acquire a target. (See Auto-Acquisition (ACQ) Mode Symbology: Gun Acquisition, p. 2.11.)

The funnel sight is the only sight available until the radar locks on to a target, at which point GDS and GDS funnel sights become available. (Pressing **GUN_SELECT** 1) will cycle through all three sights at this point.)

The funnel represents a 40ft wingspan target at ranges between 250ft (the wide end of the funnel) and 5000ft (the narrow end of the funnel). There are dots along the funnel marking 1000, 2250 and 4000ft ranges.



A/A GDS and A/A GDS FNL Sight Symbology

Once you have a target designated, three gun sights are available — FNL, GDS and GDS FNL. Press **GUN_SELECT** 1 to cycle through the three sights.

If you lose radar lock on the designated target, the gunsight will automatically revert to FNL, and the radar will switch to GUNS auto-acquisition mode and attempt to re-acquire the target.

The following symbology appears when GDS or GDS FNL sights are selected. GDS FNL is a combination of GDS symbology and the FNL sight.

GDS pipper. Indicates where bullets will fall at the targets current range. Align this pipper with the target.

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Radar range scale, target altitude and **target aspect angle** function as in MRM mode. See p. 2.12.

Turn plane line. Represents the computed projection of the target's plane of motion. It is drawn from the gun cross through the reticle, to the edge of the HUD. You can use this line as a steering aid in a high-aspect attack.

A/G MASTER MODE SYMBOLOGY

The following sections give an overview of the symbology displayed on the HUD for Air-to-Ground combat. For more detailed, step-by-step instructions on finding, designating and engaging ground targets, see **Combat: Taking Care of Business**, p. 4.51.

Selecting A/G master mode adds the **bomb mode cue** to the lower right corner of the HUD, which tells you which of the three bomb modes — CDIP, AUTO OF AUTO LOFT — you are currently using. These bomb modes control what symbology is displayed on the HUD and how weapons are released. PB 5 of the A/G Arm page cycles through them (see A/G Armament Page (A/G ARM), p. 2.28).

AUTO and AUTO LOFT Bomb Modes

AUTO bombing mode is a blind bombing mode. The HUD provides you with azimuth steering information, a target designator and countdown to release. AUTO LOFT mode employs the same symbology, but assumes a loft trajectory for the weapon.

A/G reticle and range arc. Appears when you switch to A/G master mode. In AUTO and AUTO LOFT bomb modes, it is centered on the flight path indicator. The tick marks and heavy arc on the perimeter of the A/G reticle display slant range to target — the range on a straight LOS from your aircraft down to your target — values between 0 and 23,000ft. The arc moves counterclockwise as range *decreases*. Each outer tick mark represents 1000ft, with the first revolution indicating 23,000 to 12,000ft and the second revolution 12,000 to 0ft. Target range is indicated by a tick mark on the inside of the bar. (The range arc is radar dependent — if EMIS LMT is activated, range information will not be available. See Up Front Controls, p. 2.64.)

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ASL. The azimuth steering line (ASL) stretches from the TD diamond perpendicular to the horizon, providing a steering reference relative to the horizon. In the final phase of any run you should steer so that the ASL remains centered over the A/G reticle.

Command heading cue. This cue marks the aircraft aimpoint on the HUD heading scale. Steering toward the heading indicated by this cue keeps you on course toward your target.

ESL (AUTO LOFT only). By keeping the elevation steering line (ESL) centered on the A/G reticle, you will provide the selected weapon with its maximum loft trajectory and therefore maximum standoff distance.

Frag cue. The frag cue represents the edge of the predicted frag envelope for the currently selected weapon (see p. 2.21).

Release cue. The release cue is a small line perpendicular to the ASL that appears when TREL (*time-to-release*, see below) reaches 10 seconds or less. It provides you with range and release anticipation cues. It first appears about 5° above the velocity vector and moves down to intersect the flight path indicator as TREL goes to zero. The release cue will disappear if your steering error is greater than 20° (in other words, if the ASL moves more than 20° to the left or right of the A/G reticle).

Press the pickle button down (WEAPON_PICKLE button 2 on your joystick) before TREL reaches zero and hold it down while the release cue crosses the flight path indicator — the weapon will be released at this point. If multiple weapons have been selected for release (see A/G Arm Pushbuttons, p. 2.29), *continue to hold down the pickle button* — the release cue is repositioned after each weapon release and the process is repeated until the last weapon is dropped. Once the last weapon is released, the release cue disappears and the A/G reticle begins to flash. Releasing the pickle button stops the reticle from flashing.

TD diamond. Regardless of the sensor used to acquire the target position, the CC computes the HUD position of the TD (target designator) diamond so that it represents LOS (line of sight) to the target.

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TPULL (AUTO LOFT only). The time-to-pull countdown (in minutes:seconds) indicates the time remaining before you must pull up to align the flight path indicator with the ESL in order to give the weapon its maximum loft trajectory. The ESL appears 5 seconds before the expiration of TPULL. The TPULL cue will disappear when steering error is greater than 20°.

TREL. The time-to-release countdown (in minutes:seconds) begins when the target is within weapon range and the steering error is less than 20° .

TTGT. The time-to-target countdown (in minutes:seconds) is displayed in all A/G modes, whenever you have a target designated and steering error is greater than 20° .

CDIP BOMB MODE

Continuously Displayed Impact Point (CDIP) bomb mode is a computed, manually initiated release mode. The computer constantly recalculates the point at which the weapon will impact and displays this on the HUD. (Variations in terrain altitude are figured into the computation of impact point — if you are flying over hilly or rough terrain, the CDIP will change constantly in reflection.) You control the timing of weapon release, and you do not have to have a target designated before you pickle.

When you press and hold the pickle button (WEAPON_PICKLE; joystick button 2), the position of the A/G reticle becomes your designated target, and the computer switches to AUTO bomb mode. The CC then begins to calculate TREL and ASL as described under AUTO and AUTO LOFT Bomb Mode Symbology, p. 2.18. You continue to control weapon release steering in case multiple bombs will be dropped. If you let up the pickle button, you reenter CDIP mode.

Target designation is optional. If the target is designated, its position is computed as explained under the AUTO **and** AUTO LOFT **Bomb Mode Symbology**, p. 2.18. The range vector to the target is computed as the differ-



ence between the target position and the aircraft position. Your aircraft's altitude over the target's altitude is used to compute the bomb range and position the CDIP display.

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A/G reticle and range arc. In CDIP bomb mode, the A/G reticle represents the weapon impact point. Press the pickle button when the center of the reticle is over the area you wish the weapon to hit. (If you have a target



designated, you will want to align the A/G reticle with the TD diamond.) When you press the pickle button, the point marked by the reticle becomes the designated target and the reticle recenters on the flight path indicator.

The tick marks and heavy arc on the perimeter of the A/G reticle display slant range to target, as described under AUTO and AUTO LOFT Bomb Mode Symbology — see p. 2.18 for details and diagrams.

DIL. The Displayed Impact Line descends from the flight path indicator (see **Basic HUD Symbology**, p. 2.5) to the A/G reticle. The computer calculates a Displayed Impact Line (DIL) which appears on the HUD. You maneuver so that the line of your target's motion is along the DIL and then give the release signal as soon as the target crosses the pipper on the HUD. The Displayed Impact Line provides an azimuth steering reference to help you position the reticle over the target.

Frag cue. The frag cue represents the edge of the predicted frag envelope for the currently selected weapon. To avoid the frag envelope, make sure this frag cue is *below* the flight path indicator at the time of detonation. For most low-level deliveries, you will have to fly low enough that the frag cue is above the flight path indicator when you release your weapon — your exit maneuver must bring the frag cue back below your the flight path indicator before detonation, or you risk taking damage from your own weapon.

TD diamond. When you press the pickle button, the point marked by the A/G reticle becomes your designated target. As you hold down the pickle, the A/G reticle snaps back to the flight path indicator and the computer enters AUTO bombing mode. The release cue and TREL appear, and the weapon release continues as described under AUTO and AUTO LOFT Bomb Mode Symbology, p. 2.18.

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A/G GUN SIGHT SYMBOLOGY

The CDIP sight is used to aim the gun while in A/G master mode. When you press GUN_SELECT 1 to select your gun while in A/G master mode, the CDIP symbology appears on your HUD. The A/G reticle and range arc and TD diamond function exactly as they do in CDIP bomb mode. The DIL and frag cue are not displayed.

AGM-65 Symbology

When you are in A/G master mode, have an AGM-65 as your currently selected weapon, and master arm is on, several symbols that are specific to the AGM-65 Maverick appear.

A/G reticle. Fixed near center of HUD to provide a reference to aim manually boresighted missile.

Station 2 LOS. Mavericks can be loaded on weapons stations 2 and 8 — a left and a right underwing station. The line-of-sight (LOS) for the seeker head of the missile currently in priority on station 2 (the left station) is marked by a hollow circle and indicates where the seeker head is looking. When AGM-65 cueing is set to AUTO (see **Weapon Video Page (AGM-65, GBU-15)**, p. 2.59), this circle will snap to the TD diamond for the currently designated A/G target.

Station 8 LOS. The line-of-sight (LOS) for the seeker head of the missile currently in priority on station 8 (the right station) is marked by a hollow square. It functions in the same way as the Station 2 LOS.

NAV AND INST MASTER MODE SYMBOLOGY

Bank angle scale. Indicates your current bank angle in degrees from horizontal. When the pointer points to the 0° tick mark, your wings are horizontal and you are flying straight and level. When it



points 30° to the right of 0° , you are in a 30° banking turn to the left. (Your wings are tilted 30° , with the left wing down and the right up — this sends you to the left.)

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ILS SYMBOLOGY

The ILS (Instrument Landing System) projects additional information on your HUD to facilitate landing. ILS symbology appears on your HUD and your ADI when the ILS is activated and you are in NAV or INST master mode. To activate the system, go to the UFC main menu and press PB 5 until the text next to the button reads ILS ON. (See UFC Main Menu, p. 2.65.)

Glideslope Steering Bar. This horizontal line indicates your altitude relative to a 3° glideslope (the optimal angle for descent). If you are above this glideslope, the velocity vector will be above this line. If you are below this glideslope, the velocity vector will be below the line.

Glideslope Deviation Scale/Indicator. This scale on the left side of the HUD measures your deviation from the recommended 3° glideslope. A small, v-shaped caret shows your current deviation. The center of the scale marks the recommended glideslope. The top tick marks 1° above the glideslope, while the bottom tick marks 1° below.

Localizer Steering Bar. This vertical line indicates your horizontal lineup with the runway. If you are to the left of the runway, the velocity vector will be to the left of this line. If you are to the right of the runway, the velocity vector will be to the right of the line. This bar shows your position relative to the center line of the runway and doesn't depend on your heading.

Localizer Deviation Scale/Indicator. This row of dots in the center of the HUD measures your deviation from a dead-on (straight-ahead) approach to the runway. A vertical arrow marks your current deviation. The center circle marks a dead-on approach. The leftmost circle marks a 2.5° deviation to the left of the runway, and the rightmost circle marks a 2.5° deviation to the right.

For more information on using ILS information to land, see **Flight:** Landing, p. 3.18.



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MULTI-PURPOSE DISPLAYS (MPDS)

A Multi-Purpose Display is a video display unit which provides information from aircraft and weapons systems on a series of interchangeable screens or "pages." From the MPD main menu, the pilot presses the buttons surrounding the unit (called "pushbuttons" or "PBs") to display different pages. For reference in this chapter, these PBs are numbered 1-20, starting in the upper left and moving counter-clockwise.

The Multi-Purpose Color Display (MPCD) units in the F-15 function in the same way as MPDs, but the display is in color. Air-to-Ground and Air-to-Air Radar information cannot be displayed on a color display, so these options are not available from the main menu of the MPCD.

MPD MAIN MENU

The MPD main menu is the top-level menu from which all other pages can be selected — from any of these pages, click PB 11 (marked by an M) to return to the MPD main menu. You can select MPD pages while the game is paused.

- PB 1(ADI) Attitude DirectorIndicator page (p. 2.25)
- *PB 2* (A/A ARM) Air-to-Air Armament page (p. 2.26)



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- PB 3 (A/G ARM) Air-to-Ground Armament page (p. 2.28)
- *PB* 4 (HSI) Horizontal Situation Indicator page (p. 2.32)
- *PB* 5 (TSD) Tactical Situation Display page (p. 2.34)
- *PB 6* (PROG) Master Mode Programming (p. 2.37)*
- PB 12 (TGT IR) Targeting IR page (p. 2.38)
- PB 13 (TEWS) Tactical Electronic Warfare System page (p. 2.42)
- PB 14 (A/G RDR) Air-to-Ground Radar page n/a on MPCDs (p. 2.45)
- PB 15 (A/A RDR) Air-to-Air Radar page n/a on MPCDs (p. 2.49)
- PB 18 (ENG) Engine Data page (p. 2.58)
- PB 19 (WPN) Weapon Video page (p. 2.59)

*PB 6 does not call up a page — instead, it brings up a submenu.

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1. ATTITUDE DIRECTOR Indicator Page (ADI)

The Attitude Director Indicator (ADI) page displays information about your airspeed, angle-of-attack, altitude, turn rate, heading, etc. The symbology is the same as or similar to the symbology that appears on the HUD.



These features are described under Basic HUD Symbology, pp. 2.5:Angle-of-AttackIndicated airspeedBarometric altitudeWaterlineHeading scaleHeading scale

The **radar altitude scale** is displayed on the ADI when it is displayed on the HUD. This feature is described under **Customizable Basic Symbology**, p. 2.9.

Although the **bank angle scale** only appears on the HUD when in NAV and INST master modes, it always appears on the ADI page. It is described under NAV and INST Master Mode Symbology, p. 2.23.

Slip indicator. Visually indicates how much your aircraft is drifting left or right, with reference to the aircraft's nose. If you are flying straight, your aircraft's nose is heading in the same direction as your flight path, and the ball on the slip indicator will be in the middle of the box. If the heading of your aircraft's nose is not the same as the heading for your flight path, then you are slipping, and the ball will indicate the position of your nose relative to your flight path (your flight path is the center of the slip indicator box).

Turn rate scale. Indicates your turn rate in degrees per second. The center tick mark indicates a turn rate of 0° /sec, and the tick marks to the right and left indicate turn rates of 10° /sec and 20° /sec to the right and left.

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2. AIR-TO-AIR Armament Page (a/a arm)

The Air-to-Air Armament page displays the placement, number and types of air-to-air ordnance loaded on your aircraft. The display presents a rough top-down view of your aircraft, with the nose of your aircraft oriented toward the top of the display. The large triangular "brackets" represent the wings of your aircraft.

The rough locations of the eight air-to-air ordnance stations on the underside of your aircraft are indicated, along with the type and status of weapon loaded at each station. (Only one weapon can be loaded at each station.)



A/A ARM SYMBOLOGY

Rounds remaining. This figure lists the number of gun rounds remaining.

Missile type. Lists the type of missile loaded at a station:

7F	AIM-7F	9_M	1	AIM-9M		9_P	AIM-9P
7м	AIM-7M	91	5	AIM-9L		120a	AIM-120A

Missile status. Lists the status of each missile, according to the table below:

Status	Criteria
SRM/MRM	• Missile aboard — SRM indicates it is a short-range missile
	(AIM-9), and MRM indicates it is a medium-range missile
	(AIM-7 or AIM-120).
STBY	• You are in the correct missile launch mode (MRM or SRM)
	for the missile on this station
RDY	• A/G master mode is not selected
	• Master Arm switch is set to ARM
	• The missile is in priority
HUNG	Missile aboard after launch command
	(i.e., missile has malfunctioned)
 BLANK>	No missile aboard this station

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- *PB 2* Toggle **gun rate** between HIGH (6000 rounds per minute) and LOW (4000 rounds per minute).
- PB 14 (scan) Locks/unlocks the seeker head of the AIM-9 from the boresight. When uncaged, the seeker head attempts to lock onto the currently designated target. scan is boxed when the seeker head is uncaged.

MISSILE LAUNCH SEQUENCES

There are two possible launch sequences, depending on whether your loadout consists of all MRMs or a combination of MRMs and SRMs.



In a mixed AIM-120A/AIM-7 loadout, all AIM-120s will be in sequence before AIM-7s. At any point in the sequence, you can press **MISSILE_REJECT** (4) to skip the missile in priority and pass over to the next missile in sequence. You must cycle through the rest of the missiles if you want to return to any skipped missiles, in their sequence.

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3. AIR-TO-GROUND ARMAMENT PAGE (a/g arm)

The Air-to-Ground Armament page gives you an overview of number and types of air-to-ground ordnance you're currently carrying, along with the currently selected weapon and gun rounds remaining. From this page you can set gun rate, the interval distance between bombs, and the number of bombs to be dropped.

A/G ARM SYMBOLOGY



RDY (READY). If RDY is boxed, weapons can be released. If RDY is not boxed, make sure master arm is on, A/G master mode is selected and the currently selected station(s) contains weapons.

Rounds remaining. This figure lists the number of gun rounds remaining.

Air-to-Air Ordnance. Lists the number and types of air-to-air weapons remaining on the plane. Switch to the A/A Arm page to get more detailed information about your air-to-air ordnance.

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PB 2	Toggle gun rate between HIGH (6000 rounds per minute) and LOW (4000 rounds per minute).		
PBs 3 and 4	Control the tot selected station release option weapons releas carrying four <i>dropped, two f</i> Options , p. 2.	tal quantity of weapons released from all ns when either RP SGL OT RP MPL weapon is active. This is the <i>total</i> number of sed — if the setting is 4 and two stations bombs apiece are selected, <i>four bombs are</i> <i>rom each station</i> . (See Weapon Release 31.)	
	PB 3 controls f digit. Quantiti actual quantity weapons loade	the ones digit and PB 4 controls the tens es can range between 1 and 29, but the y dropped is limited by the number of ed on the selected stations.	
PB 5	Cycle through bomb modes — the current mode appears next to the button. Bomb modes control what symbology is displayed on the HUD to guide the pilot through weapon release, and how much of the release procedure is controlled by the computer.		
	CDIP	A calculated, manually initiated release. The point where the weapon will impact on the ground is continually re-calculated and projected onto the HUD, but you con- trol release.	
	Αυτο	The HUD provides you with azimuth steering information, a target designator and target information. The azimuth steer- ing information helps you align with the target, while the computer calculates when to release the weapon and gives you a countdown. If you are pressing the release button (on your joystick) when the count- down reaches zero, the weapon(s) are auto- matically released.	
	AUTO LOFT	This mode is the same as AUTO mode, except it assumes you want a loft trajecto- ry for the weapon released.	
	For more infor Combat: Deci	mation on each of these bomb modes, see iding What to Take , p. 4.7.	

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PBs 12 and 13	Control the interval between weapon release for RP SGL and RP MPL drops from the selected station(s). (See Weapon Release Options , next page.)
	Intervals are given in feet of weapon range (i.e., how many feet from the first weapon the second weapon will impact the ground). PB 12 controls the tens digit and PB 13 controls the hundreds digit; interval settings can range from 0 to 990ft.
PBs 16-20	Select/deselect an A/G weapon station. Each button represents an A/G weapon station — beneath each is a list of the type and number of weapons loaded on that station. Click the PBs to select and deselect the stations — a box appears around the weapon type when a station is selected.
	Multiple stations can be selected, but only if they are

carrying the same type of ordnance.

The stations are set up as follows:



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WEAPON RELEASE OPTIONS

The following buttons control how weapons will be released from the currently selected weapons stations when the release signal is given. Only one can be selected at any given time — a box surrounds the currently selected option:

- PB 6 (1/sTA) When this option is selected, one bomb from each selected station will be released with each press of the pickle button. Quantity and interval settings (see above) are ignored the number of weapons dropped with each release is controlled by the number of stations selected.
- PB 7 (RP SGL) When the ripple single option is selected, bombs are released one at a time from each of the selected stations. The total number of bombs dropped is determined by the *quantity* setting and the distance between releases is determined by the *interval* setting.
- *PB 8* (RP MPL) When the ripple multiple option is selected, one weapon is released from all selected stations with each drop. The total number of bombs dropped is determined by the *quantity* setting, the number of bombs dropped with each release is controlled by the number of stations selected, and the distance between releases is controlled by the *interval* setting.

Example

The conformals (PBs 17 and 19) are loaded with six MK-82 bombs apiece. Both are selected. The release quantity is set to 4, and the release interval is set to 200. The following happens at release, depending on which weapon release option you have selected:



1/sta. Two MK-82s are released — one from the left conformal and one from the right — with each

weapon release command. You can continue dropping weapons until there are no weapons left on the conformals.

RP sgL. One MK-82 is released initially. 200ft away, another MK-82 is released from the opposite conformal. 200ft away from this drop, another MK-82 is released. 200ft from the third drop, the fourth MK-82 is released. (Note only one weapon release command was issued.)

RP MPL. Two MK-82s are released — one from the left conformal and one from the right. Two hundred feet away, two more MK-82s are released, one from each conformal. (Again, note that only one weapon release command was issued.)

4. HORIZONTAL SITUATION INDICATOR PAGE (HSI)

The Horizontal Situation Indicator (HSI) provides azimuth information to help you orient towards steer points and TACAN stations. The autopilot also uses HSI information to maintain course when coupled steering is active on the A/P submenu of the UFC. (See **HSI Pushbuttons**, p. 2.33, and **Autopilot** (A/P) Submenu, p. 2.70.)



HSI SYMBOLOGY

The HSI is a top-down view of the area around your aircraft (marked by the small aircraft symbol in the center of the display). Your nose is always oriented to the top of the display.

Compass rose. Indicates magnetic compass headings — north (N), east (E), south (s) and west (w) are indicated and the tick marks indicate 10° increments. The heading at the top of the display (i.e. the heading the aircraft symbol is "flying" toward) is your current heading. (As you turn and your heading changes, the compass turns around the aircraft symbol, which remains fixed.)

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NAV AND TACAN steering data blocks. List heading (in degrees), range (in nm) and *ETA or ETE (h:mn:sc) for the currently selected steer point (sp) or TACAN station (TCN), depending on whether TCN (PB 6) or NAV (PB 10) is cur-

*ETA or ETE is displayed depending on which is selected on the UFC data menu. See UFC Data Menu, p. 2.72.

rently selected. See HSI Pushbuttons, next page.

Steer point position. Marks the position of the currently selected steer point relative to the position of your aircraft, if that steer point is within range. PBs 16 and 17 increase and decrease display range.

TACAN station position. Indicates the position of the currently selected TACAN station, relative to your aircraft. This symbol will only appear when the currently selected TACAN station is within your current display range. PBs 16 and 17 increase and decrease display range.

HSI PUSHBUTTONS

- PB 16 and 17 Cycle in each direction through display ranges 10, 20, 40, 80 and 160nm. The currently selected range appears between the buttons.
- *PB 6 and 10* Choose HSI steering mode. Only one steering mode can be active at a time; a box surrounds the label of the currently active mode.
 - TCN (PB 6) Activate TACAN steering mode. (In this mode, the steering data block provides information on the currently selected TACAN station, and autopilot steers toward this station when *coupled steering* is enabled.)
 - NAV (PB 10) Activate NAV steering mode. (In this mode the steering data block provides information on the currently selected steer point, and autopilot steers toward this point when cou*pled steering* is enabled.) Steering modes can also be set with PB 6 of the UFC main menu. See 6. Steering Data (NAV/TCN/TGT STR), p. 2.68.

If you are unfamiliar with TACAN stations and how to select them, see 2. Tactical Aid to Navigation (TACAN) Submenu, p. 2.66. If you are unfamiliar with steer points and how to select them, see 10. Steer Point (STR ...), p. 2.71. For more information on coupled steering, see 9. Autopilot (A/P) Submenu, p. 2.70.

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5. TACTICAL SITUATION DISPLAY PAGE (TSD)

The Tactical Situation Display (TSD) page displays a digitized satellite map of the area of operation. Superimposed on this map are steer point and flight path symbology. You can focus on your current position, or "look ahead" to upcoming steer points.

Unlike other displays, it is truly useful to display this in a color MPD (the bottom MPD in the pilot's cockpit, the right and left MPDs in the WSO's cockpit). When the terrain is displayed in color, it provides a valuable reference aid when compared to air-to-ground radar returns.



TSD SYMBOLOGY

A/G radar search cue. Indicates the area currently being scanned by the A/G radar. The cue appears when you select RDR with PB 7, and the A/G radar is in any mode other than High Resolution Map (HRM) mode. The cue is affixed to an LOS line extending out from the present position marker.

See A/G Radar Modes, p. 2.45, for details on the different A/G radar modes. See TSD Pushbuttons, p. 2.36 for details on switching between cues.

Azimuth (Az). Gives azimuth position for the targeting IR or HRM cues. The number indicates degrees from the nose of your aircraft, L and R indicate whether the cue is to the left or right of the aircraft.

Distance from centerline. Indicates the distance (in nm) from the center of the display based on the selected TSD range setting.

Magnetic heading. Your aircraft's current heading.

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HRM cue. The HRM (High Resolution Map) cue marks the position of the current HRM or "patch map." The cue appears when you select RDR with PB 7, and the A/G radar is in HRM mode. It is affixed to an LOS line extending out from the present position marker.

See A/G Radar Modes, p. 2.45, for details on the different A/G radar modes. See TSD Pushbuttons, p. 2.36, for details on switching between cues.

Present position marker. This symbol marks the current position of your aircraft — the larger of the two intersecting lines represents your wingline. You can adjust this symbol to appear either at the bottom or center of the display with PB 6 (see **TSD Pushbuttons**, p. 2.36).

Range (R). Gives the distance of the targeting IR or HRM cue from your aircraft, in nm.

Range markers. Indicate the range scale (in nm) based on the selected TSD range setting. (See TSD Pushbuttons, p. 2.36.)

Targeting IR cue. Indicates the area currently being viewed by the targeting IR camera. The cue appears when you select FLIR with PB 7. It is affixed to an LOS line extending out from the present position marker. (See **TSD Pushbuttons**, p. 2.36.)

SEQUENCE POINTS

Sequence point is a term used to describe F-15E navigation symbols. They are connected by a line which indicates your planned flight path. The shape used to indicate a sequence point varies according to the type of sequence point:

Base	Steer	Target	Initial
	Point	Point	Point
	0	Δ [

Base. Base is marked by a homeplate-shaped icon, indicating the position of the airbase you took off from at the start of the mission.

Steer points. Steer points are a series of geographical points that mark the route you are to fly. They are represented by small circles and are numbered in the order that you are to reach them.

Target points. Target points are marked by triangles, and indicate points of intended weapon delivery. Note that these are not targets in the sense of a moving ground vehicle or aircraft whose position is tracked by a sensor device — a target point is simply a steer point at which you will release weapons.

Initial points. An initial point indicates a steer point just prior to a target point. Initial points are square and follow the steer point numbering system.

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TSD PUSHBUTTONS

PB 6	Toggle position of present position marker between the bottom (BOT) and center (CTR) of the display. The cur- rently selected option appears above the button.
PB 7	Select which sensor cue is displayed — A/G radar (RDR) or targeting IR (FLIR). The currently selected option appears above the button. When RDR is selected, the HRM cue or the A/G radar search cue appears on the map. When FLIR is selected, the targeting IR cue appears instead. See TSP Symbology , above.
PBs 13 and 14	Cycle through display ranges in each direction — 10, 20, 40 and 80nm. The currently selected range appears between the two buttons.
PB 17	Cycle the position displayed between present position (PP) and follow-on steer points.
	When PP is selected, the TSD displays the area surround- ing the present position marker. Any steer points visible within the selected display range are also displayed.
	Press PB 17 to "look ahead" through your follow-on steer points (i.e., the steer points you haven't yet flown to) in sequence. The TSD displays the area around the currently selected steer point (the number of this point appears below PB 17).
	After cycling through the last steer point on your route, pressing PB 17 again returns you to PP (present position).
PB 18	(DCL) Declutter the display by removing all symbology except the present position marker, the sensor cue and the azimuth and range information in the upper left cor- ner of the display. This option is boxed when it is select- ed; press PB 18 again to deselect it.


The master mode programming feature allows you to reconfigure which pages appear by default in an MPD when you switch to A/A, A/G or NAV master modes. INST master mode is not configurable.

If, for example, you find it's often useful to have the Targeting IR page up in MPD 4 (rightmost MPD in the WSO's cockpit) when you're in A/G master mode, then you probably want to program MPD 4 so that Targeting IR is the default page in A/G master mode.

You can pause the game to program MPDs.

To program an MPD:

- Go to that MPD and press PB 11 (M) to jump to the main menu, if you are not already there.
- Press PB 6 (prog). A menu appears in the center of the main menu display (see graphic).



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This menu tells you the order in which you will choose pages for the display — first is NAV mode, second is A/A mode, and third is A/G mode. (In front of each number is the page displayed for the master mode; after the number is the master mode.)

- 3. Press a PB along the perimeter of the MPD to select the page you want to be displayed in this MPD for the NAV master mode (e.g., press PB 5 (TSD) to select the TSD page). The page listed in front of number 1 will change to the page you just selected.
- 4. Press a PB to select a default page for the A/A master mode.
- 5. Press a PB to select a default page for the A/G master mode.
- 6. Press PB6 to end programming.

There is no way to skip ahead to the master mode you want to reprogram. Once you've pressed PB 6 (PROG) to begin the sequence, the first button you press is the default for NAV master mode, the second button is the default for A/A master mode, and the third is the default for A/G mode. If you wish to end the sequence at any point, press PB 6 (PROG).

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12. TARGETING IR PAGE

The Targeting IR page displays video from the FLIR (Forward-Looking IR) camera housed in the AN/AAQ-14 pod of the LANTIRN system. You must have the AN/AAQ-14 pod loaded in order to use the Targeting IR page (see **Interface: Arming**, p. 1.10).

TARGETING IR PUSHBUTTONS



- PB 1 (CDES) Activate/deactivate continuous designation. When active (i.e., CDES surrounded by a box), the current object or area being tracked by the targeting IR camera (TRK is boxed, see PB 10, next page) will be designated as the current A/G target. If nothing is being tracked (i.e., TRK is not boxed), the next object or area to be tracked will be designated as the new A/G target. (The word "DES-IGNATE" will appear briefly in the display whenever the A/G target is designated in this manner.)
- PB 5Toggle between wнот (white-hot) and внот (black-hot) displays;
the currently selected option appears next to the button. On a
white-hot display, the "hotter" an object is (i.e., the more heat it
radiates) the brighter it appears on the display. Black-hot is the
inverse of this the hotter the object, the darker it appears.

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PB 6Toggle track mode between A/A and A/G; the currently selected option appears by the button.

- In A/A track mode, the targeting IR camera will track aircraft inside its FOV and provide an IR target TD box on the HUD, in addition to the radar target TD box.
- In A/G track mode, the targeting IR camera will track ground objects and positions only. No additional target designator is displayed on the HUD.

PB 10 (TRK) is used to initiate tracking in both cases.

Cycle through fields of view — wFOV, NFOV or ENFOV; the currently PB 7selected option appears by the button. WFOV covers the greatest area with the least magnification, whereas ENFOV covers the least area with the greatest magnification — see the chart below for details.

FOV	Video Dimension	Magnification	
WFOV	5.85° x 5.85°	2.3X	
NFOV	1.67° x 1.67°	8X	
ENFOV	.835° x .835°	16X	

- PB 10 (TRK) Enable/disable target track. When enabled (i.e., surrounded by a box), the targeting IR camera tracks the object or area inside the *tracking gate*. If CDES is also boxed (see PB 1, above), enabling TRK will also make the object or area within the tracking gate your A/G target. (The word "DESIGNATE" will appear briefly to signal you that an A/G target has been designated.)
- PB 12 (BST) Return camera view to boresight (i.e., aiming at a point ahead of the aircraft's nose), if TRK is disabled (i.e., not boxed). If TRK is enabled, this button has no effect.
- PB 16 (DCL) When declutter is active (i.e., surrounded by a box), the pod LOS cue, LOS cue local position, NFOV and ENFOV display size markers, the target position and the attack timer are removed from the display. Press PB 16 again to deactivate DCL and recall these features.
- PB 19 Activate/deactivate the laser designator. Toggles between ARM (laser is deactivated, or "not lasing") and LASE (laser is actively lasing the target). SAFE appears if master arm is off; MASK appears if something is blocking the laser LOS.

The pushbuttons marked by arrows pan the camera, if TRK is disabled. If TRK is enabled, they have no effect. The key name for each action is listed in parentheses.

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- PB 3 Pan camera left (TFLIR_LEFT 公Shift)+)
- PR 8 Pan camera down (TFLIR_DOWN 分 Shift ↓)
- PB 13 Pan camera right (TFLIR_RIGHT; [☆Shift]→)
- PR 18 Pan camera up (TFLIR_UP; 公 Shift 个)

Maximum pan angle for the camera is 150° right/left and 150° up/down.



TARGETING IR SYMBOLOGY

ENFOV display size marker. This marker is only visible in NFOV and shows the area that will be visible in ENFOV. See Targeting IR Pushbuttons: PB 7, p. 2.38.

Laser designator. Indicates what the laser is doing:

SAFE	Master arm is OFF and the laser cannot be used.
ARM	Master arm is set to ARM and the laser is ready for use.
LASE	Laser is lasing target.
MASK	Something is blocking the laser LOS (e.g., you have dropped into a valley and the target the targeting IR camera was tracking has disappeared behind a hill).
Lacer ra	nge to target Appears when laser is active gives slant range (i.e.

Laser range to target. Appears when laser is active, gives slant range (i.e., range along the LOS) to target, in feet.

Laser status. Indicates the status of the laser — L means the laser is ready to use or, if flashing, that the laser is in use. M indicates the laser is masked (see above).



Pod LOS cue. This small dashed box provides a quick idea of the approximate azimuth and elevation of the targeting pod FLIR/laser LOS (line of sight) with respect to your aircraft. If you drew a line between the sighting index (your aircraft) and the pod LOS cue (the point at which the targeting pod is aimed) all objects crossing this line would be "seen" by the targeting pod. LOS is dependent on elevation as well as azimuth, however, so the cue provides only a visual approximation of LOS.

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Pod azimuth (Az). Gives the exact azimuth direction of the camera pod in degrees to the left (L) or right (R) of center. This tells you how far to the left or right the camera is looking — 030R indicates the camera is looking 30° to the right of the nose, for example.

Pod elevation (EL). Gives the exact elevation in degrees up (U) or down (D) from your aircraft — for example, 110D indicates that the camera is looking 110° down from your aircraft (so far down, that it is actually pointing behind the aircraft — see the diagram above).

Tracking gate. The object or area inside this gate will be tracked when *tar-get track* (TRK) is enabled (see PB 10, above). If CDES is boxed, this area or object will become your currently designated ground target (see **Targeting IR Pushbuttons**, p. 2.38).

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13. TEWS PAGE

The Tactical Electronic Warfare System (TEWS) combines four different defensive systems into one display page. The AN/ALR-56C Radar Warning Receiver (RWR) detects and displays threats. The AN/ALE-40 Countermeasures Dispenser (CMD) dispenses chaff and flares. The AN/ALQ-135 Internal Countermeasures Set (ICS) is the onboard radar jammer and is cued by the AN/ALQ-128 Electronic Warfare Warning Set (EWWS) receiver.

Chaff and flares will only be available if you load them. See **Interface:** Arming, p. 1.10.

TEWS SYMBOLOGY

The TEWS presents a top-down view of the area around your aircraft. Your aircraft is in the center of the display, marked by the aircraft symbol.



CMD status. Lists chaff (CHF) and flare (FLR) rounds remaining.

ICS status. Indicates the status of your jammer:

EMIS	EMIS LMT is on, disabling the jammer.
STBY	Standby — \ensuremath{EMIS} LMT is off, but the jammer is not currently emitting.
JAM	EMIS LMT is off, and the jammer is currently emitting.

The EMS button, which disables radar and jammer emissions, is on the UFC, to the right of the keypad. See **Up Front Control (UFC)**, p. 2.64.

Sector indicators. An indicator will light up when a high priority (i.e., locked-on or missile-guiding) emitter is within 5° of its azimuth. For example, if a threat has locked on to you, turning to place it 85°-95° to your right would cause the right sector indicator to light up. Use the indicators in this way to try breaking a radar-emitter's lock by "beaming" it (turning so that your flight path is perpendicular to the emitter).

TACAN and NAV steering data blocks. Same as the steering data blocks on the HUD — lists *heading* (in degrees), *range* (in nm) and *ETA or ETE* (h:mn:sc) for your currently selected TACAN station or sequence point. See **Basic HUD Symbology: Steering Data Block**, p. 2.7, for more details.

Threat symbols. The following symbols are used to mark threats. A circle around a symbol indicates that the threat has a radar lock on you. If a symbol is flashing, it is passing missile guidance commands to a missile (not necessarily a missile that is aimed at you, but you can never be too careful).

 \wedge Air emitter

Ground emitter

♦ Missile emitter

An alphanumeric code inside the symbol identifies the type of aircraft or ground threat. The Threat ID Code Table below lists all threat objects and their codes.

The TEWS will only display missiles if they have onboard active radar seekers (e.g., the AIM-120 and AIM-54). In any case, a missile displayed on the TEWS won't have an ID, merely an icon.

THREAT ID CODE TABLE

Air Emitter Codes

Ground Emitter Codes

Code	Air Emitter	Radar System	Code	Ground Emitter	Radar System
14	F-14	AWG-9	EW	GCI	Bar Lock/
15	F-15	APG-70			Flat Face
16	F-16	APG-68	2	SA-2	Fan Song
18	F/A-18	APG-65	3	SA-3	Low Blow
21	MilG-21	Spin Scan	6	SA-6	Straight Flush
22	Su-22	High Fix	8	SA-8	Land Role
23	MiG-23	High Lark	10	SA-10	Flap Lid
24	Su-24	Orion A	11	SA-11	Fire Dome
25	MiG-25	FoxFire			(ACQ radar)
27	Su-27	Slot Back	SD	SA-11	Snow Drift
29	MiG-29	Slot Back	13	SA-13	Snan Shot
31	Su-30	Slot Back	23	7511-4-23	Gun Dish
35	MiG-35, Su-35	Zhuk-PH	RO	Boland	Sull Distr
40	F-111	APQ-169	НΔ	Hawk	
41	Tornado	Doppler 72	S	NSA Missile Boat	Fire Control
42	TU-22	Tail gun radar	0		Radar
43	B-52	Tail gun radar	AA	AAA	Fire Can
EW	AWACS				
F1	F1 Mirage	Cyrano IV			
F4	F-4E	APQ-120			
F5	F-5E	APQ-153			

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THREAT LOCATION AND STRENGTH

The TEWS indicates a threat's azimuth position relative to yours, and how strong its signal is. The stronger a threat's emissions, the closer its icon appears to the marker representing your aircraft on the display. (See **Combat: Threat Location and Strength**, p. 2.44.)

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TEWS TONES

In addition to visual symbology, the TEWS also provides audio cues in the form of different-pitched tones and warbles. A short, relatively low-pitched "boop" (.25 sec, 800 MHz) indicates a new radar spike has appeared on the display. A brief warble, alternating five times between a lower and higher pitch (800/1600 MHz, 2.5 sec total duration) indicates something has a radar lock on you. This warble will be repeated every 30 sec for the duration of the lock. When a threat is launching a missile at you, another, faster warble alternating much between a lower and higher tone will repeat continuously until the threat is gone or you're dead. (This could be the last sound you hear.)

TEWS PUSHBUTTONS

- *PB 2* (DCL) Declutter the display by removing the compass rose and all friendly emitters.
- *PB 20* Cycle through **CMDS/ICS control options** manual (MAN), semi-automatic (SEMI) and automatic (AUTO). The currently selected option appears below the button.
 - MAN Chaff and flares must be dropped manually; one cartridge is dropped per command. Jammer must be enabled/disabled manually.
 - SEMI Chaff is dropped manually, but the computer determines the number dropped per command, according to the current situation. Flares are dropped as in manual (MAN) control. Jammer must be enabled/disabled manually.
 - AUTO TEWS controls all aspects of chaff release and jammer operation. (*Note:* AUTO mode can use up chaff very quickly.)

Flares are always released manually.

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14. AIR-TO-GROUND RADAR PAGE (A/G RDR)

Although the F-15E has both Air-to-Air and Air-to-Ground Radar pages, the radar information displayed comes from the same radar system - the AN/APG-70. This powerful radar system can gather information on either ground or air targets, but it can't do both at the same time. For this reason, you cannot have both pages up at the same time. If you try to pull up the A/G Radar page when the A/A Radar page is open in another MPD, you will receive a RADAR IN USE error message. If you click the A/G RDR page button again, the A/G Radar page will open and the A/A Radar page will close automatically.

There are two exceptions. If you have a static "patch map" (HRM) up on the A/G Radar page, the HRM will remain up even if you call up the A/A Radar page in another MPD. (See A/G Radar Modes, below.) You won't be able to switch to another A/G radar mode until you close the A/A Radar page, however. If you are tracking a target with the A/A Radar page, you will not be able to open the A/G Radar page.

This section provides a basic overview of A/G Radar symbology and features. For a more detailed, step-by-step explanation of how to find and designate targets with the air-to-ground radar, see Combat: Finding and Designating Targets, p. 4.51.

A/G RADAR MODES

The F-15's air-to-ground radar has several modes designed to overcome the difficulties associated with radar surveillance of ground targets. It can provide static images which give a far more detailed picture of terrain features than conventional radar, for more accurate targeting. It can also track moving ground vehicles. You switch to different modes by using the PBs around the display — see A/G Radar Pushbuttons, p. 2.48.

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RBM MODE

RBM, or Real Beam Map mode, is the basic A/G radar mode. It displays contact information for the arc in front of your aircraft (your aircraft is at the bottom center of the display). Real beam maps are low resolution — they are not useful for targeting as the designation may be off by hundreds of feet. However, they update quickly (with a sweep of 90° per second) and can be used to view upcoming terrain, or locate a



general target area to be detailed in a High Resolution Map (HRM). RBM mode has a minimum range of 4.7nm and a maximum range of 80nm (actual ranges are dependent on radar LOS).

HRM Mode



HRM (High-Resolution Map) mode provides a static, high-detail, top-down Synthetic Aperture Radar (SAR) image (also known as a "patch map") of a certain area. An HRM image can be called up from any other mode and is used to view an area with greater detail for targeting. Each HRM requires about 4-10 seconds to create. They have a minimum size of .67nm and a maximum size of 40nm.

GMT (GROUND MOVING TARGET) MODE

On this display, no terrain data whatsoever is displayed. Instead the positions of moving vehicles are marked by small "+"s. Moving targets cannot be detected beyond 32nm, regardless of the radar range that is selected. When engaging ground vehicles, you can use this mode to designate a target, then cue the targeting IR camera to that target.



IGMT (INTERLEAVED GMT) MODE



Interleaved GMT mode superimposes GMT target data over the RBM terrain map. Moving targets cannot be detected beyond 32nm, regardless of the radar range that is selected.

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A/G RADAR SYMBOLOGY



Cursor azimuth and range. These figures indicate the cursor's position on the radar display with respect to your aircraft.

Display window (DW). The display window polygon appears when an HRM map is commanded, indicating the area to be mapped. An "X" through the display window indicates that no map can be generated for the cursor position requested.

Map time-to-go. This number is an estimate of how long it will take to construct an HRM map. It is displayed only when the cursor function is set to MAP (see A/G Radar Pushbuttons, p. 2.48), and the cursor is within mappable radar limits.

Range arcs. Range arcs are provided on RBM and GMT displays. They mark 25, 50, 75 and 100% of the selected range.

Sequence point symbology. *Sequence points* appear on the A/G Radar display when they fall within the currently selected radar range. A maximum of five can be displayed on the A/G radar at any given time.

The symbology is the same as that used on the TSD — see **Sequence Point Symbology**, p. 2.35, for an explanation of the terms below.

 \Box Base \bigcirc Steer point \triangle Target point \Box Initial point

Zero azimuth line. This is the straight line that runs through the center of RBM, GMT and IGMT displays. The radar returns in these displays are stabilized for up to $\pm 10^{\circ}$ of drift, and this line can be used as a ground track reference.

In GMT and IGMT modes, this symbol is used to show moving ground vehicles.

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A/G RADAR PUSHBUTTONS

- *PB 6* Cycle **radar mode** between RBM, GMT, HRM and IGMT. The currently selected mode appears above the button. (See A/G Radar Modes, p. 2.48.)
- *PB* 7 Toggle cursor function between TRGT (target) and MAP. Both functions are available in any radar mode. The currently selected option appears above the button.

TRGT Click on an area to designate it as your target.

MAP Click on an area to create an HRM image of it.

You can choose a resolution for the map using PB 8, below. If you move your cursor to an area that is unmappable, an error message will appear in the bottom center of the display. See A/G Radar Messages, next page, for an explanation of potential error messages.

PB 8 Cycle through HRM display window sizes — .67, 1.3, 3.3, 4.7, 10, 20 and 40nm. The current DW size is displayed above the button.

This option controls how far an HRM map is zoomed in when one is commanded — when it is set to 1.3 for example, the HRM will be 1.3 x 1.3 nautical miles. It does *not* affect the range of an HRM that is already visible on screen. The range setting for the HRM affects where on the radar display you can command a map; see A/G Radar Messages, next page, and Combat: HRM Limit Table, p. 4.54.

PB 9 Cycle through RBM, GMT and IGMT radar arc sizes — FULL (50°, or 25° to either side of your aircraft's nose), HALF (25°) or QTR (12.5°).

Decreasing the arc size decreases the amount of time it takes the radar to scan, but limits the scan area. This option does not affect an existing HRM.

- PB 13/14 Cycle through RBM, GMT and IGMT mode radar ranges in either direction — 4.7, 10, 20, 40 and 80nm for RBM or 4.7, 10, 20 and 32 for GMT/IGMT. The currently selected range is displayed between the two buttons.
- PB 16 (FREEZE) Freeze/unfreeze the radar display (affects RBM, GMT and IGMT modes only). As long as the display is frozen, the radar information on the screen is not being updated. (The radar is also not actively emitting, so freezing makes you temporarily less visible.) The option is boxed when the radar is frozen; click PB 16 again to unfreeze it.
- *PB 18* (SNIFF) Limit/allow radar emissions. When boxed, the radar does not transmit, and data on the display is not updated.

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A/G RADAR MESSAGES

The following messages are displayed in the bottom center of the radar screen.

BLIND ZONE. The map cursor is in the blind zone (within 8° to the left or right of the aircraft's nose). The radar cannot create an HRM image in this area.

DESIGNATE. Displayed for five seconds after a target designation is commanded.

DW RANGE LIMIT. The map cursor is outside the maximum or inside the minimum range limits. The radar cannot create an HRM image in this area. See **Combat: HRM Limit Tables**, p. 4.54.

GIMBAL LIMIT. The map cursor is outside radar gimbal limits (60° to the left and right of the aircraft's nose). The radar cannot create an HRM image in this area.

For more information on the azimuth and elevation limits to making an HRM, see **Combat: HRM Limit Table**, p. 4.54.

15. AIR-TO-AIR RADAR PAGE (A/A RDR)

Although the F-15E has both Air-to-Air and Air-to-Ground Radar pages, the radar information displayed comes from the same radar system — the AN/APG-70. This powerful radar system can gather information on *either* ground or air targets, but it can't do both at the same time. For this reason, you cannot have both pages up at the same time. If you try to pull up the A/A Radar page when the A/G Radar page is open in another MPD, you will receive a RADAR IN USE error message. If you click the A/A RDR page button again, the A/A Radar page will open and the A/G Radar page will close automatically.

There are two exceptions. If you have a static "patch map" (HRM) up on the A/G Radar page, the HRM will remain up even if you call up the A/A Radar page in another MPD. (See A/G Radar Modes, p. 2.45.) You won't be able to switch to another A/G radar mode until you close the A/A Radar page, however. Also, if you are tracking a target with the A/A Radar page, you will not be able to open the A/G Radar page.

This section provides a basic overview of A/A Radar symbology and features. For a more detailed, step-by-step explanation of how to find and designate targets with the air-to-air radar, see **Combat: Detecting Aircraft beyond Visual Range**, p. 4.19.

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A/A RADAR SEARCH MODES

The air-to-air radar has eight possible search modes, which are selected by pushbuttons. Only one mode can be active at a time. A box will appear around the label of the currently selected mode. The modes are described in the following sections.



- *PB 6* (RWSH/RWSM/RWSI) Cycle through Range While Search (RWS) modes, enabling the mode that appears above the button.
- PB 7 (RGH) Enable Range Gated High (RGH) mode.
- PB 8 (vs) Enable Velocity Search mode.
- *PB 9* (VCTR) Enable Vector mode.
- *PB 10* (DTWS/HDTWS) Toggle between **Track While Scan (TWS)** modes, enabling the mode that appears above the button.

HIGH RWS MODE (RWSH)

In **High RWS mode**, the radar sends out a high pulse repetition frequency (PRF) emission. High PRFs are better at detecting high-closure contacts, but low- or no-closure contacts may not show up at all. This means a MiG racing in at you head-on can be detected from a great distance away, but a MiG flying in front of you at roughly your speed will vanish from the radar screen.

MEDIUM RWS MODE (RWSM)

In **Medium RWS mode**, the radar sends out medium PRF emissions. Medium range PRFs are not as good at detecting aircraft at long ranges and they are prone to returning clutter, but they are better at showing low closure targets.

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INTERLEAVED RWS MODE (RWSI)

Interleaved RWS mode sends out both high PRF and medium PRF emissions, alternating between bars. This will be your primary search mode, for it provides the high PRF benefits of long-range, high-closure contact detection and the medium PRF benefits of better low-closure contact detection.

High closure means the distance between you and the contact is increasing or decreasing rapidly. Low closure means this distance is increasing or decreasing slowly.

RANGE GATED HIGH MODE (RGH)

Range Gated High mode is another intermediate pulse repetition frequency mode. It emits at a single PRF between that of high and medium RWS modes, but evaluates data electronically to extract low- and high-closure targets. It may not detect all targets that RWSI might, but it may detect certain targets more quickly.

VELOCITY SEARCH MODE (VS)

Velocity Search mode is best at detecting targets with a closure rate between 80-2400 knots at long range. However, it does **not** detect low- or no-closure targets at all. The velocity search mode display is different from that of any other mode — instead of sorting contacts by azimuth and range, as do other modes, it sorts them by azimuth and closure rate. See **Radar Symbology**, p. 2.54, for an illustration.

VECTOR MODE (VCTR)

The scan rate for **Vector mode** is about 35° per second — about half the normal scan rate. It takes about twice as long to complete a scan, but the computer's processor uses this additional time to enhance detection of objects with a low radar cross-section (RCS — a measure of an aircraft's visibility to radar). This mode will pick up lower RCS contacts (such as frontal and tail aspect targets) at greater distances.

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TRACK WHILE SCAN MODES

In **Track While Scan** modes, the radar can track the movement of targets while continuing to scan for contacts.

DTWS

In TWS mode, the radar looks at a much smaller area of the radar screen and tracks the movement of all contacts in that area. The targets' headings are indicated by a bar on the contact square. The area scanned is updated about every two seconds.

The size of the area scanned is determined by your azimuth setting — if the current setting is 60° , the radar performs a 2-bar, 60° scan. If the setting is 30° , the radar performs a 4-bar, 30° scan. See *scan elevation* and *azimuth scan angle* under Other A/A Radar Pushbuttons, next page.



TWS mode is useful when you have a target designated, because it allows you to see other radar contacts. (In other modes, the designated target is the only target visible.) It also means your radar is painting several contacts in an area, rather than only painting your target — a situation much less likely to alarm that target.

HDTWS

High-Data rate TWS mode is the same as TWS mode except it scans only a 2-bar, 30° scan in about one second.

For more information on using TWS modes, see Combat: Track While Scan (TWS), p. 4.31.



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OTHER A/A RADAR PUSHBUTTONS

- PB 2 (EL) Cycle scan elevation through 1, 2, 4, 6 and 8 bars. This controls the height of the radar scan the radar scans one bar, moves up several degrees and scans another. The higher the setting, the more bars that are scanned, but scans take longer to complete. (Bars are set automatically in TWS based on the azimuth scan angle setting, below.) See Combat: Set Search Scan Limits, 4.21, for details.
- PB 3 (FS) Cycle the number of frames stored for a display of radar history through 0, 1, 2 and 3. When set to a number greater than zero, that many old, fainter "blips" remain on the display to mark past positions of a contact as the radar updates.
- PB 5 (H/c) Enable/disable Hot/Cold a box appears around the label when enabled. Hot/Cold refers to a blip's closure rate — "hot" means a positive closure rate (i.e., the aircraft is coming toward you); "cold" means a negative closure rate (i.e., the aircraft is moving away from you). When H/c is enabled, targets that are closing in on you will be displayed with an arrow pointing toward you. Targets that are moving away from you will be displayed with an arrow pointing away from you. (Available in RWSH, RWSM, RWSI, RGH, and Vector search modes *only*.)
- PB 12 Set azimuth scan angle to 60°, 30° or 15° to either side of your aircraft's nose. A wider angle returns information for a larger area, but increases the time it takes to make a scan.
- PB 13/14 Cycle through radar ranges 10, 20, 40, 60, 80 or 160nm. The currently selected range appears next to the button.

Having the radar ranged out really far doesn't mean contacts at these ranges will necessarily be picked up. Your success in picking them up will depend greatly on their closure rate and the search mode you are in.

- PB 16-17/19-20 Slew TWS scan area (TWS and HDTWS modes only). Normally, the TWS scan area is centered on your designated target or the contact the computer marks as primary. You can slew the area to be scanned to a different part of the screen to view contact information for that area. Arrows appear next to these pushbuttons when you are in TWS or HDTWS mode, indicating which way the antenna slews.
- *PB 18* (sniff) Limit/allow radar emissions. When boxed, the radar does not transmit, and data on the display is not updated.

A/A RADAR SYMBOLOGY

A/A RADAR GRID

All Modes Except Velocity Search



The A/A radar presents a top-down view of a cone of space in front of your aircraft. The nose of your aircraft is at the bottom center of the display. The horizontal lines on the grid represent range, and the vertical lines repre-

sent azimuth angles.

For example, if the display range is 80nm, then the top

horizontal line on the grid represents 80nm, the next lower line represents 60nm, the next lower 40nm and so on.



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Velocity Search Mode

In velocity search mode, the vertical lines of the grid represent azimuth, as described above. Horizontal lines indicate a contact's speed. No range information is given; however, all contacts displayed are within the current radar range setting.



SYMBOLOGY — NO TARGET DESIGNATED

The following symbology displays on the radar at all times, whether you have a target designated or not.



Antenna azimuth scale. The scale at the bottom of the display marks the azimuth position of the radar antenna. The lines of the radar grid mark 60°, 30° and 0° of azimuth; a caret moves along the scale to indicate where the current azimuth direction is. Hollow circles mark azimuth limits, when the azimuth movement of the radar antenna has been limited with PB 12 (see Other A/A Radar Pushbuttons, p. 2.53).

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Antenna elevation scale. The scale along the left side of the display indicates the antenna's current elevation. Tick marks call off 10,000-foot increments. Hollow circles mark elevation scan limits, and the caret marks the antenna's current position.

Bank angle indicator. Indicates the current angle of the horizon. This symbol means nothing with reference to the radar grid — it is simply a duplication of the horizon information provided by the pitch ladder. It tells you quickly which way you are turning without your having to look up from the radar screen.

Cursor position. Gives the current azimuth and range position of the cursor on the display. (Azimuth is on top.)

Current bar. Indicates which bar the radar is currently scanning. See the explanation of scan elevation under **Other A/A Radar Pushbuttons**, p. 2.53.

Current range setting. The current range setting is listed in the upper right corner of the display, as well as next to PB 13.

Scan PRF. Displays either HIGH or MED, indicating whether high or medium PRFs are currently being emitted. (See A/A Radar Search Modes, p. 2.50.)

Contact Symbology

- Half-intensity contact (e.g. an aged target position in a radar history)
- Full-intensity contact (current marker)
- Friendly contact. When an IFF query is sent out, friendly contacts will change from a square to a circle. See 3. Identification Friend or Foe (IFF), p. 2.67.
 - TWS contact. The heading vector points in the direction the contact is moving.



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Friendly TWS contact.

Non-designated primary target. If you do not have a target designated when you switch to TWS mode, the computer will select the closest contact as a primary target and mark it with a star.

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SYMBOLOGY — TARGET DESIGNATED

When you designate a target in RWSI, RWSH, RWSM, RGH, VS or VCTR mode, all other contacts disappear from the screen — this is called Single Target Track (STT) mode. In TWS and HDTWS modes, contacts near the designated target will continue to be displayed after target designation.

(You can designate targets manually by clicking on a contact on the radar screen, or you can have one of the air-to-air radar's acquisition modes designate a target. To "undesignate" the target, re-select a search mode using one of PBs listed under A/A Radar Search Modes, p. 2.50. For more detailed information, see Combat: Designate the Target, p. 4.28.)





Azimuth caret. Marks your target's azimuth on the azimuth scale at the bottom of the display.

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Elevation caret. Marks your target's ASL in feet — for example, 10-0 means 10,000 ft. and 16-2 means 16,200 ft.

Range caret. Marks your target's range on the right side of the radar grid. The target's closure speed is displayed numerically (in knots) next to the grid.

Speed caret. In Velocity Search (VS) mode, the caret on the right side marks the target's closure speed instead of range. The target's closure speed is given numerically (in knots) next to the caret.

Target aspect angle. Indicates which aspect of the target is facing you, measured in degrees (the final zero has been dropped for brevity). An aspect of τ indicates you're facing your target's tail (0°); H indicates you're facing his nose (180°). An aspect of 16R indicates you're facing a point between the aircraft's nose and its right wing. 9L indicates you're facing the pilot's left wing. See **Combat: Aspect Angle**, p. 4.71.

Target heading. Lists your target's magnetic heading, in degrees. These numbers correspond to positions on the heading tape — 360 is north, 090 is east, 180 is south and 270 is west.

Target true airspeed. Lists your target's true airspeed (TAS) in knots.

Contact Symbology

- Non-designated TWS contact. The heading vector points in the direction the contact is moving.
- Non-designated friendly TWS contact. When an IFF query is sent out, all contacts returning a "friendly" response become circles. See
 3. Identification Friend or Foe (IFF), p. 2.67.
- Primary designated target (PDT). A heading vector is displayed for
your designated target, no matter what mode you are in it will be
twice as long as a non-designated target's heading vector. If you send
out an IFF query and your target returns a "friendly" reply, the symbol
will "mipple," or flash, between a star and a circle.
- Secondary designated target (SDT). You can designate multiple targets while in TWS mode. The first target you designate becomes your primary designated target. When you designate another target, the first target becomes a secondary target and the new target becomes your primary. You can have up to eight targets designated at a time. The heading vector for a secondary target is as long as the vector for a primary target — about twice as long as the heading vectors of non-designated targets.

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Missile Mode Symbology

The features listed below appear on the radar as well as on the HUD when you are in MRM launch mode, or when you are tracking a target with radar in SRM launch mode and an AIM-9L or AIM-9M is in priority. See **Medium Range Missile (MRM) Launch Mode Symbology**, p. 2.12, for a description of each.

ASE circle and steering dot Postlaunch min/max TTA or TTI Shoot cue Prelaunch TTA or TTI Radar range scale

Missile fly-out dots. In addition, once you've launched an AIM-120 or AIM-7, a tiny dot will appear at the bottom of your primary target's heading vector. It moves up the heading vector as TTI counts down to zero — when TTI is halfway to zero, the dot will be halfway up the vector. (Dots will not appear on the heading vectors of secondary targets when multiple weapons are in flight.)

18. ENGINE DATA PAGE (ENG)



The following data is listed for both engines. Out-of-limit parameters — parameters that fall above or below recommended levels — are boxed and also appear in yellow on a color display.

RPM PER. Measurement of the N_2 compressor RPM — can range between 0% and 110%.

TEMP c. Measurement of the fan turbine inlet temperature in degrees Centigrade — can range between 100° —1375°.

FF/PPH. Measurement of fuel flow from the fuel tanks, in pounds per hour.

NOZ POS PER. Lists how far the engine nozzles are open as a percentage of total. Zero percent is totally closed, 100% is totally open.

OIL PSI. Lists the oil pressure for each engine — between 0 and 100 PSI.



This page displays video from the AGM-65 and GBU-15. This section gives an overview of the two displays and their features. For an explanation of how to engage a target with these weapons, see **Combat: AGM-65 Maverick**, p. 4.65, and **Combat: GBU-15**, p. 4.66.

WEAPON VIDEO: AGM-65

Video display ends as soon as an AGM-65 is fired. The video for the next AGM-65 (if there is one) immediately replaces it.

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AGM-65 Symbology

Elevation tick marks. These three mark a 5°, 10° and 15° look-down angle.

Max/min range markers. Only displayed when AUTO weapon cueing is enabled and you have an A/G target selected. These tick marks represent the minimum and maximum effective ranges for the AGM-65. The numbers beside the max and min range markers list how much time before the weapon reaches max/min range in seconds. If no number is listed, the weapon is already within that range.

NFOV markers. Only visible in WFOV, these markers frame the area that would be visible if NFOV were selected.

Pointing cross. The pointing cross shows where the missile's seeker head is looking. (You cannot control this feature.) Coordinates for the **azimuth** (AZ) and **elevation** (EL) of the pointing cross appear in the upper left corner.

Range caret. Only displayed when auto weapon cueing is enabled and you have an A/G target selected. This caret marks the target's current range with respect to the max and min range markers. When this caret is between the two markers, IN RNG will appear beside it.

Targeting cross hairs. The targeting cross hairs are slewable if you have *manual weapon cueing (MAN)* selected. When you lock onto a target, the cross hairs center on it. See **AGM-65 Pushbuttons**, p. 2.60.

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AGM-65 PUSHBUTTONS

Most of the buttons below toggle between options. In these cases, the currently selected option appears next to the button.

PB 6 Toggle weapon cueing between AUTO and manual (MAN).

- AUTO The weapon seeker head automatically cues to your designated A/G target.
- MAN You cue the weapon seeker head to your designated target using the slew buttons (below).
- *PB* 7 Toggle display field of view between wFOV $(\pm 30^{\circ})$ and NFOV $(\pm 15^{\circ})$. The currently selected option appears above the button.
- PB 10 (TRK) Activate/deactivate target track. When enabled (a box appears around it) while in manual (MAN) weapon cueing mode, the missile seeker head will lock onto the object or area currently in the center of the cross hairs. If activated while in AUTO weapon cueing mode, the missile seeker head will lock on to whatever is currently in the cross hairs when you switch to manual (MAN) weapon cueing mode.
- PB 12 (BST) If manual (MAN) weapon cueing is selected, and target track is not active (TRK is not boxed), this button will return the AGM-65 viewpoint to the boresight. Otherwise the button has no effect.
- *PB 3, 8, 13 and 18* Use these pushbuttons to **slew the targeting cross hairs**, if weapon cueing is set to manual (MAN) and target track (TRK) is not active.

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WEAPON VIDEO: GBU-15

The GBU-15 has two launch modes — direct and indirect. In direct (Lock on Before Launch or LOBL) launch mode, you simply designate your target, aim the seeker head toward it as you would with an AGM-65, gain a lock and fire. No further video information is displayed after you fire.

In indirect (Lock on After Launch or LOAL) launch mode, you can steer the weapon after it is released using the video information displayed in the MPD. You must have an AN/AXQ-14 datalink pod mounted on your aircraft to do this — this feeds the steering information to the GBU-15.



GBU-15 Pushbuttons

PB 6 Toggle weapon cueing between AUTO and manual (MAN).

- AUTO The weapon seeker head automatically cues to your designated A/G target.
- MAN You cue the weapon seeker head to your designated target using the slew buttons (below).
- *PB 9* Toggle launch mode between direct (DIR) and indirect (IND).
 - *DIR* In direct launch mode, you designate your target and fire when you have a lock on it. You can slew the missile's seeker head before launch, but you have no control over it, and no video information is displayed for it, after launch.
 - *IND* In indirect launch mode, you can release the weapon without a target lock and steer it after release using the video information displayed in the MPD. (How much steering control you have over it depends on which *launch profile* you select).

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For indirect launch mode to be available, you must have an AN/AXQ-14 datalink pod loaded on your aircraft.

- PB 7 When you select indirect (IND) launch mode, pushbutton 7 becomes active, cycling through indirect mode launch profiles normal (NORM), transitional (TRANS) and terminal (TERM). The profile you select determines how much control you will have over the seeker head and the nose of the weapon itself:
 - NORM In a normal loft profile, the weapon flies ballistically (i.e., as it would if it were an unguided projectile) for 1.75 seconds after release, then automatically enters a transitional loft profile.
 - TRANS A transitional loft profile is automatically entered shortly after you release a bomb with a normal launch profile. You can manually select a TRANS launch profile before launch by pressing PB 7. (TRANS will be boxed when it is selected.) With a TRANS loft profile selected, you can control the yaw of the weapon (its heading) after launch using PBs 8 and 13. You cannot control the weapon's pitch.
 - TERM With a terminal loft profile, the seeker head attempts to automatically lock on your target. You can use PBs 3, 8, 13 and 18 to control the weapon's pitch and yaw.
- PB 10 (TRK) Activate/deactivate target track. When enabled (a box appears around it) while in manual (MAN) weapon cueing mode, the missile seeker head will lock onto the object or area currently in the center of the cross hairs. If activated while in AUTO weapon cueing mode, the missile seeker head will lock on to whatever is currently in the cross hairs when you switch to manual (MAN) weapon cueing mode.
- *PB 12* (BST) If manual (MAN) weapon cueing is selected, and target track is not active (TRK is not boxed), this button will return the AGM-65 viewpoint to the boresight. Otherwise the button has no effect.
- *PBs 8 & 18* Control **the seeker head** before launch and **the yaw** of the weapon after an indirect launch with a terminal launch profile.
- *PBs 3 & 13* Control **the seeker head** before launch and **the pitch** of the weapon after an indirect launch in a terminal launch profile.
- *PBs 16 & 17* Control **the yaw** of the weapon after an indirect launch in a transitional launch profile.

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Aiming cross hairs. These cross hairs represent the point at which the GBU-15's *seeker head* is pointed and can be slewed until you have a target locked. When you lock on a target, the cross hairs center on the target.

The seeker head of a GBU-15 slews independently of where the missile's nose is pointing in NORM OF TRANS launch modes. (Just because the seeker head has locked to its target, doesn't mean the nose is pointed toward the same spot.) In **direct mode**, you can slew the seeker head until you lock on to a target and release the weapon. You have no control over the missile after launch. In **indirect mode**, you can release the weapon before you have a target lock, and then steer the missile to target after it is launched. (See Launch Modes, p. 2.61.)

Min/max/optimum launch range. Only displayed after you have designated an A/G target. These marks represent the minimum and maximum ranges for the weapon. Launch ranges are determined by the aircraft altitude and airspeed. Optimum launch range is the range at which the bomb has maximum energy for reaching the target.

Nose index marker. This symbol marks the point at which the nose of the GBU-15 is aiming. Note that this point does not always coincide with where the seeker head is aiming. In direct mode you have no control over where the missile's nose is pointed. In indirect mode you may have control of this, depending on which launch profile you have chosen. (See Launch Modes, p. 2.61.)

Range caret. Only displayed after you have designated an A/G target. The caret marks the current range to target with reference to the launch ranges. IN RNG appears next to the caret when you are within min and max ranges.

Time to min/max range. Only displayed after you have designated an A/G target. The numbers beside the max and min range markers give how much time before the weapon reaches max/min range in seconds. If no number is listed, the weapon is already within that range.

TOF counter. Indirect launch mode only — the *time of flight* counter counts the seconds that the missile is in flight, starting at weapon release (zero) and ending when the weapon impacts.

UP FRONT CONTROLS (UFC)

The Up Front Controls (UFC) consists of a keypad, six rectangular data display windows and ten pushbuttons. On the UFC main menu, the pushbuttons control functions or call up submenus. On the submenus, the pushbuttons control different functions. For reference in this chapter, the PBs are numbered from 1 to 10 moving counterclockwise from the top left.



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Select Master Mod

The following buttons and switches on the UFC always control the same features, regardless of which menu is currently displayed.

- MENU Call up the UFC main menu from any submenu or from the data menu (see UFC Main Menu, p. 2.65).
- DATA Call up the UFC data menu from the main menu or any of its submenus (see UFC Data Menu, p. 2.72).
- A/P Engage the autopilot.
- EMS Limit/allow any emission that might give away the presence or position of your aircraft. When emissions are limited, the radar is placed in sniff mode and the ICS (jammer) in standby. The EMIS LMT indicator light comes on, EMIS appears on the TEWS page, and SNIFF is boxed on the radar display. When emissions are allowed, the EMIS LMT light goes off and the radar and jammer can freely emit — assuming they have been activated. (For details, see Indicator Lights: EMIS LMT, p. 2.73, TEWS Symbology: ICS Status, p. 2.42, and A/A Radar Pushbuttons, p. 2.53, or A/G Radar Pushbuttons, p. 2.48.)

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UFC MAIN MENU

This is the default UFC display. Click the pushbuttons listed below to select the submenus described. Click the MENU button to return to the UFC main menu at any time. The submenus are described in more detail in the following sections, on the pages indicated.

- PB 1 (LAW .../OFF) Call up the Low Altitude Warning (LAW) system menu. The number listed next to LAW is the current altitude setting for the system; LAW OFF indicates the system is inactive. See p. 4.13.
- PB 2 (TCN ...) Call up the Tactical Aid to Navigation (TACAN) submenu. The currently selected TACAN channel is listed next to the button (e.g., 112X or 056Y). See p. 2.66.
- PB 3 (IFF NORM/AUTO/OFF) Cycle through levels of Identification Friend or Foe (IFF) — OFF (no queries are sent), NORM (A/A radar contacts are queried when you press IFF_INTERROGATE 1) or AUTO (A/A contacts are queried automatically when they are designated as targets). See p. 2.67.
- PB 4(TF NORM/OFF) Toggle the Terrain Following (TF) radar on (NORM) and
OFF. You must have the AN/AAQ-13 pod of the LANTIRN system
mounted on your aircraft in order to activate the TF radar. See p. 2.67.
- PB 5 (ILS ON/OFF) Toggles the Instrument Landing System (ILS) ON and OFF. When on, ILS information is displayed on the HUD and ADI in NAV or INST master modes. See p. 2.68.
- *PB 6* (NAV/TCN/TGT STR) Cycle the current steering data between NAV, TCN and TGT. Note: There must be a TACAN station in range for TCN to be available, and you must have an A/G target designated for TGT to be available. See p.2.68.
- *PB* 7 (N-F NORM-WH/NORM-BH/OFF) Cycles the HUD FLIR display through OFF (no FLIR imagery displayed), NORM-WH (FLIR imagery displayed, hottest areas appear white) and NORM-BH (FLIR imagery displayed, hottest areas appear black). See p. 2.69.
- PB 8 (HUD DATA) Call up the HUD options submenu. See p. 2.69.
- PB 9 (A/P OFF/ATT/ALT/HDG/NAV/TCN) Calls up the autopilot (A/P) submenu. The abbreviation next to A/P tells you if the system is inactive (OFF) or, if active, tells you which autopilot submode or combination of submodes is being used (ATT = attitude hold, ALT = altitude hold, HDG = heading hold, NAV = coupled steering to steer point, TCN = coupled steering to current TACAN station). See p. 2.70.
- PB 10 (STR ...) Cycle through steer points. The currently selected steer point is listed next to STR. See p. 2.71.

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1. LOW ALTITUDE WARNING (LAW) SUBMENU



When active, the Low Altitude Warning system alerts you if you fall below a certain radar altitude. On the LAW submenu, you can turn the system on and off and set the altitude at which the warning sounds.

- *PB 3* (DECREASE) Decrease the altitude at which the system warns you that you're flying too low, by 100ft per click.
- PB 8 (INCREASE) Increase the LAW altitude by 100ft per click.
- *PB 5* (ON OF F) Toggle LAW system on and off. Current status appears next to the button.

The current LAW altitude setting is displayed next to PB 2.

2. TACTICAL AID TO NAVIGATION (TACAN) SUBMENU

Airfields and tanker aircraft use TACAN channels to provide pilots with position information. Each airfield or tanker has a different station ID and operates on a TACAN channel ranging between 001 and 023. Ground stations are identified with the letter "Y" after the channel number; aerial tankers are identified with the letter "X." You can select different channels via the TACAN UFC menu.



Current channel. Displayed between PBs 1 and 10.

Station ID. Name of the station using the current channel (between PBs 3 and 8).

Range (RNG). Distance in nm to this station.

Heading (HDG). Heading to the current station in degrees.

- PB4(PREVIOUS) Switch to next lower TACAN channel.
- PR 7 (NEXT) Switch to next higher TACAN channel.
- PB 9(ETA or ETE) Toggles between a display of your Estimated Time of Arrival (ETA) or your Estimated Time Enroute (ETE) for the currently selected station.

3. IDENTIFICATION FRIEND OR FOE (IFF)

Aircraft use "friend or foe" transponders to determine another aircraft's alignment. The transponders on allied aircraft will return a "friendly" message when queried by another allied aircraft.

There is no menu for the IFF system. The IFF button on the UFC main menu (PB 3) cycles through control options for IFF interrogation. The currently selected option appears next to the button:

OFF	No IFF queries can be sent to A/A radar contacts.
NORM	Currently displayed A/A radar contacts will be identified when you press IFF_INTERROGATE [] (after a couple of seconds of processing delay).
AUTO	The primary designated A/A radar target is automatically queried when the radar locks on to it.

See Contact Symbology, p. 2.55, for pictures of the symbols that mark friendly and enemy aircraft on the A/A radar display.

This option controls only IFF interrogation, not IFF response. Your aircraft will automatically respond to all IFF queries.

4. TERRAIN FOLLOWING (TF) RADAR

The Terrain Following radar calculates your above ground level (AGL) altitude from radar returns off of terrain. It can only be activated if the AN/AAQ-13 pod of the LANTIRN system, which houses the radar, is mounted on your aircraft before you take off. (For details on choosing a loadout with this option, see Deciding What to Take, p. 4.7.) There is no menu for the TF radar - the TF button (PB 4) on the main UFC menu toggles the radar on (NORM) and OFF.

LAW is automatically set to half of the TF altitude when TF is set to NORM. TF altitude is set to the altitude you are flying at when you engage the TF radar.

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5. INSTRUMENT LANDING SYSTEM (ILS)

The ILS (Instrument Landing System) is a ground- or carrier-based system that adds vertical and horizontal alignment symbology onto your HUD and ADI to aid you when landing. There is no menu for the ILS system — The ILS button (PB 5) on the UFC main menu toggles the ILS on and off. For an explanation of ILS function and features, see Additional HUD Symbology: ILS Symbology, p. 2.23.

6. STEERING DATA (NAV/TCN/TGT STR)

PB 6 on the UFC main menu cycles through steering modes — NAV, TCN and TGT.

- NAV When enabled, steer point data is displayed in the steering data block of the HUD. If coupled steering is enabled on the A/P
 Submenu of the UFC, autopilot (when enabled) will steer toward your currently selected steer point when it is enabled.
- TCN When enabled, TACAN station data is displayed in the steering data block of the HUD. If coupled steering is enabled on the A/P Submenu of the UFC, autopilot (when enabled) will steer toward the currently selected TACAN station. (*Note: A TACAN station must be within range for you to select this option.*)
- *TGT* When enabled, data for your currently selected A/G target point is displayed in the steering data block of the HUD. If coupled steering is enabled on the A/P Submenu of the UFC, autopilot will steer toward this target point. (*Note: You must have an air-to-ground target designated to select this option.*)

See Basic HUD Symbology: Steering Data Block, p. 2.7, for a detailed description of the steering data block, and 9. Autopilot (A/P) Submenu, p. 2.70, for an explanation of coupled steering.

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7. NAVFLIR (N-F)

The NAVFLIR system projects Forward-Looking IR camera imagery onto your HUD. It is essentially a night vision aid — it allows you to "see" an infrared image through the HUD. NAVFLIR is intended to help you with navigation — terrain features show up better against the sky at night when viewed with IR. You may also see the "hotter" returns of aircraft and vehicles, but the Targeting IR is somewhat better designed for tracking these (see **12. Targeting IR Page**, p. 2.38).

There is no menu for the NAVFLIR. Pressing the N-F button (PB 7) of the UFC main menu cycles the HUD FLIR display through OFF (no FLIR imagery displayed), NORM-WH (FLIR imagery displayed, hottest areas appear white) and NORM-BH (FLIR imagery displayed, hottest areas appear black).

You must have the AN/AQ-13 pod of the LANTIRN system loaded on your aircraft for NAVFLIR to be available. See Interface: Arming, p. 1.10.

8. HUD OPTIONS SUBMENU

The HUD Options Submenu allows you to modify your HUD by adding and removing the data listed below. To add one of the options below to the HUD, click on its pushbutton until an asterisk appears in front of the option on the submenu. To remove the option from the HUD, click the pushbutton again and remove the asterisk.

- *PB 3* (TAS ...) Add/remove true airspeed info from the HUD. The number listed is your current TAS.
- *PB 4* (RALT ...) Add/remove radar altimeter from the HUD. The number listed is your current radar altitude.
- *PB* 5 (THRUST) Add/remove thrust percent display from HUD.

For information on where these features appear and what they indicate, see **Customizable Basic Symbology**, p. 2.9.



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9. AUTOPILOT (A/P) SUBMENU

The A/P submenu is displayed when you select PB 9 from the UFC main menu.

Selecting the A/P submenu is not the same as activating the autopilot the A/P menu controls the features of the autopilot, but the autopilot will not take over control of the aircraft unless you activate it. Press AUTOPILOT A, or click the A/P button on the UFC keypad to toggle the autopilot on and off.

Current A/P mode is displayed in the window between PBs 1 and 10. The autopilot has five modes:

If you *manually select* one of the following modes, the autopilot will enter the selected mode when engaged. An asterisk marks an enabled mode on the submenu.

A/P STR	Coupled steering is enabled — PB 2 (STR MODE) enables and
	disables this mode. When enabled, the autopilot alters your
	current flight heading to steer toward the currently selected
	TACAN station (STR MODE - TCN) or steer toward your current
	steer point (STR MODE - NAV).
A/P ALT	Altitude hold is enabled — PB 4 (ALT HOLD) enables and dis-
	ables this mode. When altitude hold is enabled, the autopilot
	alters your flight attitude and pitch so that your current alti-
	tude (barometric or radar) is maintained.

If neither of these modes is enabled, the autopilot will *automatically* enter one of the following modes when you press AUTOPILOT [A] or click on the A/P button on the keypad of the UFC. Which mode you enter depends on your bank angle:

A/P HDG	Heading hold mode — entered if your bank angle is less than	
	7°. Autopilot maintains your current pitch and heading but	
	levels your wings.	
A/P ATT	Attitude hold mode — entered if your bank angle is greater than	

7°. Autopilot maintains your current pitch and bank angle.

Autopilot is currently disengaged. Press AUTOPILOT A or A/P OFF click on the A/P button on the keypad of the UFC to toggle the autopilot on and off.

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PUSHBUTTON FEATURES

- *PB 2* (STR MODE) Enable/disable coupled steering see above.
- *PB 3* Toggle between NAV and TCN steering modes.
- *PB 4* (ALT HOLD) Enable/disable altitude hold see above.
- *PB 5* Toggle altitude source data for the altitude hold feature between barometric (BARO) and radar altimeter (RDR).



10. STEER POINTS (STR ...)

Steer points are a set of points that mark your planned route. They are numbered and used to maintain course during a mission. Steer points that mark areas for weapons delivery are called target points and the points prior to target points are called initial points (TSD, A/G radar); all are considered steer points, however.

Normally, as you exit a steer point, the next steer point in sequence automatically becomes your currently selected steer point. PB 10 of the UFC main menu allows you to manually cycle through steer points.

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UFC DATA MENU

The UFC data menu allows you to change certain symbology on the HUD and displays current position data. Click the DATA button on the UFC keypad to call up the UFC data menu.



- *PB 1* (NAV ...) Cycle through steer points. (See 10. Steer Points (STR ...), p. 2.71.)
- PB 6 Toggle all HUD time displays between LOCAL and ZULU time. Local time is time with respect to the time zone you are in; ZULU time is time with respect to the Greenwich meridian. Time is given in hours:minutes:seconds.
- PB 8 Toggle between heading/range and fuel remaining data for the look-ahead steer point. *Heading* is given in degrees and *range* in nautical miles. *Fuel remaining* is an estimate of the amount of fuel you will have left when you reach the steer point, in pounds, based on the current fuel flow.
- PB 9 Toggle between a display of ETA and ETE for all steer point data blocks (on the HUD, on the HSI, etc.). ETA is Estimated Time of Arrival, or the time at which you will arrive at the steer point. ETE is Estimated Time Enroute, or the amount of time it will take you to get to the steer point. Time is given in hours:minutes:seconds.
- *PB 10* Toggle between heading/range and fuel remaining data for the currently selected steer point, given as above.

TIME. Lists the current game time beside PB 5.
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ADDITIONAL Cockpit features

INDICATOR LIGHTS

These lights indicate the status of certain systems, or that you have exceeded certain flight parameters.



EMIS LMT. Indicates the ICS system (internal jammer) and the APG-70 are prevented from emitting. The EMS button on the keypad of the UFC toggles EMIS LMT on and off. See **Up Front Controls (UFC)**, p. 2.64, for details.

MASTER CAUTION. Indicates a warning light is on — click MASTER CAUTION to display a list of indicator lights for different systems. Lights that are on indicate damaged systems. See Master Caution Panel, next page.

AUTO. Indicates autopilot is active. Press the AUTOPILOT (A), or click the A/P button on the UFC keypad to toggle the autopilot on and off. See Up Front Controls (UFC), p. 2.64, for details.

AI/SAM. Indicates an airborne interceptor (aircraft) or SAM has locked onto you.

LOW ALT. Indicates you are flying below the altitude set for the Low Altitude Warning (LAW) system. See 1. Low Altitude Warning (LAW) Submenu, p. 2.66, for details.

OBST. Indicates the terrain-following (TF) radar has detected a terrain obstacle in your flight path. If it is possible that the autopilot will not be able to pull up in time to avoid the obstacle, this light will flash — take manual control of the aircraft to avoid crashing!

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TF FAIL. Your TF radar system is no longer operational. (For, a description of the TF radar, see **4. Terrain-Following (TF) Radar**, p. 2.67.)

PRG CFF. When TEWS control is set to SEMI, this light indicates a chaff program is ready to be released. When TEWS control is set to AUTO, this light will flash when running a chaff program (i.e., chaff is being released).

FLAPS. Indicates your flaps are extended.

SPD B. Indicates your speed brake is extended.

GEAR. Indicates your gear is down.

BRAKE. Indicates your wheel brakes are applied.

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MASTER CAUTION PANEL

The lights on this panel warn you of systems damage and malfunctions.



L/R BLEED AIR. Bleed air leak in the left (L) or right (R) engine. If you don't shut down the engine immediately, you run the risk of a fire starting.

L/R ENG CONT. Left or right engine control inoperative. You cannot afterburn, and your maximum engine thrust is reduced.

L/R OIL PRESS. Left or right engine oil pressure is low. If you don't shut down the engine immediately, you run the risk of a fire starting.

L/R BURNER. Left or right afterburner is inoperative.

L/R FUEL PUMP. Left or right fuel pump is failing or inoperable. If both lights are lit, descend below 30,000ft and do not exceed military power, or you risk flaming out your engines.

L/R GEN. Left or right generator is failing or inoperable. If both lights are lit, you've lose most displays (the ADI will continue to function via an emergency generator — see **Standby Instruments**, p. 2.77). You've also lose control of your speed brakes.

HYD PC1/2. Primary hydraulic circuit 1 or 2 is inoperable. When both lights are lit, you have no radar, no speed brake control and reduced flight control authority. (When the UTIL hydraulic gauge is red you have even less control — See Standby Instruments, p. 2.77.)

FLT CONT. When lit, the Control Augmentation System (CAS) is inoperable. See **Flight: Auto-Control Systems**, p. 3.11, for details on this system.

AUTOPILOT. Autopilot system inoperable.

TARGET IR. Target IR camera system inoperable.

NAV FLIR. NAV-FLIR system is inoperable.

PACS. When lit, you can't release weapons, except by jettison.



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GUN. Gun inoperable.

сем сомр. Central computer out. You will lose all displays — HUD, MPDs, UFC, etc.

TEWS. TEWS is inoperable. (You can still able drop chaff and flares manually.)

RADAR. Radar inoperable.

нир. You've lost HUD display.

ADC. Air Data Computer damaged or inoperable. You lose pitch ratio, autopilot altitude hold and all HUD symbology except heading scale.

FUEL LOW. Lights up when total fuel is less than 2000 lbs.

OXYGEN. OXYGEN is low. You will eventually black out if you do not reduce altitude below 10,000ft.

MINIMUM. Lights up when chaff or flares are low.

CHAFF. Flashes when you are dispensing chaff. Constantly on when chaff is at minimum.

FLARE. Flashes when you are dispensing flares. Constantly on when flares are at minimum.

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STANDBY INSTRUMENTS

These are the analog counterparts to the computerized HUD system and can be relied upon in case of systems failure. Most are present in both cockpits, and only the angle-of-attack and vertical velocity indicator require main generator power. All others either require no power, or they are patched into both the main and emergency generators.

You will need to use VIEW_PILOT_MPD F2 view to see the standby instruments in the pilot's seat.



Airspeed indicator. The airspeed indicator operates off of pitot-static pressures and requires no power. It registers indicated airspeeds between 60 and 850 knots.

Altimeter. The standby altimeter operates from a static pressure source and requires no power. The setting on this altimeter sets the barometric pressure for the Air Data Computer (ADC), which is then used to compute barometric altitude for other systems, such as the HUD and ADI MPD.

Angle-of-Attack indicator. The AoA indicator is located in the front cockpit only and is driven by electrical signals from the AoA probe. Angles from 0° to 45° are displayed. An OFF message is displayed if electrical power is lost, Air Data Computer (ADC) data is invalid, or the indicator itself fails.

Attitude Director Indicator (ADI). This is a self-contained, electrical gyrohorizon instrument that indicates the aircraft's attitude relative to the horizon.

Compass. This conventional magnetic aircraft compass is only located in the front cockpit.



Engine Monitor Display

DISCHARGE

AMAD

EVEIVE

Extinguisher

Switch

Engine Monitor Display (EMD). Although not an ana-

log instrument, this LED display duplicates data from the engine data MPD - RPM%, engine temperature, fuel flow, nozzle position and oil pressure. When engine data exceeds the display range of the EMD, that display window will go black. For an explanation of these features, see Engine Data Page, p. 2.58.

Fire warning panel/extinguisher. Consists of a switch, several buttons and lights.

The extinguisher switch has three settings:

DISCHARGE	Discharges extinguisher into	AMAD
	selected areas. Use AMAD and I	, Panel
	ENGINE R buttons (described	Left/Right
	below) to select the areas	Engine Panel
	where the extinguisher is dis-	
	pensed. (Note that the more	A/B Burn-Through
	areas you select, the less	Lights
	extinguishing material reaches any given area.)	
	The extinguisher can only be discharged once.	

Normal switch position. OFF

Tests all lights. TEST

The lights and buttons work as follows:

- The lights on this display come on when there is a fire in the AMAD Airframe Mounted Accessory Drive (a device which connects the engine to generators and hydraulic pumps on the aircraft). Press the lights, then flip the extinguisher switch to DISCHARGE.
- L ENGINE R These lights alert you to a fire in the left or right engine. Push the lights to select either or both engines, then flip the extinguisher switch to DISCHARGE.

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The *AB burn-through* lights indicate that a fire has been detected in the left or right afterburner can. To put out the fire, refrain from using your afterburners until the light goes out.



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Fuel indicator. Indicates the level of fuel in internal and external tanks. The analog gauge at the top of the display shows the amount of fuel remaining in the F-15's internal tanks. The numerical gauge below this shows total fuel remaining. Below this, two numerical gauges show the amount of fuel in the two external wing tanks or the external centerline tank, depending on which is selected with the dial at the bottom of the display. (The right gauge reads 0000 when centerline is selected). All fuel readings are given in pounds.

A bingo bug on the analog gauge marks the current bingo fuel setting. When *total fuel* reaches bingo level, an audio warning will alert you. The bingo bug adjustment switch allows you to increase and decrease the bingo fuel setting. (Bingo fuel is the amount of fuel thought necessary for you to get back to base. If you have less than this amount, you may not make it.)

Fuel from the centerline tank is used first, then fuel from the wing tanks, then internal fuel.



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Jettison dial and button.

The dial selects what will be jettisoned when you click on the pushbutton. (Master arm does not have to be on for you to jettison.) Gun ammunition is never jettisioned.

OFF No ordnance can be jettisoned

ALL All ordnance

COMBAT External fuel tanks



AA Air-to-air ordnance (except missiles on wing stations, which cannot be jettisoned)

AG Air-to-ground ordnance

Master arm switch. This switch has two settings — ON and SAFE. When master arm is set to SAFE, no weapons can be fired. When set to ON, all ordnance can be released. When master arm is ON, the gun cross appears on the HUD (in all master modes).

Vertical Velocity Indicator (VVI). The VVI operates by electrical signals from the ADC. It displays vertical velocity on a 0 to 6000ft./min. scale. An OFF message appears if power is lost or the display is malfunctioning.



Arm

Safe

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