

NATOPS FLIGHT MANUAL
NAVY MODEL EF-24G 973112
AND UP AIRCRAFT



A1-EF24G-NFM-001

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COMMAND

NATOPS FLIGHT MANUAL - NAVY MODEL EF-24G
A1-EF24G-NFM-001

COMNAVAIRFOR A1-EF24G-NFM-001
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COMNAVAIRFOR MANUAL A1-EF24G-NFM-001

From: Commander, Naval Air Forces

Subj: NAVAL AIR TRAINING AND OPERATING PROCEDURES STANDARDIZATION
(NATOPS) EF-24G GENERAL FLIGHT AND OPERATING INSTRUCTIONS

1. **Purpose.** To issue policy and procedural guidance applicable to a broad spectrum of users and complement individual NATOPS manuals. This is a complete revision and should be reviewed in its entirety.
2. **Background.** The NATOPS program is a positive approach toward improving combat readiness and achieving a substantial reduction in the aircraft mishap rate. Standardization, based on professional knowledge and experience, provides the basis for development of sound operating procedures. The standardization program is not intended to stifle individual initiative, but rather to aid commanding officers in increasing their unit's combat potential without reducing command prestige or responsibility. With the objective of maintaining agile standardization guidance, Commander, Naval Air Forces accepted responsibility for NATOPS program management previously contained in OPNAVINST 3710.9.
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4. **Records Management.** Records created as a result of this instruction, regardless of media or format, shall be managed per the Secretary of the Navy (SECNAV) Manual 5210.1.
5. **Reports and Forms.** Reports and forms required by this instruction are listed in appendix L.

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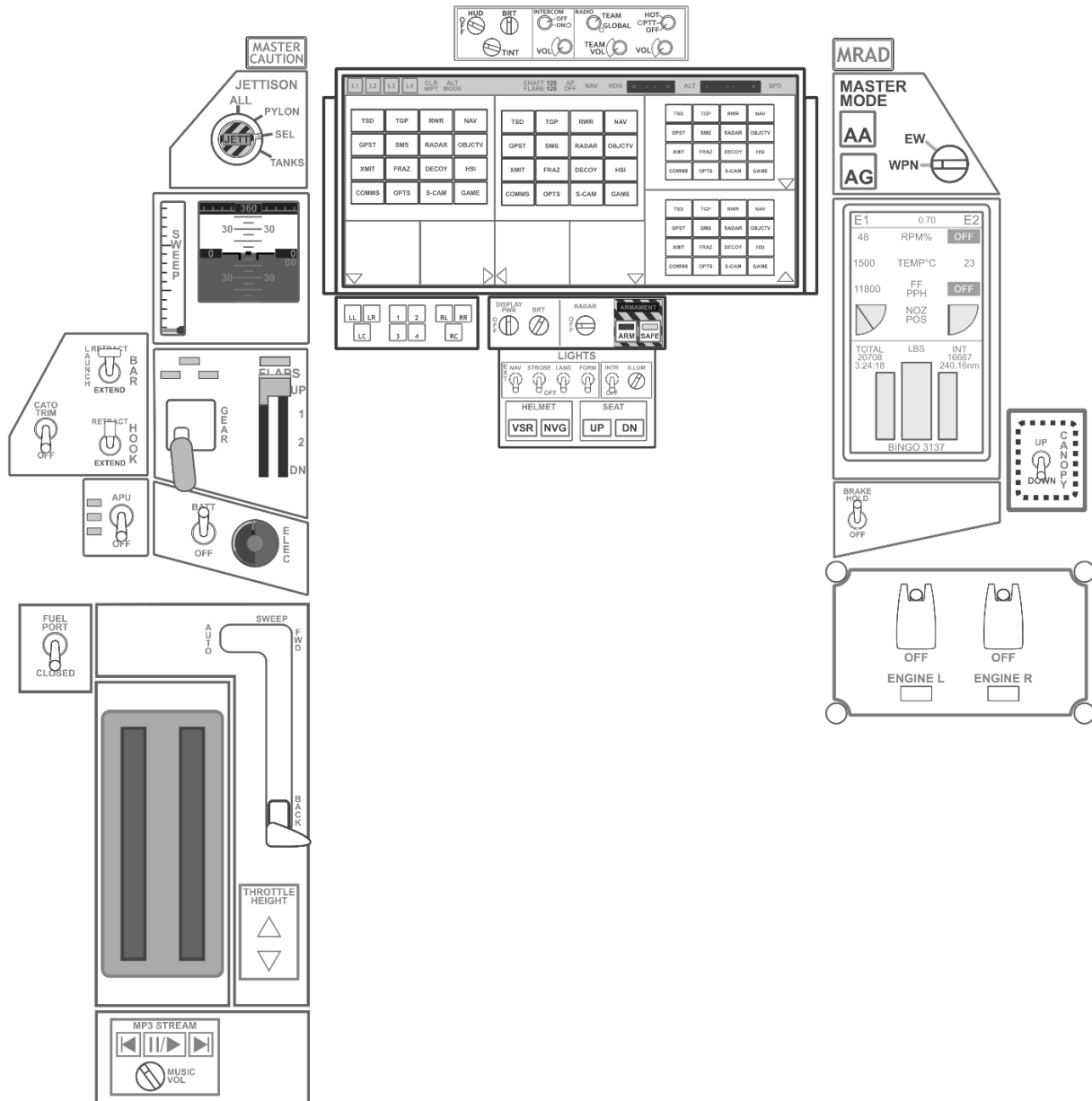
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1.1 - OVERVIEW

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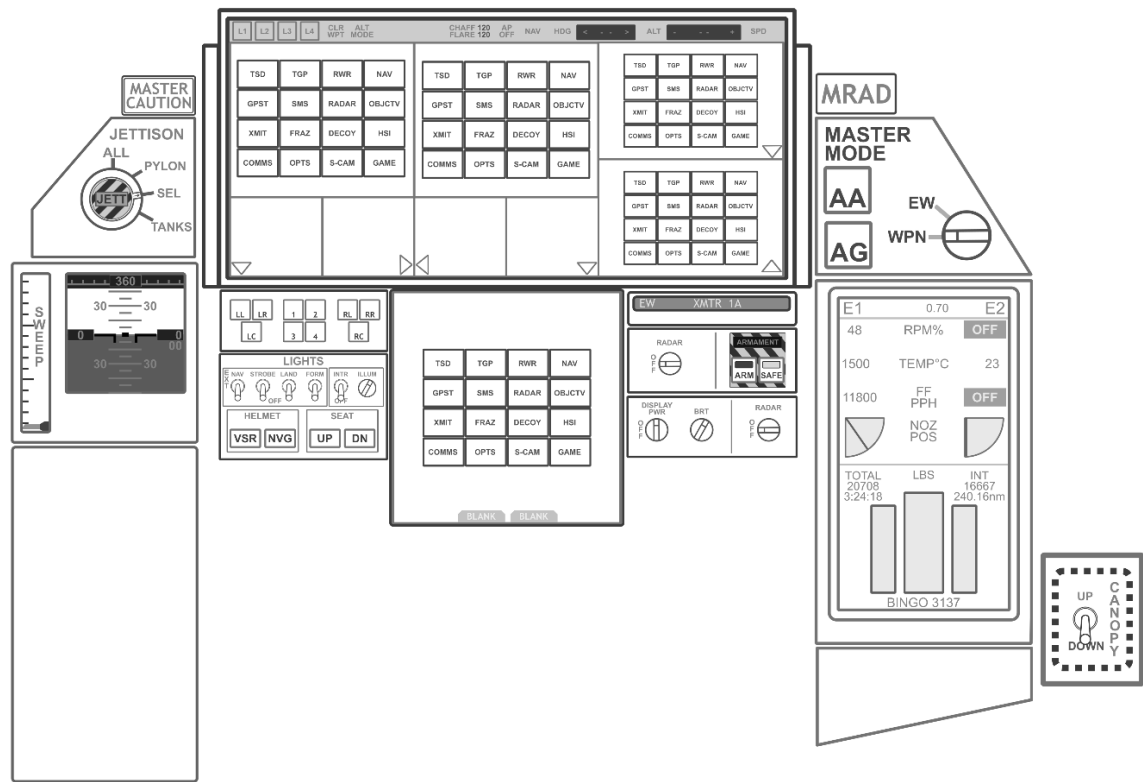
In this manual, you will find instructions to guide both the pilot and EWO in operating the EF-24G Mischief in a complicated electronic warfare theater. Begin by reading the aircraft overview and cockpit instruments to gain a situational understanding of the cockpit's layout. It is mandatory to memorize the Mischief's procedures.



(Pilot station cockpit diagram)

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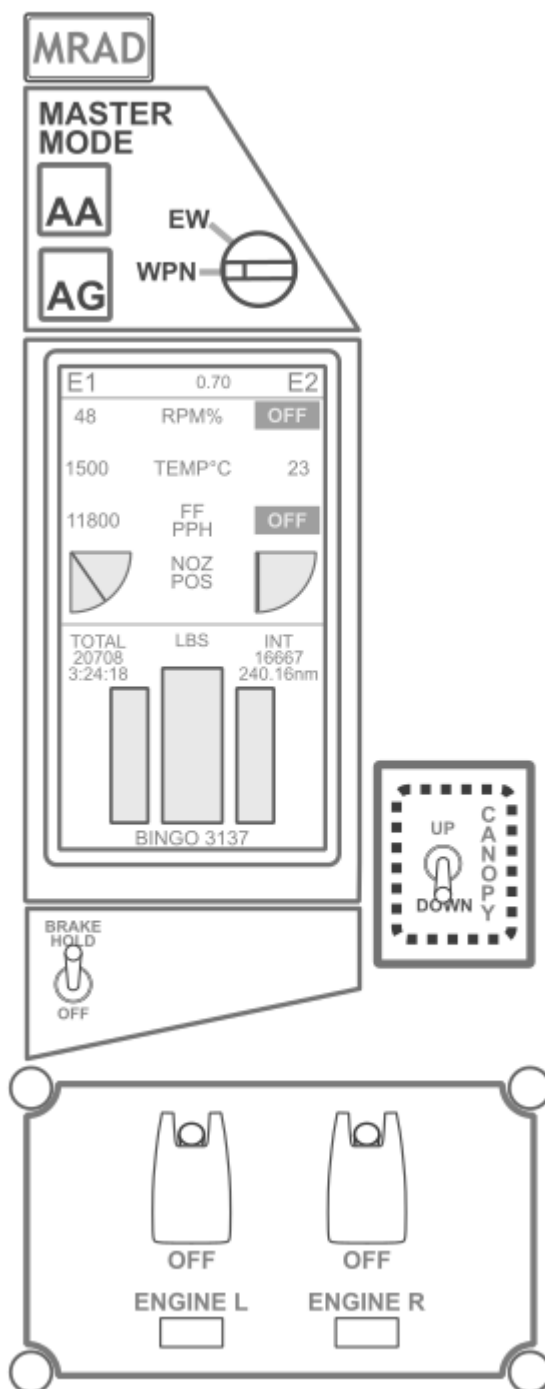
(EWO station cockpit diagram)

1.2 - AIRCRAFT OVERVIEW

The EF-24G Mischief is a CATOBAR capable, shwing-wing, electronic warfare, multirole aircraft. The EF-24G was created in 2032 by Northrop Grumman in the NEXT GENERATION ELECTRONIC WARFARE AIRCRAFT (NGEA) program. The EF-24G entered fleet service in 2034, replacing EA-18G squadrons. The aircraft is flown by two crew members: the Pilot In Command (PIC) in the front seat, and the Electronic Warfare Officer (EWO) in the rear seat. The EF-24G's fuel capacity is 16666 pounds, which can be expanded by 3805 pounds with the use of external fuel tanks. There are 13 hardpoints on the aircraft. Four weapons stations are found on the belly, and three are on each wing. There are two stations for mounting fuel tanks under the air intakes and there is one station for mounting the AN/ANQ-34 targeting pod below and to the right of the EWO's cockpit. The EF-24G's primary Electronic Warfare capacity comes in the form of AN/ALQ-245, which can be mounted in four locations: both forward belly stations and both bottom wing stations.

1.3 - COCKPIT INSTRUMENTS

RIGHT CONSOLE:



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Bottom: Engine ignition/master switch (covered) & engine failure lights

Bottom left: Parking brake switch

Bottom right: Canopy control switch

Center: Engine RPM, Temperature, Flow rate, and Nozzle position indicators.

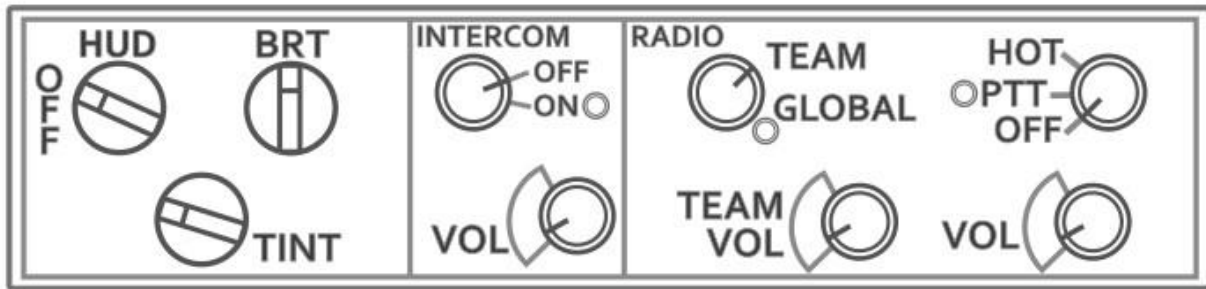
Center bottom: Internal and external fuel gauge & flight distance and time

Top left: AA & AG Master mode selection

Top right: Weapon & Electronic Warfare master mode selector

Top: MRAD (Master Radiate) Indicator & Disable button

TOP CENTER CONSOLE:



Left Section:

- Left: HUD power
- Bottom: HUD tint
- Right: HUD Brightness

Center Section:

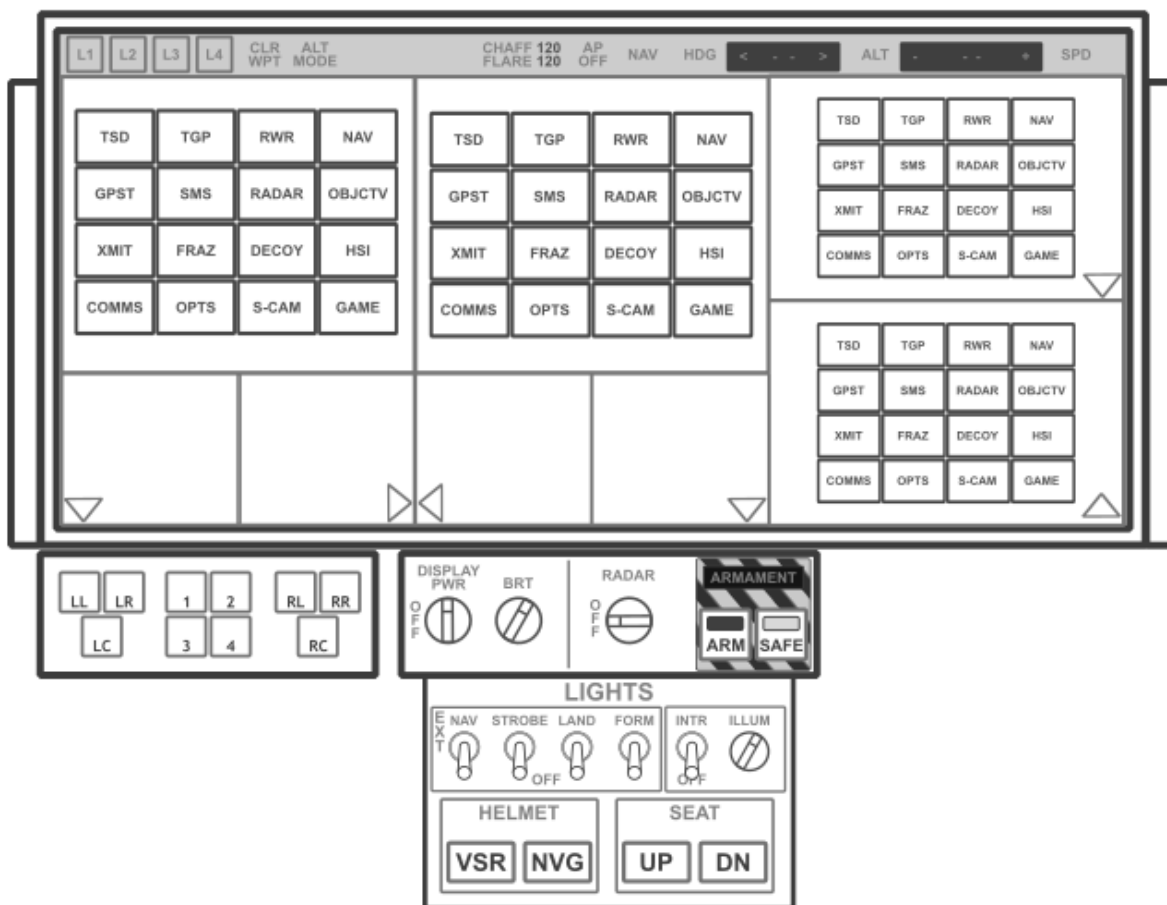
- Top: Intercom power
- Bottom: Intercom volume

Right Section:

- Left Top: Radio channel select
- Left Bottom: Team comms volume
- Right Top: Mic activation setting knob
- Right Bottom: Global radio volume

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CENTER CONSOLE:



Top: [ATMFCD](#)

Bottom Left: [Jettison select panel](#)

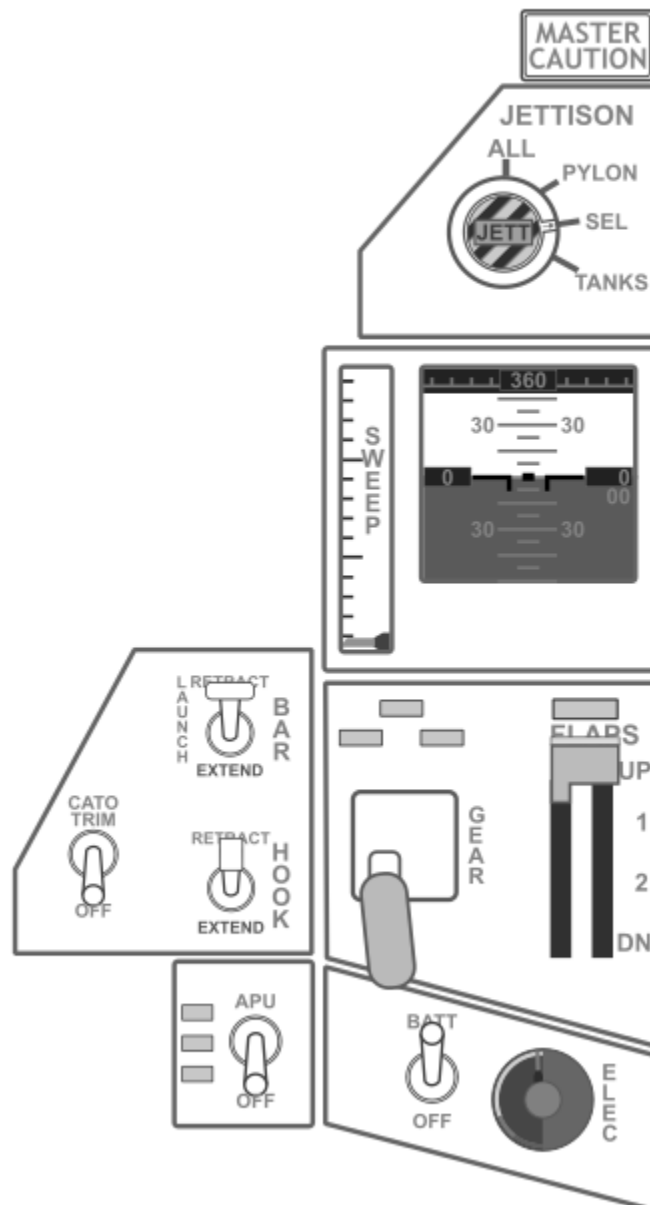
Middle Left: Display power

Middle Center: Display brightness

Middle Right: [Radar](#) power

Bottom Right: [Master arm & safe button](#)

LEFT CONSOLE:



Top: [Jettison knob](#) & Master Caution Button

Middle left: Wing sweep indicator

Middle right: Standby ADI

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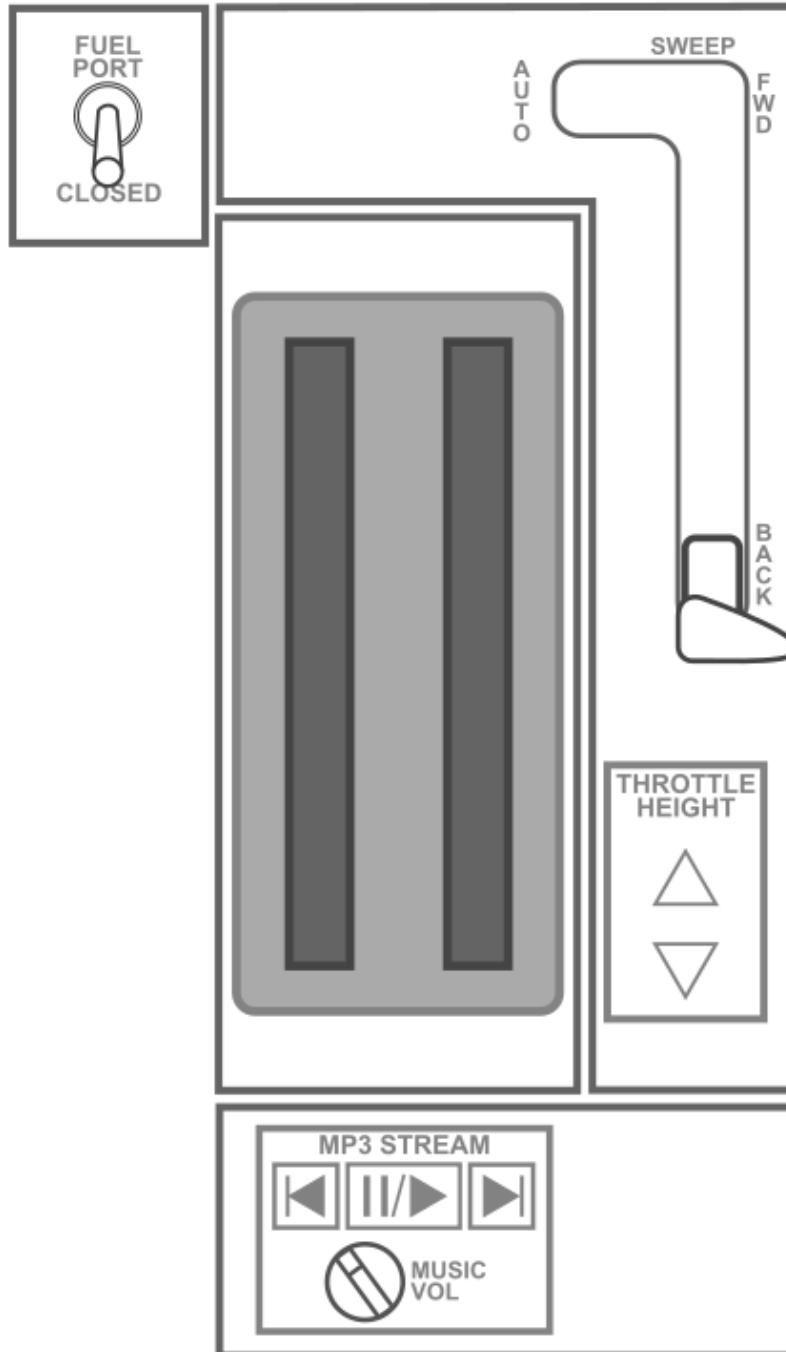
Bottom Left Section:

Top: Launch bar
Middle: Tailhook switch
Bottom: APU Switch & Status lights
Left: CATO Trim switch

Bottom Right Section:

Left: Landing gear lever & indicator lights
Right: Flaps lever & position indicator
Bottom: Battery Switch & charge indicator

BOTTOM LEFT CONSOLE:



Top Left: Fuel port switch
Middle bottom: Music player
Middle: Throttle

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Right Top: [Wing sweep control lever](#)

Right Bottom: Throttle height adjustment

1.4 - STARTUP PROCEDURE

1. Start BATTERY
2. Close CANOPY
3. Set Lights AS REQUIRED
4. Start APU and confirm THREE APU LIGHTS
5. Start DISPLAY POWER
6. Start RIGHT ENGINE and confirm RPM, FFPPH, and TEMP NOMINAL
7. Start LEFT ENGINE and confirm RPM, FFPPH, and TEMP NOMINAL
8. Set ATMFC D AS REQUIRED
9. Shut down APU
10. Check Microphone ON
11. Check Wings BACK FOR TAXI
12. Check Master Arm OFF

NOTE: Nominal engine performance is 16% RPM, ~100°C TEMP, 400lb Fuel Flow Pounds Per Hour (FFPPH). Starting either engine before APU is THREE LIGHTS will lead to ignition failure.

In the event of ignition failure, shut down the failed engine, and confirm APU THREE LIGHTS ILLUMINATED. Once NOMINAL, repeat steps 6 or 7 as applicable.

1.5 - TAKEOFF AND LANDING (RUNWAY)

TAKEOFF:

1. Set Flaps 2
2. Set Wings AUTO
3. Set Parking Brake ON
4. If TWR is under 0.8:
 - a. Advance throttle to AFTERBURNER
5. If TWR is above 0.8:
 - a. Advance throttle to MIL POWER (Maximum dry thrust)
6. Disengage Parking Brake
7. Rotate to 5 degrees at 170KIAS
8. Set Flaps 0
9. Set Landing Gear UP

LANDING:

1. Contact Tower For Permission to Land
2. Line Up with Runway (Note: Runway Number Indicates its Heading in Tens of Degrees)
3. Set Wings FORWARD
4. Set Flaps FULL DOWN
5. Set Landing Gear DOWN
6. Slow to 200KIAS, descend to 1500 feet.
7. Slow to 160KIAS once within 3NM
8. Descend to 750ft
9. Slow to +8 degrees AoA (Angle Of Attack)
10. Descend to 250ft
11. Once within 100ft, Flare (5 to 10 Degrees)
12. Set Throttle IDLE
13. Set Speedbrake FULL

NOTE: The carrier-capable landing gear is designed to withstand the harder landing forces involved, and due to the low clearance attempts to flare too aggressively may result in a tail strike.

1.6 - TAKEOFF AND LANDING (CARRIER)

PREFACE:

When Landing Gear is DOWN, Hook DOWN, and Carrier Lights ON(Final Approach), the IFLOLS is visible in your lower-left HUD. Information is relayed via a data-link connection to the carrier. Prioritize use of the HUD IFLOLS over the physical IFLOLS whenever possible, especially in low visibility.

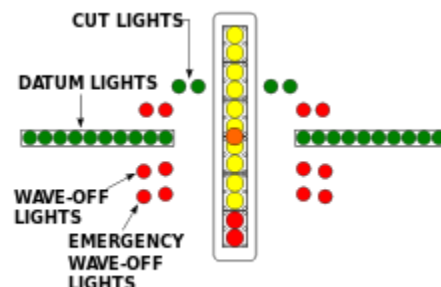
During carrier landings, aim to keep your AOA at 8 degrees. Adjust speed accordingly

TAKE OFF:

1. Contact Tower For Taxi To Catapult
2. Check Launch Bar DOWN
3. Check CATO Trim ON
4. Taxi To, and Attach to Catapult (USE HUD SYMBOLOGY FOR ASSISTANCE)
5. Set Wings AUTO
6. Set Flaps 2
7. Wait Until Shield Raised. Set Launch Bar UP.
8. Salute Catapult Shooter, Grip Right Handlebar
9. Advance throttle to Afterburner
10. After Launch, Wait 3 Seconds, Then Take Control
11. Perform Clearing Turn As Required
12. Set Flaps UP
13. Set Landing Gear UP
14. Set CATO Trim OFF

LANDING - CASE 1:

1. At 800ft, Set Tailhook DOWN
2. Engage Speedbrake
3. Lower Landing Gear, Slow to 220KIAS.
4. Set Wings FORWARD
5. Set Flaps DOWN
6. Descend to 600ft
7. Contact Tower For Landing Information
8. Turn to Intercept Glideslope
9. Slow to AoA 8 (Adjust power accordingly)
10. At $\frac{3}{4}$ miles, LSO will call out "[CALLSIGN], Call the Ball."
Response format - "[CALLSIGN], Ball."



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Example:

LSO - "Kilo 1-1, call the ball."

Pilot - "Kilo 1-1, Mischief Ball"

NOTE: IF BALL NOT VISIBLE OR INSTRUCTIONS ARE REQUIRED EARLY,
RESPOND "[CALLSIGN], Clara Ball" AND LSO WILL PROVIDE
INSTRUCTIONS IMMEDIATELY RATHER THAN AT $\frac{3}{4}$ MILES.

11. Follow the "Meatball" to landing: If the Light is low, so are you. If the Light is high, so are you. Try to keep the Ball in the Center. (BALL WILL INCREASE BRIGHTNESS WHEN CENTERED)
12. In final stages of approach, follow LSO *TO THE LETTER*.
13. Maintain AoA of 8. Do NOT Flare.
14. Upon Contact, Advance Throttle to Afterburner
15. (If Wire Caught) Hold Afterburner for 4 seconds. Set Throttle IDLE. Set Hook UP, Set Wings BACK, Set Flaps 0, Taxi to Parking Area
16. (If Wire Missed) Bolter! (SEE WAVE OFF PROCEDURES ON NEXT PAGE.) Monitor Fuel Levels.

LSO GUIDANCE

After calling the ball, the LSO will give guidance down from $\frac{3}{4}$ miles. If Clara Ball has been called, it will begin immediately.

The commands are as follows:

- Come left - Turn slightly left
- Right for lineup - Turn slightly right
- Power - Reduce descent rate, add some power to compensate resulting loss of airspeed
- You're too high - Increase descent rate, reduce power to compensate
- Wave off! - **WAVE OFF IMMEDIATELY, RE-ENTER A HOLDING PATTERN TO THE LEFT. SEE NEXT PAGE FOR PROCEDURES**
- Bolter! - You've touched the deck but missed the wires - go around! **SEE BELOW FOR PROCEDURE**

WAVE OFF PROCEDURES:

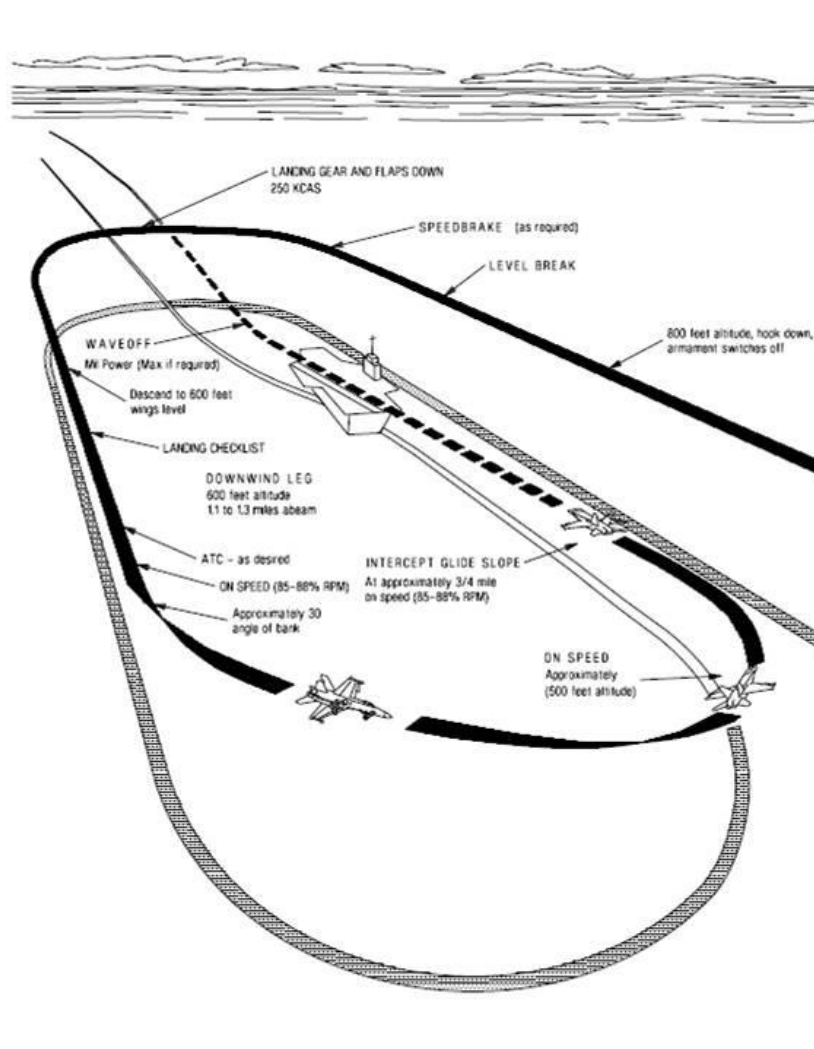
On Wave Off/Bolter Callout:

1. Advance Throttle to Afterburner
2. Pull up to +10 Degrees (WARNING: Maintain Safe AOA.)
3. Keep Airspeed Above 180KIAS
4. Once Airspeed 250KIAS, Power Back and Hold Airspeed
5. Turn Onto Downwind

After Procedure Complete, See Landing (CASE 1) Checklist

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CASE 1 Diagram:



1.7 - VARIABLE GEOMETRY WINGS

DESCRIPTION:

In order to reduce drag at increasing Mach numbers, the EF-24G's wings have been designed to articulate, thus vastly increasing top speed and efficiency. The wings may either be manually controlled or automatically managed by the aircraft based on current indicated Mach.

BASIC OPERATION:

1. In "AUTO" wings will move for balanced lift/drag ratio
2. FORWARD moves the wings fully out, maximizing lift
3. BACK moves the wings fully aft, minimizing drag at the cost of lift
4. If the wings are in any position other than FORWARD (or, full forward in AUTO) the FLAPS will not deploy
5. If FLAPS are down, the wings will not articulate, and a clicking noise may play to alert the pilot



1.8 - EWO HCU BINDS

DESCRIPTION:

To aid the EWO in their electronic warfare tasks, the EF-24G comes with two Hand Control Units allowing a huge amount of control without having to reach and interact with the [ATMFCD](#). The controls primarily differ from the Pilot HOTAS controls when in EW Master Mode, with specific binds for controlling jammer mode and target.

The HCU controls differ depending on if in WPN Master Mode, EW, and if the Left HCU Trigger is held. Any section labeled "MODIFIED" means functions accessible while holding the L-HCU trigger.

● **WPN Master Mode**

- Right Hand:
 - Joystick - SOI Slew Control
 - Joystick Press - Select/WPN Target
 - Button - Switch Weapon
 - Trigger - Fire
- Left Hand:
 - Joystick Left/Right - Switch SOI Page
 - Joystick Up/Down - Zoom (on [RADAR: elevation control](#))
 - Button - Cycle Jammer Transmit Mode
- Left Hand MODIFIED
 - Joystick Left/Right - Switch SOI Page
 - Joystick Up/Down - Increase/Decrease Selected Jammer Power

● **EW Master Mode**

- Right Hand:
 - Joystick - SOI Slew Control
 - Joystick Press - Designate Jammer Target
 - Button - Switch Jammer
 - Trigger - Start/Stop Jammer
- Left hand:
 - Joystick Left/Right - Switch SOI Page
 - Joystick Up/Down - Zoom (on RADAR, elevation control)
 - Button - Cycle Jammer Transmit Mode
- Right Hand MODIFIED:
 - Joystick - SOI Slew Control
 - Joystick Press - Designate Jammer Target
 - Button - Switch Jammer (Reverse order)
 - Trigger - Start/Stop Jammer

1.9 - WEAPON/PYLON JETTISON CONTROLS

DESCRIPTION:

Equipment mounted on the EF-24G will affect it in three ways: Increased weight, increased drag, and increased RCS. There may be situations where these factors are problematic, for instance in missile evasion or a sudden dogfight. At times like this, the EF-24G comes with an improved jettison system, allowing weight and drag to be shredded



Usage:

1. Choose what you wish to jettison
 - a. ALL - All stores will be dropped (TGP and CANNON cannot be jettisoned)
 - b. PYLON - The three Left and Right wing stations will be jettisoned
 - c. TANKS - External Fuel Tanks will be jettisoned
 - d. SEL - Whatever you have configured via SEL JETT or in [SMS](#) will be jettisoned
 - i. Each button displays what store is or was on it
 - ii. Grayed/Slashed out text means the munition was fired
 - iii. Red illumination indicates selected for jettison
2. Grab the JETTISON knob with trigger
3. Rotate to correct position (VISUALLY CONFIRM)
4. Press the controller button to JETTISON

NOTE: The pylons that munitions are mounted on will remain on the aircraft after firing the weapon, they add drag and increase RCS. It is advised to when able jettison these to improve aircraft performance.

"Shit I selected ALL again" - Anonymous Pilot

2.1 - BDYNAMICS ADVANCED TOUCHSCREEN MULTI-FUNCTION COLOR DISPLAY WITH GLASS-COCKPIT UI (ATMFCD)



OPERATION:

1. Set DISPLAY to ON
2. Set brightness AS DESIRED
3. Use the triangle buttons to adjust screen size
4. Interact with system prompts with a touch
5. Press the MENU button to return to the menu at any time
6. Set a display as SOI to interact with it using your HOTAS
7. Press and hold the layout save button to save your current layout

THE ATMFCD IS A TOUCHSCREEN

DESCRIPTION:

Created by BDynamics, the ADVANCED TOUCHSCREEN MULTI-FUNCTION COLOR DISPLAY (ATMFCD) is a high-tech solution to the pilot interface. Operating as a touchscreen, the ATMFCD's operation is intuitive. With interaction being done by a touch of the screen. The screen can be segmented into several shapes and sizes, allowing certain sensors to be prioritized over others. In addition, "Quick select" buttons are present, allowing the operator to rapidly switch between sensors.

NOTE: Some operators have reported accidentally touching the buttons on the ATMFCD, which has caused incidents such as negligent

discharges. It is advised to caution the position of your hands around the screen to avoid this.

2.2 - MNAV NAVIGATION DISPLAY



BASIC OPERATION:

1. Select NAV on the ATMFC
2. Press (or hold) the + to zoom in and - to zoom out (Left hand HOTAS function available)
3. Press GPS-S to send the GPS coordinates of a location to your [GPST](#)
4. Detected enemy units will appear on the NAV screen
5. Carriers and friendlies will show up on the display
6. Carrier landing guidelines will also appear on the display
7. Close contacts will group together to prevent clutter

DESCRIPTION:

The MNAV is an avionics suite designed to help with navigation as well as situational awareness. Made in 2022, this display incorporates one of the most advanced systems developed by Garmin. A new and critical feature is Datalink, through which friendly aircraft

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can point out targets as well as connect directly to an E-2, E-3, and/or E-4 AWACS aircraft. Datalink provides global IFF for all aircraft, setting new standards in military safety.

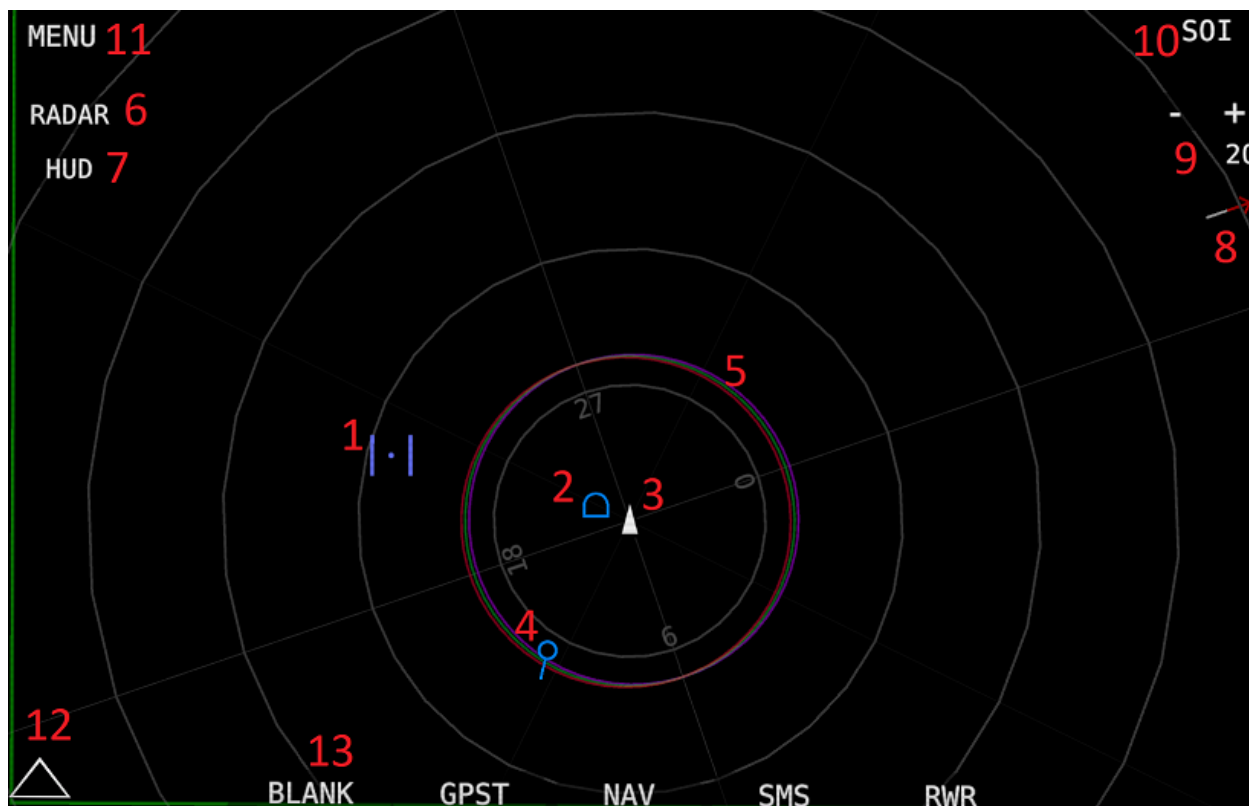
The MNAV system also comes equipped with the GPS-T Global Positioning System - Tracking. This subsystem is a highly accurate GPS/Waypoint targeting system that is used through the MNAV Navigational displays and the TSD. These GPS Markpoints can also be sent to other aircraft through Datalink. This system could also be used to employ GPS guided weapons

1. Select NAV on the [ATMFCD](#)
2. Set NAV page as SOI
3. Use the Joystick Thumbstick on your Flight-stick to slew cursor over desired area of the NAV page
4. Use the Throttle Thumbstick to control NAV zoom
5. Press GPS-S to create a GPS markpoint

NOTE: There is a dedicated [GPS-T page](#) on the ATMFCD for managing GPS points and groups

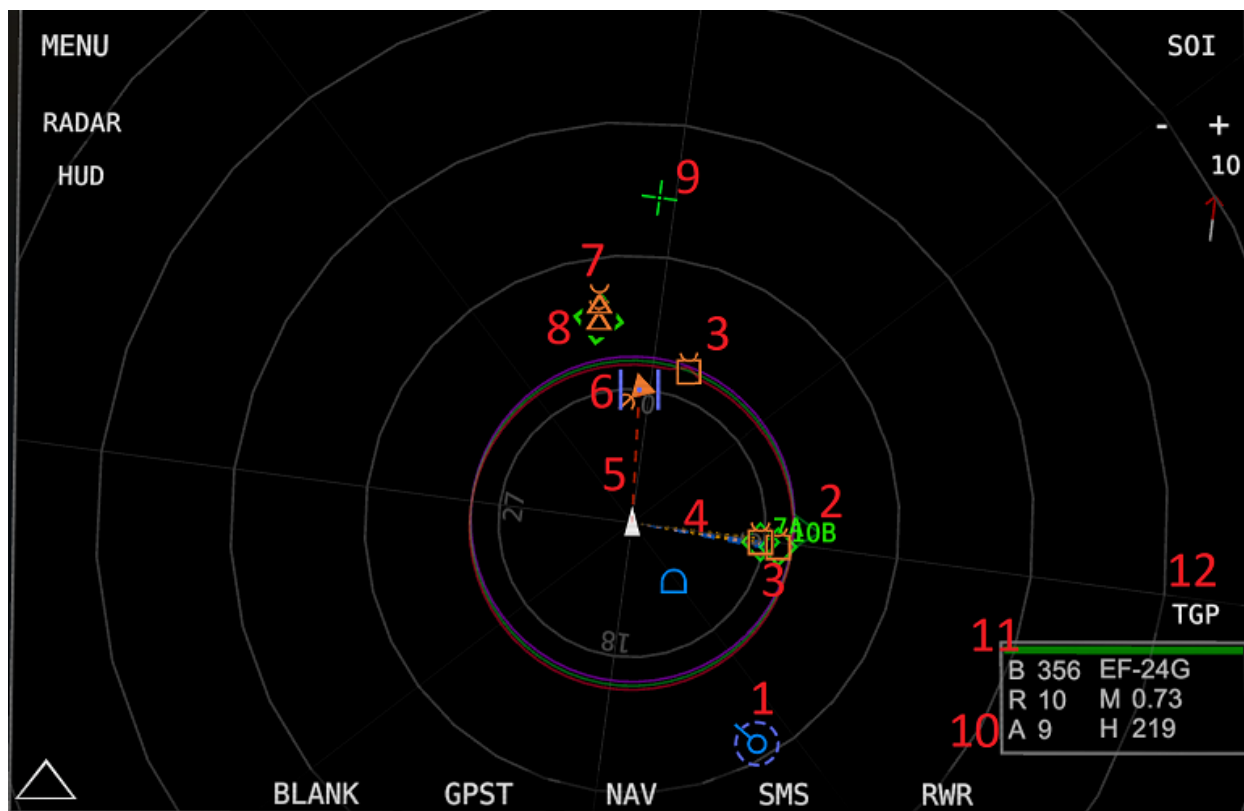
NOTE: GPS Jamming may reduce the accuracy of the MNAV. When GPS is jammed, the system will fall back onto an INS. However, the INS will drift over time.

2.3 - TACTICAL SITUATION DISPLAY (TSD)



SYMBOLLOGY:

1. Target Designator Cursors
2. Friendly Ground Unit
3. Own-Aircraft Indicator
4. Friendly Aircraft Unit
5. HI, MEDIUM, LOW band spectrum indicators
6. RADAR Controls Subpage Toggle
7. HUD Controls Subpage Toggle
8. North/South Compass Direction
9. Zoom and current zoom (Left thumbstick HOTAS controllable)
10. SOI Enable
11. MENU Button
12. Display Resize Button
13. Subpage Quick Select Bar



SYMBOLGY CONTINUED:

1. Weapon Selected Target
2. Jammer Target Indicator
3. Enemy Ground Target
4. Outgoing Jamming Indicator
5. Incoming Radar Lock
6. Enemy Aircraft Icon (Filled in: Correlated With Onboard Sensors)
7. RWR Estimated Enemy Aircraft Position
8. EW Selected Target
9. TGP Look Point
10. Hovered Aircraft Information
11. Track Confidence Bar
12. TGP Slew Button

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the AN/APG-92 Radar and the Sniper Targeting Pod. For situational awareness, it compiles all datalink contacts into one display and displays them on the HMD. Allowing not only a two-dimensional picture, but a real-time 3D view painted right before the operator's eyes. Such amounts of information allow experienced operators to maintain supreme battlefield awareness. Inexperienced aircrew may suffer from information overload. It is advised to configure how much information is displayed to the operator's needs.

Tracks have three primary states:

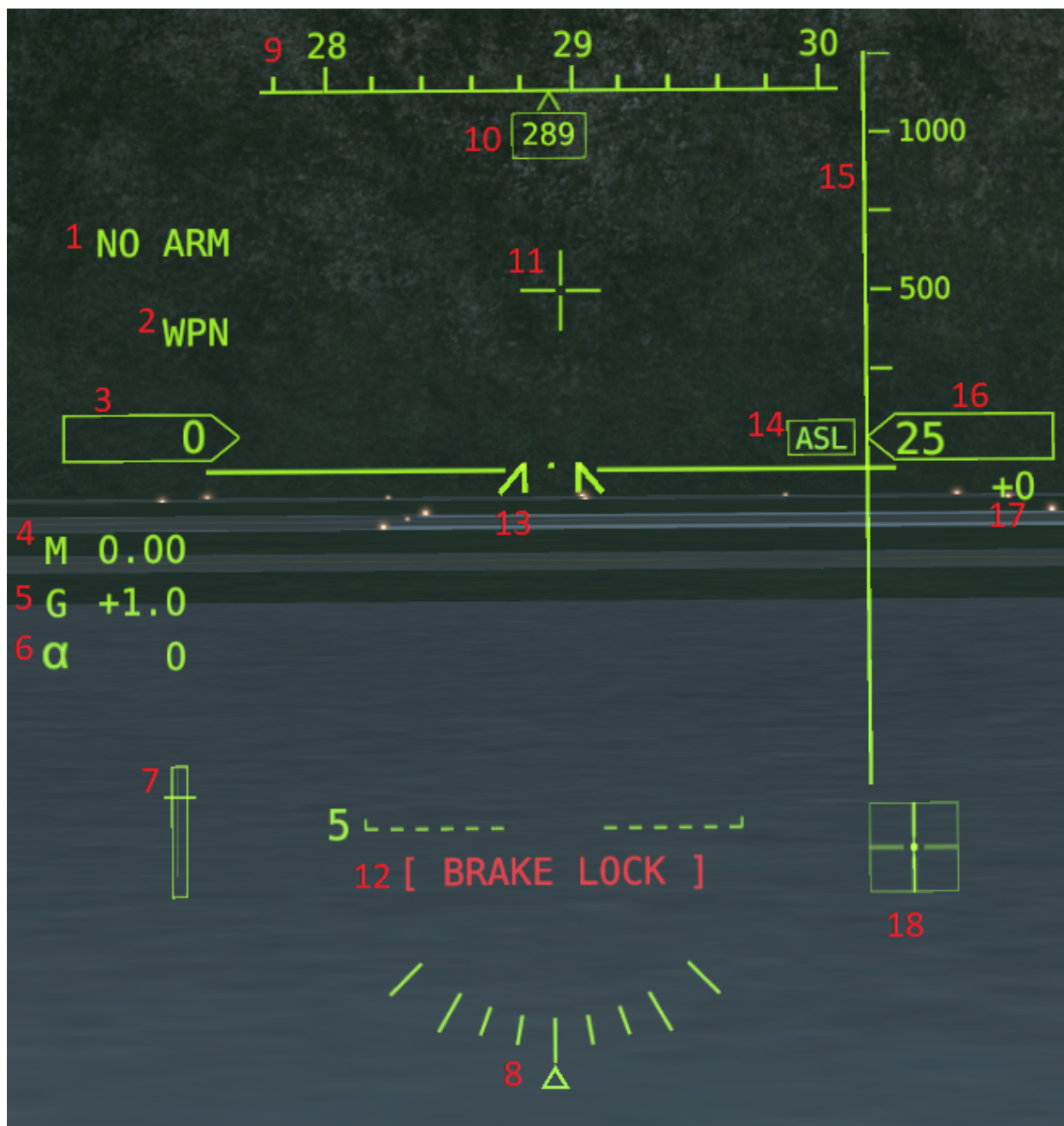
1. **Low Confidence** - Tracks produced by only RWR scans, or that haven't been updated in several seconds will become Low Confidence. These tracks cannot have EOTS slaved to them, create GPS points, and are indicated on the TSD as poor tracks
2. **High Confidence Remote** - A track from offboard (or not actively being updated) created either by high-precision triangulation, or a precise sensor such as RADAR or TGP
3. **High Confidence Own Sensors** - Denoted by a filled in icon, track is live, and accurate, produced data by own aircraft sensors. This is the best quality of track

A track file that has no sensor pointed at it will steadily decrease in quality. While degrading in quality, the aircraft will attempt to "predict" the motion of the target based off last known velocity and position. It is important to understand that the predicted tracks location may be inaccurate, and as such caution should be taken before firing upon one of these tracks

NOTE: GPS Jamming may degrade the positional accuracy of datalink contacts on the TSD. Advise caution when "GPS LOST" warning is present

NOTE: Contacts only visible by the RWR will have a lower confidence than targets with a primary sensor. RWR-only contacts may appear to "jump" around as their position is solved, and weapons fired at these contacts will be less effective. Contacts visible by own onboard sensors will be filled in solid

2.4 - HEADS UP DISPLAY (HUD)



SYMBOLGY:

1. Armed Weapon/Master Arm
2. Master Mode
3. KIAS
4. Mach
5. Current G-Force

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6. Angle Of Attack
7. Throttle Position
8. Bank Angle Indicator
9. Heading Tape
10. Current Heading
11. Pilot Look Indicator
12. Cautions & Warnings
13. Waterline Marker & Wing Sweep Indicator
14. Altitude Readout Mode
15. Altitude Tape
16. Current Altitude
17. Vertical Speed
18. Stick Position Indicator

DESCRIPTION:

Developed by *Rockwell Industries*, the EF-24G's Heads Up Display is a marvel of modern engineering. Through a combination of advanced optics and ultra-high-resolution displays, the HUD features multi-color symbology fully integrating with the Block IV JHMCS. The pilot can clearly distinguish HUD markings and the outside world. However, the HUD's electrochromic tint option allows the pilot to prioritize HUD symbology over visibility, making it a powerful tool to aid in Beyond-Visual-Range (BVR) engagements.

2.5 - JHMCS BLOCK IV (HMD)



BASIC OPERATION:

1. Enable HUD
2. Lower Visor
3. Set HUD brightness AS DESIRED
4. The Heads-Up Display (HUD) is displayed above the ATMFCF (SEE HUD DIAGRAM BELOW)
5. All datalink contacts are displayed on the HMDS.



SYMBOLGY:

1. Armed Weapon/Master Arm
2. Pilot Look Heading
3. TSD Weapon Selection
4. KIAS
5. Mach
6. G-Force
7. Angle Of Attack
8. Pilot Look Indicator
9. Altitude
10. Targeting Pod Indicator
11. Jamming Indicator

NOTE: When a DLZ is needed for weapon employment it will appear on the right side of the HMD

2.6 - AN/AAQ-34 SNIPER TARGETING POD (TGP2)



SYMBOLGY:

1. Mode Cycle
2. Sensor Type Cycle
3. Stow Forward Button
4. Enable HMD Display/Controls
5. Wings Attitude Indicator
6. Slave To Waypoint
7. Slave To GPS Point
8. Create New GPS Point
9. Toggle Visible TGP Limits
10. Zoom In/Out (Throttle Joystick HOTAS Available)

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11. TGP Slew Limits
12. Toggle NVG Mark Laser

BASIC OPERATION:

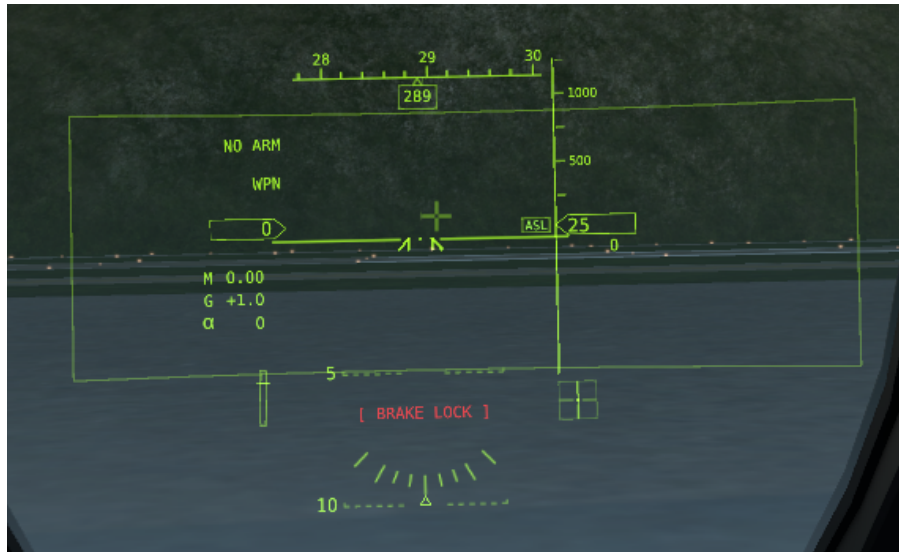
1. Ensure the Pod is equipped on the appropriate station.
2. Navigate to the TGP page on the MFCD.
 - a. If "NO SIGNAL" Error displayed, return to menu and repeat step 2
3. Set the Pod as SOI
4. Slew the Pod with the thumbstick.
5. Zoom the Pod in/out by pressing the Zoom +/- buttons.
 - a. Alternatively, Zoom by pressing the Throttle Thumbstick Forward/Backward
6. Press SENS To cycle between Sensor Modes
 - a. COLOR: A visible wavelength color sensor, good for target ID
 - b. DAY: Typical IR sensor mode
 - c. NIGHT: Higher Sensitivity IR with sky filtering

DESCRIPTION:

The AN/ANQ-34 SNIPER Targeting Pod is an advanced precision targeting system currently in use with many military aircraft. SNIPER is instrumental in the employment of many air-to-ground weapons, being necessary for use of optically-guided and laser-guided weapons. SNIPER can also dramatically improve the accuracy of GPS guided and iron bombs. SNIPER must be mounted externally to the aircraft prior to startup to function. The targeting pod contains a high-resolution, forward-looking infrared (FLIR) sensor that displays an infrared image of the target to the pilot. The pod has 7 zoom levels, allowing it to be effectively be used as both a targeting and reconnaissance system. The pod also contains a CCD camera used to obtain target imagery in the visible portion of the electromagnetic spectrum. The pod is equipped with a laser designator for precise delivery of laser-guided munitions and an Infrared marker for targeting coordination at night. The guidance laser is always on, but the marking laser can be toggled on/off. A laser rangefinder provides accurate ranging information up to 23NM. The targeting pod is POINT and AREA stabilized, simplifying target acquisition and weapons employment. The pod can be locked at ranges up to 23NM, however it is possible to observe with limited resolution for an additional 5NM.



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(Example of radar FOV limits with "HUD" option)

BASIC OPERATION:

1. Enable RADAR POWER
2. Open RADAR Page on the ATMFC
3. Set the RADAR as SOI and use the Joystick Thumbstick to slew the RDR Cursor
 - a. Slew the cursor out the top/bottom of the screen to change displayed range
 - b. Slew the cursor off the left/right side to change the scan azimuth
4. Use the Throttle Thumbstick to set RADAR Elevation
5. Enable HUD as desired
6. Once contact visible on RADAR:
 - a. Slew cursor over target and depress the thumbstick to TWS/Softlock
 - b. TWSed target is automatically marked as PDT
 - c. Depress once on a non-PDT target to mark it as PDT
 - d. Depress a second time to enter STT
 - e. The Bearing, Range, Altitude, and Airspeed (BRAA) of the target is shown in the bottom right of the display.

ACM BORESIGHT:

Depress and hold Joystick Thumbstick while RADAR is marked SOI for >1 second to enter H-BORE mode. Any contact (aircraft OR missile) that enters the search area and is detected will be immediately locked.

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DESCRIPTION:

The AN/APG-92 Radar is an advanced Active Electronically Scanned Array (AESA) radar. It has a maximum range of 64 Nautical Miles and an effective launch range of 40 Nautical Miles. The radar can select up to 4 HIGH-RATE TWS contacts, and simultaneously feed an unlimited number of low-rate TWS contacts to the [TSD](#). It is important to note that the Locking function does not function as a traditional Single-Target-Track (STT) would. In addition to providing a large amount of radar energy to the locked target, the APG-92 can also maintain 4 HIGH-RATE TWS tracks.

NOTE: The AIM-120D can be fired via either the TSD or the RADAR. The track that will be fired upon is denoted with a small * beneath the contact on the HMD, and is determined by which page is set as SOI.

2.8 - PASSIVE ELECTRONIC WARNING SYSTEMS (PEWS)

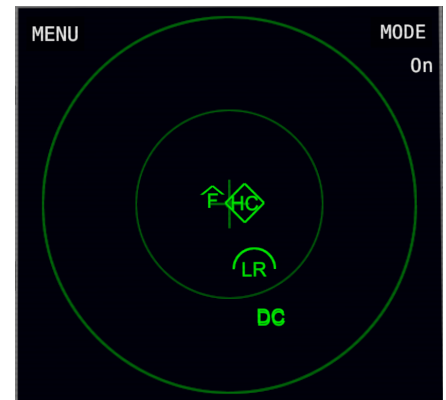
OVERVIEW OF PEWS SYSTEMS:

1. **AN/ASQ-289 Combined Electronic Warfare Suite**
 - a. Passive system (use is undetectable).
 - b. Radar detection, identification, lock status, and launch status information.
 - c. Terminal-stage ("Pitbull") ARH missile detection.
 - d. Feeds data to the TSD triangulation system.
 - e. Electromagnetic spectrum analysis
2. **AN/AAR-60 Enhanced Missile Warning System (EMWS)**
 - a. Passive system (use is undetectable).
 - b. Missile launch detection.
 - c. Missile approach detection.
3. **AN/APR-73 Passive Proximity Radar System (PPRS)**
 - a. Passive system (use is undetectable).
 - b. Detects any nearby object
 - c. Limited to 1NM
4. **ALE-47 Countermeasures Dispensing System (CMDS)**
 - a. Active system (use is detectable).
 - b. Dispersion of Chaff.
 - c. Dispersion of Flares.

2.8.1 - AN/ASQ-289 COMBINED ELECTRONIC WARFARE SUITE (RWR Function)

BASIC OPERATION:

1. Select the RWR on the [ATMFCD](#)
2. Press the *Mode* button then select *ON* or *MUTE* to turn on the system
3. Enemies will first start with a semicircle on top, then, a circle will appear over them when they lock you on (radar spike)
4. Targets that the RWR believes to be of the greatest threat will be marked with a diamond symbol
5. Airborne targets will have a triangle on top
6. Missiles gone "Pitbull" will show as a red M
7. Pitbull missiles that have acquired a target will show as a red circle with a red M inside
8. A Continuous Wave (CW) radar beam is indicated with a change of the source radar to red with a flashing circle, accompanied by an aggressive



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tone. CW beams indicate the launch of a SARH missile.

9. Symbology:

- a.  Primary threat, RWR identified most dangerous
- b.  Most recently detected contact
- c.  Airborne threat
- d.  Locked on/Tracking radar threat
- e.  SARH Guidance indicator, missile in the air
- f.  Active Radar Guided Missile Acquired on you

10. Threats:

- a. 4 - MAD-4 Radar
- b. LR - Forward looking radar on NMSS Cruiser
- c. F+ - ASF-58
- d. F - ASF-30 or ASF-33
- e. DS - Enemy SAM Radar
- f. SR - Enemy FCR
- g. SL - Mobile Surface MRM Launcher Radar
- h. MC - NMSS Cruiser top radar for VLS
- i. SA - SAAW Mobile SAM
- j. DC - Drone Carrier or DMS Cruiser
- k. DF - Drone Fighter, Manta UCAV
- l. HC - Enemy Carrier
- m. A - CIWS Air Defense
- n. E4 - Friendly AWACS
- o. AE - Enemy AWACS
- p. 26/FA - F/A-26B
- q. 45/FS - F-45A
- r. 94/AH - AH-94
- s. 55/T - T-55
- t. 24/EF - EF-24G
- u. C - Allied Carrier
- v. DM - Allied Cruiser
- w. R - Allied FCR Radar
- x. E - Allied SAM Radar

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- y. SL - Mobile Surface AIM-120C Launcher Radar
 - z. B - Backstop Radar System
 - aa. MW - Missile Warning Radar Truck
 - bb. EW - Early Warning Radar
11. Listen for audio cues or look at the RWR screen for info on targets

DESCRIPTION:

The AN/ASQ-289 Radar Warning Receiver (RWR) is an advanced electronic warfare suite developed by BAE Systems in 2023. It features the latest technology in attention-grabbing audio-visual cues and easy to read symbols for fast target acquisition, the culmination of 50 years worth of research and designs. With the AN/ASQ-289, situational awareness is at your fingertips - or ears! The RWR has a nearly unlimited omnidirectional range. The AN/ASQ-289 was developed as a response to the increasing threat of Russian and Chinese fighters launching missiles undetected and without warning until mere seconds to impact. Using a variety of classified high-tech systems, the RWR is the all-seeing eye of the sky.

NOTE: Contacts closer to the center of are higher in strength, not necessarily closer in distance

2.8.2 - AN/AAR-60 EMWS (ENHANCED MISSILE WARNING SYSTEM)

BASIC OPERATION:

1. Missile launches detected by the EMWS are displayed as a yellow line on the RWR display and are accompanied by an enunciation.
2. Incoming missiles (Both radar and IR-guided) are displayed as two orange lines on the RWR display and are accompanied by a tone.

DESCRIPTION:

The EMWS system is a passive missile approach and launch detection system developed by Lockheed Martin. The EMWS consists of multiple IR cameras placed around the aircraft. Missile launches are detected at a range of 10 Nautical Miles. Incoming missile detection ranges vary greatly from missile to missile and factors such as if the motor is still burning.

NOTE: The EMWS has a blindspot located directly above the aircraft

2.8.3 - AN/APR-73 PPRS (PASSIVE PROXIMITY RADAR SYSTEM)

BASIC OPERATION:

1. Objects within 1NM are automatically detected and placed on the TSD
2. Objects that exit the 1NM range will enter "drift" mode on the TSD and stop updating.

DESCRIPTION:

The AN/APR-73 PPRS functions by analyzing the background EM radiation surrounding the aircraft to exploit reflections from nearby ground and air targets and can accurately discern bearing, range, speed, and direction.

2.8.4 - AN/ALE-47 CMDS (COUNTERMEASURES DISPENSING SYSTEM)

BASIC OPERATION:

1. Place hand on throttle.
2. Press top circular button on controller to deploy chaff AND flares.
3. Open the CMS page to adjust countermeasures profiles.
4. ENUNCIATORS:
 - a. CHAFF/FLARE - Successful dispense of a Chaff/Flare
 - b. CHAFF/FLARE LOW - 10 Chaff/Flares remaining
 - c. CHAFF/FLARE EMPTY - 0 Chaff/FLares remaining

DESCRIPTION:

The ALE-47 CMDS has been the standard countermeasures dispensing system since 1998. In that time it has proved itself to be reliable and effective. It holds 120 chaff and flares each. See sections [5.2](#) and [5.3](#) for information on countermeasures strategies.

2.9 - AUTOPILOT/AUTOTHROTTLE PROCEDURES



1. There are 4 NAV options to select from
2. ALT and SPD can be used in conjunction with either NAV or HDG
 - a. NAV: Navigation AP when selected will fly to the currently selected waypoint. Waypoints have to be selected through the [mission computer](#) for NAV mode to function.
 - b. HDG: Heading AP will hold the designated heading, and can be changed by pressing and holding the arrows next to the readout. Note that the autopilot can only bank up to 30 degrees.
 - c. ALT: Altitude AP will hold the designated altitude, and can be changed by pressing and holding the + or - signs next to the readout
 - d. SPD: Speed AP, or Autothrottle will attempt to hold the speed that you are going when you press the button. It is unable to use Afterburner, and as such may be unable to hold a speed depending on your altitude and loadout.
3. Applying a strong control input may disable one or multiple running APs with an audible warning
4. The AP OFF button will disable all running autopilots

3.1 - Electronic Warfare Overview

3.1.1 - Types of EWAR

Electronic warfare (EW) is the Discipline of warfare that covers the electromagnetic spectrum including Radars, Radios, Navigation Equipment, Datalinks, and other EM Equipment. EW is made up of 3 Sub Disciplines

- Electronic Attack (EA) - Degradation of enemy EM equipment
- Electronic Protection (EP) - Defense from enemy electronic attack
- Electronic Support (ES) - Classification and analysis of enemy use of the EM Spectrum

The scope of this document is the principles and employment of electronic attack as it pertains to the EF-24G and may not entirely be true to real EA

3.1.2 - Frequency Bands

The electromagnetic spectrum encompasses all frequencies of electromagnetic radiation. Including radio waves, visible light, and gamma radiation. Electronic Warfare is mainly concerned with the radio spectrum, which is composed of frequencies ranging from 3Hz to 3,000 GHz. These frequencies are normally organized into "bands".

Each band of frequencies have pros and cons, and are used for different applications.

- **Low Band (30hz-2GHz):** Generally used for early warning radars or long-range communications. Low band radars have an incredibly long range, but relatively low fidelity on tracks.
- **Mid Band (2GHz-8GHz):** Generally used for medium-range search radars
- **High Band (8GHz-27GHz):** Generally used for high-resolution radar tracking. The fidelity of high frequency radar is ideal for missile guidance, missile warning systems, and ground mapping.

In the same way that humans can only see visible light, radio wave devices are only able to see signals within their frequency band. Any attempts of jamming a system with the wrong frequency band will have

little to no effect on the threat system. I.E, low-band noise jamming will not affect a high-band fighter radar.

3.2 - Principles of Electronic Attack

The purpose of electronic attack (EA) is to degrade the abilities of an enemy to operate within the electromagnetic spectrum, with one of the key targets being radars. Modern Radars work by sending out a pulse of radio energy on a specific frequency and listening for a return. By using properties such as the delay between the radar's transmission and return, as well as the Doppler effect, a target's range, speed, altitude, and direction can be determined. While some radars may use these properties differently, they all are open to exploitation through Electronic Attack.

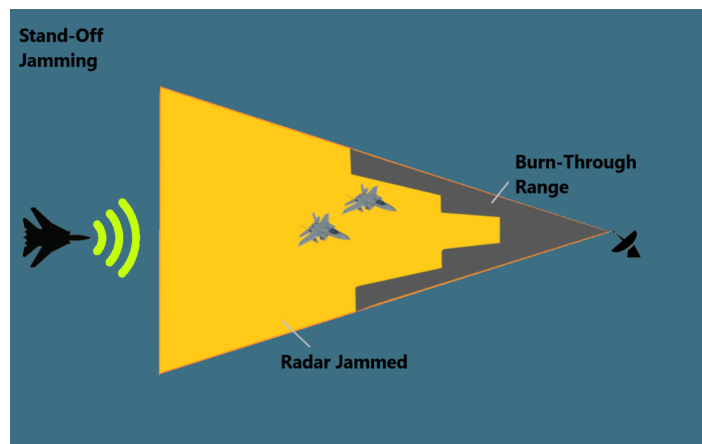
Electronic Attack methods

3.2.1 - Noise

The simplest form of radar degradation is noise jamming. Noise jamming is carried out by an emitter continuously transmitting a bombardment of noise on the frequency band a target radar is operating on. Low band noise can heavily disrupt the reception of GPS, radio communications, and early-warning radars; while mid and high band noise can disrupt fire control radars.

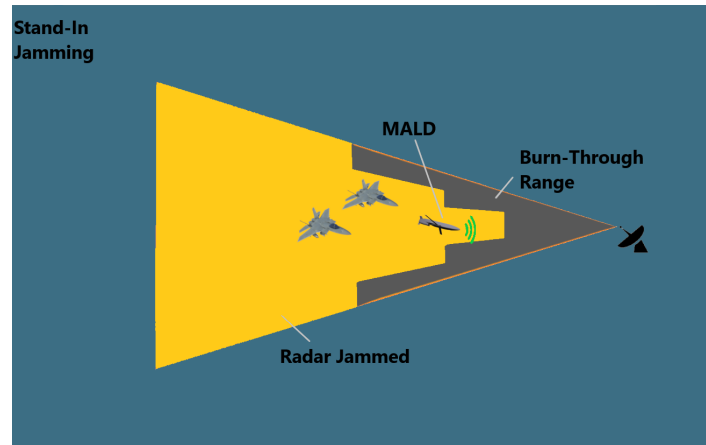
Noise Jamming Concepts

- **Burn-through Range:** Burn-through range is the range where a radar can overcome the effect of jamming. The range is a function of the target's radar cross section, jamming power output, and the threat radar's power output.
- **Jamming Corridors:** The Jamming corridor is a region of airspace drawn along the azimuth of the jamming source and the target that is being jammed. Allies must be within the corridor to enjoy the benefits of noise jamming.
- **Stand-Off Jamming:** Jamming done from behind friendly assets. Most commonly done by EW aircraft



carrying high-powered jamming pods.

- **Stand-In Jamming:** Jamming done in between friendly assets and the threat radar. Most commonly done by MALDs.
- **Home-On-Jam (HOJ):** The ability of some A2A missiles and SAMs to use received jamming energy to guide to the jammer. The missile guidance is degraded due to a lack of ranging information.



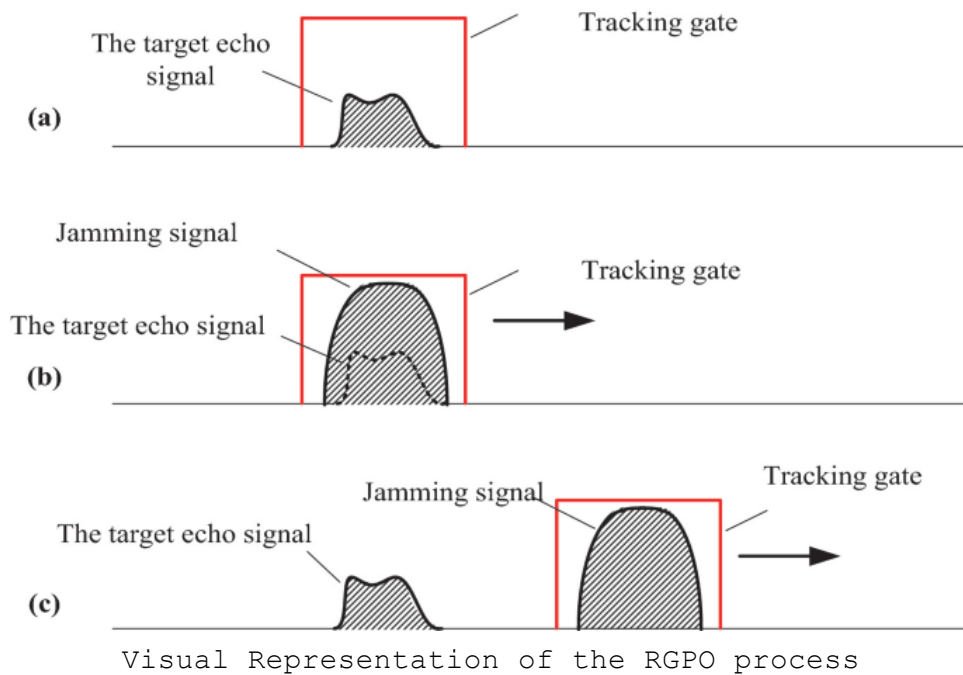
3.2.2 - Deception

Digital Radio Frequency Memory

Digital Radio Frequency Memory (DRFM) is the process of receiving, modifying, and retransmitting threat radar pulses to exploit vulnerabilities. It is done by digitizing a received RF signal, then reconstructing and modifying the signal based on desired effects.

Range Gate Pull Off

Range Gate Pull Off (RGPO) counters an attacking radar that has acquired a single target track (STT). If successful, RGPO can break the STT. RGPO works by exploiting a threat radar's range-gate, which is the span of ranges where it expects the target to be. For example, a target in an STT should move no more than 1500ft between pulses; any returns outside this range gate can be ignored. To exploit this range gate, an emitter begins by copying the attacking radar's signal and sending it out immediately at a higher power; creating a loud but false track within the expected range gate. Because the radar is now tracking the generated false target, the jammer can begin adding a delay to its retransmission; essentially "walking" the false radar track's perceived range away from the defending aircraft's actual position. After a significant amount of delay has been added to the false track, the emitter can cease its retransmission. This causes the threat radar to attempt to reacquire a target within a range gate that no longer contains the defending aircraft.



Signature Augmentation

Signature augmentation is a form of DRFM where the jamming aircraft/decoy modifies a threat radar signal in order to appear as a faux aircraft. This can be achieved by replicating engine micro-doppler returns, radar cross section, or range profile of the desired aircraft. Signature Augmentation is done by the Signature Augmentation Subsystem (SAS) in the EF-24G.

Note: if this is all a little too confusing you can read this [brilliant explanation](#)

3.2.3 - Tactics

Below is a chart with the three primary jamming modes, their advantages, disadvantages, and counters

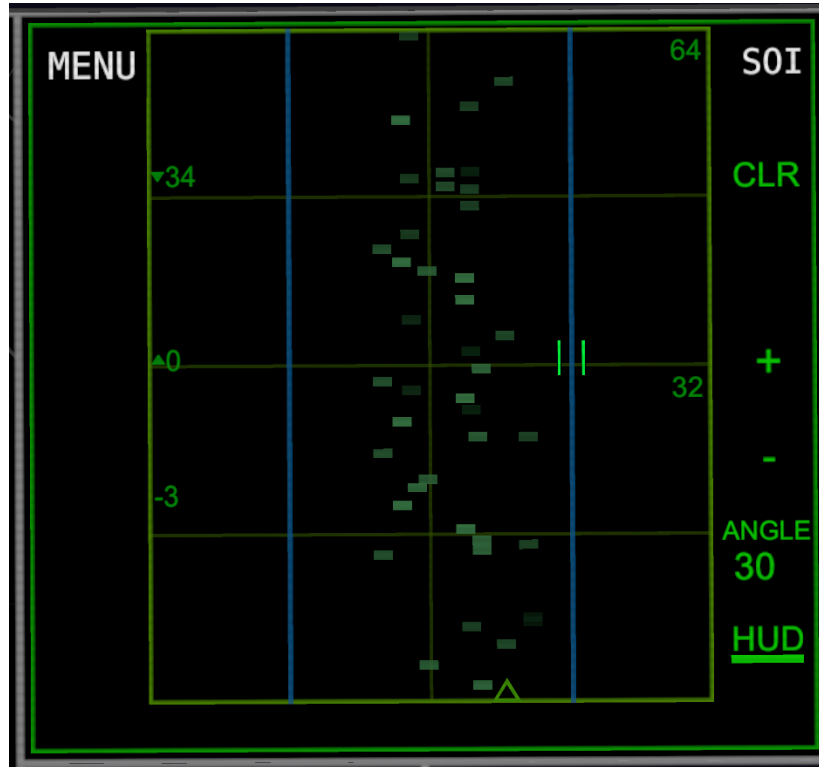
	VTOL VR	Jammer Modes		
		DRFM	NOISE	SAS
Effect on opponent radar	Scan	False contacts at incorrect range and/or bearing.	Reduced effective range on noise bearing, appearance of "bricks". Affects all radars on the selected band(s)	Incorrect target signature (misidentification)
	TWS	" "	Unable (HOJ only)	" "
	STT	No lock on false contacts. Range-gate-pull-off (RGPO) when locked	Unable (HOJ only)	" "
	Support Role	False target "decoys"	Reduced range/hiding other contacts on same bearing. Jam comms in low-band. TODO: Jam GPS	Decoy
	Advantages	Automatic frequency matching. Can create "decoys" without expending anything. Can pull off STT locks.	Wide frequency band -- can jam multiple radars in the same band at once if close together. Prevent or delay radar lock on self or others along same bearing to radar.	Can trick opponent to use improper tactics (mostly a PVP thing). Can't be tracked by HOJ.
	Drawbacks	Only affects specific targeted radar. Within normal detection range, true position is also present among the false contacts. Can still be locked on for some time. Range of lock-on/detection is hardly reduced.	Radar unavailable while jamming. Presence/bearing is given away. Need to manually set frequency band.	True position not hidden. Detection from further away (decoy pulse is stronger than true radar return)
	Counters	Burn-through. Friendly radars to cross examine (unaffected on different frequency) HOJ at close-range (low noise)	Burn-through. HOJ	Burn-through. TGP, Visual identification. Still able to lock and fire

EWAR targets the human behind the radar just as much as the radar itself. If you can sufficiently confuse, delay, or obstruct the operator you've successfully defeated the radar the same as if you totally jammed it. The goal is to make it as confusing as possible for the operator, thus multiple forms of jamming should be used in conjunction. DRFM is much more confusing if the real contact is obscured by noise as well, or if there are MALDs decoy jamming in close proximity to appear as the real contact. A single MALD flying on its own will likely be identified and ignored, multiple within DRFM jamming, even if correctly identified will cause sufficient difficulty to the operator to prevent an operator from acting.

NOTE: A common counter to NOISE jamming is HOJ

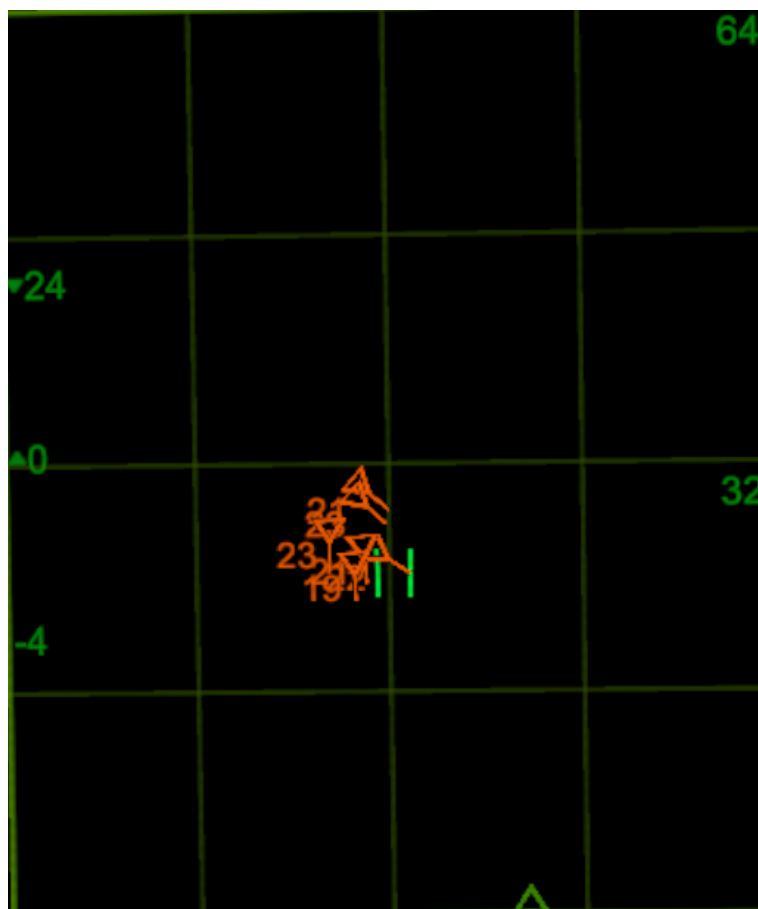
3.3 - Effects of ALQ-245 Jamming Modes

3.3.1 - Noise



- **Air To Air Radar:** Noise jamming on radar will appear as multiple green bricks, affectionately referred to as "poop bricks". Operators are able to select the jamming bricks to initiate a HOJ sequence. True radar contacts will be hidden within the noise, and will not appear until burn-through range.
- **Air To Ground Radar:** Noise jamming on the high band will heavily disrupt the radar ground mapping of the AH-94. The range that the FCR can detect ground units will also be decreased.
- **Terrain Following:** Noise jamming on the high band will disrupt the terrain following radar of cruise missiles, degrading its navigation.
- **Communications:** Low band jamming will jam any radio communications transmitting to the target; leading to comms sounding like static for the recipient. Note that friendly aircraft comms can also be affected by friendly jammers.
- **GPS:** Low band jamming will jam the reception of GPS for both friendlies and combatants. If GPS is jammed, the jammed aircraft, cruise missile, or bomb will fall back on INS for guidance. While not as detrimental for aircraft, GPS jammed munitions have an increased likelihood of missing their intended target due to INS drift.

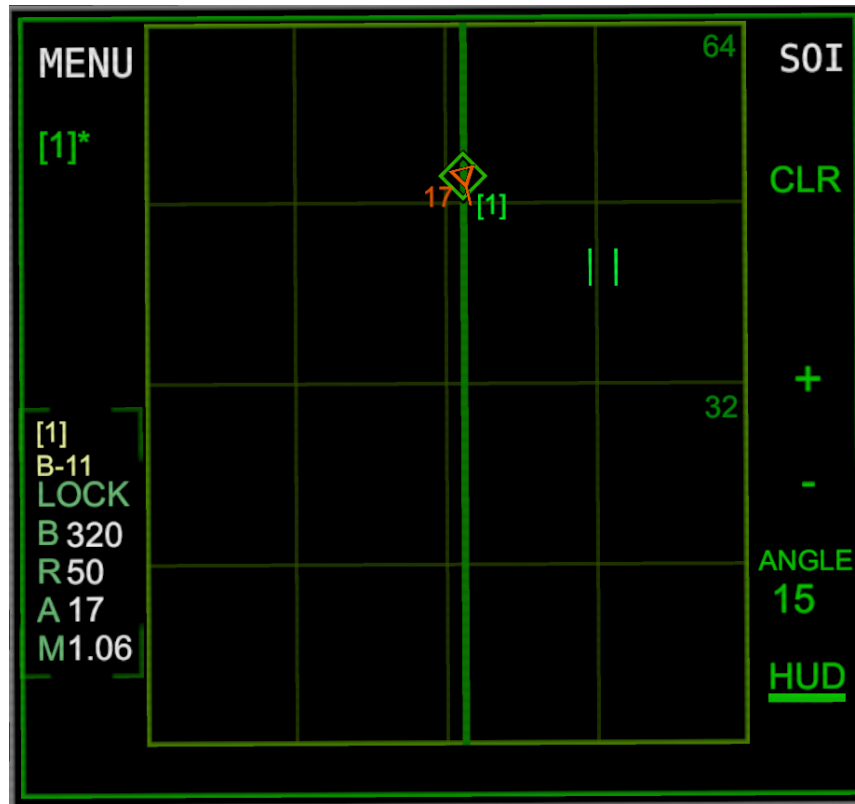
3.3.2 - DRFM



- **Search:** Employing DRFM on a threat radar in search mode will create multiple false contacts surrounding the jamming platform. Having multiple jammers in DRFM on the same threat will further increase the amount of fake contacts. Note: One max-powered transmitter will create 3 false contacts.
- **STT:** Employing DRFM on a threat radar in STT will initiate RGPO. RGPO will attempt to break an STT, and has an effect similar to chaff's effect on threat radars.

NOTE: DRFM only protects the jamming aircraft, and cannot be used to support friendly assets. Additionally, ownship radar use is not inhibited by the use of DRFM jamming

3.3.3 - SAS



An EF-24G SAS jamming as a B-11

SAS will receive, modify, and retransmit incoming radar pulses to disguise itself as any desired aircraft. However, due to SAS outputting a higher amount of power than the incoming pulse, the detection range of the jamming platform will drastically increase. It is advised for operators to manually increase/decrease the power output appropriate for the aircraft being emulated. You don't want to appear 50 miles away while disguising as an F-45!

3.3.4 - Power Management

Increasing the power to a jammer transmitter has different effects depending on the jamming mode.

- Noise: Increases the raw power transmitting from the pod. Creating more noise on the threat radar's scope and decreasing burn-through range.
- DRFM: Creates more fake contacts on the threat radar's scope and increases effectiveness of RGPO

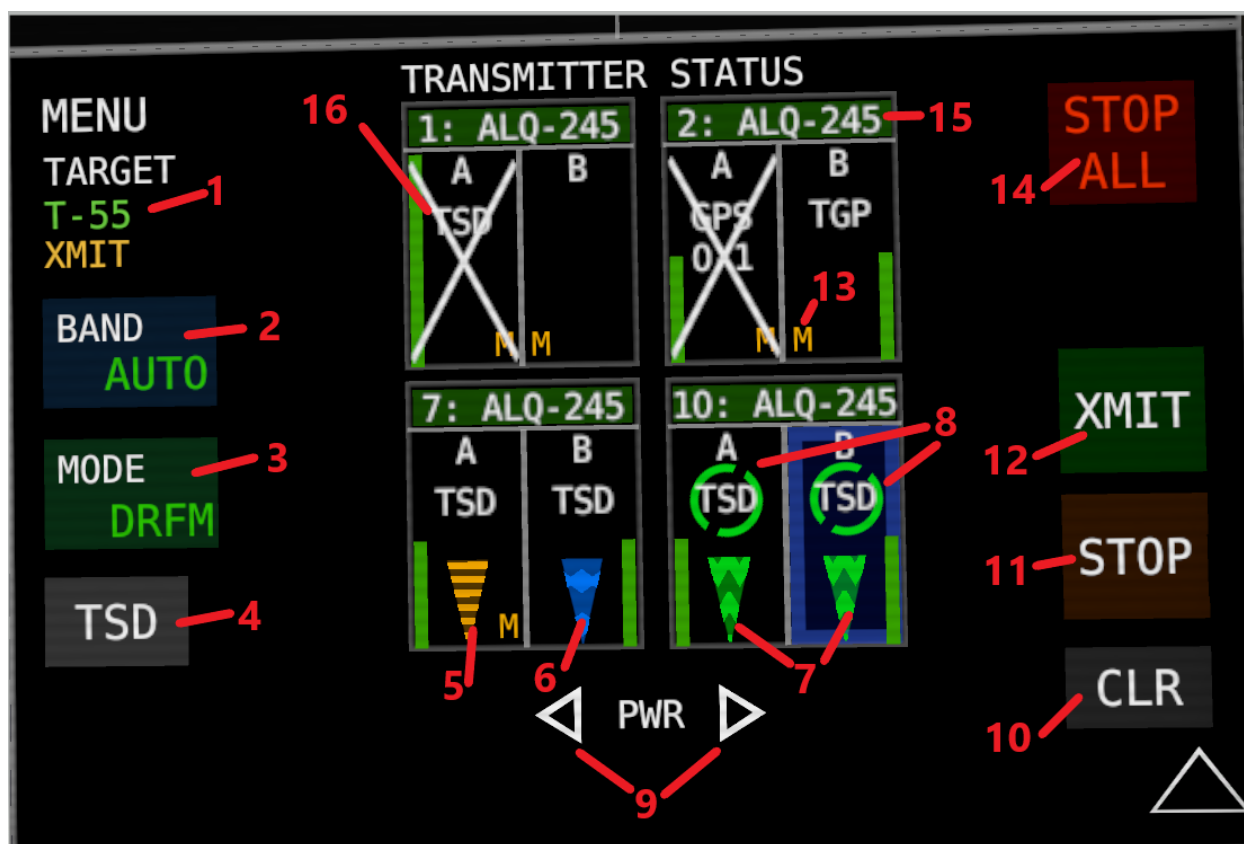
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- SAS: Increases the detection range that the SAS jamming aircraft appears on threat radars. With this in mind, it may be advantageous to lower the SAS power output to appear at more reasonable ranges

NOTE: Ownship radar use is not inhibited by the use of SAS spoofing

3.5 - XMIT Page

SYMBOLOLOGY:



- 1) Transmitter Current Target ID
- 2) Band Selection Button
- 3) Jamming Mode Selection Button
- 4) Target Source Button
- 5) Active Noise Jamming Indicator
- 6) Active SAS Jamming Indicator
- 7) Active DRFM Jamming Indicator
- 8) Active RGPO Indicator
- 9) Transmitter Power Adjust Buttons
- 10) Clear Target Button
- 11) Stop Transmitting Button
- 12) Start Transmitting Button
- 13) Transmitter Band (LO, M, HI)
- 14) Stop All Transmissions Button
- 15) Jammer Battery Bar
- 16) Outside Jammer Bounds Warning

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DESCRIPTION:

The transmitter page is the primary display used to manage and monitor jammer transmitters. It allows operators to view the power ratios, targets, jamming modes, and active jammers at a glance. The page also contains buttons to change the power ratios, jamming modes, and transmissions; allowing the pilot to manage the transmitters without [specialized HOTAS commands](#) that are only available to the EWO.

3.6 - ALQ-245 Employment

3.6.1 - NOISE JAM

1. Select the emitter to be used
2. Select 'noise' mode
3. Select target source: [TGP](#), [TSD](#), [GPS](#), or [FRAZ](#)
4. Select band
 - a. Low: GPS, COMMS, Some early warning radars
 - b. Medium: Fighter radars and SAM radars in search mode
 - c. High: SAM & Fighter radars in STT, missile warning radars
5. Begin emitting

3.6.2 - DRFM SPOOF/RGPO

1. Select the emitter to be used
2. Select 'DRFM' mode
3. Select a radar-emitting target from the [FRAZ](#) or [TSD](#)
4. Begin emitting
 - a. If the target switches to a STT the emitter will automatically attempt [RGPO](#), indicated by a green circle

3.6.3 - SAS SPOOF

1. Select the emitter to be used
2. Select 'SAS' mode
3. Select the intended signature to be spoofed
4. Select a radar-emitting target From the [FRAZ](#) or [TSD](#)
5. Begin emitting

3.7 - ADM-160J Employment

DESCRIPTION:

The ADM-160J Miniature Air Launched Decoy - Jam (MALD) is a small jet powered glide missile intended to act as a false target/decoy. The ADM-160J contains a two way Datalink, giving capability to use the MALD as an external EW sensor, and allowing post-launch commands/updates to be sent. MALD is able to be reprogrammed or retasked mid-flight, allowing it to quickly react to new threats and adapt to the battlefield. MALDs have a loiter time of 8 minutes and a max speed of just above 0.9 Mach

3.7.1 - Launch and Control

Deployment:

1. Ensure Master Arm ON
2. Open the DECOY page
3. Select the decoy you wish to employ
 - a. Already fired MALDs will have a * next to their name
4. Optional: Select MALD mode of operation
5. Optional: Preplan flightpath
6. Press "DEPLOY"
7. Call out "Trojan" To avoid confusion with other launch warnings.

Navigation Control:

1. Open the DECOY page
2. Select the decoy you wish to update
3. GPS Navigation Guidance:
 - a. Create a GPS point, be sure to set altitude correctly
 - b. Optionally: Create a gps PATH, ensure PATH mode on, select the first point in the path
 - c. Press "GPS"
4. NAV Guidance:
 - a. Slew the nav cursors over the point you wish to guide to. Be sure to set altitude correctly. The MALD will go to where the NAV cursors are currently hovering over
 - b. Press "NAV"
5. Press "UPDATE"

NOTE: A MALD can be deployed before setting up a path/navigation point, it will fly straight and level based on the aircrafts current heading and altitude. MALDs in flight can have their path updated at any point.

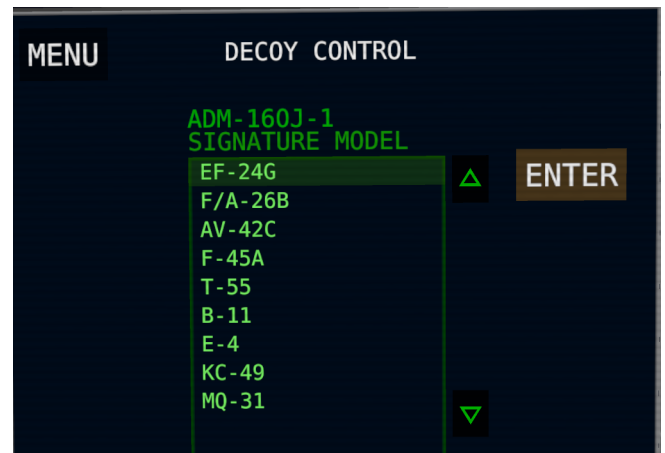
NOTE: If no prior setup is done, the MALD will be launched in "COLD" mode, and will not do any jamming/decoy/spoofing. Read below section for setup, which can be done before or after launch.

3.7.2 - Decoy Mode

Decoy mode is the "classic" MALD mode where the missile will utilize SAS jamming to appear as a different contact type on radars. This allows it to be targeted and engaged rather than you or your flight. Covering the MALD with support jamming can further increase the confusion.

Usage:

1. Select the MALD you wish to update
2. Press "DECOY"
3. Choose the airframe for the MALD to mimic
4. If deployed: Press "UPDATE"

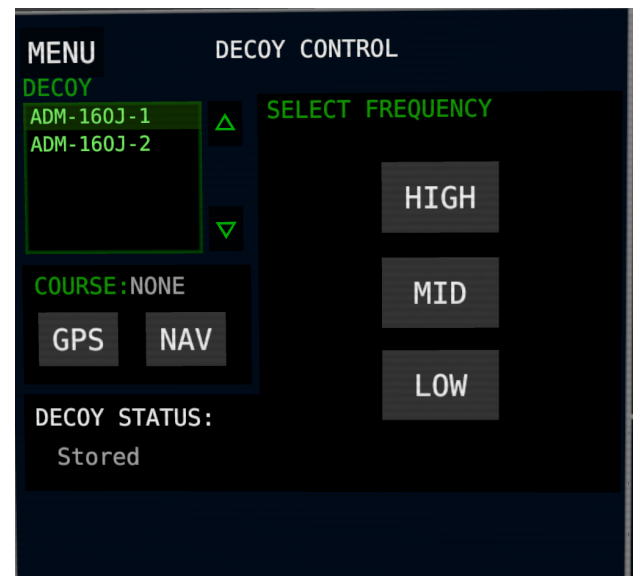


3.7.3 - Noise Mode

Noise mode allows the MALD to transmit typical barrage jamming against up to two targets. The primary advantage of this as opposed to jamming targets yourself is the risk of HOJ is no longer present.

Usage:

1. Select the MALD you wish to update
2. Press "NOISE"
3. Select the correct frequency band for your target
4. Choose a targeting mode:
 - a. AUTO - MALD selects based off RWR pings
 - b. TSD - Targets active TSD selection
 - c. GPS - Targets current GPS point
 - d. TGP - Targets what you have locked with TGP



4.0 - WEAPON EMPLOYMENT

4.0.1 - WEAPONS ARMING

Before any weapons can be fired, they must be armed. This feature is nothing new, however the EF-24G allows three main ARM modes.

1. **A2A Master Mode** - With the WPN/EW Select Knob in the WPN position, pressing "ARM" then "AA" will arm all A2A weapons on the aircraft
2. **A2G Master Mode** - With WPN/EW Select Knob in the WPN position, pressing "ARM" then "AG" will arm all A2G weapons on the aircraft.
3. **EW Master Mode** - With WPN/EW Select Knob in the EW position, you will have control of onboard jammers and jamming selection. Master ARM is not required to use the jammers. Deployment of MALDs requires ARM.

Multicrew ARM usage: The Master ARM system has 3 states: "SAFE" "IN-CONTROL ARMED" "OTHER-SEAT ARM"

1. **SAFE** - Weapons will not fire. Some HUD symbology is hidden.



2. **IN-CONTROL ARMED** - The aircraft is ARMed and you are able to fire weapons.



3. **OTHER-SEAT ARM** - The aircraft is ARMed, but the other person has weapon control, they can fire weapons. (MALDs can be deployed by either seat when ARMed)



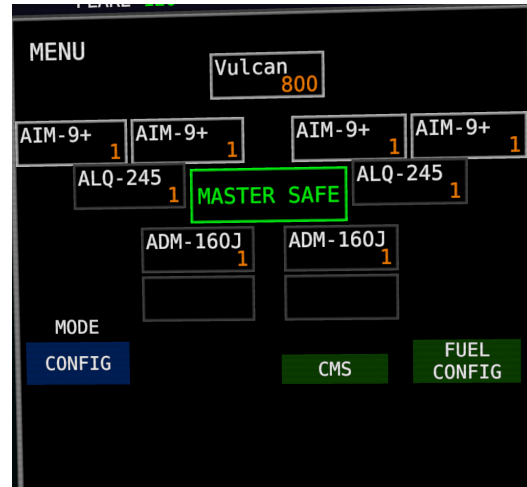
NOTE: In both to A2A and A2G WPN modes, the GUN is available, however in A2A the symbology will be in the form of a Gun Funnel (Or GDS sight if data is aval.), and in A2G it will be a CCIP sight (with moving-target prediction when data available)

4.0.2 - SMS ATMFC D PAGE

The EF-24G's SMS ATMFC D page shows all hardpoints and the weapons currently stored on it. Additionally it indicates the ARM state of the aircraft, and of each individual weapon. Additionally there are subpages for CMS setup, and FUEL setup.

Within the page you may take 3 primary actions:

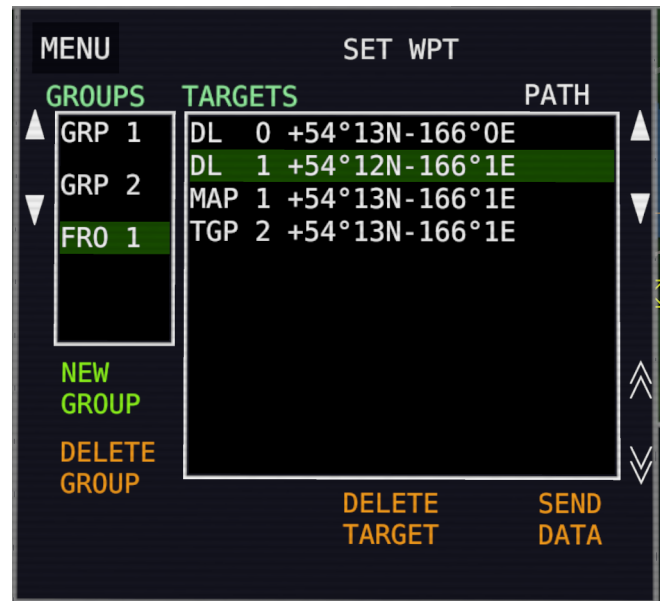
1. **CONFIG** - Change weapon settings, such as targeting mode, ripple, or fire modes.
2. **ARMING** - Toggle weapon ARM state
3. **JETTISON** - Mark a weapon for selective jettison



4.0.3 - GPS ATMFC D PAGE

The GPS ATMFC D page allows for centralized upload, download, management, and designation of GPS Coordinates. There are three types of GPS groups:

1. **Mission Groups** - Sent by the mission, designated **MSN**.
2. **Standard Groups** - Initially created when you create your first GPS point, or anytime the NEW GROUP button is pressed, designated **GRP**
3. **Datalink Groups** - Sent via Datalink, group designation is first three letters of the pilot name, ie **CHASE** -> **CHA1**



GPS Points can be created the following ways:

1. **TGP** - Point the TGP and press TGP-S, shown as **TGP** in list
2. **NAV** - Slew NAV cursors over a point, and press GPS-S, shown as **NAV** in list
3. **DL** - Created anytime someone sends a GPS point (no matter what sensor they used), shown as **DL** in list

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4. TSD - Hover cursors over a track, and press GPS-S. Low or fast moving tracks cannot have a GPS point created, shown as **TSD**. This means you can create a GPS point from the following sensors as well:
 - a. Any Datalinked contact
 - b. PPRS (Passive Proximity Radar System)
 - c. RWR Triangulation (Assuming high enough confidence)
 - d. TGP (Even after moving the TGP off to another contact)

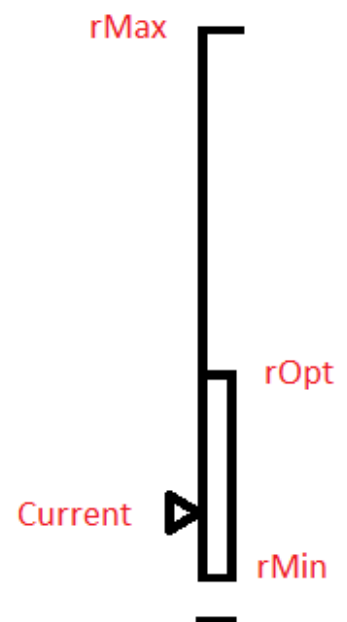
The GPS page is split into two segments: the group list on the left and the coordinate list on the right. The group list can be navigated with the arrow buttons on the left, and the coordinate list with the ones on the right. Group prefixes indicate their source (see list above). New groups can be created and deleted with the NEW GROUP and DELETE GROUP buttons. Selected coordinates can be set as a waypoint with the WPT button, and a group can be made into a path for cruise missiles with the PATH button. Currently selected coordinates are displayed on the NAV and HUD as a large triangle. Coordinates in a group are displayed on the NAV as small triangles. When using GPS bombs, the bombs will guide to the currently selected coordinates. If set to AUTO mode, the selected coordinates will automatically cycle down in the list after release of a bomb.

4.0.4 - DYNAMIC LAUNCH ZONE (DLZ) INDICATOR

The Dynamic Launch Zone (DLZ) indicator is used in the employment of all missiles, air to air or air to ground (save for the AGM-89 and -161), to show the effective launch limits of the weapon. The DLZ resembles an elongated six (6), and it appears directly left of the altitude tape when a suitable missile and target has been selected, and will also show in the HMD.

There are 4 key symbols on the DLZ:

1. **rMax** - Indication of the maximum range of your weapon, assuming your target will not deviate from their current course
2. **rOpt** - Optimal launch range at which even if the target maneuvers and runs cold the weapon will still hit
3. **rMin** - Minimum effective range of the weapon, below this range it will be unable to maneuver to intercept the target



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4. **Current** - This is the range to the target, its position within the DLZ shows you the weapons ability given the current parameters.

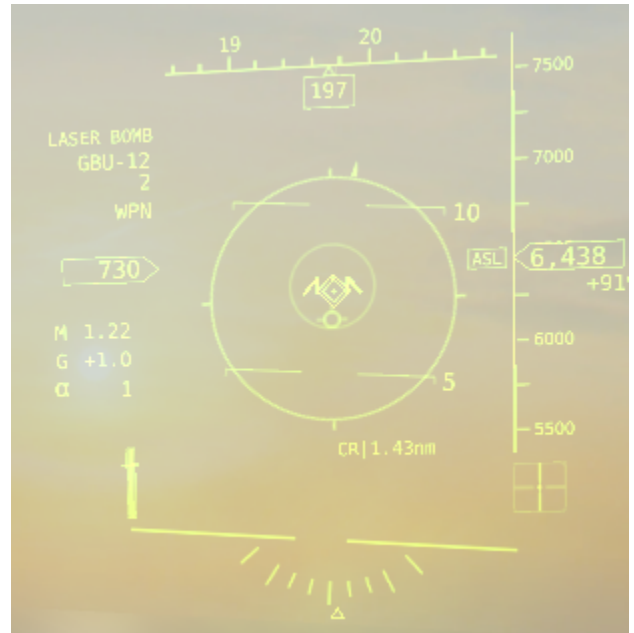
NOTE: The DLZ is a great tool, however a pilots own intuition and knowledge of both their weapons system, and opponent is frequently far superior to the data displayed by the DLZ. Pilots who experiment with their weapons will find kills can be obtained at far beyond indicated ranges.

The exception being AIM-120D and AIM-54C, which use an IDLZ (Improved Dynamic Launch Zone) that provides a more accurate display of the weapons capabilities.

4.1 - GBU-12 LASER-GUIDED BOMB

BASIC OPERATION:

1. Check Master Arm ON
2. Check in A2G Master Mode
3. Acquire a TGP target, either
 - a. Use the TSD, slew over a target and press "TGP"
 - b. Manually slew the TGP over a target
4. Align bomb diamond inside firing reticle (best shot inner circle)
5. Call out "Paveway"
6. Ensure unobstructed LOS to the target throughout the flight of the bomb
 - a. Small corrections can be made



EMPLOYMENT STRATEGIES:

The GBU-12 offers two primary advantages over GPS bombs. The first is the ability to hit moving targets, and to adjust/correct their flight path post-launch. The second advantage is the immunity to Jamming. Advances in Jamming technology means fighters will have to operate in an environment in which GPS may be degraded or outright denied. GPS munitions may find themselves ineffective, whereas a GBU-12 will always hit its mark.

OPTIONS:

1. TARGET MODE
 - a. LASER - Normal laser-tracking mode
 - b. DUMB - Disables laser tracking, CCIP Dumb Drop Mode

4.2 - GPS-GUIDED BOMBS

AVAILABLE GPS GUIDED BOMBS/GLIDE BOMBS WITH THE EF-24G:

1. GBU-38 500lb Bomb
2. GBU-39 250lb Glide Bomb

BASIC OPERATION:

1. Check Master Arm ON
2. Check in A2G Master Mode
3. Acquire a GPS target through one of the methods listed in section [4.0.3 - GPS ATMFC D PAGE](#)
4. Ensure correct GPS point is selected in the GPS page
5. Align bomb diamond inside firing reticle (Best shot inner circle)
6. Press trigger to release
7. Call out "Pickle"



EMPLOYMENT STRATEGIES:

GPS-Guided bombs are best suited for precision strike roles. With the GBU-38 acting as a great bunker-buster, and the GBU-39 being able to take out long-distance targets with ease. With the downsides that only stationary targets can be hit and GPS accuracy can easily be degraded by low band jamming. If the "GPS LOST" warning is present, use caution. Consider an alternative weapon strategy or destroy the Jammer. To improve range "LOFT" before the drop point by pulling up to approximately 30 degrees, this will allow the bombs to travel for much farther

OPTIONS:

1. TARGET MODE - Targeting options
 - a. MANUAL - Default mode, GPS guided targeting the currently selected GPS point
 - b. AUTO - GPS guided, however after the bomb drops will automatically cycle to the next GPS point in the group. Recommended for striking multiple targets in one pass
 - c. DUMB - Disables GPS guidance, CCIP Dumb Drop Mode
2. AUTO REL RATE - Rate at which bombs should be dropped continuously while the trigger is held. Rate is in units per minute.
 - a. 120 b. 240 c. 480

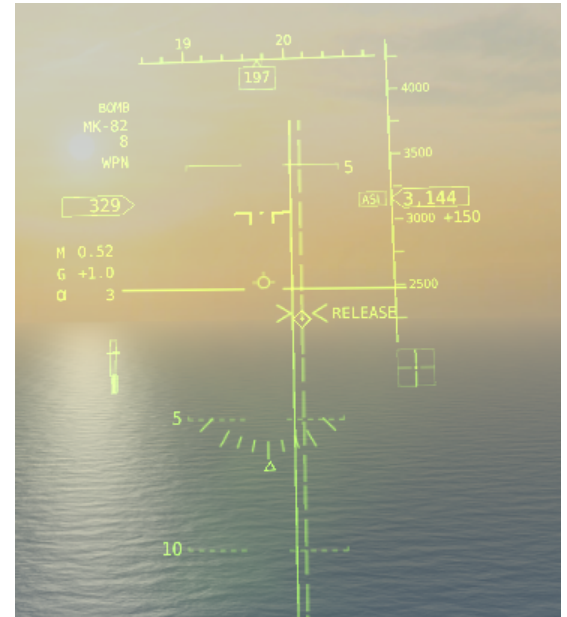
4.3 - UNGUIDED BOMBS

AVAILABLE UNGUIDED BOMBS/HIGH-DRAG BOMBS WITH THE EF-24G:

1. Mk.82 500lb bomb
2. Mk.82AIR 500lb High-Drag bomb
3. Mk.83 1000lb bomb

BASIC OPERATION:

1. Check Master Arm ON
2. Check in A2G Master Mode
3. For CCRP Release Mode:
 - a. Acquire a TGP target, either by slewing the TGP over target, or "TGP" button in the TSD
 - b. Ensure CCRP AUTO selected in OPTIONS & configured as needed
 - c. Align aircraft with the Azimuth Steering Line
 - d. Hold down trigger until the bomb is automatically released
4. For CCIP Release Mode:
 - a. Visually acquire target (TGP can be used for more accurate CCIP calculation)
 - b. Climb to 5000ft above target
 - c. Dive towards target
 - d. Press trigger to release when bomb piper is over target
5. Call out "Pickle"



OPTIONS:

1. CCRP AUTO - Enables if holding the trigger will auto-drop the bomb once over release point
 - a. ON
 - b. OFF
2. RELEASE AREA - distance around a target in which rippled bombs will be dropped
3. SALVO - Number of bombs released per drop. Options are 1 to the number of bomb hardpoints you have.
4. RIPPLE - Rate at which bombs should be dropped continuously while the trigger is held. Rate is in units per minute.
 - a. 120 b. 240 c. 480

4.4 - ANTI-RADIATION MISSILES

AVAILABLE ANTI-RADIATION MISSILES WITH THE EF-24G:

1. AGM-126 SideARM II
2. AGM-88 High-speed Anti-Radiation Missile (HARM)
3. AGM-88S Advanced Anti-Radiation Guided Missile (AARGM)
4. AGM-188 Medium (Range) Anti-Radiation Missile (MARM)

BASIC OPERATION:

1. Check Master Arm ON
2. Check in A2G Master Mode
3. Select a target on the [TSD](#)
 - a. The target must be an emitter, designated with a small radar-on icon on the TSD
4. Ensure ARM seeker slaves to target
5. Confirm target is within range (See 3.0.4)
6. Press trigger to launch
7. Call out "Magnum"

EMPLOYMENT STRATEGIES:

It is suggested that in all air-to-ground missions where there is a reasonable chance of radar-guided anti-air presence, that one or more Anti-Radiation missiles be equipped in at least one aircraft participating in the flight. Anti-Radiation missiles are the primary Suppression of Enemy Air Defenses (SEAD) weapons, and are designed solely for that purpose. Enemy radars that notice a ARM in the air may turn their radar off, and enable a RADAR DECOY, this gives you the opportunity to hit the target with a differently guided weapon (DEAD).

"I heard the 26 guys are giving free drinks to us dudes on SEAD duty" - Anonymous pilot at servicemen's club

"YGBSM" - Every EWO ever

4.5 - AGM-161 JOINT ANTI-SURFACE STANDOFF MISSILE (JASSM)

BASIC OPERATION:

1. Check Master Arm ON
2. Check in A2G Master Mode
3. Acquire a GPS target through one of the methods listed in section [4.0.3 - GPS ATMFC D PAGE](#)
 - a. Optionally setup a PATH of multiple GPS points
 - b. Ensure PATH mode is enabled, and first point in the path is selected
4. Align target within targeting circle
5. Call out "Greyhound"

EMPLOYMENT STRATEGIES:

The AGM-161 excels at destroying static targets at long-range. It is not recommended to engage targets at close range as it has reduced maneuverability, and it is not recommended to engage moving targets as while there is an optical seeker, its limited FOV and long flight times make it only useful for minor corrections. However, AGM-161 is a capable weapon of choice for destroying SAM systems at range (as long as they are not defended), or striking static targets such as bunkers from great range.

NOTES:

The AGM-161 uses an onboard Terrain Following Radar (TFR) to prevent collisions with the ground, however, as this is a radar it is susceptible to Jamming. If there is such a worry, manually program a higher-altitude path.

4.6 - AGM-89 ANTI-SHIP CRUISE MISSILE

BASIC OPERATION:

6. Check Master Arm ON
7. Check in A2G Master Mode
8. Acquire a GPS target through one of the methods listed in section [4.0.3 - GPS ATMFCD PAGE](#)
 - a. Optionally setup a PATH of multiple GPS points
 - b. Ensure PATH mode is enabled, and first point in the path is selected
 - c. DO NOT LEAD YOUR TARGET. The AGM-89 will resolve lead on its own
9. Align target within targeting circle
10. Press trigger to launch
11. Call out "Bruiser"

EMPLOYMENT STRATEGIES:

The AGM-89 is the premier choice for striking naval targets due to its impressive stand off range, active terminal modes, and devastating warhead. The on board radar will automatically enable when approaching the final waypoint in their path, and identify any ships in the vicinity. Additionally the AGM-89s onboard guidance computer will attempt to resolve the intended target, using the radar's data and estimated target position at time of launch.

OPTIONS:

1. TERMINAL MODE
 - a. SEA SKIM - In terminal phase, fly extremely low to hit at the waterline
 - b. SSEVASIVE - Sea Skim Evasive - In terminal phase fly extremely low, additionally use onboard RWR and guidance logic to fly an approach that attempts to dodge CWIS and anti-missile missiles
 - c. DIRECT - Directly fly to the target, with no additional guidance
 - d. POPUP - Fly an SSEVASIVE path until near-to the target, in which it will pop up and dive to hit the target superstructure

4.7 - ACTIVE RADAR GUIDED MISSILES

AVAILABLE ACTIVE RADAR GUIDED MISSILES WITH THE EF-24G:

1. AIM-120D AMRAAM
2. AIM-54C LRAAM

4.7.1 - ARM Guidance Mechanics

[Section 5.2.1](#) contains a detailed explanation of ARM capabilities, but in regards to launching ARMs there are three primary guidance modes:

1. **Supported Launch** - Typical lock-launch mode with midcourse guidance
 - a. Supported is the optimal mode whenever possible
 - b. While in flight missile will be given updated target positions
 - c. At a predetermined distance enables own radar and attempts to search for target around predicted point
 - d. If lock is lost, missile still flies to predicted point
2. **MADDOG** - Visual-fire mode, risky and with low pK
 - a. Flies in a straight line from launch point
 - b. Searches a 30 deg area for any targets
 - c. Due to straight-line path has lower energy/range
3. **Home On Jam** - Acquire and follow jamming energy to counter noise jamming
 - a. Follows jamming energy along the beam
 - b. Due to straight-line path has lower energy/range
 - c. If jamming energy is lost switches to maddog-type operation

4.7.2 - AIM-120D ADVANCED MEDIUM RANGE AIR-TO-AIR MISSILE (AMRAAM)

BASIC OPERATION:

1. Switch Master Arm On
2. Check A2A master mode
3. Select AIM-120
4. Select [TSD](#) on [ATMECD](#)
5. Acquire a target with either:
 - a. TSD - Select a TSD Track
 - b. [RADAR](#) - Select a track as PDT or STT
6. Confirm intended track has * beneath it on the HUD



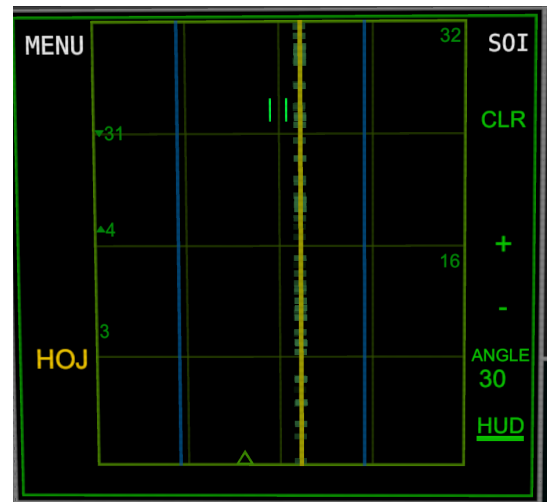
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7. Align the steering cue dot in the Targeting Circle
8. Press trigger to launch.
9. Call out "Fox Three"

HOJ Employment:

1. Switch Master Arm On
2. Check A2A master mode
3. Select AIM-120
4. Open the RADAR and locate Noise Jamming
5. Select the Jamming on the bearing you wish to fire upon
6. Wait for the bearing to stabilize (visually confirm in the HUD)
7. Press trigger to launch
8. Call out "Fox Three"

NOTE: Weapons launched in HOJ do not contain ranging information, rather they act like a "beam rider" flying a direct path, this gives them far less range than a typical launch mode



EMPLOYMENT STRATEGIES:

AIM-120D excels in long range beyond visual range (BVR) engagements. In conjunction with AEGIS, PATRIOT, or E4 systems relaying accurate positional data, AMRAAM-D can be employed effectively at ranges exceeding 45NM. In situations when external radar sources are not present, AMRAAM is well suited to work in conjunction with APG-92 or even TGP tracks. AMRAAM's 39lb warhead is more than capable of critically damaging even the most resistant enemy aircraft. In electronically denied environments the missile can independently home on the emissions of a jammer.

OPTIONS:

1. MADD OG - Enables visual-launch mode
 - a. Enabled
 - b. Disabled

4.7.3 - AIM-54C LONG RANGE AIR-TO-AIR MISSILE (LRAAM)

BASIC OPERATION:

1. Switch Master Arm On
2. Check A2A master mode
3. Select AIM-54
4. Select [RADAR](#) on [ATMFCD](#)
5. Select a track as PDT or STT
6. Align the steering cue dot in the Targeting Circle
7. Press trigger to launch.
8. Call out "Fox Three" To avoid confusion with other launch warnings.

EMPLOYMENT STRATEGIES:

AIM-54C excels in long range beyond visual range (BVR) engagements. Unlike the AMRAAM the LRAAM cannot guide off datalink but it makes up for this disadvantage with its extended burn phase and optimized flight profile. Additionally the missile features a large warhead increasing it's lethality particularly in the case of a near miss/proximity fuse activation. In electronically denied environments the missile can independently home on the emissions of a jammer.

NOTE: While the missile is officially called LRAAM, those who employ it fondly refer to it by its predecessors name: Phoenix

NOTE: The AIM-54 requires a continuous radar track to maintain guidance, as opposed to the AIM-120D which guides off the TSD-DL tracks.

OPTIONS:

1. MADDOG - Enables visual-launch mode
 - a. Enabled
 - b. Disabled

4.9 - AIM-7 SEMI-ACTIVE MEDIUM RANGE AIR-TO-AIR MISSILE

BASIC OPERATION:

1. Switch Master Arm On
2. Check A2A master mode
3. Select AIM-7
4. Select [RADAR](#) on [ATMFCD](#)
5. Select acquire a STT on a target
 - a. TSD-AUTOLOCK Mode may be used as an alternative
6. Align the steering cue dot in the Targeting Circle
7. Press trigger to launch.
8. Call out "Fox One" To avoid confusion with other launch warnings.

The AIM-7 supports [HOJ](#) functionality

EMPLOYMENT STRATEGIES:

The AIM-7 was one of the first missiles with true BVR capabilities, unlocking a new era of aerial combat. The AIM-7 equipped on the EF-24G is an improved model, with a more capable motor and a lost-lock-recovery capability. Due to the need to maintain an STT all the way into impact, the recommended strategy for BVR is to launch higher and faster than your opponent so that your missile arrives first. Luckily, the EF-24G is the fastest and highest-flying fighter on the battlefield.

NOTE: The target must remain in an STT throughout the flight of an AIM-7. Should you lose the lock, attempt to relock the target immediately and the missile may still guide; however, should the target be lost for several seconds, it is unlikely it will hit.

4.10 - AIM-9X BLOCK III IR-GUIDED AIR-TO-AIR MISSILE

BASIC OPERATION:

1. Check Master Arm ON
2. Check A2A master mode
3. Select AIM-9+
4. Uncage seeker (automatically uncages by default)
5. Align targeting reticle with enemy aircraft
6. Wait for high-pitched tone
7. Fire weapons (trigger by default)
8. Call out "*Fox Two*"

EMPLOYMENT STRATEGIES:

IR-Guided missiles are best-suited for engagements of less than 4NM due to them not being able to detect heat signatures from medium-long ranges. Fired IR missiles have a reliable hit-rate (provided the target does not correctly employ IRCM), but it is not guaranteed that one hit will damage a vital component. As such, it is recommended to bring multiple IR-Guided missiles on a mission. IR missiles are to be used either as a last resort or a self-defense weapon. If you know there will be enemy aircraft where you're headed, pack AIM-120's or AIM-54s.

OPTIONS:

1. SEEK MODE - IR seek mode before uncaged
 - a. Uncaged - Seeker will follow any IR sig it sees, or slaves to RADAR
 - b. Vertical - Follows a vertical search pattern
 - c. Head Track - Slaved to the head
 - d. Caged - Fixed-forward
2. TRIG UNCAGE - Controls if holding the trigger will make the seeker start following the IR sig it can currently see
 - a. OFF
 - b. ON

4.11 - AIRS-T IR-GUIDED AIR-TO-AIR MISSILE

BASIC OPERATION:

9. Check Master Arm ON
10. Check A2A master mode
11. Select AIRS-T
12. Uncage seeker (automatically uncages by default)
13. Align targeting reticle with enemy aircraft
14. Wait for high-pitched tone
15. Fire weapons (trigger by default)
16. Call out "*Fox Two*"

EMPLOYMENT STRATEGIES:

IR-Guided missiles are best-suited for engagements of less than 4NM due to them not being able to detect heat signatures from medium-long ranges. Fired IR missiles have a reliable hit-rate (provided the target does not correctly employ IRCM), but it is not guaranteed that one hit will damage a vital component. As such, it is recommended to bring multiple IR-Guided missiles on a mission. IR missiles are to be used either as a last resort or a self-defense weapon. If you know there will be enemy aircraft where you're headed, pack AIM-120's or AIM-54s.

OPTIONS:

3. SEEK MODE - IR seek mode before uncaged
 - a. Uncaged - Seeker will follow any IR sig it sees, or slaves to RADAR
 - b. Vertical - Follows a vertical search pattern
 - c. Head Track - Slaved to the head
 - d. Caged - Fixed-forward
4. TRIG UNCAGE - Controls if holding the trigger will make the seeker start following the IR sig it can currently see
 - a. OFF
 - b. ON

4.12 - AIM-9E IR-GUIDED AIR-TO-AIR MISSILE

BASIC OPERATION:

1. Check Master Arm ON
2. Check A2A master mode
3. Select AIM-9E
4. Move to targets rear aspect
5. Align targeting reticle with enemy aircraft
6. Wait for high-pitched tone
7. Hold down trigger to uncage the seeker
8. Pull lead on the target
9. Press the WPN SWITCH button to fire
10. Call out "*Fox Two*"

EMPLOYMENT STRATEGIES:

AIM-9Es are best-suited for engagements of less than 2NM due to their older nature. Additionally, they lack the sensitivity to fire on targets head-on and must be employed from rear-aspect. Making them the worst choice of any A2A missile. Avoid using them unless they are the only option.

4.13 - M61A1 VULCAN 20MM ROTARY CANNON

BASIC OPERATION:

1. Check Master Arm ON
2. Select GUN
3. Select master mode depending on target, either A2A or A2G
4. When possible, acquire a lock on the target via one of:
 - a. Selecting target on [TSD](#)
 - b. Getting a [RADAR](#) STT
 - c. Slaving TGP to the target
5. Align GUN Pipper with the target
 - a. If A2A and no lock is available, place the targets wings touching the two edges of the gun funnel
6. Pull the trigger for ONE SECOND
7. Call out "*Guns Guns Guns*"

EMPLOYMENT STRATEGIES:

The Vulcan's extremely fast fire rate allows it to damage targets quickly and effectively. Against air targets it is recommended to enter the control zone. Against ground targets a stable dive at 20 Degrees or greater is recommended for maximum accuracy.

5.1 - MISSILE EVASION

Guided Missile

Noun

: a missile whose course may be altered during flight (as by a target-seeking radar device)

Ever since the first AIM-9 downed a Chinese Communist aircraft in 1958 aerial combat has revolved around the missile. Missiles come in many shapes and sizes, from heavy optically guided bunker busters, to advanced cruise missiles capable of traveling hundreds of miles. But the missiles we care about: The surface to air and air to air threats the adversary will throw at us. The role of a SEAD aircraft is by nature to get shot at, we kill things designed to kill aircraft, with aircraft. In order to execute this task successfully, you need to understand how these missiles work, and what flaws you can exploit to your success.

5.2 - RADAR-GUIDED MISSILE EVASION

OVERVIEW

In a modern combat theater, radar-guided missiles pose the most serious threat to EF-24G pilots. EF-24G units also find themselves more susceptible to radar-guided threats than other USN air combat units due to the task of destroying Surface to Air Missile sites. There is no singular tactic that will protect the airframe, however, this section aims to give you the tactics required to survive.

This section will be broken up into two parts: First, we will discuss the principles of radar-guided missiles and their relationship to other weapons systems and aircraft. Second, we will explore strategies that can be deployed to defeat radar-guided missiles in various scenarios.

5.2.1 - RADAR GUIDED MISSILE MECHANICS

A radar guided missile is, as its name would imply, a missile that works by using some form of active radar to locate, track, and kill its target. Radars provide extremely high precision updates on target location at greater range than IR counterparts, and as such radar guided missiles tend to be longer range than IR missiles. Additionally the data provided by a radar allows these missiles to lead and loft their targets, greatly increasing their pK.

Radar guided missiles are categorized in two ways: Guidance (Semi-active vs Active) and by launch platform (Ground vs Airborne)

5.2.2 - SEMI-ACTIVE RADAR HOMING MISSILES

Semi-active radar homing missiles are missiles that do not contain their own onboard radar, rather, they entirely rely on the launch platform radar to guide them. These missiles contain an onboard *radar receiver* so that they can receive the reflected radar energy off your aircraft. It is easy to tell when one of these missiles is launched at you as your [RWR](#) will first display a lock (solid circle around a contact), then the contact will switch to red and a distinct warning will play. Semi-active missiles tend to be worse than active missiles as if you defeat the lock from the launching platform the missile will fall dumb.

NOTE: Some SARH systems (notably air-launched ones) support reacquiring if a lost lock is recovered quick enough.

NOTE: SARH Missiles are capable of [HOJ](#) and may not give any indication before impact

5.2.3 - ACTIVE RADAR HOMING MISSILES

Active radar homing missiles contain their own onboard radars. These radars have two stages of flight: First, Midcourse guidance, where the launch platform will provide updates to the missile. Most (but not all!) ARH systems will acquire a lock on you while guiding the missile midcourse. The second stage, Terminal, is when the missile switches to its onboard radar to actively seek you. Once the missile has located you, the connection with its launching platform is severed and it will independently guide to hit you (should you not heed the advice in this document). This phase is easily identifiable as the missile will appear on your [RWR](#) as a red "M" with a circle around it, and a distinct audio alert. ARH missiles tend to be much more deadly as even if you defeat the launch platforms radar, the missiles onboard radar may still locate you.

NOTE: ARH Missiles are capable of [HOJ](#) and may not give any indication before impact

5.2.4 - Ground VS Air Launched Radar Missiles

Very generally, air-launched missiles are more deadly. This is because a missile launched from the air inherits the velocity of the launch platform, allowing it to travel faster. Additionally air-launched missiles have an altitude advantage, giving it thinner air and thus less drag. ALL ground based radar missile launchers, and most air (AI require STT, players may launch-in-TWS) require a STT in order to fire and guide a radar missile.

5.2.5 - ENERGY

The quote "Speed is life, altitude is life insurance" really means energy is everything. Speed and altitude are two measures of energy, and if you understand what dictates energy you can survive any missile. In your aircraft energy comes continuously in the form of thrust produced by your engines, however this thrust is relatively low. Missiles on the other hand produce most of their thrust early on, getting an exceptionally high amount of energy, but all at once. This means very quickly a missile will have all the energy it ever will have, whereas we will continuously keep producing energy. A

constant speed turn for your aircraft will result in a continuous loss of energy for the missile, which we can use to great effect.

All this can be broken down into the following statement: Aircraft have high Delta-V (potential change in velocity) but low impulse (thrust), whereas missiles have low Delta-V but high impulse. Many strategies for defeating radar-guided missiles rely heavily on the exploitation of this relationship.

TACTICS

5.2.6 - TACTIC: CHAFF

Chaff is a countermeasure consisting of thousands of thin metal fibers deployed by a defending pilot in order to disrupt a missile. The EF-24G attempts to use chaff in a manner that should confuse a radar into thinking the chaff is the target, rather than the aircraft. In order to do this you must be in a beam, otherwise the doppler effect will ruin the illusion and the radar will filter out the chaff.

Optimal strategy to employ chaff:

1. Identify the radar you intend to defeat on the [RWR](#) (missile, or other locked radar)
2. Enter a 90 degree BEAM, putting the radar either 3 or 9 o'clock
3. Deploy chaff
4. While deploying chaff, maneuver in a slow "wiggling" pattern that moves the target radar +/- 5 deg of the 90 deg beam
5. Even if deploying chaff doesn't break lock, it can greatly reduce the missile's accuracy in the terminal phase.

5.2.7 - TACTIC: TERRAIN MASKING

Terrain masking is a very straight forward tactic, it simply is the practice of putting some object, typically terrain, in between the aircraft and the radar. Radar is unable to penetrate most objects, so without a direct line-of-sight the lock will be broken, and most of the time the missile trashed. ARMs may still attempt to acquire, so after terrain masking make a significant change to your direction in order to avoid a reacquire.

Optimal strategy to terrain mask:

1. Identify the radar you intend to defeat visually using the [HMD](#)
2. Maneuver in such a way that terrain or obstacles break radar source's line-of-sight. If flying over mountainous terrain, roll inverted and pull rather than pushing down.
3. After [RWR](#) has fallen silent, make a hard direction change to avoid reacquires
4. BE CAREFUL! Flying in close proximity to terrain is dangerous, pilots transitioning from the F/A-26B may be caught off guard by the lower-G limit of the EF-24G

"There's a concerning inverse correlation between max-g and CFIT rates, don't they listen to the master caution?" - Anonymous Data Analyst

5.2.8 - TACTIC: CRANKING

Cranking is the tactic of putting a target at the edges of your radar's gimbal limits (60 degrees). It is a vital step of the BVR timeline, done directly after you fire a missile at a target in order force their missiles to travel a farther distance to you as compared to if you remained HOT. The primary advantage of cranking as compared to other techniques is the fact that you keep the target within the radar FOV, thus allowing your own missiles to continue guiding. Cranking is frequently used while DRIVING missiles, and should be a part of your normal BVR flow.

Optimal strategy to crank:

1. Launch a missile at your target
2. Choose a direction to crank (typically decided by position of enemies/friendlies and intended future defensive maneuvers)
3. Make a 60 degree turn, ensuring target is kept within the limits of the radar

5.2.9 - TACTIC: DRIVING

In order to hit their targets all missiles will "lead" rather than flying a direct path to you. This allows a much more efficient flight, and vastly improves missile pK, however, we can use this behavior against them. It is possible to dive at the ground in a way that puts the missile's estimated impact point (aka the lead point) into the ground, thus as the missile guides to you it will dive into

the ground and be destroyed. The ability to do this is situational, and is much easier against surface launched missiles.

Optimal strategy to drive a missile:

1. Identify missile visually or with [HMD](#)
2. Perform a Split-S
3. Dive down and monitor the missile
 - a. Don't hit the ground!
4. If missile fails to impact the ground prepare a follow-up maneuver

5.2.10 - TACTIC: DOPPLER NOTCHING

Modern radars have a so called "look down shoot down" capability, that is, the radar is capable of tracking targets even if there is terrain behind said target. This capability comes from the radars ability to read and filter targets based off their doppler shift. Doppler shift is caused by the velocity of an aircraft towards or away from the radar, as such it is possible to reduce the doppler shift returned by our aircraft by decreasing our closure rate. Notching is only effective if there is terrain behind you to "clutter" the returns the radar receives, and as such requires you be low altitude or the missile/radar far above you.

Optimal strategy to notch:

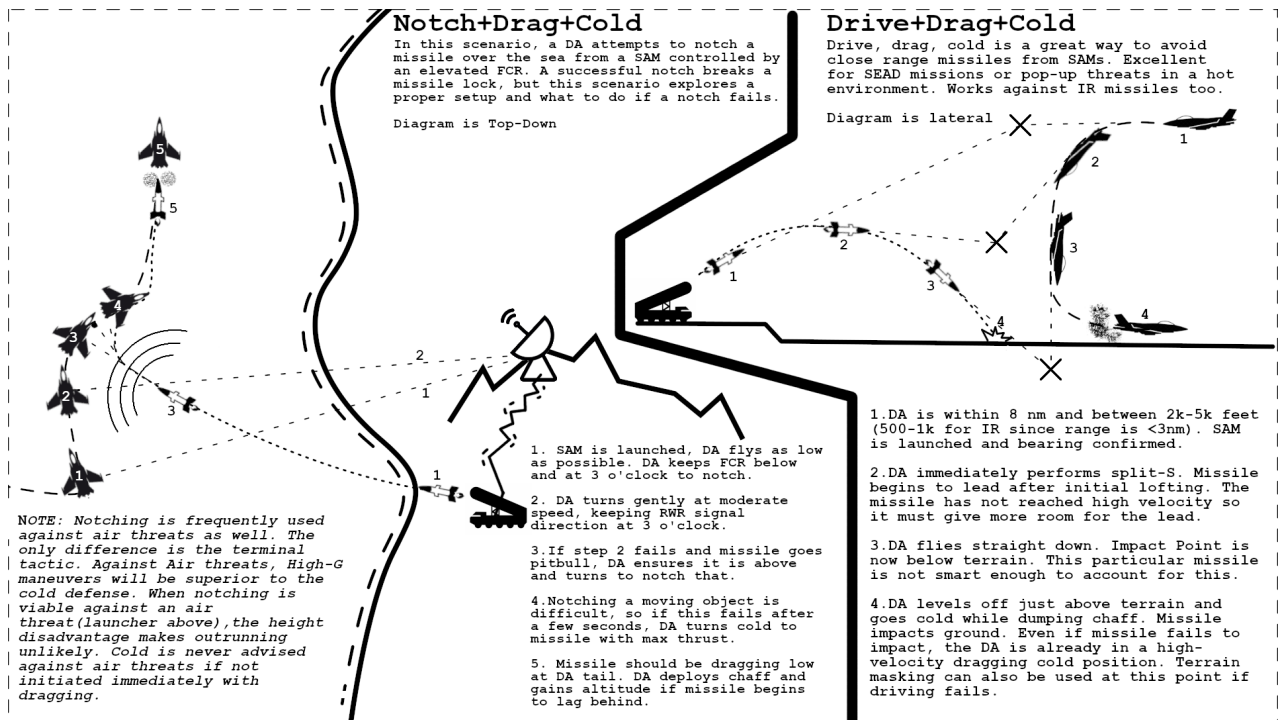
1. Identify the radar you intend to defeat on the [RWR](#)
2. Enter a 90 degree BEAM, putting the radar either 3 or 9 o'clock
3. Roll wings level to the radar (this minimizes RCS)
4. Wait for lock to drop
 - a. Notching tends to be far more effective before a radar has acquired you, and the sooner it is done. If a missile has already acquired on you it may be too late to notch
5. Once lock has dropped, make a positive G in plane maneuver away from the path of the missile

5.2.11 - TACTIC: GOING COLD / DRAGGING

As discussed above, missiles get all of their energy in the beginning of their flight, and as such there are several tactics we can employ to burn away a missile's energy. The first thing to notice is a missile's range is much lower than it initially seems, if you look at the path a missile flies it simply intercepts you at a point, relying on the fact that you continue to fly in the direction of the missile. By turning away, also called "going cold" we are able to remove this "free range" from the missile, **vastly** reducing its range. With the EF-24Gs extremely high top speeds this effect is even greater in both directions. Another step that can further improve our chances is a reduction of altitude into thicker air. In thicker atmosphere the laws of physics work against the missile, forcing it to spend a huge majority of its energy pushing through the air.

Optimal strategy to go cold:

1. Identify missile/direction of threat
2. Turn around while descending
3. Optionally: Make gentle turns from left to right to increase the energy the missile spends



5.2.12 - TACTIC: JAMMING

Jammers exist to defeat systems operating in the EM spectrum, specifically, radars. Jamming can be extremely viable as a tool to defeat radar guided missiles, refer to [section 3.1](#) for an overview and explanation of the tactics available. If preemptive jamming fails and a missile is launched at you then DRFM jamming should be employed against the missile. For SARH missiles this is a basically guaranteed way to defeat them, for ARH missiles due to their ability to reacquire you must maneuver hard while jamming to exit the path of the missile.

Optimal strategy to go jam (post-launch DRFM specific):

1. Ensure in EW Master Mode (RECOMMEND EWO TASK)
2. Set a pod to [DRFM](#), max power, one antenna
3. Select the missile using one of the following:
 - a. [TSD](#)
 - b. [FRAZ](#)
 - i. Note: the [FRAZ](#) is the easiest display to select missile on as they will be shown at the very top of the high band section
4. Start jamming
5. Perform hard maneuvers to exit radar FOV if ARM

5.3 - IR-GUIDED MISSILE EVASION

OVERVIEW

Infrared Guided missiles are some of the oldest and simplest missiles that have been employed. Often referred as "heat seekers", IR missiles guide using the thermal energy produced by the aircraft's engines. Despite IR missiles old heritage, they have continued to be improved year after year, and the modern era of IR missiles are extremely capable, able to reach out to 10NM and containing advanced thrust vectoring. Due to IR missiles significantly increased maneuverability and typical use in shorter ranges, kinetic tactics tend to be far less applicable, use them where possible, but understand they frequently will not be viable. Luckily for us, IR sensors tend to have one purpose: Track hot thing. By using countermeasures and understanding heat production on the aircraft you can create IR hotspots away from the aircraft to draw away incoming IR missiles.

EVASION:

1. Set throttle to IDLE
2. Dump 4-7 flare burst, wait ~0.5sec-1sec, and repeat
3. While dropping flares, attempt to maneuver away from the missile in a way to encourage missile line of sight with the flares

NOTES:

The EF-24G's engines produce a huge amount of thrust, and thus are *extremely* hot. Monitor the engine status panel for current engine temperatures. Especially dangerous are high-speed descents from altitude, which may raise the internal engine temperature to truly extreme temperatures.

"What's the melting point of nitinol... oh..." - EF-24G Test Pilot

6.1 - INDEX: BREVITY

- (Package/target) As Fraggged: Package/target is as stated in mission briefing
- (Target) Cold: Target is heading away
- (Target) Flanking: Target has a stable aspect of 30-60 degrees (Heading perpendicular)
- (Target) High: Target is between 10000ft and 40000ft ASL
- (Target) Hot: Target is heading towards
- (Target) Low: Target is below 10000ft ASL
- (Target) Very High: Target is above 40000ft ASL
- Bingo Fuel: Minimum fuelstate needed to return to base has been reached
- Bruiser: Launch of Anti-Ship Missile (ASM)
- Engaged Defensive: Defending against an enemy missile
- Engaged: In a fight with an enemy
- Faded: Target radar lock has been lost
- Fox 1: Launch of semi-active radar-guided air-to-air missile (AAM)
- Fox 2: Launch of IR-Guided AAM
- Fox 3: Launch of active radar-guided AAM
- Greyhound: Launch of cruise missile
- Guns, Guns, Guns: Cannon is being used
- Magnum: Launch of anti-radiation missile
- Merged: In a dogfight with an enemy
- Mudspike: Enemy ground target has radar lock
- Nails: Detection of enemy search radars on RWR
- No Joy: No visual/radar lock. Opposite of *tally*.
- Pickle: Release of bomb
- Pitbull: Active radar-guided AAM has switched to internal tracking
- Rifle: Launch of air-to-ground missile (AGM)
- Shack: Enemy ground target destruction
- Spike: Enemy Aircraft Has Radar lock
- Splash: Enemy air target destruction
- Tally: Detection of enemy on radar
- Winchester: Weapons load depleted or otherwise empty

6.2 - INDEX: ABBREVIATIONS, ACRONYMS, AND TERMINOLOGY

- AAM: Air-to-air missile
- ADA: Air-Defense-Artillery
- AGM: Air-to-ground missile
- AMRAAM: Advanced Medium-Range Air-to-Air Missile
- Angels: Altitude in thousands of feet
- ASM: Anti-Ship Missile
- ATC: Air Traffic Control
- AWACS (also referred to as AEW&C): Airborne Warning and Control System (Airborne Early Warning & Control)
- AOA: Angle Of Attack
- Ball/Meatball: IFLOLS (Improved Fresnel Lens Optical Landing System)
- Bandit: Enemy air target
- Bird: Friendly SAM
- Blue on Blue: Friendly Fire
- Bogey: Unidentified air target
- BRAA: Bearing, range, altitude, aspect
- BVR: Beyond Visual Range
- C2: Command and Control
- CAP: Combat Air Patrol
- CAS: Close air support
- CATOBAR: Catapult Assisted Take-Off Barrier Arrested Recovery
- Cat: Aircraft carrier catapult
- Chick: Friendly Aircraft
- DEAD: Destruction of Enemy Air Defenses
- ECM: Electronic Countermeasures
- Flight Level (rarely used): Altitude in hundreds of feet
- FRAZ: Frequency-Azimuth Display (pronounced freak-az)
- FFPPH: Fuel Flow Pounds Per Hour
- G-LOC: Loss of consciousness due to G-forces. Applies to both blackout and redout.
- HUD: Heads-up display
- IFF: Identification - Friend or foe
- MALD: Miniature Air Launched Decoy
- Mother/Mom: Home aircraft carrier
- Nav: Navigation

NATOPS FLIGHT MANUAL - NAVY MODEL EF-24G
A1-EF24G-NFM-001

- NATOPS: Naval Air Training and Operating Procedures Standardization
- Overlord: Nearest or otherwise on station AWACS aircraft
- Package: A group of friendly flights tasked with different objectives to fulfill a common mission
- RTB: Return To Base
- RWR: Radar warning receiver
- SAM: Surface-to-air missile
- SCUD: Russian built Short Range Ballistic Missile (SRBM)
- SEAD: Suppression of Enemy Air Defenses
- Shooter:
 - Aircraft launching/releasing munitions
 - Crew member controlling aircraft carrier catapult
- TACAN: TACTical Air Navigation. Used to automatically set WPT to RTB.
- TWR: Thrust to Weight Ratio
- U(C)AV: Unmanned (Combat) Aerial Vehicle
- Yardstick: The use of TACAN for rangefinding

END OF TECHNICAL MANUAL

CREDITS & DISCLAIMER BELOW

Credits and Disclaimer

This manual was made possible by:

- Bitzs - Writer
- C-137 - Writer
- Strikeeaglechase - Writer
- Freedomplaza - Original Document & Writing Contributions

(this manual is an official recipient of the Freedomplaza stamp of approval)

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