

USER'S MANUAL
VERSION 1.0
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for

F-4 Interceptor Game



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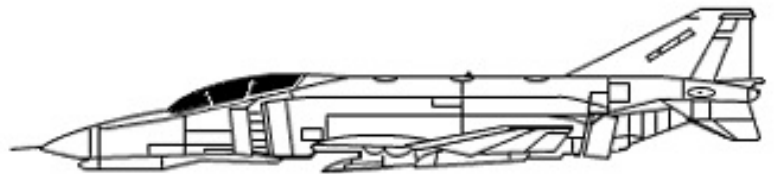
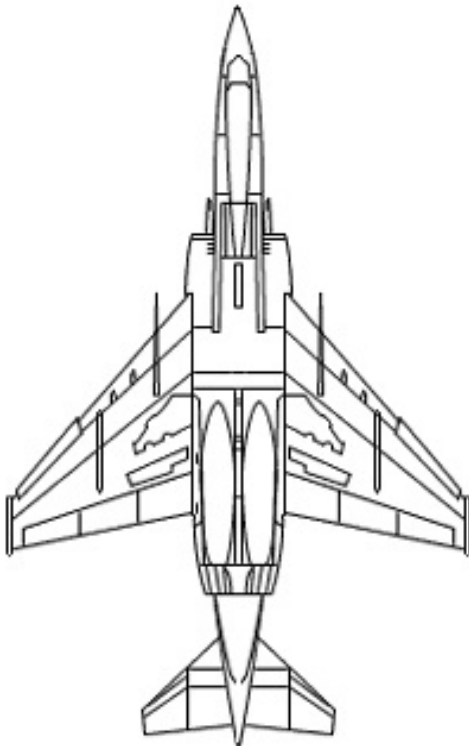
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1.0 Introduction

Lucid Technologies' F-4 Interceptor Game simulates many features of a real airborne intercept. The aircraft simulated is an F-4E Phantom II with AN/APQ-120 airborne fire control radar.

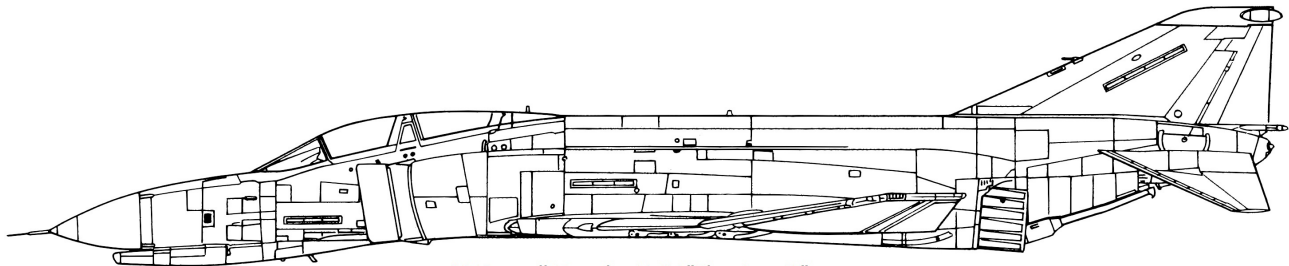
2.0 System Requirements

Lucid Technologies' F-4 Interceptor Game was written for Windows systems. It has been tested on WindowsXP and Windows10. It is distributed as a ZIP archive. Create a new folder under Program Files, such as *C:\Program Files\F-4 Interceptor*, and extract the contents of the ZIP archive to this directory. Click on *F-4 Interceptor Game 3-00.exe* to run the program. The program occupies less than 1 MB of hard disk space.

3.0 The Aircraft and Radar

3.1 The F-4E Phantom II

Crew:	Two. Front cockpit pilot; rear cockpit weapons systems operator (WSO) or radar intercept officer (RIO)
Length:	63 ft 0 in (19.2 m)
Wingspan:	38 ft 4.5 in (11.7 m)
Height:	16 ft 6 in (5.0 m)
Wing area:	530.0 ft ² (49.2 m ²)
Weight:	30,328 lb (13,757 kg) empty 61,795 lb (28,030 kg) maximum for takeoff
Powerplant:	2 × General Electric J79 axial compressor turbojets, thrust of 11,905 lb (52.9 kN), 17,845 lb in afterburner (79.4 kN) each
Fuel:	JP-4 at 6.5 lb/gal. Internal - 1,994 U.S. gal (7,549 L), External wing tanks – 2 x 370 U.S. gal (1,400 L) tanks on the outer wing
Speed:	Maximum - Mach 2.23 (1,472 mph, 2,370 km/h) at 40,000 ft (12,190 m) Cruise - 506 knots (585 mph, 940 km/h)



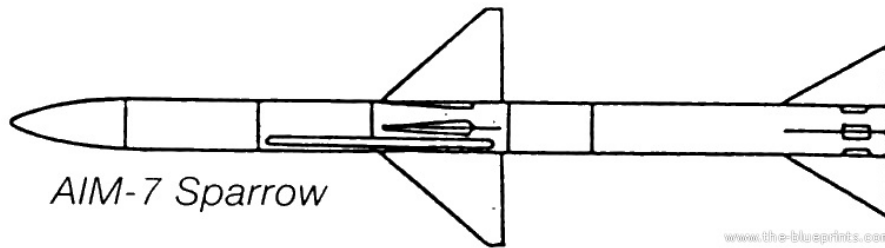
McDonnell-Douglas F-4E "Phantom II"

3.2 Air-to-air Armaments

The F-4E model has a 20 mm M61 Vulcan cannon mounted internally under the nose. The Vulcan can fire 6000 rounds per minute but only carries 639 rounds; this allows 6.39 seconds of firing. The fire control computer uses data from the radar to properly position the canon aim point in the pilot's heads up display. The probability of a canon hit is greatly increased when the radar is locked on the target.

The F-4 carries four AIM-7 Sparrow air-to-air missiles in fuselage recesses. The AIM-7 Sparrow homes on microwave (radar) energy reflected from the target. This means the F-4 must have a radar lockon so that the target is constantly illuminated by the radar beam. It also means the AIM-7

can be employed from any aspect relative to the target: head-on, side, or tail-chase.



The F-4 can carry four AIM-9 Sidewinders missiles on wing pylons. The AIM-9 Sidewinder has an infrared seeker that homes in on the heat of the target's exhaust. This means that the AIM-9 must generally be launched from behind the target. Various models of the AIM-9 have been produced since the Sidewinder's introduction in the 1960s.

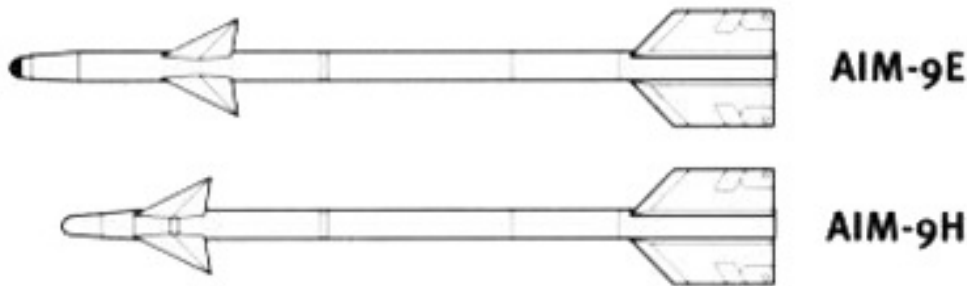


Table 1. Approximate size and weight of air-to-air missiles.

	Length	Diameter	Wing Span	Weight
AIM-7	12 ft (3.65 m)	8 in (20 cm)	3 ft 4 in (1 m)	500 lb (226 kg)
AIM-9	9 ft 10 in (3 m)	5 in (12.7 cm)	22 in (55 cm)	187 lb (85 kg)

3.3 The AN/APQ-120 Airborne Fire Control Radar

The AN/APQ-120 airborne fire control radar was manufactured by Westinghouse for the F-4E. The radar supplies data on the target angle, range, angle rate and range rate to the fire control computer. From these inputs the attack course is computed and displayed on the radar screen. The radar supplies the continuous-wave (CW) signal to illuminate the target for guidance of the AIM-7.

The radar antenna can scan from 60° left of the nose to 60° right of the nose and from 60° below the nose to 60° above the nose of the aircraft. The antenna has a 3.7° beamwidth except when locked on a target, then its effective beamwidth is 0.7°. In normal scan mode the antenna sweeps horizontally from 60° left to 60° right and back. The elevation of the scan is manually controlled from the rear cockpit. The antenna is gyro stabilized so the scan is always horizontal, and at the manually set elevation, relative to the horizon as the aircraft maneuvers. When the radar is locked on the target, the antenna azimuth and elevation are automatically controlled so that the antenna remains pointed at the target. "Lockon" can be maintained as long as the target remains within 60° of the nose.

The radar display screen is a green phosphor direct view storage tube. For airborne intercepts the radar uses a B-scan display where range is depicted by the vertical position of the target and relative bearing by its horizontal position. The relative bearing indices are displayed along the top of

the radar screen, the antenna elevation is shown by a short bar (elevation strobe) on the right side of the radar screen. For example, in Figure 1 the radar screen depicts a target that is 33° left at 18 nautical miles range while the antenna is scanning at 0° elevation. The radar display also shows an artificial horizon line that reflects the aircraft's attitude.

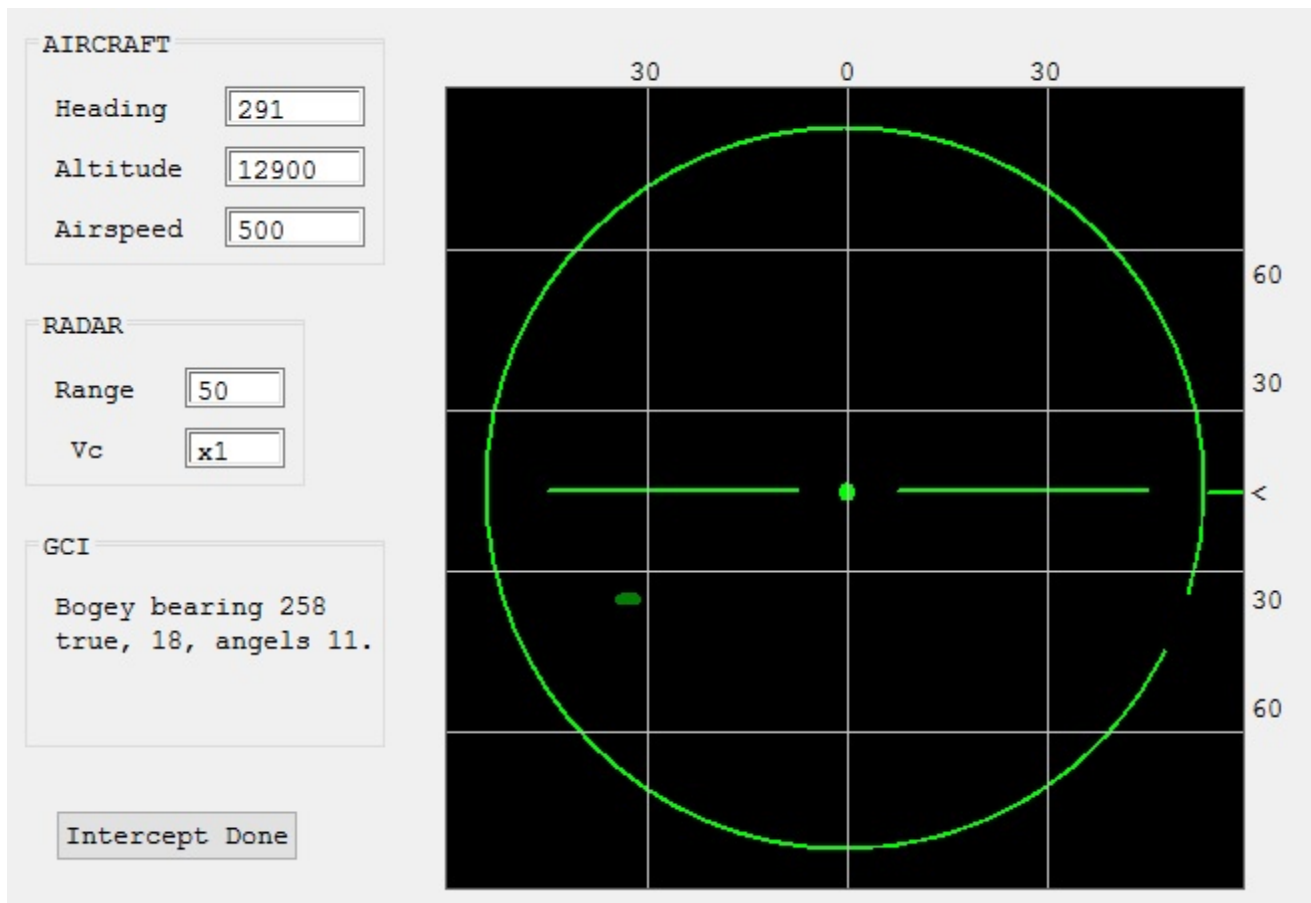


Figure 1. F-4 Interceptor Game screen

When the radar is locked on a target two more items appear on the radar display. The first is the velocity of closure (Vc) ring and the Vc gap. The counter-clockwise edge of the Vc gap shows the rate of closure on the target. The minimum velocity (100 knots opening) is the 11 o'clock position. Zero is at the 12 o'clock position, 100 knots at 1 o'clock, 200 knots at 2 o'clock, and so forth clockwise to 900 knots closure at 9 o'clock. For high speed intercepts the Vc factor can be increased to 3 making the 9 o'clock position 2700 knots of closure. In Figure 1 the closure is approximately 360 knots.

The second item to appear after lockon is the aim dot, shown in the center of the radar display in Figure 1. In this simulation the aim dot depicts a pure intercept course. To follow the pure intercept course the aircraft must be maneuvered to place the aim dot in the center of the screen.

4.0 Ground Controlled Intercept (GCI)

Simulated transmissions from a ground control intercept operator are shown in the GCI window of the game display. The GCI information appears for 4 seconds every 15 seconds. GCI uses

standard intercept terminology.

Angels = Target altitude in thousands of feet.

Bandit = A confirmed hostile target.

Bogey = An unknown target.

Relative bearing = Bearing to target relative to the heading of your aircraft.

True bearing = Compass heading to the target from your aircraft.

For example, the GCI text in Figure 1 is telling you the target is located on a compass bearing of 258°, at a distance of 18 nautical miles and is at an approximate altitude of 11,000 feet.

5.0 Program Operation

Click on the executable file (*.exe) to start the program. All program operations are controlled by individual keystrokes as shown in Appendix A.

5.1 Program Window

The F-4 Interceptor game opens a single window, see Figure 1. This window has five subsections.

1. The radar screen appears on the right side of the program window. The left edge of the screen represents a relative bearing of 60° left, the right edge a relative bearing of 60° right. The right side of the screen has the scale for the radar antenna elevation.
2. The group of indicators at the upper-left of the window are AIRCRAFT instruments showing the F-4's Heading, Altitude (in feet) and Airspeed (in knots).
3. The next group of indicators are for the RADAR. They show the current Range presented on the radar screen and the Vc gap multiplier.
4. The next box is communications from the Ground Control Intercept (GCI) operator. This text simulates radio transmissions from GCI. Radio transmissions are ephemeral, if you don't note what was said you can't go back and listen again. Similarly, the GCI text is only displayed for 4 seconds at a time so note it when it appears.
5. Finally there is the Intercept Done button. When you click on this button the radar screen presents the tracks of the F-4 and the bogey during the intercept. The track of the F-4 begins at the center of the screen. The current position of both aircraft are shown by small circles, see Figure 2. The plot area is square, spanning 80 nautical miles on a side. Another window opens asking "Are you sure you want to QUIT?" If you click Yes the game will end, if you click No you will be returned to the intercept.

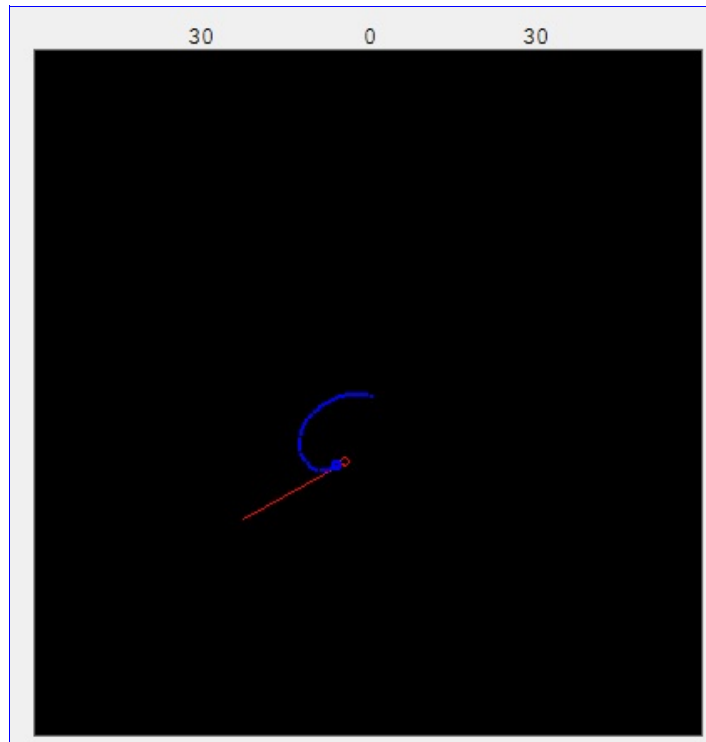


Figure 2. Intercept track plot, F-4 is blue, bogey is red.

5.2 Keyboard Controls

The function of the arrow keys depends on the two modes of the game. In

the default, or flight, mode the arrow keys control the attitude of the F-4 aircraft. The up-arrow causes the F-4 to climb. There are three pitch angles available: 10, 20 and 30 degrees. The down-arrow provides the same three angles of descent. The left-arrow causes the F-4 to bank left (port). There are three bank angles available: 10, 20 and 30 degrees. The right-arrow provides the same three bank angles to the right (starboard).

The other mode is the radar acquisition mode. This mode is toggled on and off by pressing the “A” or “a” key. When in the acquisition mode the acquisition gate will appear on the radar display. To initiate automatic track (radar lockon) the target must first be positioned between the vertical bars of the acquisition gate. This is done by moving the acquisition gate with the arrow keys. When the target is in the acquisition gate press the “A” key again and lockon will begin. If the target is not in the acquisition gate when “A” is pressed lockon will not begin.

5.3 Exiting the program

There are three ways to exit the program; all three will take you to the “Are you sure you want to QUIT?” prompt.

1. Use the normal Windows close control at the upper-right of the F-4 Interceptor Game window.
2. Use the “Intercept Done” button.
3. Crash the F-4 into the ground. If you forget you are descending to chase a low flying target you can fly into the ground!

5.4 Running an intercept

What does it mean to intercept a target and what does an intercept course look like on the radar screen? The type of intercept you run will depend on the type of weapon you intend to employ. If you plan to launch an AIM-7 you should run a pure intercept. On a pure intercept the bearing to the target will remain constant, in-other-words it will come straight down the radar screen. If you plan to launch an AIM-9, fire the canon, or perform a tanker rendezvous you will want to maneuver to be behind the target on approximately the same heading as the target, see Figure 2.

Pay attention to the information coming from GCI. Note the direction to the target and turn the F-4 to put the target on your nose then level out. This allows you to rapidly determine which way the target is drifting on the radar screen. If the target drifts left you know the target is crossing from your right to your left and you will need to turn left keep the target on a constant bearing. Take note of the target altitude reported by GCI and adjust the antenna elevation accordingly. At 20 nautical miles range the antenna sweeps an arc 7800 feet high. Assuming the F-4 is at 15,000 feet and the antenna is at 0°, at 20 nautical miles the radar will not see any target below 11,100 or above 18,900 feet. At closer distances the altitude spanned by the radar sweep is proportionately less and proper adjustment of the antenna’s elevation is even more important.

Radar warning receivers provide modern military aircraft with a warning when a radar locks on. Therefore it is common for intercepts to be done without benefit of radar lockon until it is necessary - such as just before firing an AIM-7 or the canon.

6.0 Bugs, Suggestions and Donations

The most current version of F-4 Interceptor Game should always be available at www.lucidtechnologies.info. If you discover any bugs or have suggestions for improving the program please send them to info@lucidtechnologies.info.

If you find F-4 Interceptor Game useful and would like to send a donation to Lucid Technologies you can do so via PayPal (http://www.lucidtechnologies.info/pay_card.htm).

APPENDIX A
F-4 Interceptor Game controls

Keys	Function
A, a	Toggles the radar Acquisition mode on – which provides the acquisition gate – or off - which can start automatic track (lockon).
Arrow keys	In flight mode the arrow keys control the pitch and roll of the F-4. In acquisition mode the arrow keys control the position of the acquisition gate on the radar screen.
S, s	Steady. Sets the pitch and roll angles to zero.
R, r	Changes the radar range in the sequence 50, 25, 10, 5, 50, 25, 10, 5, etc.
U, u	Moves the antenna scan elevation up one degree.
D, d	Moves the antenna scan elevation down one degree.
1	Sets the Vc gap multiplier to one.
3	Sets the Vc gap multiplier to three.
-	Decreases the F-4 airspeed by 10 knots. Minimum speed is 300 knots.
+	Increases the F-4 airspeed by 10 knot. Maximum speed is 650 knots.