

THE SIMULATOR DESIGN PHILOSOPHY

The hallmark of Doctor Soft is authenticity. In the world of micro computer flight simulation you will find none more accurate or true to life within the constraints of the hardware. This philosophy has been followed during the design and development of 'Twin Tornado'.

A Tornado is a highly responsive aircraft and special thought has been given to producing the very rapid frame rate required for authentic combat manoeuvring. When a person's vision is fixed on one object, surrounding detail is excluded by the brain. Because computer visual routines require considerable processing power, controls have been provided to turn off parts of the visual in order to maintain a high frame rate.

We avoid 'arcade sprites' and concentrate on Vector Graphics which is by far the best way to show true range, 3D depth, perspective and orientation. Instrumentation is very comprehensive. Aerodynamics and spatial position are handled in 32 bit arithmetic to an accuracy exceeding .05 inches.

WING SWEEP

The Tornado aircraft can vary its wing sweepback angle from 25 degrees to 68 degrees. For landing and air patrol loitering the wings are swept forwards to increase lift at low air speeds. For high speed flight they are swept back to increase the critical Mach number of the wings and reduce drag. At air speeds below 220 knots they should be forwards and at mach 0.6 or above swept back. They must be forward before selecting flap. Likewise the flap should be fully retracted before sweeping back. The wings may not be swept forward at speeds greater than 350 knots.

For each configuration of Flap and wing speed there is both a maximum (structural damage) and minimum (stall) speed. The actual speeds given include a small margin for safety. Approaching limits an audible warning is given.

Indicated Air Speed (IAS) in Knots:

Min sweep, full flap	
Min 120	Max 250
Normally around 150	
Min sweep, full flap	
Min 150	Max 250
Normally around 200	
Max sweep, no flap	
Min 220	Max 730

GETTING STARTED

For your first flights stay in training mode and practice landings, firstly using centre line approach reset, then approach reset, then try to position yourself following the notes under 'circuit'. Use auto throttle as much as possible.

Only when you have mastered these basics will you have a chance of getting home in one piece. It may take

some time before you gain the proper 'feel' of the aircraft. Mastery will have been achieved when control becomes instinctive.

It is important to remember when flying realistic type flight simulations that they have to be FLOWN! You must go TO the action. You must read the instruments to find the action or it will come to you in such a rapid and deadly way that you may never even see your attacker!

Flying IS a demanding task and all the information and instruction required has yet to be put in one book, let alone the limited space of this manual. Oddly, the most difficult task is manoeuvring and lining up with the runway for an approach and landing (many amateurs are quite good at combat!). Instrument flying takes months to learn and must be continually practised for a pilot to remain 'current', therefore it is suggested that the serious would-be pilot studies the many books available on flying and instrument flying.

If you become frustrated and can't seem to get going, then there is some basic concept you still have to grasp (like the fact that you must turn towards the pointer to see a target), or you are attempting the difficult aspects before mastering the basics of flight. Relax, take a break, read the manual through and try some easy training.

PILOTS NOTES

Taxying

Release wheel brake, increase throttle and keep the speed below 50 kts whilst off the runway.

Taking off

Check runway length, wheel brake on, air brake in, flaps out and wingsweep forward. Increase throttle to max. When at full power release wheel brake and take note of wind conditions. At 130 kts pull back, raising the nose, until the aircraft clears the ground then retract gear. As the VSI increases push the stick forward to maintain a shallow angle of climb. At 190 kts IAS retract flaps. Accelerate to Mach 0.6 (sweeping the wings back at Mach 0.4). Pull stick back and climb away steeply to your flight level. If your speed drops ease the stick forwards.

LEVEL FLIGHT

Reduce power and lower nose to check the climb. Use the altimeter and the VSI to check for level flight, making small adjustments in pitch using the outside and artificial horizons. Control speed with power. Always keep the speed under tight control. Flying too slowly can cause a stall, when the wings are unable to produce the required lift from the slow airflow and the aircraft suddenly drops. Recovery is possible but may take several thousand feet.

Turning

The effect of applying bank is to start a turn, but the

aircraft will slip and the nose will yaw towards the lower wing tip. The stick must be moved back to keep the nose on the horizon, thus providing the additional lift required to turn the aircraft and enable it to maintain height. Turn rates are restricted to a maximum of 4g (4 times the force of gravity) but at low airspeeds are further restricted by reduced lift.

Climbing and Descending

When climbing and descending the engine thrust must be altered if a constant speed is required. The use of Auto Throttle will hold a constant airspeed within the thrust limit of the engines.

Approach

When permission to land has been granted the simulator will always position the aircraft ready to join the runway extended centre line. During the approach the pilot must position his aircraft in the middle of the ILS radio beam and fly down towards the runway at 160 kts with wings forward, flaps out and gear down at a height of 300 ft per mile (i.e. 5 miles out/1500 ft.). To locate the near centre of the ILS beam fly at an angle to the runway until the BRG equals the runway QDM. At this point the aircraft must be turned directly towards the runway. The ILS pointers should now be obeyed by small adjustments of aircraft attitude to obtain precise position. Cross winds are compensated by heading sufficiently into the wind in order to cancel any drift.

Landing

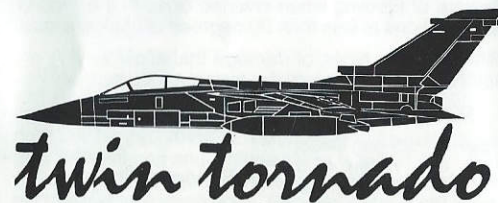
Close to the runway disengage auto throttle and reduce speed to 130 kts confirming that the gear is down and that the wheel brakes are off. Flare out by reducing the rate of descent and thrust. When touched down push the stick forwards and use the nose wheel steering to keep to the centre line. Check auto throttle is disengaged select wheel brake and reduce thrust to minimum.

Navigation

The essence of navigating is being able to visualise the 360 degree compass directions. (see HDG) The Runway 'QDM' is simply the direction of the runway from the landing end (as served by the ILS) towards the takeoff end. To find the correct point from which to start the approach when away from the circuit, first point straight at the field. HDG will now equal BRG. The BRG we would like to see is the runway heading (QDM). If the BRG is MORE than the QDM, turn right to make the HDG MORE; if the BRG is LESS, turn left to make the HDG LESS. A crude but effective way of 'lining up' when the runway is too far away to see clearly.

Circuit

This is the name given to the natural flow of aircraft taking off, climbing ahead, turning back passing the runway, then approaching again for a landing in the same direction as the take off.



INTRODUCTION

Thank you for buying this Doctor Soft simulation.

This program can be operated in the normal single mode, or in the unique TWIN mode by connecting the optional cable to a pair of C64 computers, and loading the program into both computers. The cable is easily obtainable, see voucher for details. Connecting instructions are issued with the cable.

Loading cassette or disc is entirely conventional. Follow the instructions on the label. Cassette turbo loading will take about 3 mins.

A Joystick is required and connects to port 2. A second joystick connecting to port 1 can be used as an alternative to keyboard control or engine thrust.

Please study this manual closely even if you have considerable flight experience. Start by reviewing the instrument panel with the panel 'on screen' in front of you. The instruments are described from left to right across the panel.

INSTRUMENTS

RPM Revs per minute of engines

Shows total engine power output. Instrument changes to purple at afterburner ignition. Afterburners produce high thrust but are very thirsty on fuel! Reheat and afterburner are equivalent terms. Engine thrust may be controlled manually (key or extra joystick) or automatically via auto throttle.

HDG Heading of aircraft

This is the compass. It shows the direction the aircraft is pointing (heading), relative to magnetic North. It shows 0 to 360 degrees clockwise from magnetic north. A full turn around back to the starting direction is a 360 degree turn. A half turn to face the opposite direction is a 180 degree turn. A right angle or quarter turn is a 90 degree turn. The fixed directions of North East South and West are 0, 90, 180, and 270 degrees magnetic. Thus if we are on a heading of 90 degrees magnetic, a 90 degree turn right will bring us onto a heading of 180 degrees magnetic.

RMI Radar/Magnetic bearing Indicator

This pointer always points towards the landing runway or the enemy aircraft, e.g., when 'down' and right the 'target' (runway or aircraft) is behind and right. Remember this instrument is showing the 'plan view' situation and will enable you to turn the aircraft to bring the runway or aircraft into view.

BRG Bearing of 'target' (runway or enemy aircraft)

This shows the direction of the target relative to magnetic North. In effect it is the Heading to fly to reach the target at that instant. It is a digital presentation of the direction of the RMI pointer.

SERNo Serial Number

This is the number of the actual aircraft you are using. If you destroy this aircraft by crashing or ejecting you will be given a new aircraft with the next number in sequence.

AIRSPED INDICATOR (ASI) shows indicated airspeed (IAS)

One of the peculiar aspects of aviation to the newcomer is that this instrument does not actually show the correct speed of the aircraft! As it measures the strength of the blast of air due to the speed of the aircraft, a little thought will show that as the air thins out with altitude, for the same real speed the ASI will indicate less and less. Using this under-reading instrument is not as crazy as it seems, as the wing 'feels' this reduced blast and develops less lift accordingly. Thus, performance depends closely on IAS. The ASI is calibrated in knots

(nautical miles per hour) 100 knots = 115 MPH. This display is normally analogue and digital, however when auto throttle is in use, the digital part shows the speed required. In this mode the legend changes to AMI.

MACH METER (MACH) shows Mach number

Mach number is the speed of an aircraft, expressed as a fraction of the local speed of sound. This instrument is a cornerstone of high speed flight. To the pilot this is his 'speed' more than any other measure. The local speed of sound varies slightly with altitude, being around 670 knots at sea level and falling to below 600 knots in the colder air at high altitude. Thus Mach 2.0 at 30,000 feet is about 1200 knots. Any speed over Mach 1 is deemed 'Supersonic'.

HORZ Artificial Horizon

This important instrument is always central on the panel and the centre of the pilots instrument 'scan'. It shows to the pilot the pitch and roll attitude of the aircraft. It is vital to read the display correctly: the smaller line in the centre represents the aircraft viewed from the tail looking forward and is always fixed to the 'glass' of the instrument; the larger line represents the horizon and follows the true horizon. If the aircraft is climbing in a right turn the small symbol will be above the line with its right wing closer to the line. To recover when disorientated roll the aeroplane till the flashing sky marker is at the top, then pull or push to bring the aircraft symbol onto the horizon bar.

ILS Instrument Landing System

A narrow beam of radio waves is transmitted up from the runway along the approach path. Two instruments receive these signals: The GLIDESCOPE (G/S) to the left of the Artificial Horizon for vertical guidance down to the runway, and a LOCALISER above the Artificial Horizon for horizontal guidance to the runway centreline. If, for example, the pointers are right and below their middle marks then the correct position lies to the right and below the aircraft. The pilot should increase his rate of descent, and turn a little to the right. On regaining the correct flight path, adjustments in the opposite sense are required.

DIST Distance to Runway or Enemy Aircraft

This is shown digitally in nautical miles. 1 nautical mile = 1.15 miles. Gunfire is not normally effective over 0.5nm. Approaching the runway your altitude should be 300 feet per nm out, e.g. 3.0 nm at 900 feet.

VSI Vertical speed indicator

This instrument is to the right of the Artificial horizon. It

shows rate of climb (the pointer above the mid position) or rate of descent (pointer below mid position). It is used in helping to maintain level flight, or in setting up a steady rate of descent for an approach and landing.

ALT Altimeter

Shows altitude of aircraft in feet. Digital part of display shows thousands of feet, pointer shows hundreds. One full revolution of the pointer is one thousand feet.

E/ALT Enemy altitude

Shows the altitude of the enemy aircraft being tracked by the RMI pointer.

FUEL

Shows total fuel tanks contents. Engines will flame out when this reaches zero, speed can be maintained by descending in a glide and a 'dead-stick' landing may be possible!

AMUN Ammunition

Shows ammunition remaining.

FLAP

Shows position of wing flaps (used for slow flight).

GEAR

Shows position of landing gear (undercarriage). The maximum speed for lowering the gear is 300 knots.

WING

Shows wing sweep angle in degrees (swept for fast flight).

BRKE Brake

This is a dual indicator showing A for Airbrake operation and W for wheelbrake operation. Note that both can be on together and are independently controlled.

FLIGHT CONTROLS

Joystick port 2 Control stick and fire button
Joystick port 1 or keys, (<) / (?) Engine thrust
Space bar Wheel brake off
B Wheel brake on
W Retract air brake
S Extend air brake
R Retract flaps
F Extend flaps
T (1) Gear up
G Gear down
Q Gun sight off
A (1) Gun sight on
E Manual throttle
D Auto throttle
H Wingsweep back
Y Wingsweep forward
Return Ejection seat

SIMULATOR CONTROLS

1 Long range visual
2 Short range visual
3 Day visual
4 Night visual
6 (2) Decrease reheat frequency resonance
7 (2) Increase reheat frequency resonance
0 Ground data base enable
+ Runway area data base only
- Disable ground visual
f1 (2) Mode select
f3 Reverse control stick

Training mode only

f5 Centre line approach reset
f7 Approach reset
Return Runway reset

Air combat modes

P Permission to land

Twin mode only

Restore Reset simulator after data break

- (1) Key active when aircraft in the air
(2) Key active when aircraft stopped on ground

SIMULATOR MODES & SKILL LEVELS

There are three modes and seventeen skill levels (0-16) available on this simulator. The modes and skill levels are changed by selecting the title page (key f1) and following the instructions. In all modes skill level affects wind direction and strength, the higher the number the more difficult the wind during take off and landing.

In AIR TO AIR COMBAT MODE, skill level also alters enemy aircraft skill both in avoiding your attack and in developing his own attacks. The higher number makes him more dangerous.

In TRAINING MODE all forms of crash are inhibited, but the screen border will flash when a crash would have occurred.

In TWIN AIR TO AIR COMBAT MODE, the highest of the two skill levels selected is made the common skill level.

In both combat modes, to enter the air to air combat submode, the aircraft must climb past 6000 ft. The air to air combat submode will now be locked in for all heights. For permission to land the aircraft must be below 5000 ft, the guns disarmed, and further than 2 miles from the enemy aircraft.