P51 Mustang Attack Flight Simulator

FLIGHT MANUAL

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TAPE $29.⁹⁵
DISK $34.⁹⁵
CABLE $10.⁹⁵

32K Machine Language

Contents

INTRODUCTION

P51 MUSTANG FLIGHT SIMULATOR is both an aerial dogfight game and a flight simulator.

With one computer it is a flight simulator with the ability to takeoff, land, fly to other airports, do aerobatics, and practice shooting at a drone aircraft.

Two computers allow you to have a very realistic aerial dogfight battle. Each computer is a separate plane with the ability to see and shoot at the other plane. If the computers are side by side they may be connected with a 3 wire cable via the RS-232 ports. If you and a friend have modems you may connect your computers by MODEM over the phone lines.

No other piece of software for any personal computer has ever attempted a real time fast action game of this type over a MODEM. We are very proud of this innovation and hope you have hours of enjoyment battling friends across town from the comfort of your home.
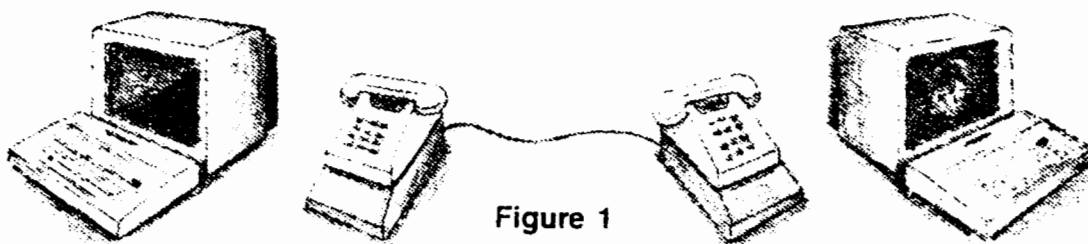
PROGRAM REQUIREMENTS

For Flight Simulator:
1) 32K or 64K Color Computer
2) One joystick (spring centering and trims are highly desirable, such as on Radio Shack's deluxe joystick)

Side by Side Aerial Dogfight:
Two computers (connected as diagrammed in Fig. 1)
One 3 wire RS-232 cable ($10.95 from Tom Mix Software)

Figure 1

Modem Aerial Dogfight
Two computers, a 300 baud modem for each computer

YOUR AIRCRAFT AND ITS FLIGHT SPACE

Your aircraft has performance approximately equal to the best of the WWII fighter aircraft such as a P51-Mustang, Messerschmidt BF-109 or Mitsubishi Zero-sen.

Your flight space measures 20 miles x 20 miles x 51,000 feet. This is divided into 4 equal quadrants. At the center of each quadrant is a 400 ft. x 5,000 ft. runway running North-South. To the right or left of each runway is a beacon.

You are in a wrap around world. If you fly beyond the north boundary of quadrant 1 you will immediately appear at the south boundary of quadrant 3. Flying straight in any one direction will bring you back where you started from.

If you are flying "single" (not linked to another computer) the other plane becomes a drone. He will fly a straight descending course. He will go from 51,000' down to 0' and instantly pop back up to 51,000'. When the drone is very high and you are low it is possible for him to be out of visual range even if you fly to his same location on radar and look straight up. In such cases just loiter in the area until he descends closer to your altitude. The drone is traveling at about 120 mph so you will tend to pass him up when trailing him. The drone allows you to have target practice. The drone will however never turn nor shoot back.

AIRCRAFT PERFORMANCE

Maximum level cruise speed at sea level	—	344 mph
at 20,000 ft.	—	460 mph
Maximum rate of climb at sea level	—	4,000 ft/min.
Maximum rate of climb speed at sea level	—	160-180 mph
Service Ceiling	—	40,000 ft.
Approach Speed (Flaps Dn)	—	120-130 mph
Rotation Speed (Takeoff Speed—Flaps Up)	—	110 mph
Glide Ratio at 120 mph, flaps dn, gear up 37,000' - 13:1		
sea level - 9:1		

Engine is turbocharged and gives full power up to 20,000' available power drops as you go above 20,000'. At 32,500' ½ power is available.
Armament — 1 gun in each wing, 99 rounds for each gun.
Fuel Capacity — approx. 10 minutes at full throttle.
Landing Gear are Retractible, Flaps are either full up or full down.
Landing Gear cannot withstand ground speeds greater than 200 mph.
Stall speed at sea level   Flaps up   —   100 mph
                             Flaps down   —   85 mph

SCREEN DESCRIPTION

dicates wing leveler "ON"

Alternately displays your mode and mode of other player

Stall warning appears here

Digital Heading

Indicates Radar is now viewing Quadrant 1

DESCRIPTION, OPERATION & READING OF THE INSTRUMENTS

Air Speed Indicator — marked in MPH × 10, gives **TRUE** air speed.
There is no wind so your ground speed equals the air speed.
Indicator range is 50–450 mph.

Altimeter — indicator range is 0 thru 51,000 feet. Long needle is 100's of feet. Short needle is 1,000's of feet. Small line on outside of altimeter circle is 10,000's of feet.   ;

MDA light — located left of the letters "ALT". Flashes when you are below the Minimum Descent Altitude which is permanently set at 500 feet. When you are below 500 feet you cannot be seen by the enemy's radar. Thus, whenever the MDA light is flashing you are blind to the enemy's radar. A high pitched beep-beep-beep sounds for 10 seconds whenever you go from above 500 feet to below 500 feet. This serves as a warning not to hit the ground.

Heading Indicator — Gives aircraft heading relative to true north. Though less accurate than the digital heading the analog indicator is easier to read. Press 'H' key to return to Hdg indicator when viewing the radar.

Radar — pressing key 1, 2, 3 or 4 gives a ground radar view of the corresponding quadrants. The line in the center of the scope picture is the runway in the center of each quadrant. The radar antenna is located on the ground and transmits its picture to your plane. The enemy's trace shows up in red, while your trace will be blue. When the enemy is in war mode he will not show up on your radar if he is below 500 feet. Your aircraft will always show up on your own radar regardless of altitude. Any aircraft that is on, or directly above a runway will not show up on either radar.

The radar display is a "storage scope" which means that all points plotted remain on the scope. Eventually a trace representing the aircraft flight path will form. If the scope gets cluttered you can clear it by pressing the 1, 2, 3 or 4 key again.

To view the heading indicator instead of the radar, press the 'H' key.

Wing Leveler — toggles on and off by pressing the 'L' key. An L is displayed at the upper left of the Air speed indicator if the wing leveler is on. The wing leveler will level the wings if the joystick is near center. This makes the plane much easier to handle, especially if you have joysticks without spring centering. The maximum roll rate is lower when the Wing Leveler is on.

Aileron Position Indicator — corresponds to joystick position in the left-right direction. The ailerons control ground steering. You can pivot while stationary by applying brakes, giving ¼ throttle and steering with ailerons.

Elevator Position Indicator — corresponds to the joystick position in the up-down direction. Pulling back pulls the nose up. Pushing forward pushes the nose down. When centered there is no lift created. This means that to maintain level flight some up elevator must be applied. 2-4 increments down from the center mark will usually work at speeds between 150-350 mph. The faster you are going, the less up elevator you will need.

Throttle Indicator — OP stands for OPen throttle. CL stands for CLosed throttle. The '↓' and '↑' keys change the throttle setting. The setting will remain in the same position until changed by the '↑' '↓' keys. If you are above 20,000 feet full throttle will not be attainable. The throttle indicator is also a power indicator, it shows % of full power being produced. On a real piston airplane engine throttle setting and power being produced are two separate things. However, on this simulator to conserve space and for ease of operation the two are one and the same.

Fuel Gage — You will be filled with fuel whenever you are on a runway and not moving. If the fuel runs out, the throttle indicator will drop to CLosed and you will have to glide down with no power. At full OPen throttle the fuel will last about 10 minutes. At ½ power it will last 20 minutes, at ¼ power it will last 40 minutes, etc. In other words the fuel flow is directly proportional to the throttle power setting. Your airspeed has no effect on fuel flow.

Flaps — The flaps are cycled up and down with the 'F' key. To cycle from one position to the other takes about 8 seconds. Flaps down increases lift and greatly increases drag.

Gear — the landing gear are cycled up and down with the 'G' key. If the gear are not fully down when you land you will land on your belly and damage the plane. If you exceed 200 mph while on the ground the gear will be destroyed and you will fall onto your belly if up elevator is not being applied. If you make a very hard landing the gear will collapse and you will land on your belly. In all of the above 3 cases the destruction of the landing gear is represented with a bullet hole directly below the letters "GEAR". This particular bullet hole can therefore be a result of your own aircraft abuse or can be caused by being hit with a bullet from the enemy. All other bullet holes can only be caused by being hit with a bullet from the enemy.

Whenever you are on your belly, the engine is disabled and the throttle will not operate. Flying with the gear down increases drag and lowers your air speed. If you touch down off of the runway the landing gear will be bent due to the rough ground. If bent, the landing gear will not retract.

SHOTS — indicates the number of shots remaining in each of the two guns. You are reloaded whenever you are on a runway and not moving. The guns will shoot continuoysly when the fire button is pressed. It is not necessary to repeatedly press the fire button to fire more than one shot.

MODE indicator — The "W", "P", "T" and "U" keys choose WAR, PEACE, TALK and TURKEY respectively. The mode you are in and the mode the enemy is in are displayed alternately. If the enemy is declaring war while you are not in war mode, a low tone is sounded each time his mode is displayed. The tone is also sounded if the enemy requests "TALK" mode. A 'bleep' noise is sounded when TURKEY is displayed. Declaring peace has no associated sound. Also, when both computers are in the same mode there is no sound made.

MODE DESCRIPTIONS —

PEACE MODE — designed to allow newcomers to familiarize themselves with the game without fear of being shot down. If both computers are in PEACE mode all runways are safe to land on for both computers. If the supply of airplanes is low 2 airplanes for each runway will be supplied by pressing 'N' (stands for New airplanes). If either computer is not in PEACE mode the 'N' key will not work. Pressing the fire button while in PEACE mode will cause WAR to be declared but will not allow bullets to be fired for 10-20 seconds. This forces both players to give a 10-20 second warning before opening fire. The Geneva Convention dictates that you declare war before firing.

WAR MODE — Only runways under your command are safe for your plane to land on. Landing on an enemy's runway or on his sector will allow his ground personnel to shoot at you, you will receive a bullet hole about every 4 seconds while on the ground (it is likely that you will not be able to take off again). When the enemy is in war mode you may only reset to runways under your command. The runways in your command are displayed as **black numbers on a white background** in the margin to the right of window. You can capture an enemy runway (and any planes on that runway) by hitting that runway's beacon 5 or more times. You will then have command of that runway and of that quadrant.

When one player has no more airplanes he is expected to surrender by going from WAR to PEACE mode. The victorious player is then expected to also go into PEACE mode after which either player may press 'N' to restore 2 planes to each runway. After 'N' is pressed the Answer computer will have command of runways 2 and 4 while the originate computer will command runways 1 and 3.

TALK MODE — If both players choose TALK mode the play of the game "Freezes" thus allowing you to each pick up the phone and converse with each other. The game un-freezes after both computers go to any mode other than TALK mode.

TURKEY MODE — merely allows you to call the other guy a turkey. Going from PEACE mode to TURKEY mode is essentially the same as declaring war, the only difference is that TURKEY means you have not fired a shot yet. Declaring TURKEY for over 20 seconds will enable your fire button. When you do press the fire button you will always transmit WAR mode.

ATTITUDE INDICATOR — located in the margin left of the window. The indicator line follows the position of the horizon. The center represents 0° (level). The marks are at 30° intervals. When the line is at the top of the window you are at −90° (straight down). With the line at the bottom of the window you are at +90° (straight up). The attitude indicator was included primarily because whenever the window is all blue, or all black you have no other clue as to what your attitude is.

STALL INDICATOR — The word STALL will flash on and off whenever your airspeed is near or below the point where even full up elevator will not sustain level flight. Stall speed is affected by the Flaps and your altitude (for a detailed discussion see "getting technical").

WINDOW VIEW — the window gives a forward looking view of the world. The sky is blue, the ground is black. The ground and horizon are flat. (Some have said this is because the program author lives in Kansas). The visual range at which you can see the other plane is 3½ miles in the center of the window and increases to 7½ miles at the edges. (You can see farther out the corner of your eye). At first the other plane will appear as a very small white dot. The dot will then get bigger and bigger until he gets to 4000′ feet or closer, at which point he will appear as an airplane. The enemy is within shooting range whenever he is within visual range, however it is of course much easier to hit him as he gets closer.

The beacons of all 4 runways are always visible. At long distances they will appear as bluish colored dots. As they get closer they will become larger and larger white dots. Only the runway lights of the quadrant you are in are within visual range. If you fly towards any of the beacons you will eventually see the runway lights "pop" into view.

The window cracks whenever the plane crashes or collides with the other plane.

The angle of view out the window is 45° up, 45° down, 60° left and 60° right. (This is a WIDE angle view).

RUNWAY STATUS — located in the margin right of the window. Numbers with a white background are quadrants under your command, numbers with a black background are quadrants under command of the enemy. Each runway starts with 2 planes. Originate starts with command of quadrants 1 and 3 while Answer starts with command of quadrants 2 and 4. The plane you are in is not included in the display. If you crash (crack the windshield) your plane is totaled and is beyond repair. You must acquire a new airplane (see "choosing a runway").

If a plane is damaged but has no crack in the windshield the plane is repairable. Each runway has a repair shop for one (and only one) aircraft. After you exit a damaged aircraft it is placed in the nearest repair shop, unless the nearest repair shop is full in which case your plane is lost.

A plane under repair will appear as a line instead of an airplane symbol. Repair will take from 20 seconds to 5 minutes depending on the extent of the damage and the distance from the runway. (see "bullet holes")

CHOOSING A TAKEOFF RUNWAY — To exit the plane you are currently in press 'R' and 1, 2, 3, or 4 keys simultaneously. You will then appear at the end of the runway you chose in a new airplane. 'R' stands for "Reset" or "Runway", whichever you prefer. The originate computer is always placed slightly right of centerline, the answer computer is always placed slightly left of centerline. When the enemy is in war mode you may NOT reset to a runway under his command. Resetting to a runway without servicable planes cannot be done. (A plane under repair is not servicable).

You may reset to another runway at any time but normally you will only want to do so if the plane you are currently in is destroyed or on a runway and stopped. Resetting from a moving aircraft is like 'ejecting' and thus causes the plane you are currently in to be destroyed (cracked window).

RUNWAY BEACONS — The beacon at each runway contains the defenses for that runway. Hitting a beacon of an enemy runway 5 or more times will give you command of that quadrant and will capture any planes at that runway. All four beacons are always visible. Only the runway of the quadrant you are currently in is visible.

SKILL LEVELS

	Level		
	Beginner 1	**Standard** 2	**Advanced** 3
Beacon Hits required to capture a quadrant	1*	5	10
Plane Hits: Bullet holes to foe ratio	1 hit = 2 bullet holes	1 hit = 1 bullet hole	**2 hits = 1 bullet hole cannot inflict more than 7 bullet holes
Altitude below which radar cannot see enemey	can always see enemy	500	500

*Beacon also appears bigger than normal.
**When both players are in level 3 1 hit = 1 bullet hole and both players can inflict 15 bullet holes.

The program starts out with both players in Level 2. To change the level both computers must go to TALK mode. While the computers are "Frozen" press the 1, 2, or 3 keys to choose your level. The level chosen will be displayed left of the TALK message. The level the enemy chooses is displayed to the right of the TALK message.

TRYING YOUR FIRST FLIGHT

Flying an airplane is difficult! Before attempting a dogfight with anyone try flying the plane by yourself for a few hours to get the feel of the plane. When flying in the singles mode it is best not to use the MODEM version. The CABLE version has a faster update rate. Everything will move at the same speed but will move smoother.

1) After program executes you will see the airplane panel and either a red or a blue sky. Press the 'C' key to change the color of the sky. When the sky is the desired color press 'ENTER'.

2) The words "Originate or Answer?" will now be displayed. When flying single you may choose either one. Press "O" or "A" to choose.

3) The words "MODEM Y/N" will appear. "Y" will choose modem version, "N" chooses Cable version. We recommend the Cable version for single sessions.

4) After pressing "N" in step 3 you will see ½ displayed in the window. This is your prompt to choose your initial takeoff runway. Press the "1" key.

5) You are now facing North at the end of runway 1.

6) If your joystick has trims, adjust them so that the ailerons are perfectly centered. Position the elevator trim 2-4 increments below the center mark.

7) Press the "L" key to turn on the wing leveler.

8) Assure that the fuel is full and you are fully loaded with 99 bullets.

9) Press and hold the 't' key until the throttle indicates full open.

10) Wait until the airspeed reaches 110 and pull full back on the elevator. The plane should rise from the ground. Slowly release back pressure on the elevator so as not to climb too steeply, or you will stall.

11) Press the 'G' key to raise the gear.

12) Climb to 1,000 feet (long needle on 0, short needle on 1). Level the plane out by applying less up elevator. If you fly straight and level the plane will eventually accelerate to about 340 mph. The steeper you climb the slower the plane will fly. You are in a high performance piston airplane but it will not climb straight up for more than a few seconds. To some the plane will seem low powered and sluggish while to those who have flown low performance aircraft such as a Cessna-150 the plane will seem like a "hot-rod".

13) Keep flying straight and level at a North heading. The beacon of runway 3 will be visible directly ahead. The wing leveler will help you keep the wings level. You should see your flight path being drawn on the radar scope. After about a minute you will reach the northern boundary of quadrant 1. You will then be in quadrant 3. The runway of quadrant 3 will be visible directly ahead. The runway will become better defined and bigger as you get closer. To view yourself on radar press the '3' key as you are now in quadrant 3. In about 2 minutes you will come to the northern boundary of quadrant 3. at which time you will again be in quadrant 1. You are in a "wrap around" world. The runway ahead is the runway you took off from.

FIRST LANDING

Each quadrant is 10 miles x 10 miles. From the center of the runway to the edge of the quadrant is 5 miles. The runway is 5,000 feet long (about 1 mile). Please keep these dimensions in mind when you view yourself on radar as you make your landing approach. The easiest way to practice landings is to stay straight and level after taking off and landing on the runway in the quadrant ahead of you. This way you will always be aligned with the runway and all you need to worry about is the elevator and throttle. Landing is difficult! Do not expect a good landing the first try, just be thankful this is a simulator and not a real airplane!

We are assuming you are flying straight and level at 1,000 ft. altitude at about 340 mph. At 5-6 miles from the runway reduce the throttle to $1/8$. As the airplane slows down slowly increase up elevator as needed to maintain 1.000 ft. At about 3 miles from the runway the airspeed will be 200 mph. At this point push the "G" key to lower the gear. When the plane slows to 150 mph push the "F" key to lower the flaps. When the plane slows to 130 mph start your descent. The center of the crosshairs is where the plane is headed. The end of the runway should be at the center of the cross hairs. If you are too high reduce the throttle. If you are too low, increase the throttle. At 100 ft. if you know you "have the runway" reduce the throttle to zero and slowly pull back on the elevator. As you get close to the ground the horizon should be level with the cross hairs or slightly above the cross hairs. Ideally, the STALL indicator should sound at about the same time you touch the ground. When on the ground. press and hold the 'BREAK' key to apply brakes. When you are completely stopped you will be filled with fuel and bullets.

BULLET HOLES

Each time the opponent hits your plane one bullet hole will appear. There are 15 possible bullet hole locations. Each hole has an associated malfunction. The order in which they appear is random. However, the less serious malfunctions are more likely to appear first. The hole locations and their associated malfunction is diagrammed in figure 5.

Figure 5   Bullet Hole Locations and Associated Malfunction
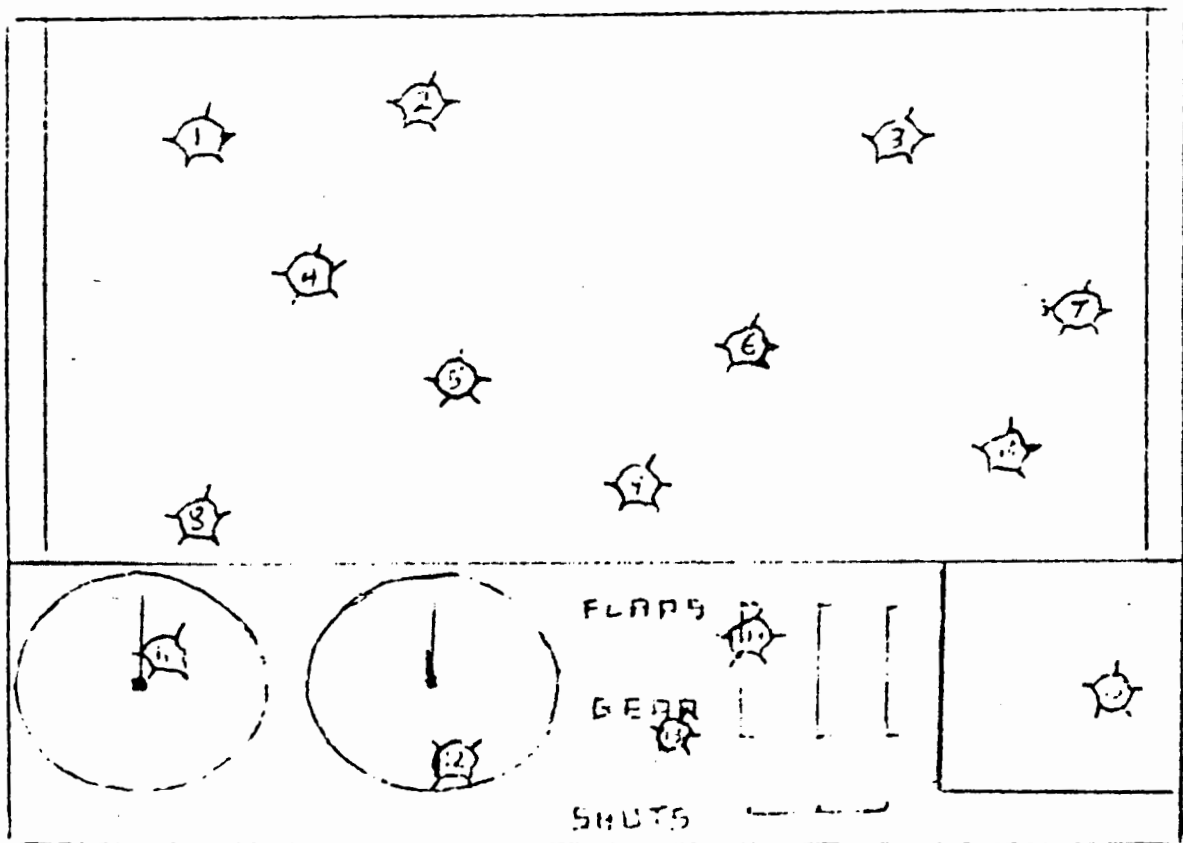
1. Max Engine Power Reduced 8 increments
2. Cannot Decrease Power
3. Max Engine Power Reduced 12 increments
4. Elevator Neutralized
5. Guns Jammed
6. Cannot Increase Power
7. Max Engine Power Reduced 11 increments
8. Elevator less effective
9. Tendency to turn extreme right, wing leveler disabled
10. Tendency to turn left, wing leveler disabled
11. Air Speed Indicator Inoperative
12. Altimeter Inoperative
13. Landing Gear Broken
14. Fuel Leak, all fuel will leak out in one minute or less
15. Radar Inoperative

None of the malfunctions are necessarily fatal. It is possible to "ditch" the plane without cracking the windshield even with 15 bullet holes. It is, however, very difficult! If you "ditch" your plane into a quadrant which is under enemy command your plane will be captured. In this case it is to your advantage to crash and render the plane beyond repair. If you land in an enemy quadrant, on or off the runway, you will be shot at by ground personnel and will receive a bullet hole every 4 seconds.

If you successfully land a damaged plane in a quadrant under your command your plane will remain yours and can be repaired. Repair time is determined as follows:
Each bullet hole adds 20 seconds.
Collapsed landing gear adds another minute.
Bent landing gear adds 20 seconds.
Distance from runway adds from 20 sec. to 9 minutes depending on how far away you land.
Repair time will vary plus or minus 30 seconds.
Maximum repair time possible is 14 minutes.
When the straight line in the margin changes to a small airplane symbol, the plane is repaired and ready for use.

MAX LEVEL CRUISE SPEED TABLE

ALTITUDE IN FEET	SPEED IN MPH	% POWER AVAILABLE
sea level	344	100%
5,000	363	100
10,000	396	100
15,000	420	100
20,000	460	100
25,000	452	81
30,000	433	58
35,000	398	39
40,000	327	19

SUMMARY OF COMMANDS

Fire Button on right joystick — fire bullets
Right Joystick — Elevator and ailerons
Left Joystick — not used
'↑' '↓' — throttle
1, 2, 3 or 4 — view corresponding quadrant on radar
R and 1, 2, 3 or 4 — Reset to runway 1, 2, 3 or 4
H — Return from radar display to heading display.
G — Cycle the landing gear
F — Cycle the flaps
L — Toggle wing leveler on or off
W — Declare WAR
P — Declare PEACE
T — Declare TALK
U — Declare TURKEY
N — New airplanes at runways
'BREAK' — Applies brakes while key is pressed.

WHILE SYNCHRONIZING THE MODEMS

'←' '→' — Move the pointer left or right
'↑' — Set the pointer
'ENTER' — Manually exit Synchronize routine

UPON PROGRAM EXECUTION

'C' — Change sky color
'ENTER' — Procede
'A' or 'O' — Originate or Answer
'BREAK' — Sends $55 while key is pressed
'Y' or 'N' — Y for Modem; N for Cable

PROGRAM INITIALIZATION QUICK REFERENCE LIST

1) TAPE — CLOADM, DISK — LOADM "P51"
2) 'C' Key for sky color
3) 'ENTER' key to procede
4) 'O' or 'A' for Originate or Answer
5) 'Y' for MODEM; 'N' for CABLE

IF MODEM WAS CHOSEN

a) pressing keys sends ASCII codes to MODEM
   (some smart MODEMS need this)
b) Press and release 'BREAK' key to enter SYNCH routine

ORIGINATE	ANSWER
c) use '←' '→' keys to position pointer below the null	c) Does nothing
d) '↑' sets the pointer	d) Does nothing

6) 1, 2, 3 or 4 key to choose takeoff runway

DETAILED DESCRIPTION OF PROGRAM INITIALIZATION

1) TAPE — CLOADM program will auto execute; DISK — LOADM "P51" program will auto execute
2) Press 'C' key to change color of the sky. On most TV's the sky color will be either blue or red each time the 'C' key is pressed. Adjust the color and tint controls on the TV if needed.
3) Press 'ENTER' after obtaining a blue sky.
4) "Originate or Answer?" is now displayed. Press 'O' or 'A' to choose. When linked to another computer by MODEM or CABLE one must be Originate and the other must be Answer.
5) "MODEM Y/N" is now displayed. Press "Y" for MODEM version "N" for CABLE. If the MODEM version is chosen you will enter the SYNCHRONIZE routine. If the CABLE version was chosen you will procede directly to step 6.
6) ⅓ is displayed. The numbers displayed represent the location of the four runways. Press 1, 2, 3, or 4 to choose the corresponding runway you wish to take off from.

SYNCHRONIZE ROUTINE

1) After pressing 'Y' in answer to the prompt "MODEM Y/N" two limit lines will appear above and below the prompt "MODEM Y/N".
2) At this time pressing keys will send standard ASCII codes over your MODEM at 300 BAUD. Pressing keys at any other time does **not** send anything over MODEM. Most modems can be set to originate or answer manually and do not need to send their MODEM characters from the keyboard. If your Modem is already manually set to Originate or Answer then procede directly to step 3.
3) Pressing the "BREAK" key performs two functions:
   a) While the "BREAK" key is held down you will send $55 to your modem.
   b) Upon release of the "BREAK" key you exit the mode which sends keyboard characters to the modem and you enter the SYNCHRONIZE ROUTINE.
4a) At this point if you are the answer computer you should see red bars form between the two limit lines except at the edges. The bars represent data received correctly. The Answer computer plays a passive role during the SYNCHRONIZE routine. When Originate is done synchronizing your sky will be restored to total blue and ⅓ will appear as a cue to pick your takeoff runway.
4b) The Originate computer plays an active role during the synchronize routine. Red bars should form between the limit lines. After 2 complete scans there should be a well defined NULL area. The Null area typically appears as partial red bars falling off to a totally black area. Depending on the Modems and phone connection the null may vary in appearance. The idea is to look for any black regions. Position the pointer directly below the center of the null area by pressing the "←" or "→" key. It is not critical that the pointer be exactly at the center of the null, within 1 or 2 positions left or right of center will normally work. After the pointer is at the desired position press the "↑" key to set the pointer. If everything is set up properly the originate computer will now automatically exit the synchronize routine within 10 seconds. Upon exit your sky will be totally blue and ⅓ will appear at the bottom of your window. You are now ready to choose your takeoff runway. The SYNCH setting is now permanently set for the duration of the game. Both Originate and Answer may manually exit the SYNCH routine by pressing "ENTER". This, however, should never be needed if you are connected properly.

COMMENTS ON HAVING A DOGFIGHT BY MODEM

Your phone connection may occasionally produce noise which will cause data to be misread. This can cause various disturbances, none of which destroy the playability of the game. The following may occur —

1) The location of the other plane will be misread causing him to momentarily disappear from view.
2) False bullet holes will appear. This can be very disturbing, but the associated malfunctions will only be felt momentarily. The bullet holes in the window will be erased if the horizon passes over them. The program is made so that for the bullet holes to be refreshed and for the malfunctions to remain you must continuously receive data from the other plane that you are hit. There is no routine which erases the bullet holes, however. That is why the bullet hole remains until it is erased by the horizon.
3) You may spuriously gain or lose command of a sector. This is the only type of mis-read error which has permanent effects. You can look upon it as ground forces overunning the sector.

All of the above occur very infrequently, especially if you have a clear phone connection. During all the hours of testing the above errors only happened when something was set up wrong or the connection was poor. Every effort was made to prevent occasional data errors from inflicting permanent effects.

REMEDIES TO COMMON PROBLEMS

PROBLEM	POSSIBLE CAUSE
Joystick does not move the ailerons or elevator	Joystick not plugged into "Right Joystick" port.
When attempting to fly single (not linked to another computer) the program "freezes".	Printer, modem or other device is plugged into RS-232 port.
When dogfighting by MODEM the program "freezes".	Both computers are in TALK mode.
	The computer on the other end has unplugged his MODEM from his computer.
	Any type of disconnection that causes your computer to continually receive a Lo at the RS-232 port.
You are originate and the program will not automatically synch after pressing the 't' key.	MODEMs not functioning properly.
	Phone connection is too noisy.
	The Answer computer has manually exited the SYNCH routine and is no longer sending you the expected SYNCH tone.

COMMENT: This program has been successfully tested over long distance phone lines. Both AT&T and SPRINT connections worked. The SPRINT connection did produce occasional mis-read errors but was definitely playable. The program will update slightly slower over long distance phone lines.

PROGRAM TECHNICAL SPECIFICATIONS

Processor: 6809 E
Update rate: 7-9 frames/sec by CABLE (average of 8)
3-5 frames/sec by MODEM (average of 4)

All routines are in the program. No jumps to ROM are made. No additional MODEM software is needed.

Requires 32K of memory.

Both computers update at the same rate. After performing all calculations and screen updates your computer goes into a data transmit ready state. As soon as both computers are in the data transmit ready state both computers trade information.

Data Transmission rate: 300 BAUD by modem
6,000 BAUD by direct cable

GETTING TECHNICAL

There are several features of this simulator which are not totally realistic. Some of them are discussed below

1) Window View -

The view out the window of a real aircraft is the direction the **plane is pointing,** in this simulator your window view is the direction the **plane is traveling.** At cruise speeds the two are one and the same. But when at low speeds (such as during a good landing) the nose is pointing several degrees higher than the direction the plane is traveling. The program points the window view in the direction the plane is traveling in order to make landing easier. If you place the horizon slightly above the window center mark you know you are in a slow descent, and are assured of a soft landing.

2) Bullets -

In a real aircraft the bullets that you shoot would not travel to the center of the window when you are in a tight loop. Instead they would drop off towards the bottom of the window. To simulate this effect would require lengthy, time consuming trajectory calculations for each pair of bullets shot. The update rate would be slowed down and the enemy would be more difficult to hit.

3) Stalls -

In a real aircraft stalls are solely a function of the wing angle of attack. For each wing at a given speed there is a specific angle above which air ceases to flow smoothly over the wing and lift drops greatly. Stalls can occur at any speed if you apply enough up elevator. Most planes are designed so that full up elevator brings you past the stall point.

This simulator never truly stalls. If it did you would tend to frequently stall the plane during a dogfight. You have no pressure feedback from the control surfaces and you don't feel the G forces caused by tightly looping, both of which are valuable to sensing the stall point in a real aircraft.

Your STALL indicator would more accurately be described as a stall SPEED warning. Your indicator is solely a function of speed, not angle of attack. It functions just as most people think it should, but it is actually unrealistic.

4) Update time constant -

The program assumes that a fixed period of time (¼ second for Modem, ⅛ second for CABLE) has passed between each update. During times that the update rate is slower (such as during fast rolls or when the windshield is cracked) the computer does not compensate for the increased time added to each update. Thus it's as if you go into slight "slow motion." This is not realistic, but both computers will always update at the same rate, thus not allowing an advantage to either plane.

PRINCIPLES OF CONTROLLED FLIGHT

TURNS

It is common to think that Ailerons turn the plane and that the elevator controls only up and down. Truth is ailerons **roll** the plane, elevator controls **up and down** and/or the **turn** rate. When the wings are level, up elevator causes the plane to go up, but when banked 90° left or right, up elevator causes the plane to turn (change heading). When banked somewhere between level and 90° and you apply up elevator some of the force is directed upward and some is directed left or right. The ailerons are used to roll to the desired bank angle, the elevator then is used to apply the force which turns the plane. **In summary: ailerons** *roll* **the plane, elevator** *turns* **the plane.**

SPEED

It is common to think that the throttle controls speed. Truth is that during stable sustained flight the elevator has more to do with speed than the throttle. If you continually apply up elevator the plane will slow down. Decrease the amount of up elevator and the plane will speed up. During a landing approach with the throttle cut, applying more up elevator will momentarily cause the plane to rise, but the long term effect is to slow the plane down (and possibly stall). To decrease your rate of descent you must apply more **throttle,** not more elevator. When you apply more throttle the short term effect is for the plane to speed up. But the long term effect is for the plane to climb and for the speed to settle back down to its original value. After thinking all this through you will agree that the long term effects of elevator and throttle are as follows:

> throttle controls climb or descent rate
> elevator controls speed.

When in an uncontrolled dive remember that up elevator will only cause you to go up if your wings are level. Applying elevator when your wings are not level only turns you sharper.

When you are upside down the elevator controls are reversed, up will make you go down, down will cause you to go up.

For ease of operation there is no rudder control on this simulator.