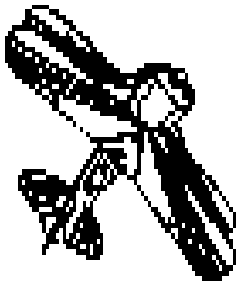
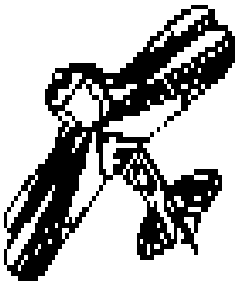



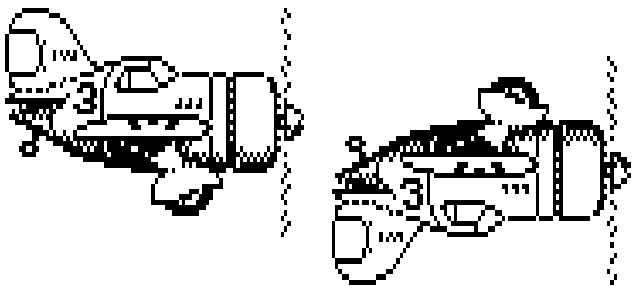
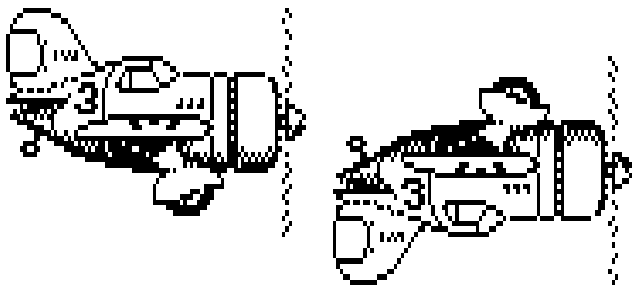
BHXP1
EXPERIMENTAL AIRCRAFT
VERSION 1.0


BY

BRUCE

HELLSTROM

JANUARY 1987

DOCUMENTATION FOR BHXP1 EXPERIMENTAL AIRCRAFT VERSION 1.0

Written January 1987 by Bruce Hellstrom for the TI99/4A and GENEVE home computers.
Released to the public domain January 1989 after final adjustments and bug fixing.

OVERVIEW

The BHXP1 is an experimental aircraft in the final testing stages before FAA approval. The airplane itself is a modified version of an airplane purchased in 1984. The plane has been restructured to handle higher speeds and has been fitted with a much more powerful engine. The instruments have been replaced with larger, easier to read models and DME (distance measuring equipment) has been added.

STARTING OUT

The program is designed for use with the Editor/Assembler module.

TO LOAD ON THE TI99/4A:

1. Select the RUN PROGRAM FILE option from the Editor/Assembler menu.
2. Type in DSK*.BHXP1 where * represents the disk drive the program disk is in.
3. Program will load and begin running and in a few seconds will show the main menu screen.
4. Continue to the ONCE LOADED section.

TO LOAD ON THE GENEVE 9640:

1. Load the GPL interpreter.
2. Set the GPL speed to 1.
3. Load the Editor/Assembler cartridge.
4. Select the RUN PROGRAM FILE option from the Editor/Assembler menu.
5. Type in DSK*.BHXP1 where * represents the disk drive the program disk is in.
6. Program will load and begin running and in a few seconds will show the main menu screen.

ONCE LOADED

Select item "1" from the menu. This is the "Take Off" option. Enter a value of 0 for both wind and chop. The instrument panel will appear. The airplane is sitting on the runway ready for take-off.
Read the INSTRUMENTS AND CONTROLS section while the instrument screen is in front of you. Push the "M" key to return to the menu. Read SOME FLYING BASICS to learn some of the basic information necessary for flight.

STANDARD OPERATIONS PROCEDURES

PREFLIGHT CHECKLIST

1) Program loaded
2) Alpha lock off (TI99/4A Only)
3) Joystick #1 operating normally and plugged in.
   *Note - Some early versions of MDOS for the 9640 may require joystick #2 instead of #1

TAKE OFF - NORMAL

1) Pitch set to 4
2) Full throttle
3) Pull back at 75 mph for lift off
4) After climbing to a safe altitude (500 ft), push stick forward and trim to 150 mph
5) Climb out at 150 mph

TAKE OFF - SHORT FIELD

1) Pitch set to 5
2) Full throttle
3) Flaps down at 70 mph
4) Climb at 70 mph until clear of obstacle
5) Push stick forward to obtain 100 mph before raising flaps, then immediately pull back to continue climb with flaps up
6) Push stick forward and trim to 150 mph
7) Climb out at 150 mph

CRUISE

Below 9000 ft, 75% power
Above 9000 ft, full power

LANDING - NORMAL

1) Fuel selector to fuller tank
2) Trim to 100 mph
3) Lower landing gear and flaps
4) Trim to 80 mph

LANDING - SHORT FIELD

1) Fuel selector to fuller tank
2) Lower landing gear and flaps
3) Trim to 70 mph with flaps down

TESTED PERFORMANCE FIGURES

Speeds

Never exceed	260 mph
Top speed (sea level)	230
Cruise (75%, 9000 ft)	222
Maneuvering speed	175
Maximum flap extension	130

Climb

Best rate	150 mph	950 fpm

Ceilings

Service	17,500 ft
Absolute	19,750

Stalls

Flaps up	67 mph
Warning horn and light	76
Flaps down	58
Warning horn and light	65

CONTROL SUMMARY

Joystick	- pitch and bank
1-9	- joystick pitch effectiveness (stick force)
A	- abort approach or landing and go to full power
B	- back to airport for ILS approach
C	- climb, increase power
D	- descend, decrease power
E	- extend or raise landing gear
F	- flaps, raise or lower
G	- gas, select other tank
H	- hold pitch (trim setting)
I	- invert nav bearing, 90 or 270 degrees
J	- jam, pilot in jam, stop everything
K	- keep on going (see J)
L	- leveler, wing leveler on or off
M	- menu, return to main menu

CAUSES FOR CRASHES

MISSED RUNWAY
Descending to ground level off the runway surface or at too great an angle to runway alignment (090 or 270 +/- 18 degrees)

TOTAL WIPEOUT
Impact with ground at high rate of descent

LOST CONTROL
Going over 130 mph on the ground (takeoff or landing) or wing tip hits ground due to excessive angle of bank

CAUSES FOR CRASHES (CONTINUED)

TOO HARD
Touched down on runway but too hard. Max safe rate of descent is 300 fpm. Beware of inherent lag in VS indicator

LOST FLAPS
Flaps lowered at speed over 130 mph. Severe structural damage results

LOST WINGS
Pulling more than 3.8 g's may cause wing failure (see maneuvering speed)

LOST TAIL
Exceeding 260 mph may cause severe vibration of tail surfaces, causing structural failure

TOO LOW
Hit TV transmitter tower, mountain, building, or other obstruction or terrain during ILS approach. Happens when off course, when too low before intercepting glide slope, when going too far below glide slope, or going below decision height or crossing runway threshold while still in clouds

INSTRUMENTS AND CONTROLS

When reading this section you should have the control panel in front of you as you read about each instrument.
Lights that are on are represented by a red or green circle. Lights that are off are shown by smaller white dots. On all dials, a pointer is represented by a dot in the center and a dot or line at the end. If there are two dots at the end, the pointer is at their midpoint. The pilot controls the plane with the joystick, the digits 1-9, and the letters A-L.

LIGHTS

Marker beacons - On the left side of the panel are 3 lights marked "OMI". These are the marker beacon lights. Used only for an ILS approach. Right light (inner marker) is not used. Middle light (middle marker) lights 1.5 miles from touch down point. Left light (outer marker) lights 4.2 miles from touch down point, at point where glide slope should be intercepted

LVL - located below the marker beacons, this light indicates when the automatic wing leveler is activated (key "L")

STL - located on the right side of the panel. This light comes on at the same time a horn does. Both warn you that the airspeed is getting dangerously low. If the stall actually occurs, the horn becomes more shrill and the nose of the plane falls rapidly. If you do not recover promptly, the plane will go into a steep dive

FLAP - located on the right lower portion of the panel. These 2 lights indicate the position of the flaps, up or down

GEAR - just below the flap lights are the gear indicator lights. A single red light above the "U" indicates the landing gear is up. 3 green lights indicate that all wheels are down and locked in place.

INSTRUMENTS AND CONTROLS (CONTINUED)

INSTRUMENTS

In the center portion of the panel are 9 guages labeled as follows:

ALTM - Altimiter. The 2 digits in the upper corner represent the ten thousand and thousand digits, the dial represents thousand foot intervals. For instance, 12,500 ft above sea level (not necessarily ground level!) would be represented as "12" and the dial pointer straight down. Each tick mark on the dial represents 100 ft and the pointer moves in 25 ft increments

AH - Artificial horizon. 3 dots in a line represent the airplane as seen from behind. If the plane banks to the left, the left dot goes down and the right dot goes up. tick marks on the right side mark 30 and 60 degrees of bank. The horizontal line extending from the left side represents the horizon, relative to the nose of the plane. If the line is below the center airplane dot, the nose is above the horizon. The horizon line moves in 5 degree increments, the wing dots move in 9 degree increments.

AS - Airspeed indicator. Reads from 0 to 300 mph. Each tick is 30 mph. Straight up is 0 or 300 mph, straight down is 150 mph

DG - Directional gyro. The needle points to the airplane's heading. If there is a wind, the ground track may differ. Up is North (360 deg), right is East (090 deg), etc. Each tick is 36 degrees. The needle moves in 9 deg increments

TURN - Turn indicator. This instrument displays the rate of turn. If the needle is straight up, the plane is not turning. If it points to the first tick from the center, the plane is turning at the rate of 3 deg/sec. This "standard rate turn" requires 2 minutes to make a 360 deg turn. The next tick mark is a 1 minute turn, 6 deg/sec

VS - Vertical speed indicator. This rate instrument shows how fast the plane is climbing or descending. Due to the way this instrument is constructed, there is a delay before its reading is accurate. Therefore it should be used to determing the rate only after it has stabilized. When the needle is pointing to the left, the rate of climb is 0 feet per minute (fpm). When pointing up, the rate of climb is 500 fpm. When pointing down, the plane is descending at 500 fpm. Each tick mark represents 200 fpm

TACH - Tachometer. This does not really show revolutions per minute but shows percent power. Up is 0 or 100%, right is 25%, down is 50%. Each tick mark is 10%

FUEL - Fuel guages. The left guage is for the left tank (in the left wing). The right guage is for the right tank. If a fuel tank runs dry, the engine will cut out. You must select the other tank and bring back the desired power setting. If one tank has more fuel than the other, the plane will tend to turn toward the heavier side. Each tank holds fuel for 70 min at full power.

OTHER INSTRUMENTS

DME - Distance Measuring Equipment. This instrument is located at the upper right of the panel. A green light shows that the instrument is on and working. The DME measures the distance from the VOR station at the airport in miles.

NAV - Navigation radio. This instrument is located on the right center of the panel above the flap indicator lights. This instrument is used either for an ILS approach or to receive the enroute navigation signal from the VOR. The light on top labeled "I", is on for an ILS approach. Note: when making an ILS approach and the airplane breaks through the cloud cover into clear air below, the instrument automatically changes from ILS mode to VOR mode and the light goes off. the 2 lights on the left side are labelled "T" and "F" ("to" and "from"). When passing over the ground station, the indication changes from one to the other. At the bottom of the display there is a number 090 or 270. This is the bearing to or from the ground station (when in VOR mode only). The face of the instrument has three tick marks. If the needle is aligned with the center mark, the plane is exactly on course. If the needle is at a tick mark, the plane is 20 deg off course in VOR mode, 4 deg off course in ILS mode. On the left side of the instrument is a horizontal needle which indicates whether the plane is above or below the glide slope when making an ILS approach (it does not move in VOR mode). Each increment is 1/10 deg above or below.

JOYSTICK - Controls aircraft attitude.
Push forward - nose down
Pull back - nose up
To right - bank to right
To left - bank to left
Nose up and down (pitch) is also affected by the pitch effectiveness setting. the degree of banking is dependent on how long the stick is held to either side. The maximum angle of bank is 63 degrees

KEYS - Depressing several keys select options and control various functions of the plane.

A Aborts landing or approach. If ILS approach, NAV switches from ILS to VOR mode and the clouds disappear. In all cases, full power is applied immediately.
B Back to airport for ILS approach. This can only be selected if east of the outer marker. A cloud cover suddenly forms, obscuring the ground.
C Climb - power is increased, more the longer the key is held.
D Descend - power is reduced, more the longer the key is held.
E Extend or raise landing gear.
F Flaps are raised or lowered. Do not lower flaps when speed is above 130 mph. Beware of sudden loss of lift when raising flaps.
G Gas tank is selected. Caution, if a tank is run dry, the engine will stop. If one tank has more fuel than the other, the plane will tend to turn to the heavier side.

KEYS (CONTINUED)

H Hold trim setting at current pitch position. Push this key while pushing or pulling the stick to set trim to that position indefinately. Subsequent stick movements are in addition to the held position. Trim settings can be accumulated by holding the key and stick for several seconds. Beware of high pitch effectiveness settings when cranking in trim.

I Invert the NAV bearing from 270 to 90 or vice versa. Although the number changes, for ILS mode the needle display is not affected.

J The pilot is in a jam and needs to stop the passage of time momentarily. This can be used to study the docs and instruments, or just take a break from flying.

K Keep on going. Restarts time after J key is used.

L Wing leveler. When on, the plane rolls to wings level position and maintains it. If the stick is used to bank, the plane will return to level as soon as the stick is released. The wing leveler will keep the plane level even if the fuel tanks are uneven, and will return it to level in severe turbulence.

M Menu. Returns to main menu. First shows information on the screen regarding plane's condition at the time key was pressed.

MENU OPTIONS

1) TAKE OFF
With this option, the airplane is sitting at the end of runway 27 (heading 270 degrees or due west). The airport is at sea level.

2) IN FLIGHT
With this option, you are asked first what altitude in feet above sea level you wish to start, second, what the ground level is (also above sea level), and third, the starting velocity. The power and trim are automatically set to maintain level flight at that speed and altitude. If the altitude is too high, there may not be enough power to maintain level flight at the specified speed. If the altitude is the same as ground level, you can try taking off from an airport higher than sea level. The runway direction is selected randomly. Your starting position is within 5 miles of the primary airport where the VOR and ILS are located. When doing this, you are taking off from a secondary airport from which you can not land.

3) LANDING

You are about to join the down wind leg for a landing on runway 27. You are heading 45 degrees at an altitude of 1000 ft above sea level at 130 MPH. The airport is at sea level and your location is about 1 mile south west of the threshold of the runway. For the landing to be safe, you must touch down on the runway surface and be able to stop within the overrun. This means that the touch down must be within a mile of the threshold. When several miles from the field, a digit will appear on the screen above the panel. The value of this digit and it's height above the panel represent the distance to the touch down point (The east end of runway 27). This figure is in the east-west dimension only and is not affected by being north or south of the runway. That is why the distance shown by this digit will sometimes be different than the reading of the DME.

LANDING (CONTINUED)

If the digit is exactly above the pointer in the center of the panel, you are intersecting the line of the runway, no matter which direction you are headed. The position of the digit to the left or right indicates which direction the runway would be if you were heading exactly due east or due west, whichever is closest to your present position.
The digit indicates the distance in tenths of miles from the touch down point and the height above the panel indicates the number of miles, for example, if the digit is a 3 and it is located right above the pointer in the middle of the panel, then your distance is .3 miles from the touch down point. If the same digit is up 1 row on the screen, then the distance is 1.3 miles. If the 3 appears 2 rows above the initial example, then the distance is 2.3 miles.

4) SHORT FIELD LANDING

You are positioned for a landing as in option 3. The only difference is that there is a ridge of mountains 400 feet high just 1/2 mile east of the runway. So if upon approach, you stray below 400 feet when farther east of the runway, you're history. If that's not enough, the runway is also shorter, so you must be on the ground within 1/2 mile of the threshold.

5) ILS APPROACH

ILS stands for Instrument Landing System. An ILS allows for a safe method of landing even if visibility is poor or the ceiling (cloud bottoms) is low. The ILS locates the airplane precisely in space relative to the runway threshold. At this particular airport, if you bread through the clouds at the decision height (DH), which is only 300 feet above the ground, you will be just 1 mile from the runway and in a position to try and make the landing. This approach can also be selected with the B key if you are east of the outer marker. If you choose option 5, you will automatically be positioned 8 or so miles east of the airport and within 1 or 2 miles north or south of the center line. You will be at an altitude of 2000 feet, heading west at 140 MPH. The ceiling is not known, but it is probably above the 300 ft DH, but it may be below it. Your first task is to turn as necessary to center the needle. You should also slow down to a more acceptable approach speed and lower the flaps and landing gear so that you won't have to mess with them later. Do NOT go below 1200 ft before you cross the outer marker! As you approach the outer marker, located 4.2 miles east of the runway, the outer marker light will go on. Once past the transmitter, the light will go out. At this time you should be well established on the glide slope, that is, the glide slope needle on the left side of the NAV display should be centered. Now concentrate on keeping both needles as close to the center as you can. If things get out of control, call "missed approach" on the radio and execute the missed approach procedures: abort the approach and apply full power (A key), climb straight ahead to 1500 ft, then a climbing right turn to 2000 ft, heading 090.

ILS APPROACH (CONTINUED)

The middle marker is located 1.5 miles out. The light for this marker will not stay on as long because you are closer to the transmitter on the ground. Your altitude passing over it should be 450 ft. You could break into the clear at any moment. You must not go below 300 ft. in the clouds. If in the clouds still at 300 feet you must call missed approach. The signal to you that the you are below the clouds is the sky turning blue again and the ILS light on the NAV display going out. You will then see the digit appearing above the panel to tell you of your location and distance from the touchdown point.
If you pass the threshold of the runway while in the clouds and without calling missed approach, you will crash with the message, "TOO LOW".

WIND AND CHOP

After you select your choice from the main menu, you specify the wind and turbulence (chop) strength. Each can be in a range from 0 to 3 meaning none to severe.

SOME ADDITIONAL NOTES

The pitch effectiveness setting is selected using the 1-9 keys. This setting tells the program how far you would be pulling back or pushing forward the stick in a real airplane. A pitch setting of 1 is similar to barely pulling or pushing on the stick and may seem like nothing is happening. A pitch setting of 9 is like pulling or pushing the stick to it's limits and can be dangerous. In all practical flying, you should rarely have to use a stick force more than 5 with a normal setting of 3.

Using the H key (hold trim setting) will accumulate trim very quickly and can also be dangerous at high pitch settings. An example is upon take off when trimming to your climb speed of 150 mph. The pitch should be set to 4 on take off and when you start to trim the nose. As you get closer to your climb speed, you should reduce the pitch to 2 and continue trimming the nose while holding the stick forward. This can prevent you from suddenly putting the plane into a dive.

SOME FLYING BASICS

For the following examples, you can use the in flight option from the menu, put the aircraft at 5000 feet at the speed suggested in the example.

DESCENDING

Set the plane up as above with a speed of 100 mph.

1) Hold down the D key for about 2 seconds and listen for a drop in power.
2) Notice the tach change.
3) Because the power has been reduced, the plane initially slows down a little. As the plane slows down, the wings produce a little less lift. This causes the nose to drop. When the nose drops, the plane begins "coasting downhill" which in turns brings the speed back to the original value but the plane is now descending.
4) The VS dial now shows the rate of descent. (It stabilizes slowly).
5) The altimeter begins to show the altitude dropping.

CLIMBING

This is exactly the opposite of descending. Start in level flight again, but increase power. The engine noise will increase, the tach will show the increase, the speed will initially increase followed by a climb, and the altimeter will show the gain.

SLOWING DOWN

Set up again at a speed of 100 mph. Now reduce the power as if to descend. However, when the instruments show the descent has begun, pull back on the stick. Pulling back on the stick will create more lift because it tilts the wings back. This will slow the descent, bring the nose back to level, or cause a little climb depending on the pitch. If you reduced power enough, even though the stick is held back, the nose will again fall. Hold down the H key to "crank in some trim". This will pull the nose up again. As you make these adjustments, notice that the speed is falling and, if you do it just right, your altitude stays just about the same. Once you have slowed down to your desired speed, you may increase power again to maintain altitude.

SPEEDING UP

This is just the opposite of slowing down. Increase power and when the climb starts, push the nose down. Use trim as needed. When the desired speed has been reached, decrease powler as necessary to maintain altitude.

SOME FLYING BASICS (CONTINUED)

LEVELING OFF FROM A CLIMB OR DESCENT

This is very easy if you wish to keep the same airspeed, just adjust the power until the plane is not climbing or descending anymore. There are many times however when you want to increase speed when leveling off, such as when making the transition to cruise speed after taking off and climbing to your target altitude. This is accomplished by pushing the nose of the plane down until the plane is not climbing anymore. This increases airspeed. To level off from a descent, you would pull back and increase power.

HOLDING ALTITUDE WHILE TURNING

When the airplane is banked in a turn, the plane will start to drop due to reduced lift on the wings. If the turn is steep enough, it is necessary to hold back on the stick to bring the nose up during the turn and keep the VS constant. Set up the plane at the maneuvering speed of 175 mph and experiment with turning. You may need to adjust the pitch effectiveness to maintain altitude during steep turns.

SUPPLEMENTARY ILLUSTRATIONS

On the program disk are some supplemental illustrations for this documentation which can be printed on an EPSON FX-80 compatible graphics printer.
To do this, you must use EXTENDED BASIC and place the program disk in drive 1. Use the command OLD DSK1.SUPPRINT to load the file. The program will then print the supplementary illustrations.

****

THIS PROGRAM IS BASED ON A 1982 TI BASIC PROGRAM FROM JOHN DOW.
ALL ASSEMBLY CODE AND MODIFICATIONS ARE BY

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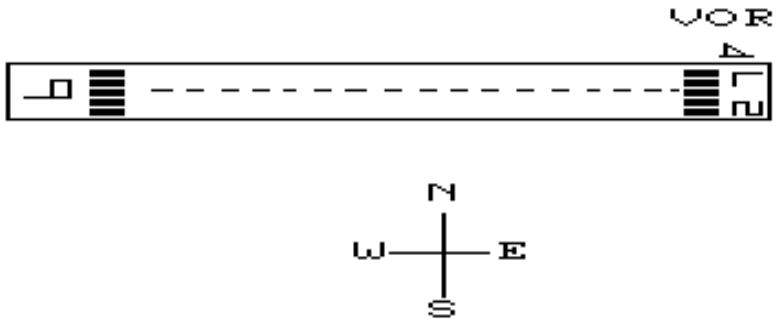
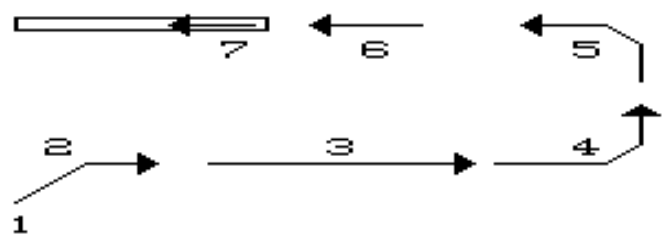
FIGURE 1--AIRPORT



SUPPLEMENTS TO BHXP1
FLIGHT SIMULATION
PROGRAM

1989 BRUCE HELLSTROM

FIGURE 2 -- LANDING



1. INITIAL POSITION ALT 1000FT HEADING 045
2. TURN "DOWN WIND" HEAD 090 ALT 1000FT
3. SLOW DOWN TO APPROACH SPEED LOWER FLAPS AND GEAR
4. START DESCENT, TURN TO BASE LEG, HEAD 360, DESCENDING
5. CONT DESCENT TURN FROM BASE TO FINAL HEAD 270
6. CONT DESCENT, GET LINED UP WITH RUNWAY. CONTROL DESCENT TO TOUCH DOWN SHORTLY AFTER PASSING THRESHOLD.
7. FLARE TO TOUCHDOWN SOFTLY ENOUGH, PULL BACK ON STICK AND MONITOR POWER TO CONTROL RATE OF DESCENT.

FIGURE 3 -- ILS APPROACH