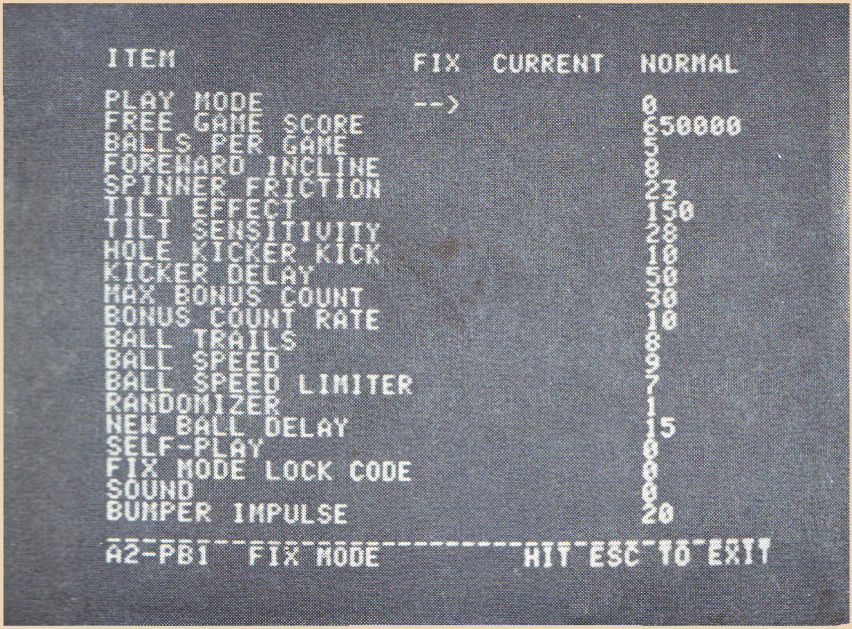
A2-PB1
"NIGHT MISSION" PINBALL
Adjustment Manual



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A2-PB1
"NIGHT MISSION" PINBALL
Adjustment Manual

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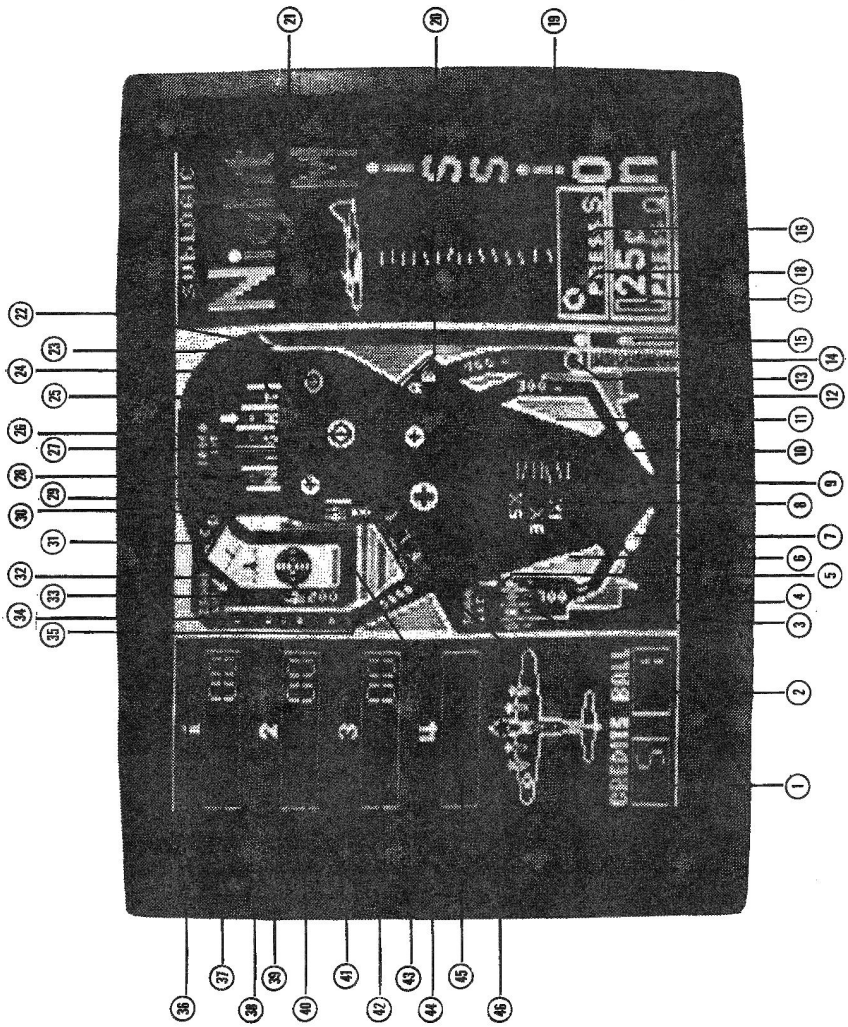


Figure 1. A2-PB1 "Night Mission" Layout and Features

1. Credits digits: counts quarter insertions and free games
2. Ball digits: indicates the ball currently in play
2b. Match digits: cycle through a match sequence at the end of the game
3. DROP rollover lanes.
4. SPECIAL and FREE GAME!!! lites
5. DROP lane arrows
6. Left V-Impulser
7. Left flipper
8. Bonus multiplier lites
9. Bonus count up/count down lites
10. Right flipper
11. Right V-Impulser
12. Game mode digit for SubLOGIC modes 0 to 9 (blank for user modes)
13. Hole kicker
14. Striker gauge
15. Striker
16. BOMB AGAIN! lite. Goes on for extra ball.
17. Quarter insertion slot.
18. Start push button.
19. GAME OVER lite
20. AB standup targets
21. TILT lite
22. Ball escape door.
23. Small bumper (with British symbol)
24. NIGHT rollover lanes.
25. Lane lites.
26. Large bumper
27. Small bumper (with German symbol)
28. NIGHT lane arrows.
29. Spinner value increase arrow.
30. Outer spinner.
31. CD standup targets.
32. Dive bomb chute 25,000 arrow.
33. Dive bomb chute spinner.
34. City lites.
35. Bomb release line.
36. General's Stars (1-million point indicators)
37. Player 1 digits.
38. High Score to Date lite.
39. Player 2 General's Stars.
40. Player 2 digits.
41. Player 3 General's Stars
42. Player 3 digits.
43. Dive bomb chute.
44. Player 4 General's Stars.
45. Player 4 digits.
46. FLY standup targets.

Introduction

The A2-PB1 Pinball program simulates a modern arcade-type pinball game. We spent many hours evaluating and measuring a wide variety of pinball games in arcades to make sure that the functions and features correspond to today's pinball games. We also measured dynamic characteristics such as ball speed, gravity effect, standard ball guide and flipper rotation angles using a stop-watch, protractor, and ruler (hopefully when nobody was watching) to make sure that the ball action corresponds to the physics of a real pinball game.

Pinball games vary widely in their features and ball action. From a features standpoint, the quarter slot and startup button are the same on all machines, and glowing orange or blue 7-segment digits are used universally (mechanical counters are a thing of the past). Glowing orange 7-segment digits are used for score, ball count, credits, and match on A2-PB1. A quarter slot and push button are also used. It may seem strange to have a quarter slot on a microcomputer game, but the insertion of quarters, credit counts, winning of free games, and startup procedures are so closely tied together on a real pinball game that the simulation demanded it.

The multi-player selection method on real games is also quite standard, but unless you know the procedure, it can be quite baffling. The coin slot and start button allowed us to simulate multi-player startup correctly, so you can get familiar with how to put real machines into multi-player modes by learning on this one. You will rarely find any instructions on how to do this in an arcade, especially if it is a true enthusiasts' arcade. Pinball game startup and jargon are things that you are assumed to know before you enter the door.

Flippers typically sweep angles of 40 to 50 degrees. We use 45 degrees on A2-PB1, which may seem rather small if you are used to other microcomputer pinball games. This in no way limits ball control, however, because the physics of real flippers (including tip effects, steady ball holding, and smooth roll-down) provide precise control over the full flipper sweep range.

Other pinball features vary so widely between machines that no good compromise could be reached. We therefore made the parameters that control the simulation fully adjustable. Ten standard modes are provided, and you can vary the 40 adjustments to create up to 100 of your own modes that you can rapidly switch between.

Adjustment procedures will be covered shortly, but it's first necessary to get familiar with the game's features and their names. These will now be described.

Features

Night Mission Theme and Layout

Night mission's theme is a WW II night bombing run. The bomber involved is a B-17 Flying Fortress, and while the Americans flew mostly daylight missions, a few B-17s were piloted by the British RAF who frequently went on night missions. There are USAF wing markings on the plane, however, so you can think of this as a night mission in the Pacific (the USAF frequently flew at night over Japan). Just think of the plane as being a B-29.

The pinball game's layout is shown in Fig. 1. Most of the features are self-explanatory. The ball chutes and tunnel in the upper left are referred to as the *bomb release line* (the vertical chute), and *dive bomb chute* (the U-shaped tunnel with a small spinner and 200 written in it). Eight lites turn on in the bomb release line when the NIGHT sequence is made (all NIGHT letters off). These lites are *cities*.

Ball Dispensing and Action

This is a multi-ball pinball game. Up to 4 balls can be in motion simultaneously. Up to 3 balls can be captured in the dive bomb chute. They are all released when the ball drains, the proper sequence ABCD is met, or when the 4th ball enters the chute.

Machine inclination (gravity) effects are considered in ball travel. Ball-surface collisions consider restitution (bounciness) and tangential friction (stickiness) effects. These effects are user adjustable.

Ancillary Features

The playfield has five bumpers, seven standup targets, nine rollovers and two spinners. A hole kicker that captures and holds a ball for a few seconds, then *kicks* it out is located above the striker pull gauge. Many of the parameters associated with these items are adjustable.

A bonus scoring and countdown system is located on the playfield between the *V-impulsers*. Maximum bonus count is adjustable.

A special ball projection technique allows balls to roll over objects (lites, designs, and legends) on the playfield without erasing them. In addition, you can't see an inverted image of what the ball is rolling over through the ball as you can on other games that use simple exclusive-or projection. This makes dense designs and writing on the playfield possible.

Competition Features

Real pinball games are often used for competition. People try to beat the free game score, high score, and other players in multi-player games. All of these features are provided. A game can get boring if it is easy to tamper with and adjust in a way that makes it too easy to get high scores. A2-PB1 is fully adjustable, and you can make it too easy, but there are safeguards for the competition-minded.

Playing modes 0 through 9 are *Official SubLOGIC Modes*. Mode 0 is set up to be a very competitive mode. It has the same sort of action and scoring that you would find in an arcade pinball game. A small digit under the right flipper indicates the mode on the screen (0 through 9). Any attempt to modify the mode using the fix system will add ten to the mode number, thereby turning it into a user mode. You can not tamper with SubLOGIC standard playing modes (except for turning the sound off and setting the lock code).

If you are playing with many players, one may be an A2-PB1 expert and know how to sneak into the fix mode and modify the game. To prevent this, you can specify a lock code (1 to 999,999). Once you exit from the fix mode, you need to submit this code to get back into the fix mode. Chances of anyone guessing the code are one in a million (almost). A zero lock code means *unlocked*.

Finally, for day-to-day competition and saving your custom designed user modes, there is the high-score/mode disk. This lets you save your mode and high score on disk and load it up again later.

Preliminary Adjustments

The A2-PB1 playfield design and battle sounds push the HI-RES display mode, color monitor, and the built-in speaker right to their limits. The following adjustments will help you get the best color, resolution, and sound.

Color Adjustment

Subtle features make a real difference in the enjoyment and excitement of a game. The pinball game is much more exciting with the sound on for instance (turning the sound off using the fix system will demonstrate this). Another subtle feature is the color adjustment.

The so-called *correct* setting of a color monitor (the one that gives perfect portrayals of violet, blue, green, and red) is not the best setting for A2-PB1. The best results can be obtained by adjusting the monitor's TINT controls so the digits glow orange and so that all the violet turns to deep blue – the point just before the digits start to show pink. With this setting, the glowing digits really stand out, and the annoying violet is eliminated from the playfield. On early, 3-color machines, the best you can do is turn the violet to blue. The digits will remain green.

Resolution Adjustment

Night Mission has a game theme, so many small numbers and letters had to be put right on the playfield, just as in a real pinball game. Some of these letters are on 3×4 matrices (instead of the standard 5×7). Low bandwidth black and white monitors (and many TV sets), and color monitors have trouble resolving some of the writing. On black and white monitors, be sure that the settings are not too bright. You can gain a bit of resolution by decreasing the brightness and contrast.

On color monitors you can trade off resolution for color by adjusting the COLOR control. Blend in color until the decrease in resolution begins to get annoying, then back off a bit. The DROP rollover lanes are a good test pattern. Poor monitors or settings will cause the letters to look more like DRIP.

Sound

There is no way to modify the fidelity of the small internal speaker. The cassette port is sent the same signal as the speaker, however, so you can use this output to drive an external amplifier and large speaker. Also note that the sound can be turned off, and its characteristics can be modified using the fix system.

The *FIX SYSTEM* and Custom Modes

Forty parameters control the characteristics of the pinball game. The ten standard SubLOGIC modes are simply variations of these parameters. The *fix system* allows you to get at these parameters and create your own playing modes. It also lets you change between SubLOGIC modes, turn the sound on or off, and put the machine in a self-play mode.

It is important to read this section before using the fix system. Some parameters, such as sound, are harmless and can be set to anything without consequence (other than the sound being turned on or off). Others such as *BALL TRAILS (LIM)* can cause the machine to crash if adjusted improperly. Fix system use will now be covered.

Entering the Fix Mode

When the machine is in its *game over* mode, type the word "FIX" on the keyboard. This will not echo on the screen, but after it is typed, a large fix menu will come onto the screen. The ITEM column lists the function, CURRENT lists the parameters in effect for the current play mode, and NORMAL lists the range of these parameters.

Using the Editor Arrow

The arrow in the FIX column on the menu points at the item that can be changed or *edited*. You can cycle this arrow to the item you want to change by hitting *return* repeatedly (or the *rept* and *return* keys simultaneously.) You can backspace the arrow through the FIX column by hitting the minus (-) key. When the edit arrow points at the correcty item, simply type in the value you want, followed by *return*. Note that the back arrow performs backspace in the edit field.

Exiting the Fix Mode

Hit *esc* (the "escape" key) to return to the play mode.

Working with Modes

All the values in the CURRENT column and the current high score comprise a *mode*. There are 110 modes numbered 0 through 109. They are broken down as follows:

Modes	Function
0	Competition Mode
1	Easy Mode
2	Self-play demonstration mode
3	Medium difficulty mode
4	High difficulty mode
5	Cosmic mode
6	Slow motion mode
7	High speed mode
8,9	Other SubLOGIC modes
10-19	User-modifications of SubLOGIC modes 0-9 (or user modes – not recommended)
20-109	User modes

You can switch between modes by typing in the mode number on the fix menu item *PLAY MODE*. Modes 0-9 come setup, but modes 10-109 are filled with garbage. Putting any undefined modes into effect will usually crash the system when you go back into play mode. Note that the CURRENT values can safely be anything as long as you remain in the fix mode.

If you try to modify any parameter in a SubLOGIC mode (except the LOCK CODE or SOUND), the SubLOGIC mode along with the change you made will automatically be copied to the current mode plus ten and the mode will switch to it. If you are in mode 6, for example, and you try to give yourself 6 balls per game, you will end up creating a new mode – mode 16. This mode will be exactly like SubLOGIC mode 6 but will have 6 balls.

Copying Modes

Very seldom will you want to start a mode purely from scratch. Usually you will want to make a few modifications to an existing mode, try out the changes, and perhaps back track to the old mode if things didn't work out right. This is where the advantages of mode copying and 100 modes to work with are realized. You can switch to a new mode and bring all the information from the old mode number with you (copy it to the new mode) by adding 100 to the mode number when you specify the new mode.

If you are in mode 50 and want to copy the mode to mode 63 and start working with mode 63, specify the *PLAY MODE* as 163.

Saving Modes

You can save the mode on a high score/mode disk. Only one mode and high score is saved per disk (the mode currently in effect), and you must exit back to play mode (game over mode) to do it. NOTE: Make sure to insert your high score disk before typing "Control-R" or "Control-W."

Adjustable Parameters

Adjustable parameters will now be covered. It is advisable to stay within the ranges specified for the parameters. If you decide to try out of range values, be aware of how data is stored in the parameters. Parameters are either one, two, or three byte values internally. When you type in a number, it is converted from ASCII to a triple precision integer (unsigned) of range 0 to 16,772,215. For one byte parameters, the least significant byte is taken. For double precision, the least and mid significants are used, and all three are used for triple precision values (such as free game score and lock code). It is impossible to specify a value above 999,999 due to the limits of the editor arrow's editing template. If you specify huge numbers for single-byte parameters, only the least significant byte will be used. A 256 will yield a zero, for example.

When you enter a modification, it is changed to binary and sent to the mode buffer. The whole CURRENT column is then updated from the mode buffer so you can see what really went into the buffer and if the mode changed because of it. The screen updating is too fast to see, but is sometimes noticeable as a small flash. NOTE: Adjustment values are always positive. Negative numbers will not be accepted by the edit arrow.

The Adjustable Parameters

FREE GAME SCORE: This is the score that when exceeded will result in a free game. The range is 0 to 999,999.

BALLS PER GAME: The number of balls issued per player per game. The range is 1 to 99. The BALL digits are the limiting factor.

FORWARD INCLINE: This is the gravity effect. Low values of about 8 are normal. High values are *strong gravity*. The range is 0 to 255.

SPINNER FRICTION: This controls how fast the spinner slows down after a ball gets it spinning. Values of about 15 look like the real thing. High values slow it down quickly. The range is 0 to 127.

TILT EFFECT: Bumping the machine jostles the ball. This controls how big the effect will be on the ball. Values of 20 or 30 are normal. The range is 1 to 255.

TILT SENSITIVITY: This determines how sensitive the machine is to bumping. A sensitive machine will TILT easily. Tilt is based on probability. This value is a mask, not a linear control the following values and resulting probabilities are available:

Value	Probability of a tilt	
0	1 in 1	always tilt
1	1 in 2	
3	1 in 4	
7	1 in 8	
15	1 in 16	
31	1 in 32	
63	1 in 64	
127	1 in 128	
255	1 in 256	rarely tilt

HOLE KICKER KICK: This is the speed at which the hole kicker will eject its ball. A value of 3 to 6 is normal. A value of 0 or 1 will cause the ball to get stuck in the hole and will freeze up the game. The range is 0 to 63.

KICKER DELAY: How long the hole kicker waits before ejecting the ball. The hole kicker activates a bomb dropping sound. Upon ejection, the A drop target is often hit, cutting the whistle off with an explosion. Long delays give a longer whistle effect. Range: 1 to 127.

MAX BONUS COUNT: The maximum bonus that will be counted. When all ten screen bonus lites lite, they are turned off and start liting up again. The system keeps track of bonuses beyond ten and counts them down multiple times upon ball drain. Range: 1 to 127.

BONUS COUNT RATE: Determines how fast the bonus will be counted down. Range: 1 (very fast) to 127 (slow).

BALL TRAILS: This determines what kind of ball trails will be generated. 00=no trails, 01=trails for balls exceeding the ball speed limit, 02=trails always.

BALL SPEED: This controls ball speed. The larger the variable, the slower. Values of 8 to 11 are about right. Range: 1 to 127. NOTE: This value should never be less than SPEED COMPENSATE/4+1.

BALL SPEED LIMITER: This limits the ball's speed by cutting the ball's velocity down to 7/8 its old velocity per display frame if the the speed limit is exceeded. Balls that exceed the speed limit also get their ball trailers turned on until they drop to the speed limit (if ball trails are set for this mode). The larger the value, the higher the speed limit. A value of 3 is a slow ball, and 15 is very fast. Range: 1 to 63.

RANDOMIZER: There is a computer behind this pinball game, and unless some random ball motion is introduced, the ball takes the same path every trime (especially out of the striker until the first flipper hit). The randomizer introduces randomness to the balls by shaking them pseudo-randomly. The random shaking is in a right and left direction and averages out to zero to keep the ball from drifting to the right or left. You can watch the randomizer work by specifying high randomizer values. Normal values are 20 to 30. Range: 0 to 251.

NEW BALL DELAY: The time the machine waits between dispensing new balls. Range: 1 (short time) to 127 (long time)

SELF PLAY: This puts the machine into a self-playing mode. In this mode, you have to get the machine started, but from then on it plays itself (automatically feeding quarters and pressing the start button as well as the flippers and striker). You can kick the machine back into fix mode by pressing the period (.) key at any time. 00 = self play off, 01 = self play on.

FIX MODE LOCK CODE: This code, if other than 0, must be typed after typing "FIX" in order to enter the fix mode from the game over mode. There is no feedback on the screen when you are typing it in, so it is much like a password in a large computer system. You must follow the number with a *return*. For the lock code 1357, for example, you must type:

FIX1357 (*return*)

The system will then enter the fix mode. After you type FIX, the system will seem to freeze up. It is waiting for your code number. Typing a wrong number, or simply a *return* will put you back into play mode. NOTE: Be sure to remember your lock code! Range: 0 = no code. 1 to 999,999 = valid codes.

SOUND: This is the sound switch. 0 is off, 1 is on.

BUMPER IMPULSE: This controls the impulse given to the balls when they hit a bumper. Values of about 30 are normal. Range: 0 (pure bounce) to 127 (huge impulse).

LEFT V THRESHOLD, VELOCITY X, VELOCITY Y and RIGHT V THRESHOLD, VELOCITY X, VELOCITY Y: These parameters control the impulse given to the balls by the V-Impulsers. The threshold determines the speed the ball must be moving to activate the impulser. Values of 1 and 2 are sensitive, 4 is normal, and 10 makes the V-Impulsers nearly impossible to activate. The X and Y velocities control the speed and direction of the impulse in the horizontal (right or left) and vertical (upward) directions. Values of X should be about 4 times those of Y to correspond to the V-Impulser's angle. Values of Y = 2 are about right. High values give strong impulses. Range: 0 to 127 on all values.

KBD FLIPPER DELAY: The keyboard hardware only lets software determine the instant a key is pressed, not if it is being held down continuously. The "Z" and "/" keys that control the flippers in keyboard mode therefore cannot act like real flipper buttons because there is no way of knowing that the key is being held down. To get around the problem, a delay is used. The system holds a flipper up for this delay time after the key is pressed, then drops it. The response characteristics are a matter of personal preference. Short delays (values below 15) give snappy response but make it nearly impossible to repeatedly press the key to keep the flipper up (this is how you hold balls with the keyboard flipper system). Long delays (above 30) make it easy to keep the flippers up, but the response seems sluggish. Values of 20 are a good compromise. Range: 0 to 127.

CITY SPOT RATE: This is the delay between cities being re-lit when a ball enters the dive bomb chute. Short spot rates (5 or less) lite them almost immediately while long delays (up to 127) cause long pauses between re-lites. Long delays affect strategy because only a few cities may be re-lit when the ball passes over them again. Range: 1 to 127.

DIVE BOMB SHOOT V: The velocity at which the dive bomb chute launches its balls. Values of 16 or 20 are normal. Don't make this value too low. If the ball doesn't get out of the chute on the first launch, it never will. Range: 0 to 63.

MATCH COUNTDOWN RATE: The rate at which match numbers are cycled through. Low numbers cause faster cycling. Values of 8 are about normal. Range: 1 to 127.

BALL TRAILS (LIM): This limits the maximum number of ball trailers that can follow a ball. Up to 9 balls can trail the orginal. This value is the number of balls times two. The only valid values are 2, 4, 6, 8, 10, 12, 14, 16, 18, and 20 for zero through nine balls. NOTE: Values other than these will cause improper ball trail indexing and can crash the machine.

DRONE SOUND: Whenever a ball is in play, a constant drone sound (supposedly aircraft engines) is generated. The characteristics of this sound can be changed by using different values in this byte. Zero will turn droning off completely. This value requires experimentation to get the sound you want. Range: 0 to 255.

EASY MULTI-BALL: When zero, the dive bomb chute holds balls when NIGHT and FLY sequences are met. When one, the chute is put into hold mode at the beginning of every ball. In both cases, the ABCD sequence, 4 balls in chute, or ball drain releases the balls.

BIG HISTORY DIAG: When set to 1, this gives a detailed history of the ball's path. This is primarily a diagnostic debugging tool that we use at SubLOGIC to analyze errors. Basically, memory from 9600 hex to bfff hex contains X, Y coordinate pairs of the last 5378 ball locations. The coordinate system used is 0,0 in the upper left corner of the screen and 279,191 at the lower right. The current buffer pointer address can be found at location b5fe, b5ff hex, least significant byte first. NOTE: This destroys part of the higher mode (modes above 50) buffers.

SOUND PERIOD: This controls the sound oscillation period for background sounds. It primarily affects droning. The higher the value, the lower the frequency. Values near 20 are about right. Making this value too low can slow down the simulation as more time is spent doing sound processing. Range: 2 to 127.

FLIPPER POWER LEFT and RIGHT: These two variables control the impulse produced by the left and right flippers. Zero results in bounce only, while values above 60 provide huge impulses. Values of 40 are about right. Range: 0 to 127.

RESTITUTION: This controls the overall bounciness of all bounce surfaces (except the flippers). High values correspond to a restitution coefficient of nearly one (totally elastic bounce). Note that some surfaces have additional damping and total elastic collisions are never possible on these (the bottom of the ball striker for example). Range: 0 to 127.

SPEED COMPENSATE: This value increases the ball speed to compensate for increases in processing times in multi-ball situations. Adjust this parameter so no noticeable slowdown occurs when 4-balls are active. Range: 0 to 255. NOTE: Never make this value greater than (BALL SPEED-1) ×4.

FLIPR RESTITUTION: This controls the overall bounciness of the flippers. Range: 0 to 127.

Resetting the High Score

You can reset the High Score to zero on any mode by typing the letter "Z" while in fix mode. You must do this for user modes because a random high score will come up in a newly created mode.

Ball Speed Dependence

The adjustable parameters have effects on one another. The most notable is the BALL SPEED which affects everything from sound quality to bonus countdown, kicker delay, and city spot rate. Keep this in mind when adjusting the ball speed parameter.

Testing Your Modes

As with a real pinball game, it is possible to adjust A2-PB1 in ways that make poor and unplayable as well as good and enjoyable games. It's even possible to generate situations where the ball gets stuck. It's a good policy to test your mode before playing it extensively.

The self-play mode is particulary useful for testing. You can immediately exit from it back into the fix mode by typing "." if anything goes wrong. The tilt system can help break a ball loose if it gets stuck, as can the randomizer.

Final testing can be performed by letting the machine play itself for a few hours at high speed (by turning the BALL SPEED way up) with the randomizer on to keep it from locking into a single ball path. If the mode has problems, this is bound to find them.

Finally, let us know if you find any problems or have any comments or exciting new modes. We're always interested in getting user feedback, and we incorporate many suggestions into our products.

Function Summary

Game Over Mode

"Q" = Insert Quarter.
"S" = Start Button.
"Control-K" = Keyboard mode select.
"Control-P" = Paddle mode select.
"Control-R" = Read a high score/mode disk.
"Control-W" = Write a high score/mode disk.
FIX = Enter fix mode.
FIX1234 *return* = Enter fix mode with lock code of 1234.

Play Mode

Paddle 0 Button = Left Flipper
Paddle 1 Button = Right Flipper
Paddle 0 Dial = Striker control
Z = Left Flipper (Keyboard playing mode only)
/ = Right Flipper (Keyboard playing mode only)
Right Arrow = Increase pull on striker (Keyboard mode only)
Left Arrow = Decreases pull on striker (Keyboard mode only)
1, 2, 3, 4, 5, Q, W, E, R, T, A, S, D, F, G, Z, X, C, V, B, *esc* = Left machine bump
6, 7, 8, 9, 0, :, -, Y, U, I, O, P, H, J, K, L, +, N, M, ,, ., / = Right machine bump
! = Machine freeze and single-step. Any other key unfreezes machine.

Fix Mode

Return = Advance the edit arrow to new parameter.
1234 Return = Replace the parameter with the value 1234 decimal.
Escape = Acts as Return, but exits to play mode afterwards.
1234 Escape = Replaces parameter with the value 1234 then exits to play mode.
Z = Reset high score to zero.

Self-Play Mode

Period key (.) = Return to fix mode immediately.
! = Freeze and single step. Any other key unfreezes.

Pinball Jargon

Bonus: *Bonus points* are counted up one-by-one as you drop targets or make sequences. This is in addition to any points you may have received for the hit. When the ball drains, the points are counted down one-by-one and a set number of points are given for each one (usually 1000 points). Bonus points are usually shown as individual lites on the playfield (a bomb in Night Mission – pool balls, or simply lites with numbers over them on other popular games).

Bonus Multiplier: This number is usually shown on the playfield as a lite that says 1X, 3X, or 5X. When the bonus is counted down, it is multiplied by this number. Instead of getting 1000 points per bonus lite, you get 3000 or 5000. You usually must make a sequence of targets or hit a special target with appropriate 3X or 5X markings to advance the bonus multiplier. In most machines, a few bonus multiplier lites can be on at once. In some cases, the highest multiplier is used. Other games count down the bonus once per bonus lite thereby giving 1×1000 + 3×1000 + 5×1000 points. Some games multiply bonus numbers together giving 1×3×5×1000 or 15000 points per bonus lite if 1X, 3X, and 5X are all on.

Captive Hole: This is a recessed hole in the playfield (usually at the end of a *tunnel*) that the ball can roll into. The hole *captures* the ball, holds it a few seconds, then quickly shoots it out. Captive holes usually trigger special events such as activating lane arrows, spinner, or target multipliers. Special sounds are produced for the few seconds that the ball is in the hole.

Credits: This indicates how many single-player games you are entitled to. Inserting quarters, as well as winning free games, advances the credits. In multi-player games, one credit is used per player.

Drain: Losing the ball between the flippers or down the outlanes.

Drop: The act of knocking down a standup target.

Hole Kicker: A captive hole.

Lane Lites: These are small lites (with no letters or numbers over them) that appear in a set of adjacent lanes. The goal is to turn all these lites ON (as opposed to lane letters that you try to turn off). Lane lites are sometimes rotatable, that is you can press one of your flippers and all the turned-on lites will move one place to the right (with wraparound). The goal is to guess which lane the ball is going to roll down as it bounces around at the top of the lanes, and to rotate a non-lit lane lite to that position before it does. Points are usually awarded for each lane lite as well as for completing all the lane lites (at which time they are all turned off).

Lite: This is how pinball game designers spell *light*.

Make: This applies to sequences of targets or events and means that you have successfully completed the sequence. In Night Mission, for example, the city lites come on when you make the NIGHT rollovers.

Match: At the end of the game you are automatically given a chance to win a free game. A set of 2-digits (sometimes the ball digits) cycles through a few random numbers, then stops at a random 2-digit number. If the last two digits in your score match the two match digits, you win a free game. Due to score inflation, most machines these days only give multiples of ten points. Match digits on real games often cycle through odd numbers that are not multiples of ten, but even these always stop on multiples of ten. In multi-player modes, each player's score is compared against the match value. With 4 players, you have a good chance of matching (the same probability as if you played 4 single-player games). You can win more than one game if more than one player matches.

Out Lanes: These are the ball guides on the sides of machine that cause the ball to drain (the D in the DROP lanes in Night Mission for example).

Rollover: A place on the playfield (usually within lanes) where you get points if the ball rolls over that point. Real pinball games have small metal sensing wires and switches to sense rollover. The sense wires come in two forms: the kind that are ramped on both sides which let the ball roll over in either direction, and the single ramp kind that only allow the ball to roll over in one direction.

Special: A special is a target (usually a rollover on one of the out lanes) that lites when you make a certain sequence. If you manage to roll a ball down the rollover when the special lite is lit, you win a free game (or only a free ball on some games).

Spot: The act of raising a standup target or reactivating a rollover target lite. On Night Mission, ball drain spots ABCD and FLY.

Standup Target: A target that protrudes out of the playfield and pops down if you hit it.

Program Statistics

Author: Bruce Artwick

Program Size:	Code	18,557 bytes
	Tables	6,858 bytes
	Screen memory	8,192 bytes
	Total	33,607 bytes + 53 bytes per mode

Ball Projection Rate: 230 balls/second

Language: 6502 assembly language

Internal Mathematics: 16-bit integer

Overall System Structure: 8-way time-sliced executive with interleaved sound.

Development System: SubLOGIC Solid-State Disk Z80 system using a TDL Z80 macro assembler with SubLOGIC's 6502 preamble, and SubLOGIC's Screen Edit 9 pixel editor.

Developed: November '81 through February '82 in Champaign, Illinois, and Amsterdam, Holland.

The high speed math routines are from SubLOGIC's A2-3D1 3-D graphics package, developed August '79.