

Black Jack 2020

A Software Update
Using Additional
Hardware

This version of Black Jack is enable with a daughter card plugged into the J5 connector of the MPU. It's controlled with a switch mounted inside the cabinet, below the right flipper. In one position, the MPU will boot to the code from 1977. In the other position, the daughter card takes over an runs the new code.

Because this implementation only addresses the PIA chips on the MPU board, it eliminates the need for the PROM, RAM, and cRAM chips at U2, U6, U7, and U8. Because of this, MPU boards with damaged chips or sockets at those locations can still be used. This implementation also uses the EEPROM on the Arduino to store the high score, credits, and audit values, so a battery on the MPU is also not required.

For details on building the hardware & software, please visit the wiki on GitHub:
<https://ballysternos.github.io/>

Black Jack 2020 Test/Audit/Parameters

(available through switch inside coin door)

00:01 - Lamps

XX:XX - Displays

00:03 - Solenoids

00:04 - Switches

00:05 - Sound (not used)

01 - Award Score Level 1

02 - Award Score Level 2

03 - Award Score Level 3

04 - High Score to Date

05 - Current Credits

06 - Total plays (Audit)

07 - Total replays (Audit)

08 - Total times high score was beaten (Audit)

09 - Chute #2 coins (Audit)

10 - Chute #1 coins (Audit)

11 - Chute #3 coins (Audit)

12 - Free play off/on (0 - off, 1 - on)

13 - Ball Save Num Seconds (0, 5, 10, 15, 20 seconds)

14 - Tilt Warning (0 - immediate tilt, 1 warning, 2 warnings)

15 - Tournament/Novelty Scoring (0, 1, 99)

16 - Music Level (0, 1, 2)

17 - Extra Ball Award (0, 1,000 - 100,000)

18 - Special Award (0, 1,000 - 100,000)

19 - Award Score Override (0 - 7, 99)

20 - Balls per game Override (3, 5, 99)

21 - Randomize Deck (0, 1, 2, 3)

22 - No Player Hit Over 16 (0, 1)

23 - Number of "Changer Dealer" hits to show Dealer's Card (0, 1, 2, 3, 4, 5, 99)

24 - Player Loses on Ties (0, 1, 99)

25 - One Special Per Ball (0 - unlimited, 1 - one)

26 - Coins Per Credit (Chute 1)

27 - Coins Per Credit (Chute 1)

28 - Coins Per Credit (Chute 1)

29 - Disable Reset (1 = Credit/Reset disabled after ball 1)

Note 1: There are no defaults - please check the settings on first power-up.

Note 2: Activating the Slam Switch will save settings and restart Attract Mode at any time.

Lamps

Credits Display: **00** / Ball in Play Display: **01**

When first entered, all lamps will flash at 2Hz.

Pressing the Credit/Reset button will change the Player 1 score to 00 and the first lamp will flash. Repeated pressing of Credit/Reset button will cycle through all lamps (00-59) and then loop back around to 99, which will flash all lamps.

Displays

Credits Display: **XX** / Ball in Play Display: **XX**

When this mode is entered, all displays will cycle through the digits (1-9), changing at 4Hz.

Solenoids

Credits Display: **00** / Ball in Play Display: **03**

When this mode is entered, the solenoids (0-14) will be energized one at a time and the solenoid number will be displayed in the Player 1 score box. Each solenoid will be energized for $3/120^{\text{ths}}$ of a second.

Pressing the Credit/Reset button will toggle the automatic advance of the solenoid number to energize the same solenoid multiple times in a row.

Switches

Credits Display: **00** / Ball in Play Display: **04**

When this mode is entered, the ID of the first closed switch will be shown in Player 1 score box. Further closed switches will be displayed in Player 2, 3, and 4 boxes. Displays will be blank if there are no closed switches to show.

Sound

FUTURE FEATURE: Credits Display: **00** / Ball in Play Display: **05**

This mode will test the sound features (when available).

Award Score Levels

Credits Display: **00, 01, 02**

The game keeps three Award Score Levels. They are set using the Self Test switch (modes 1, 2, and 3). If an Award Score is set to zero, there is no award given. Otherwise, the award is controlled by the DIP switches (Switch 6) or the Award Score Override (Self Test mode 17). The current Award Score (0, 1, or 2) is shown in the Player 1 score box.

During game play, when an Award Score Level is crossed, the player receives the award (extra ball or credit). For tournament mode, the Award Score Levels should all be reset to zero.

In these three setting modes (1, 2, and 3), the scores are changed with the Credit/Reset button. Pressing the button once increases the score by 1,000 points. Pressing and holding the Credit/Reset button will gradually increase the score. Double-clicking the Credit/Reset button will return the given score to zero.

The Award Score Override (Self Test mode 17) can be set to 0-7, or 99. A value of 0-7 overrides the setting of the DIP switches to award either an extra ball or a credit for the given score. A value of 99 turns off the override so the DIP switch (Switch 6) setting will be used.

High Score to Date

Credits Display: **04**

When a player's score exceeds the High Score to Date, the new High Score is recorded and shown during the Attract Mode. Depending on the DIP switch setting (Switch 15), the game will award 3 Credits when a high score is reached.

In this mode, the score can be changed with the Credit/Reset button. Pressing the button once increases the score by 1,000 points. Pressing and holding the Credit/

Reset button will gradually increase the score. Double-clicking the Credit/Reset button will return the score to zero.

Credits

Credits Display: **05**

This mode allows the operator to see/change the number of credits currently on the machine. The number of credits will appear in the Player 1 score box.

Pressing the Credit/Reset button will increase the number of credits up to 20, and then cycle back around to 0.

Audits

Credits Display: **06, 07, 08, 09, 10, 11**

The audit features allow the operator to inspect/reset usage values of the machine.

Double-clicking the Credit/Reset button will reset any of the audit values back to zero.

06 - Total plays - total number of games that have been played since this value was reset.

07 - Total replays - total number of credits awarded since this value was reset.

08 - Total times high score was beaten - total number of times the high score has been beaten since this value was reset.

09 - Chute #2 coins

10 - Chute #1 coins

11 - Chute #3 coins

Free Play

Credits Display: **12**

Player 1 score display will show a “0” meaning Free Play is OFF, or a “1” meaning Free Play is ON. The 0 and 1 are toggled by pressing the Credit/Reset button. As soon as the value is toggled, it is written to memory and the machine can be reset into Free Play mode.

If off, the machine will require a positive credit count in order to start a game. Credits can be added through the coin chutes or through setting mode 5.

If Free Play is on, hitting the Credit/Reset button will start a game (if in Attract mode), add a player (if ball 1 is in play), or restart the game if ball 2 or more is in play.

Ball Save

Credits Display: **13**

The Ball Save timer is controlled through this mode. The Player 1 score display will read 0, 6, 16, or 21. Why those values? I don’t know. Write your own software if you want values that make sense to you. Or, change this software—it’s easy. Seriously, though, those values are because the “21” only shows up for a tenth of a second, and I wanted the display to basically count down from 20, not from 19.

Pressing the Credit/Reset button cycles through the different values. Setting the Ball Save to “0” turns off the Ball Save feature.

Tilt Warning

Credits Display: **14**

This parameter can be set to 0, 1, or 2, and it represents the number of warnings the player gets before the machine Tilts. At “0”, the machine will tilt at the first

hard nudge. A value of “2” will warn the player twice and tilt on the third hit. A tilt warning consists of a sound.

The Credit/Reset button cycles between “0”, “1”, and “2”.

Tournament/Novelty Scoring

Credits Display: **15**

This parameter turns on and off tournament scoring (also known as novelty scoring). Instead of awarding an Extra Ball and Special (for credits), it awards the number of points specified by Extra Ball Award (parameter 18), or Special Award (parameter 19).

Set this to 0 to allow for Extra Balls and Specials (credits).
Adjusted to 1, the Extra Ball and Special will grant points.
Adjusted to 99, the DIP switch setting (switches 14 & 15).

Music Level

Credits Display: **16**

This value controls the amount of sound effects played in the game. Setting to “0” makes the sound effects minimal. A “1” gives some sound, and a “2” gives the full sound. The current level is displayed in the Player 1 score box.

The Credit/Reset button cycles between “0”, “1”, and “2”.

Extra Ball Award

Credits Display: **17**

This parameter controls the score awarded for winning a hand when “Extra Ball” is lit. It’s only used when Tournament/Novelty Scoring (parameter 15) is set to 1. Setting this score to zero will award an Extra Ball. This score can be set in 5,000

point increments between 0 and 100,000.

Special Award

Credits Display: **18**

This parameter controls the score awarded for winning a hand when “Special” is lit. It’s only used when Tournament/Novelty Scoring (parameter 15) is set to 1. Setting this score to zero will award a Credit. This score can be set in 5,000 point increments between 0 and 100,000.

Award Score Override

Credits Display: **19**

Normally, DIP switches 14 & 15 control what the player gets for achieving an Award Score. This override lets the operator set extra ball or credit for each of the 3 award scores (set in modes 1, 2, and 3) individually.

The Credit/Reset button cycles through the values 0-7 and then jumps to 99. If set to 99, the DIP switch value is used. Otherwise, the award is based on the table below.

| Award Score Override | Score 1 | Score 2 | Score 3 |
|----------------------|--------------|--------------|--------------|
| 0 | Extra ball | Extra ball | Extra ball |
| 1 | Credit | Extra ball | Extra ball |
| 2 | Extra ball | Credit | Extra ball |
| 3 | Credit | Credit | Extra ball |
| 4 | Extra ball | Extra ball | Credit |
| 5 | Credit | Extra ball | Credit |
| 6 | Extra ball | Credit | Credit |
| 7 | Credit | Credit | Credit |
| 99 | (DIP switch) | (DIP switch) | (DIP switch) |

Balls Per Game Override

Credits Display: **20**

Normally, the balls per game (3 or 5) is controlled by DIP switch 16. This setting allows that to be overridden so the operator doesn't have to go inside the head of the machine to change the value.

Pressing the Credit/Reset button cycles through 3, 5, and 99. A setting of 99 means that the balls per game will be set by DIP switch 16. Otherwise, the balls per game comes from this setting.

Randomize Deck

Credits Display: **21**

This parameter has four settings (0 - 4). For tournament modes, a hard-coded deck (option 0) is recommended in order to give every player the same cards. Descriptions of the settings are as follows:

0 - Every player uses the hard-coded deck, and every player starts from card #1 in that deck. The cards dealt will be 4, K, K, 7, J, Q, 6, Q, 6, 10, etc. for the first ball. For subsequent balls, each player will start where they left off in the deck. In the event that the player is dealt all 52 cards, they will start again at the top of the deck.

1 - Every player uses the hard-coded deck, but they all start where the last player left off in the deck. If the first player sees 4 cards, player two will begin from card #5.

2 - The deck is shuffled at the beginning of the game, and every player starts from card #1.

3 - The deck is shuffled at the beginning of the game, and every player gets the next card from where the previous player left off.

No Hit Over 16

Credits Display: **22**

This parameter controls the behavior of the Red (Change Player Card) Standups. When set to “1”, hitting a Red Standup will not hit if the player already has over 16. This is to prevent unintentional busts. A setting of “0” will hit any time a Red Standup is hit during a hand.

Number of Change Dealer Hits to Show

Credits Display: **23**

When the cards are dealt, the dealer’s bottom card is hidden with the display showing a “88”. If this setting is “0”, the bottom card is shown, giving the player the advantage of knowing the dealer’s tally. If set between 1-5, the player has to hit the Yellow Standup (change dealer’s card) in order to see the bottom card.

Player Loses Tie

Credits Display: **24**

If this parameter is set, the player will lose a tie with the dealer. A setting of 0 gives ties to the player. A setting of 1 gives the win to the dealer in the case of a tie. If set to 99, the DIP switch setting (switch 32) is used.

One Special Per Ball

Credits Display: **25**

If this parameter is set, the player will only get one special award per ball. This limit only applies to the Credit, and not to the bonus score. Set to “0” and the

player can receive unlimited Specials. Set to “1” and the player can only be awarded one special.

Press the Credit/Reset to change this setting.

Coins Per Credit 1

Credits Display: **26**

This setting controls the Coins Per Credit of Chute 1. The number of Coins shows up in the Player 1 display. The number of Credits granted appears in the Player 2 display.

Pressing the Credit/Reset button cycles through the following presets.

| Price of Credit (\$0.25 mech) | Coins (Player 1) | Credits (Player 2) |
|-------------------------------|------------------|--------------------|
| \$0.25 for 5 | 1 | 5 |
| \$0.25 for 4 | 1 | 4 |
| \$0.25 for 3 | 1 | 3 |
| \$0.25 for 2 | 1 | 2 |
| \$0.25 | 1 | 1 |
| \$0.25 for 1, \$0.50 for 3 | 2 | 3 |
| \$0.50 | 2 | 1 |
| \$0.75 | 3 | 1 |
| \$1.00 | 4 | 1 |

Coins Per Credit 2

Credits Display: **27**

This setting controls the Coins Per Credit of Chute 2. The number of Coins shows up in the Player 1 display. The number of Credits granted appears in the Player 2 display.

Pressing the Credit/Reset button cycles through the following presets.

| Price of Credit (\$0.25 mech) | Coins (Player 1) | Credits (Player 2) |
|-------------------------------|------------------|--------------------|
| \$0.25 for 5 | 1 | 5 |
| \$0.25 for 4 | 1 | 4 |
| \$0.25 for 3 | 1 | 3 |
| \$0.25 for 2 | 1 | 2 |
| \$0.25 | 1 | 1 |
| \$0.25 for 1, \$0.50 for 3 | 2 | 3 |
| \$0.50 | 2 | 1 |
| \$0.75 | 3 | 1 |
| \$1.00 | 4 | 1 |

Coins Per Credit 3

Credits Display: **28**

This setting controls the Coins Per Credit of Chute 3. The number of Coins shows up in the Player 1 display. The number of Credits granted appears in the Player 2 display.

Pressing the Credit/Reset button cycles through the following presets.

| Price of Credit (\$0.25 mech) | Coins (Player 1) | Credits (Player 2) |
|-------------------------------|------------------|--------------------|
| \$0.25 for 5 | 1 | 5 |
| \$0.25 for 4 | 1 | 4 |
| \$0.25 for 3 | 1 | 3 |
| \$0.25 for 2 | 1 | 2 |
| \$0.25 | 1 | 1 |
| \$0.25 for 1, \$0.50 for 3 | 2 | 3 |
| \$0.50 | 2 | 1 |
| \$0.75 | 3 | 1 |

| | | |
|--------|---|---|
| \$1.00 | 4 | 1 |
|--------|---|---|

Disable Restart

Credits Display: **29**

This selection will disable the Credit/Restart button during game play, after ball one is complete. At any time during ball one, the Credit/Restart button will add a player. After that, if this setting is “0”, the button will cancel the current game and start over. With this setting at “1”, the button will have no effect until the game is finished.

Press the Credit/Reset to change this setting.

DIP Switches

DIP Switches

1 - Credits/Coin — controlled through adjustments 26-28

2 - Credits/Coin — controlled through adjustments 26-28

3 - Credits/Coin — controlled through adjustments 26-28

4 - Credits/Coin — controlled through adjustments 26-28

5 - Credits/Coin — controlled through adjustments 26-28

6 - High Score Number of Credits Awarded bit 1

7 - High Score Number of Credits Awarded bit 2

8 - Melody = (Simple, OFF), (Full, ON)

9 - Credits/Coin — controlled through adjustments 26-28

10 - Credits/Coin — controlled through adjustments 26-28

11 - Credits/Coin — controlled through adjustments 26-28

12 - Credits/Coin — controlled through adjustments 26-28

13 - Credits/Coin — controlled through adjustments 26-28

14 - Novelty scoring / replay / extra ball

15 - Novelty scoring / replay / extra ball

16 - Off = 3 Balls per game, On = 5

17 - Max Credits = (5, OFF-OFF-OFF) to (40, ON-ON-ON)

18 - Max Credits second digit

19 - Max Credits third digit

20 - Credit Display = (No, OFF), (Yes, ON)

21 - Match Feature = (None, OFF), (Yes, ON)

22 -

23 -

24 -

25 - Credits/Coin — controlled through adjustments 26-28

26 - Credits/Coin — controlled through adjustments 26-28

27 - Credits/Coin — controlled through adjustments 26-28

28 - Credits/Coin — controlled through adjustments 26-28

29 - Not Used

30 - Suits carried

31 - Suits carried

32 - Off = Player loses ties, On = Player wins ties

Coin Chutes

Coins inserted during attract mode will grant credits based on Adjustments 26-28.

Coin Lockout

If the number of credits is at the maximum value (set by DIP switches 17, 18, and 19), then the coin lockout will be enabled. Otherwise, it's not.

Credit Reset

Pressing the Credit/Reset button in Attract Mode will start a 1-player game if the machine is in Free Play or there is at least 1 credit. (Pressing the button again during ball 1 will add a player.)

Skill Shot

At the start of the ball, top lanes will pulse in sequence. This is referred to as a “Roving Skill Shot.” Hitting the Roving Skill Shot will award 1000 points, play a sound, and award both suits of the same color. For example, hitting the Hearts skill shot will award both the Hearts and Diamonds light and also light the Red pop bumper.

If the ball misses all the top lanes and instead goes into the saucer, all the suit lights will be lit and 5,000 points will be awarded.

Ball Save

If enabled (parameter 13), the Ball Save will cause the “Same Player Shoots Again” light to flash at the beginning of the ball for a number of seconds. The Ball Save can be set to 0, 5, 10, 15, or 20 seconds. If the ball drains during the Ball Save time, the ball will be kicked back out to the plunger and the ball save will be over.

During Ball Save time, the amount of time left for ball save will be shown on the credits display.

At the beginning of each ball, the player’s score flashes until the first switch is hit. The timer doesn’t start until the first switch hit.

Betting & Collecting

Once the player has accrued at least 1,000 bonus, the Bonus X lights will sweep towards the saucer indicating that a bet can start. Over the course of 10 seconds, the bonus bet lights (shown on the bonus tree) will start at 1k and increase up to the player’s current bonus - 1k. Whenever the ball lands in the saucer, that bet amount will be locked in.

Once the ball lands in the saucer to lock in the bet, the cards will be dealt. For players 1 & 3, the player’s cards will show in Display Box #2. The dealer’s hand

will show in Display Box #4. If the dealer's card is hidden, it will be represented with "88".

The ball will be ejected from the saucer and returned to the player so they can do one of the following actions:

- ◆ Drain - this is most common
- ◆ Use either Red Standup target to "hit", adding another card to the player's hand. The Red Standups will be disabled if the player already has more than 16 points and "No Player Hit Over 16" is set (parameter 24).
- ◆ Use either Yellow Standup target to show dealer's bottom card. The number of hits to a Yellow Standup required to show the dealer's card can be set to 0 - 5 (parameter 25).
- ◆ Surrender the bet - if the player is likely to lose, they can hit the left spinner to dial back the bet. Using the spinner, the bet can be reduced to 1k.
- ◆ Add an Ace to the player's hand with any of the four suit rollovers in the top lane
- ◆ Putting the ball back into the saucer will complete the hand.

Winning the hand will award the wagered bonus, and increase the Bonus X Multiplier. The awards for winning are:

- ◆ 2x
- ◆ 3x
- ◆ 5x
- ◆ Extra Ball (or score, if Tournament/Novelty scoring is set)
- ◆ Special (or score, if Tournament/Novelty scoring is set)

If the hand is lost, the player will surrender the wagered portion of their bonus.

Top Lanes

Rolling through the top lanes will light them and the associated bumpers. In addition, lighting the left two lanes (Clubs & Diamonds) will light the left outlane. Lighting the right two lanes (Spades & Hearts) will light the right outlane.

Lighting all four lanes will light the spinner for 1,000 per spin.

Once all four lanes are lit, they can be lit to flash. The lanes will flash faster each time they are completed.

Awards

Points & bonus awards are noted on the playfield, but here's a rundown.

- Pop Bumpers
 - Black - 10 when dark, 100 when lit, 200 when flashing
 - Red - 10 when dark, 1,000 when lit, 2,000 when flashing.
- Left Spinner - 50 or 1,000 when lit
- 10-pt Switches - 10 points
- Slingshots - 10 points
- Saucer - 5,000
- Saucer Rollover -
- Change Player - 100 points, plus 2,000 bonus
- Change Dealer - 100 points
- Outlanes - 100 points, 50,000 when lit
- Inlanes - 1,000 points, 1,000 bonus
- Saucer Rollover - 1,000 points, 1,000 bonus

Bonus Collect

If the player wins 5 hands in one ball, and lights all the top lanes until they're flashing, they can collect the bonus during the ball by entering the saucer again.

This bonus countdown is multiplied by the 5x Bonus Multiplier.

Bonus lights that are flashing represent 2x the stated value. The 10k and 20k lights are added to the 1-9 light. Therefore, bonus can increase to 69,000 (20k flashing, 10k flashing and 9k lit). A maximum bonus of 5 x 69,000 can be achieved = 345,000 points.