Trident 2020

An update to a class Stern machine.

This rewrite of Stern's Trident is accomplished by plugging a daughter card into the J5 connector of the MPU. The SB-100 already connects to J5, so the board built will mirror J5 up so the SB-100 can still be plugged in.

This board supports a switch that will allow the operator to boot to the original Trident code and use the M6800 to run the machine. However, in the other position, the switch will halt the M6800 and allow the Arduino to boot and take over gameplay.

The code for the Arduino can be compiled to use the SB-100 for sounds, but a Wav Trigger is recommended in order to provide digital sounds.

A Wav Trigger can be purchased from spark fun or Amazon. The currently supported model is the WIG-13660.

Creating the Arduino Controller Daughter Board

Please visit the GitHub repository for instructions on building the daughter card, and compiling the software for the Arduino.

Hardware & Software Documentation: https://ballysternos.github.io/
Code Repository: https://github.com/BallySternOS

Trident 2021 Test/Audit/Parameters

00:01 - Lamps

XX:XX - Displays

00:03 - Solenoids

00:04 - Switches

00:05 - Sound

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 beaten (Audit)

09 - Chute #2 coins (Audit)

10 - Chute #1 coins (Audit)

11 - Chute #3 coins (Audit)

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

13 - Ball Save Num Seconds (0, 6, 11, 16, 21)

14 - Music Level (0, 1, 2, 3, [4, 5]) [if WAV Trigger is enabled in the build]

15 - Tournament Scoring (0-no, 1-yes)

16 - Tilt Warning (0, 1, 2)

17 - Award Score Override (0 - 7)

18 - Balls per game Override (3, 5)

19 - Scrolling Scores (0-no, 1-yes)

20 - Extra Ball Award (0 - 100,000) [only used for Tournament Scoring]

21 - Special Award (0 - 100,000) [only used for Tournament Scoring]

22 - Dim Level (2=50%, 3=33%)

CHECK ALL VALUES YOUR FIRST RUN - THERE ARE NO DEFAULTS!

Activating the Slam Switch at any time will reboot into Attract Mode.

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. Pressing the Credit/Reset button will move through the digits one at a time so they can be tested individually.

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 $3/120^{ths}$ 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**

In the future, this mode will test the sound features.

Award Score Levels

Credits Display: **01, 02, 03**

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 scoring mode (when available), the Award Score Levels will be ignored.

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.

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

Music Level

Credits Display: **14**

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. A setting of "3" plays the sounds and background music. The current level is displayed in the Player 1 score box.

The Credit/Reset button cycles between "0", "1", "2", and "3".

Tournament Scoring

Credits Display: **15**

A value of "0" indicates that Tournament Scoring is off. With a value of "1", Extra Balls and Credits will not be awarded. Instead, the player will get a point bonus (set by parameters 24 & 25). In Tournament Scoring, Award Scores will be deactivated. Pressing the Credit/Reset button toggles between these values.

Tilt Warning

Credits Display: **16**

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".

Award Score Override

Credits Display: **17**

Normally, DIP switch 6 controls what the player gets for achieving an Award Score. DIP switch 6 set to "0" awards an extra ball, and "1" awards a credit. 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: **18**

Normally, the balls per game (3 or 5) is controlled by DIP switch 7. 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 7. Otherwise, the balls per game comes from this setting.

Scrolling Scores

Credits Display: **19**

When the player's score exceeds 999,999, the scores will either wrap around to 0 or they will begin to scroll. A setting of "0" in this parameter will make the scores

wrap to 0. A setting of "1" will allow the scores to scroll through the 6-digit displays.

Pressing the Credit/Reset button will toggle this value.

Extra Ball Award

Credits Display: **20**

The Extra Ball Award is only relevant in Tournament Scoring mode. If Tournament Scoring is activated, collecting the Wow! Targets will give this award instead of Shoot Again.

In this mode, the score is 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.

Special Award

Credits Display: **21**

The Special Award is only relevant in Tournament Scoring mode. If Tournament Scoring is activated, collecting the Special Targets will give this award instead of a credit.

In this mode, the score is 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.

Dim Level

Credits Display: **22**

The Dim Level adjustment allows the operator to choose the duty cycle of "dim" lights. At a level of 2, a dim bulb will be lit 50% of the time. At a level of 3, a dim bulb will be lit 33% of the time. With some bulbs, a noticeable flash will be present at a duty cycle of 33%. With other bulbs, a 50% duty cycle will appear nearly the same as a fully-lit lamp. This adjustment should be re-checked on new machines or if the bulbs are changed.

When in this mode, the bonus lamps will toggle between the dim value and the full-lit value (every second). This allows the operator to see the contrast between the two.

Pressing the Credit/Reset button will toggle the dim level between 2 & 3.

DIP Switches

DIP Switches

This game currently ignores the DIP switches.

Coin Chutes

Right now, any of the coin chute switches will add 1 credit. A sound is played when a credit is added (controlled by Music Level).
This ignores the Credits/Coin DIP switches entirely.

Coin Lockout

If the number of credits is at the maximum value (40), then the coin lockout will be energized. 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, the playfield lights indicate that several skill shots are available.
1) Saucer Skill Shot - the saucer value ranges between 5k and 30k. Landing the ball in the saucer awards the lit value.
2) Drop Target Skill Shot - during the skill shot, all drop targets are raised. Hitting any drop target awards 10k points and 2x Bonus Multiplier.
3) Stand Up Target Skill Shot - if a stand up target is hit during the skill shot, the player is awarded 15k.
4) Left Spinner Skill Shot - hitting the left spinner during the skill shot awards the player 10k.
5) Rollover Skill Shot - hitting the rollover during the skill shot awards the player 8k and starts the left lane value at 6k.

Hitting any other switch immediately ends the skill shot mode.

During the course of normal play, the point values indicated on the playfield are honored.

Saucer - the saucer value begins at 5k and the award builds with successive hits within 10 seconds. Once the saucer is hit, it's worth 10k for the next 10 seconds. Hit again, it will increase to 20k. After 10 seconds, the value decreases one notch.

Drop Targets - the drop targets increase the bonus multiplier. Two targets are presented to reach 2x, three targets for 3x, etc. At a prescribed level, completing the drop targets will begin "Sharp Shooter" mode. At another level, the targets will be lit for Special.

Stand Up Targets - these targets increase the value of the spinners. Hitting a stand up target of a particular color will light that color to be collected with each spin. For five seconds after a stand up is hit, it will flash and the reward for spins will be doubled. For example, hitting the green stand up lights the right spinner for 400 points (plus the default 200 points for the right spinner). But, for five seconds after the green stand up is hit, the right spinner is lit for 800 + 200 points (double reward while flashing). If multiple stand ups are hit while flashing, the double reward time is multiplied by the number of flashing stand ups. When the stand ups are all cleared, Explore the Depths mode is qualified and the Extra Ball on the right in lane is lit. The second time the stand ups are completed, the Special is lit.

Pop Bumpers - the pop bumpers are worth 100 points per hit.

Rollover - the rollover target is worth 1k points and increases the value of the left in lane by 2k.

Left In Lane - the left in lane value is shown on the lights above the lane. The value begins at 2k, and will increase in 2k increments up to 14k based on how many times the rollover target is hit. The lane switch also increases the bonus by 1k.

Upper Sling Shots - the top sling shots increase the bonus value

Lower Sling Shots - the upper sling shots are worth 10 points.

Right In Lane - the right in lane awards 3k points and increases the bonus by 3k. When solidly lit, the right in lane awards an Extra Ball. If Extra Ball is not lit, the Extra Ball lamp will flash for "Rescue from the Deep" when the in lane switch is hit. This gives the player a 6-second ball save in case the ball exits through the gap in the wire form.

Right Out Lane - the right out lane awards 5k points and increases the bonus by 3k. When lit, it also awards a Special.

Tournament Mode - when tournament mode is enabled (setting 15), an Extra Ball awards the points dictated by setting 20, and a Special awards the number of points dictated by setting 21.

Qualifying and Starting Modes

Feeding Frenzy - this mode is activated by hitting alternating spinners 4 times. For example, if the right spinner is hit, the left spinner will be lit for a hurry up. The spinner will be lit for 30 seconds. Each time the same spinner is hit, the timer is reset on the alternating spinner. After 4 alternating hits, Feeding Frenzy will be qualified for 45 seconds.

Sharp Shooter - after the drop targets are cleared for 3X, Sharp Shooter mode will be qualified. Sharp Shooter will remain qualified for 45 seconds.

Explore the Depths - after all the stand up targets are hit once, Explore the Depths will be qualified for 45 seconds.

Staring Qualified Modes - when one or more modes has been qualified, the bonus lights will roll upwards and the saucer lamps will cycle. If the saucer is hit during this time, the mode will begin. One, two, or three modes can be qualified at once. If two modes are qualified, all mode points will be doubled. Three modes will grant triple mode scoring. A single mode runs for 40 seconds, two modes run for 66 seconds, and three run for 107 seconds.

Mode Scoring

During mode play, the alternate displays will show the time remaining in the current mode(s).
Feeding Frenzy - spinners are lit for 5k per spin.
Sharp Shooter - drop targets are worth 2k each.
Explore the Depths - stand up targets are worth 10k each.

Mode Completion

When the mode timer completes the player receives a bonus for each mode goal hit. Each spinner hit gives an additional 1k, each target gives 2.5k, and each stand up gives 2.5k.
If the player has scored goals in all three modes, at the end of the timer the wizard mode (Deep Blue Sea) will begin.

During normal play, when the player hasn't scored in 2 seconds, the alternate displays will show the status of each mode. For example, when Player 1 is up, the 2nd display will show Feeding Frenzy hits, the 3rd display will show Sharp Shooter hits, and the 4th display will show Explore the Depths hits.

When the player has achieved hits in all three modes, and they've successfully finished a mode (the timer reaches 0), then Deep Blue Sea will begin.

Deep Blue Sea lasts 110 seconds and all mode shots are lit for triple scoring.

In addition, when the mode begins, the saucer will be lit for a jackpot. The jackpot value is 1k for each spinner hit, 10k for each drop target, and 10k for each stand up target. To relight the jackpot, the player has to complete at least one hit of each goal (one spinner, one drop target, and one stand up). The jackpot value will then be based on those goal hits since the last jackpot.