

# Bally<sup>™</sup>/Stern<sup>™</sup> 7-digit Replacement Display Kit



# **Assembly Instructions**

When assembled, this display will replace the Bally/Stern 7-digit display used on many solid state pinball machines from 1980 to 1986. For the complete list of compatible machines, see the list at the end of these instructions.

Tools:

Soldering iron - A small to medium power soldering iron of 25-50 watts with a small tip, preferably temperature controlled, is recommended.

Wire cutters - A set of diagonal or wire cutters intended for cutting electronic component leads.

Flux Cleaner – Isopropyl Alcohol, Denatured Alcohol or Flux Remover to be used for cleaning the board after assembly.

Solder - Use only solder designated for electronic component assembly. Either lead-based or lead-free flux-core solder are both acceptable.

ightarrow Use of solid core, acid core or plumbing solder is not acceptable and will void the warranty.  $\leftarrow$ 

All soldering should be done on the bottom (non-printed) side of the boards. This kit uses "old school" through-hole components requiring only basic soldering skills to assemble. However, if you have never soldered before or are unsure of your skill level, it is recommended that you first practice soldering on a scrap board before beginning to assemble this kit. There are many references on the internet which can help you learn how.



Solder melts at around 400°F (s200°C). Remember to use care when soldering as both the soldering iron and solder are <u>extremely</u> hot and can produce serious burns. Make sure that you use an appropriate work surface since molten solder may drip and hot solder and components may damage or burn many materials.

Eye protection is recommended as solder can splash and component leads may fly when cut.

We are not responsible for any damage or injury as a result of assembling this kit.

Remember: Solder and components will remain very hot for several minutes after soldering.

## Parts List:

#### Control Board "A"

Part Description	Ref	Qty	
Printed Circuit Board 'A', Marked: P/N 1604		1	
IC, Marked: 74HCT540	U2	1	
IC, Marked: CD4543	U3	1	D CD454 8BE
IC, Marked: ULN2803	U4	1	
Transistor, Marked: 2N3906 or 2N4403	Q1-Q7	7	
Diode, 1N4148	D1-D2	2	
Capacitor 0.1uF, Marked: 104 or Capacitor 0.22 uF, Marked: 224	C1-C2	2	
Resistor 1000 Ohm Marked: Brown-Black-Black-Brown-Brown Or Brown-Black-Red-Gold	R1-R7	7	
Female Header, 2x8 Position Straight	J2-J3	2	TRUTT
Male Header, 18, 19, or 20 Positions Straight (Shipped as 2 pieces)	J1	1	

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#### Display Board "B"

Part Description	Ref	Qty	
Printed Circuit Board 'B', Marked: P/N 1602		1	007 005 005 003 002 001   133mmt 0
Printed Circuit Board spacer, Marked: P/N 1603		1	D51 D52 D53   D53 D54 D55   D64 D55 D56   D55 D60 D55   D56 D56 D56   D55 D60 D55   D56 D56 D57   D56 D50 D57   D57 0000 D57   D50 D57 D57   D57 D50 D57   D57 D50 D57   D50 D57 D57
7-Segment LED Display, Marked: 8012A	DS1-DS7	7	B.
Rectangular LED	D3,D4	2	s
Male Header, 2x8 Position Right Angle	J4,J5	2	
Foam Bezel		1	
Resistor, See table 1 for value and marking based on the color of the LED digits in your kit:	R10-R16	7	-41115
Resistor, See table 1 for value and marking based on the color of the LED digits in your kit:	R17	1	-(ini)-

Table 1, Resistor R1, R10-R15 value					
LED display color		Value	Marking		
Orange	R10-R16	150 Ohn	Brown-Green-Black-Black-Brown		
	R17	150 Ohm	Brown-Green-Black-Black-Brown		
Red	R10-R16	150 Ohm	Brown-Green-Black-Black-Brown		
	R17	150 Ohn	Brown-Green-Black-Black-Brown		
Blue	R10-R16	100 Ohm	Brown-Black-Black-Black-Brown		
	R17	150 Ohm	Brown-Green-Black-Black-Brown		
Green	R10-R16	100 Ohm	Brown-Black-Black-Black-Brown		
	R17	150 Ohm	Brown-Green-Black-Black-Brown		
White	R10-R16	100 Ohm	Brown-Black-Black-Black-Brown		
	R17	150 Ohm	Brown-Green-Black-Black-Brown		

## Start Here:

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Before starting, check the components received against the parts list on page two. If any components are missing, or you have any questions regarding these assembly instructions please contact Wolffpac Tech at 'wolffpactech@gmail.com'.

If you have any problems with the display after assembly, you may contact Wolffpac Tech at 'wolffpactech@gmail.com'. If you need to return the display for repair, we will provide a pre-paid return label. Any problem found to be due to defective components will be repaired free of charge within 1 year of purchase. Any problem found to be due to assembly error or damage will be charged for postage and the cost of any components which need to be replaced.

#### **Control Board:**

Step 1: Start with the larger PC Board 'A' marked P/N 1604:



Insert U2 (74HCT540) into the board from the top side (the side with the lettering) so that one pin goes through each hole at the location labeled 'U2'. Each chip is marked with a 'U'-shaped notch on one of the short ends:



This end should line up with the notch printed on the PC board. You may find that you have to bend the legs of the chip inwards <u>slightly</u> in order to get both rows to line up with the holes in the board. You can do this with needle nose pliers or by laying the chip on its side with the pins of one side on a hard surface pointing away from you and

gently pressing down and away on the body of the chip. Be careful not to bend the pins too far. Once inserted, you can bend the pins at the corners from the underside of the board in order to hold the chip in place.

Make sure that all of the pins from the chip are completely inserted through the holes in the board before soldering in place from the bottom.

Step 2. Repeat for U3 (CD4543) and U4 (ULN2803).

<u>Step 3</u>: Locate resistors R1-R7. Bend the leads of one resistor approximately 90° near the body of the resistor so that it forms a 'U' shape. Do not force the bend any closer than it will go with light finger pressure or you may damage the component. Insert a resistor into the board at the position marked R1 on the board. The direction does not matter. The leads should line up easily with the holes on the board. Once inserted through the board, bend the leads slightly from the underside of the board to hold the resistor in place against the board. Solder from the bottom. Trim the excess leads from the bottom of the board with diagonal cutters leaving about 1/16 inch. Repeat for R2 through R7.

<u>Step 4</u>: Locate diodes D1-D2. Bend the leads of one diode approximately 90° near the body of the diode so that it forms a 'U' shape. Do not force the bend any closer than it will go with light finger pressure or you may damage the component. Insert the diode into the board at the position marked D1 on the board. The diode <u>must</u> be inserted so that the end marked with a black line is towards the end marked on the circuit board with a line and a square solder pad. Bend the leads slightly from the underside of the board to hold in place and solder from the bottom. Trim the excess leads to about 1/16 inch. Repeat for D2.

<u>Step 5</u>: Locate capacitors C1 and C2. Insert one capacitor at the positions marked C1 on the board. The direction does not matter. Do not force the capacitors to seat against the board using more than moderate pressure. If they do not sit flush with the board, this is okay. Bend the leads slightly from the bottom of the board to hold in position and solder in place. Trim the excess lead length to about 1/16 inch. Repeat for C2.

<u>Step 6</u>: Locate headers J2 and J3. Insert one of the black female 2x8 headers into the position marked J2. Make sure that all pins are correctly inserted through the holes. You may bend the corner pins from the bottom of the board slightly to hold in position. It is <u>very important</u> that J2 and J3 are seated flush against the top of the board. For this reason it is recommended that you solder only one pin on each end of the header until you can confirm that the connector is seated flush and square with the top surface of the board. If not, reheat the pin while pressing on the connector from the opposite side. Once the connector is flush with the top of the board, solder the remaining pins in place. Repeat for J3.

<u>Step 7</u>: J1. Connector J1 is shipped in two pieces. The exact configuration will vary depending on parts availability at the time of shipment. The two pieces together will have either a total of 18, 19 or 20 pins. They are functionally identical.

- If the two pieces total 18 pin positions: The connectors are installed <u>between</u> the two positions marked with a white square. Both positions marked with a white square are both left unconnected.
- If the two pieces total 19 pin positions: Note that one of the pieces is missing a pin. The connectors are installed with the missing pin lined up with the position marked with a white square and the arrow. The position on the end of the connector marked with a white square and <u>no</u> arrow is left unconnected.

If the two pieces total 20 pin positions: Note that one of the pieces is missing a pin. The connectors are installed with the missing pin lined up with the position marked with a white square and the arrow.

The connectors are installed with the friction retainer towards the oiuter edge of the board. The two pieces must be flush with the circuit board and in line with each other. For this reason, it is recommended that you initially solder only one pin on each of the two pieces. If either connector is not in the correct position, remelt the soldered pin while pressing on the connector from the top.

<u>Caution</u>: While soldering, the exposed pins on the top side of the board will get extremely hot! Avoid getting burned!

Once you have confirmed that the connectors are flush with the top side of the board and in line with each other, solder the remaining pins.

<u>Step 8</u>: Locate transistors Q1-Q7. Insert a transistor with the flat side aligned with the printed pattern on the top of the board at the location marked Q1. Bend the leads slightly from underneath to hold them in place while soldering. Trim the leads to about 1/16 inch. Repeat for Q2-Q7

Many Stern pinball machines are wired slightly differently. If this display will be used in a Stern machine, follow step 9. Other wise skip to the Display Board assembly below.

<u>Step 9</u>: If this display will be used in a Stern pinball machine, check the cable on the pinball machine which connects to the displays at J1. For reference, the "key" location is at position 14 and is marked on the Control Board with a white square and arrow.

If the cable has a wire connection in position 12 and no wire in position 11, no changes are required. Skip to the Display Board assembly below.

If the cable has a wire connection in position 11 and no wire in position 12, no changes are required. Skip to the Display Board assembly below.

If the cable has a wire connection in <u>both</u> position 11 and position 12, you will need to cut the trace on the back of the board connecting the pins marked "X2". Use a sharp knife to cut across both ends of the trace on the back of the board. Then slide the sharp knife under one of the cut edges and peel the trace off the board.

#### **Display Board:**

Step 1: Locate PC board 'B' marked P/N 1602:



<u>Step 2</u>: Locate resistors R10-R16. Gently bend the leads of each resistor into a 'U' shape. Insert a resistor through the board at the position marked R10. The direction does not matter. Bend the leads slightly from the bottom to hold the components against the top surface and solder from the bottom. Trim the excess lead length, leaving about 1/16 inch on the bottom of the board. Repeat for R11-R16.

<u>Step 3</u>: If you <u>do not</u> want the display to operate <u>with</u> commas between the digits, skip this step and continue with step 4.

Otherwise, locate resistor R17. Gently bend the leads into a 'U' shape. Insert through the board at the position marked R17. The direction does not matter. Bend the leads slightly from the bottom to hold the components against the top surface and solder from the bottom. Trim the excess lead length, leaving about 1/16 inch on the bottom of the board.

<u>Step 4</u>: Locate J4 and J5. Insert one of the right angle headers into the position marked J4. The end with the right angle bend is inserted into the board. It is <u>very important</u> that the connectors are installed so that the black plastic is flush and perpendicular against the board and the pins on the opposite end of the connector are parallel with the PC board. It is recommended that you solder one pin on each end of the connector until you can confirm that they are correctly aligned before soldering the remaining pins. Repeat for J5.



<u>Step 5</u>: Place the spacer board (P/N 1603) on top of the display board so that the holes are aligned with the larger board underneath as shown below. Insert one rectangular LED in the position marked D3 with the <u>shorter</u> lead towards the top of the board through the square shaped pad. The leads should pass through both the spacer board and the "B" board. Make sure the LED is seated flush with the spacer board. Solder in place on the back of the "B" board (P/N 1602). Repeat for LED D4. Trim the leads to about 1/16 inch.



<u>Step 5</u>: The 7-segment displays are installed in positions DS1-DS7. Install one 7-segment LED so that the pins pass through both the spacer board and the "B" board. Insure that the LED is installed with the '.' towards J4 and J5 and that all 9 pins are correctly seated in the holes. Lay the board face down and solder one pin in each row. Inspect to insure that the display is seated tight and flush with the PC board. If not, reheat the pin while pressing on the display from the front of the board. Once the LED is correctly seated, solder the remaining pins. Repeat for the remaining 6 LED displays.

Note: The pins on the LEDs are slightly closer together than on most parts. Inspect the LED pins carefully for solder bridges between pins.

#### **Final Assembly**

<u>Step 1</u>. Wipe the back side of the board with Isopropyl Alcohol, Flux Remover or water depending on what type of solder you are using to remove the solder flux residue.

<u>Step 2</u>. When dry, peel the clear plastic protective film from the front surface of the LED displays.

<u>Step 3</u>. Install the foam bezel as shown around the outside of the LEDs. Make sure that the foam does not cover any of the active segments.



<u>Step 4</u>. Insert the display "B" board (P/N 1602) into the control "A" board (P/N 1604). Line the pins from J4 and J5 with the holes in J2 and J3 with the LEDs pointing outwards. Press down. About 1/8" of board B should slide behind J2 and J3 as shown below.



<u>Step 5</u>. With the power off, install in your pinball machine. Note that the arrow on PC board 'A' J1 points to the location of the 'key' position for the connector. If the connectors supplied at J1 totalled less than 20 positions, the pin location marked with a white square <u>will not</u> attach to the connector from your pinball machine.

#### Apply power and enjoy!

This is believed to be an accurate list of machines with displays compatible with this replacement. Since we are unable to test this board in every configuration, we take no responsibility for any errors. However, we do welcome feedback as to any errors that are found so that we can update this list.

Note: Most pinball machines which use 7-digit score displays use a 6-digit display for the credit. Please see our 6digit kit if you need a replacement.

#### Bally - P/N: AS-2518-58 :

- Skateball, 9/80
- Frontier, 11/80
- Xenon, 11/80
- Flash Gorden, 2/81
- Eight Ball Deluxe, 4/81
- Fireball II, 6/81
- Fathom, 8/81
- Medusa, 9/81
- Centaur, 10/81
- Elektra, 12/81
- Vector, 2/82
- Spectrum, 6/82
- Speakeasy, 8/82
- Speakeasy 4, 8/82
- Rapid Fire, 4/82
- Mr & Mrs Pacman, 4/82
- Eight Ball Deluxe Limited Edition, 10/82
- BMX 1/83
- Centaur II, 5/83

#### <u> Bally – Midway</u>

- X's & O's, 2/84
- Kings of Steel, 3/84
- Black Pyramid, 7/84
- Spy Hunter, 10/84
- Eight Ball Champ, 8/85
- Eight Ball Deluxe, 11/84
- Fireball Classic, 12/84
- Cybernaut, 5/85
- Beat The Clock 11/85
- Lady Luck, 3/86

#### Stern - P/N A-645 :

- Big Game 3/80
- Catacomb 10/81
- Cheetah 6/80
- Dragonfist 1/82

- Flight 2000 10/80
- Freefall 1/81
- Iron Maiden 10/81
- Lightning 3/81
- Nine Ball 12/80
- Orbitor 12/82
- Quicksilver 6/80
- Seawitch 5/80
- Split Second 8/81
- Viper 12/81



