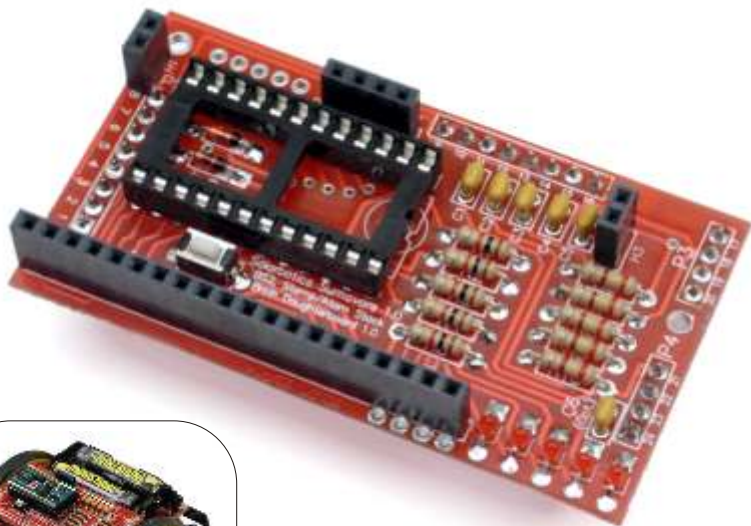# The Solarbotics SUMOVORE
Basic Stamp 2 / Stamp Stack 2 Brainboard

Ready to program your Sumovore?

Here's the BS2 / SS2 Brainboard to replace the Discrete Brain that comes with your Sumovore.

This, plus your Basic Stamp 2 or Stamp Stack 2 Microcontroller (not included) will let you customize your robot's behavior any which way you want!

Produced by

SOLARBOTICS Ltd

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BS2 / SS2 Brainboard Components

1 - Printed Circuit Board (PCB)
5 - 1k Resistors (Brown/Black/Red)
5 - 240 Ohm Resistors (Red/Yellow/Brown)
6 - 0.01µF Capacitors (labled '103')
2 - Diodes
5 - Tiny Red LEDs
1 - Basic Stamp 24 Pin Carrier
1 - Push Button Switch
3 - 4-Pin Headers (1 for building a programming cable)
2 - 8-Pin Headers
2 - 2-Socket Headers
1 - 4-Socket Header
1 - 20-Socket Header
1 - QRD1114 Edge Sensor

Tools Required

Soldering equipment
Side-cutters or fine snips

NOTE: You WILL require a Basic Stamp II, Stamp Stack 2 or similar to use this Sumovore add-on!

We strongly suggest you inventory the parts in your kit to make sure you have all the parts listed. Use a pen, pencil, pricked finger, chocolate bar - anything to mark off the items. If anything is missing, contact us for replacement parts information.

Disclaimer of Liability

Welcome to the first microcontroller-based product offered from Solarbotics Ltd. We won't make a habit of it, we promise. We hate to admit it, but <u>some</u> people like to build robots with microcontrollers. They <u>like</u> to plug a cable in from their PC to the computer and download code. Can you imagine that? *Shudder* (What other kind of response did you expect from a BEAM-centric company? Sheesh!)

This is not a kit for a microcontroller beginner. Anybody using this brainboard should already have the knowledge and techniques to make your microcontroller... microcontrol!

This kit lets you swap out the default discrete brainboard for a programmable version. If you run into any problems, it's a simple process to swap a different brain back in. Didn't you ever have days where that'd be a handy feature for you to have (umm...for the robot, we mean).

This kit features:
    Sockets for any 24-pin BS2 compatible microprocessor
    Sockets for the HVWTech Stamp Stack II BS2-clone
    5 I/O lines configured with RC circuitry to read the edge sensors
    5 I/O lines configured to drive LED indicators
    Microprocessor Reset Switch

If you don't already know, HVWTech Stamp Stack II is a larger, less expensive, functionally-identical microcontroller to the Basic Stamp 2. It has a built-in DB9 cable connector, replaceable interpreter and EEPROMs, robust power system and comes in BS2, BS2SX, and Basic Atom flavours. Oh, it can also be directly installed to a breadboard for rapid prototyping - great if you want to easily share your microcontroller between your robot and breadboard!
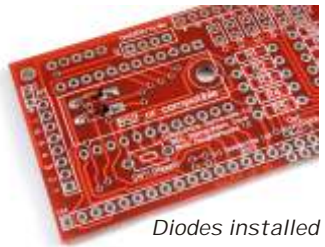
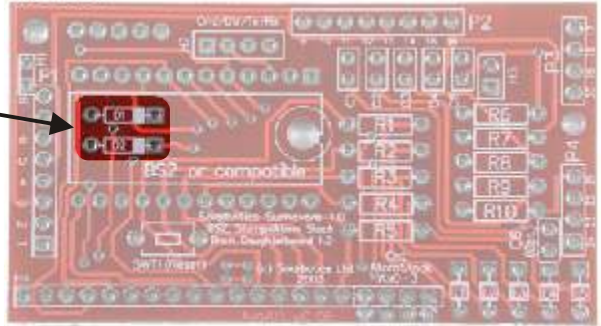Step 1 - Diodes: Bend the diode leads as shown, and install them to positions 'D1' and 'D2'. Diodes are polarity sensitive, so make sure the band on the diode matches the band printed on the PCB!

Step 1:
Diodes (x 2)

Diodes installed

Step 2 - BS2 Carrier: Install the BS2 carrier in the 'BS2 or compatible' position. There's a notch at one end, so make that line up with the notch printed on the circuit board. Backwards BS2's do not work, so keeping the alignment marks going the same way is a good thing. Yes, the carrier is soldered in over the diodes (good thing we put them in first!)
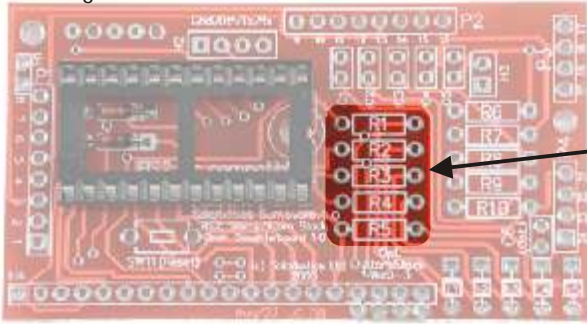
Step 2:
BS2 24-pin carrier (note notch position)

Note notch
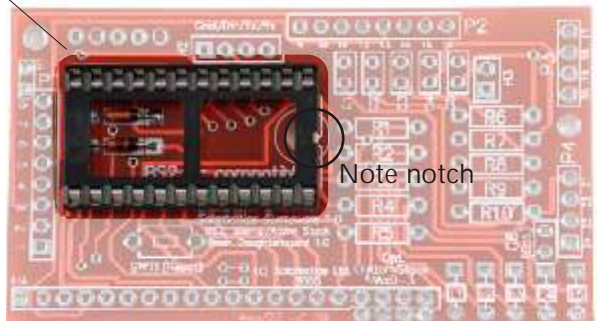
Step 3 - 1k Resistors (Brown / Black / Red): Bend and install the 1k resistors into positions 'R1', 'R2', 'R3', 'R4', and 'R5'. These are the LED indicator current limiting resistors.

Step 3:
1.0k resistors
(x 5)

Step 4 - 240 Ohm Resistors (Red / Yellow / Brown): Just like the last step, except into positions 'R6', 'R7', 'R8', 'R9', and 'R10'. These resistors are part of the RC circuit used by the Basic Stamp to read the edge sensors.
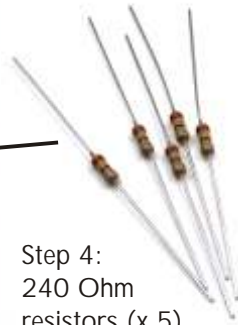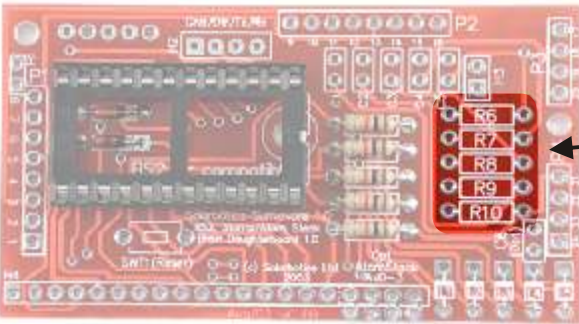
Step 4:
240 Ohm
resistors (x 5)

Step 5 - 0.01µF Capacitors (labled '103'): Install these capacitors in positions 'C1', 'C2', 'C3', 'C4', 'C5', and 'C6'. C6 is a power filter capacitor, so if you are having strange problems with your BS2, you may want to make this one bigger.
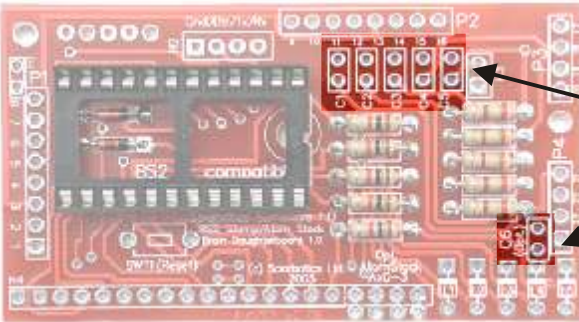
Step 5:
0.01µF capacitors
(x 6)

Step 6 - 7: SWT1 Switch and Tiny LEDs The Reset Switch is installed at location 'SWT1 (Reset)'. It ...uh... resets the microprocessor!
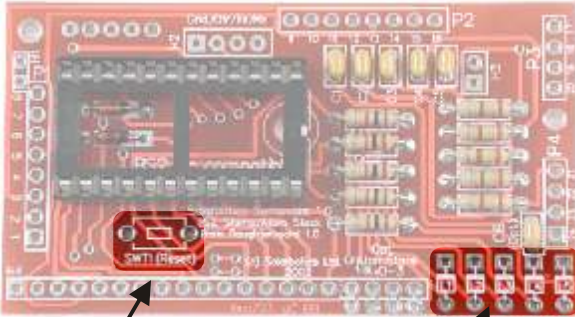
The tiny LEDs have a silver band printed on the backside, and you want that band to match the position of the one printed on the PCB at positions 'L1', 'L2', 'L3', 'L4', and 'L5'.

Note polarity stripe!

Step 6: SWT1 Reset Switch

Step 7: LEDs (x 5)

All electronic assembly complete!
Onto the pins and sockets...

NOTE: You only need to do step 8 if you plan to use an HVWTech Stamp Stack or Atom Stack. Even if you do install the headers, there is no harm to the standard operation of the BS2 Brainboard.
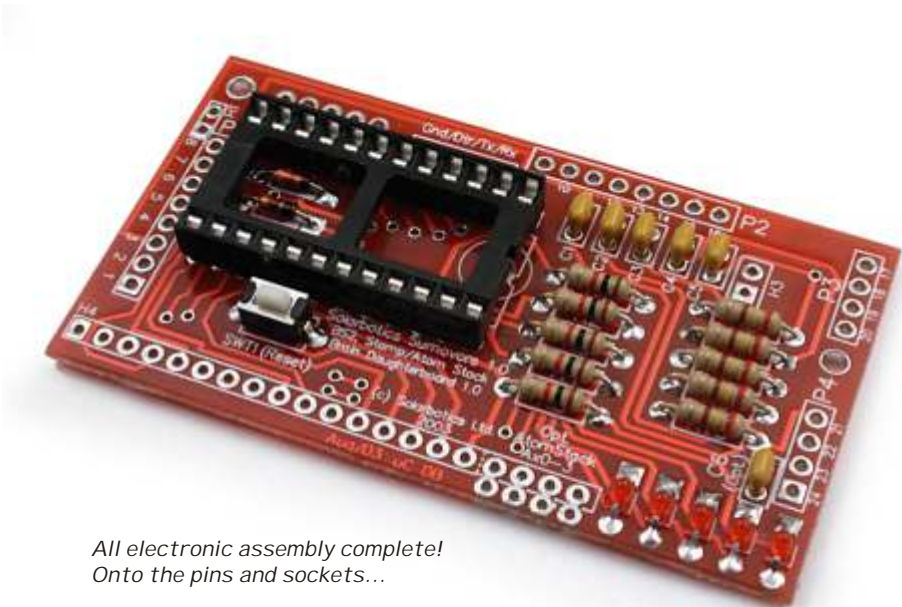
Step 8 (Optional) - Stamp Stack Socket Headers: These headers have to be installed straight up-and-down, so use the same technique you used for doing the pins on the Discrete brain. Install the header, solder only one socket tail, and check for alignment. If all is well, then solder the remaining socket tails.

Install the 2-socket headers to positions 'H1' and 'H3', the 4-socket programming head to position 'H2', and the 20-socket I/O header to 'H4'.

2-Socket Headers

4-Socket Header

20-Socket Header

The long header may be a bit stiff going in, as there are four extra holes at the end used only for the Atom Stack.

(Spare pads for switch or I/O modifications)
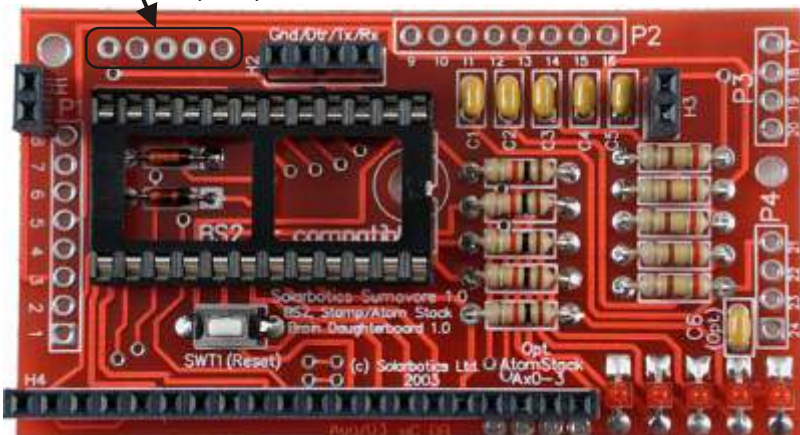
BS2 Brainboard with sockets installed on top
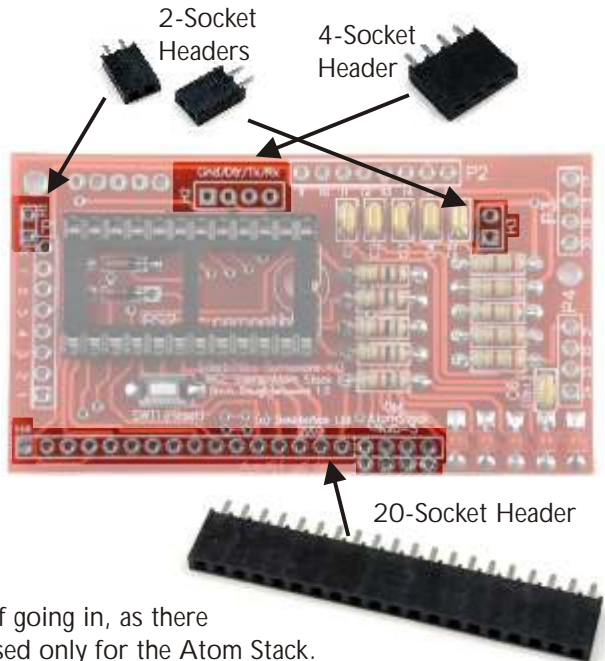
Step 9 - Pin Headers: These pin headers are installed exactly the same way as you did for the discrete brain, as these are what plugs your BS2 brainboard into the Sumovore body.

8-pin headers (x 2)

Solder the two 8-pin headers to positions 'P1' and 'P2' on the underside of the PCB (reverse to what you're used to doing).

Solder the two 4-pin headers to positions 'P3' and 'P4', again on the underside of the PCB. Make it like in the pictures, and you won't go wrong.

4-pin headers (x 2)

Install all pin headers on UNDERSIDE of Brainboard!

Pin headers installed

Completed Brainboard (minus microcontroller)

The BS2 / SS2 Brainboard
Schematics & Programming

You're almost ready to go! Install your BS2-style controller into the holder, noting the side with the little half-moon / notch symbol on it. That goes towards the middle of the brainboard. If you have a Stamp Stack, it'll only go on one way, so that's a given.

To program your BS2 directly on the brainboard, you'll need a 4-pin header for programming your brainboard. We've included a spare 4-pin header so you can build your own out of a serial cable.

You may also want to take the last QRD1114 edge sensor and install it in position 'Edge3' on the edge sensor board. Now you can take advantage of all the sensors, especially for line-follower mode!
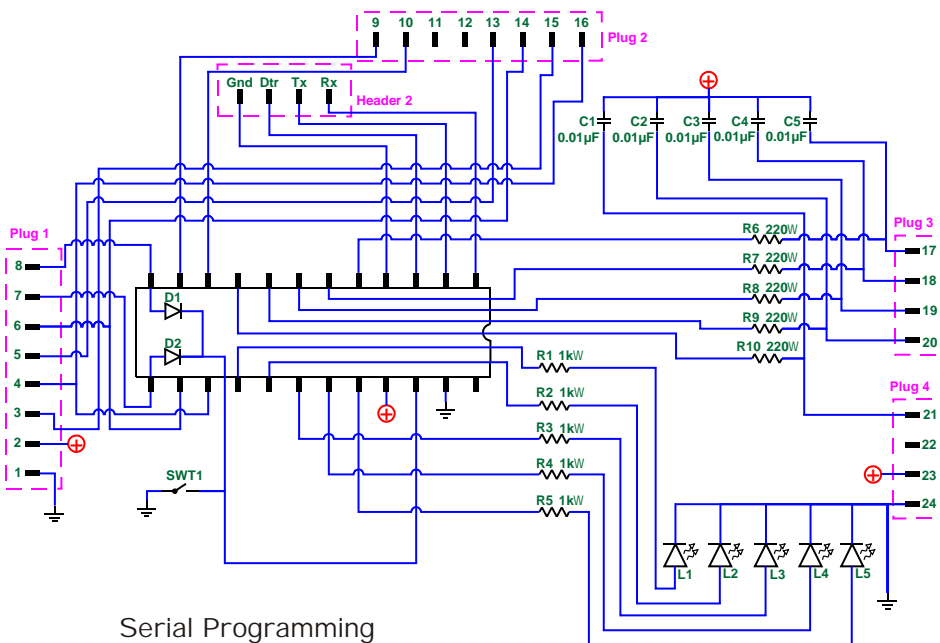
Serial Programming Cable Pinouts

DB25F Pin #	DB9F Pin #	BS2 Pin #	BS2 Function
8	1	-	-
3	2	1	Rx (Receive Data)
2	3	2	Tx (Transmit Data)
20	4	3	DTR (Data Terminal Ready)
7	5	4	Gnd (Vss)
6	6		Connect
4	7		for (LoopBack)
5	8	-	-

Basic Stamp pinout

Prog Header

Pin	Signal
Pin1	Rx
Pin2	Tx
Pin3	DTR
Pin4	Ground

Pin5 (0) — R6 220W — C9 0.01µF — Edge 5

Pin6 (1) — R7 220W — C8 0.01µF — Edge 4

Pin7 (2) — R8 220W — C7 0.01µF — Edge 3

Pin8 (3) — R9 220W — C6 0.01µF — Edge 2

Pin9 (4) — R10 220W — C5 0.01µF — Edge 1

Pin10 (5) — IR Detect Right

Pin11 (6) — IR Detect Left

Pin12 (7) — Motor Enable Right

Pin13 (8) — Motor Enable Left

Pin14 (9) — Motor Direction Right

Pin15 (10) — Motor Direction Left

Pin16 (11) — R1 1kW — L1

Pin17 (12) — R2 1kW — L2

Pin18 (13) — R3 1kW — L3

Pin19 (14) — R4 1kW — L4

Pin20 (15) — R5 1kW — L5

Pin21 — ⊕

Pin22 — SWT1 Reset

Pin23

Pin24

Default Program Operation:

The program we wrote to be the default for the Sumovore (feel free to change…) contains both line-follower and sumo modes, which is self-selected by reading the reflection back from the edge sensors.

On a black sumo platform, the Sumovore is started on a black surface, it kicks into sumo mode and self-calibrates its edge sensors. Releasing the reset button causes the 5 second countdown to begin (shown on the 5-LED display). When the white edge of the ring is detected, the sensor that saw it first triggers the same number LED indicator which stays on until a different edge sensor is triggered.

On a while line-follower platform, the Sumovore kicks into line-follower mode.

These are relatively simple programs to show what you can do. The source code is availabe from our website, and is well documented. Feel free to use the code as a starting point for your own programming projects.

If you have any questions regarding this kit, please contact us!

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