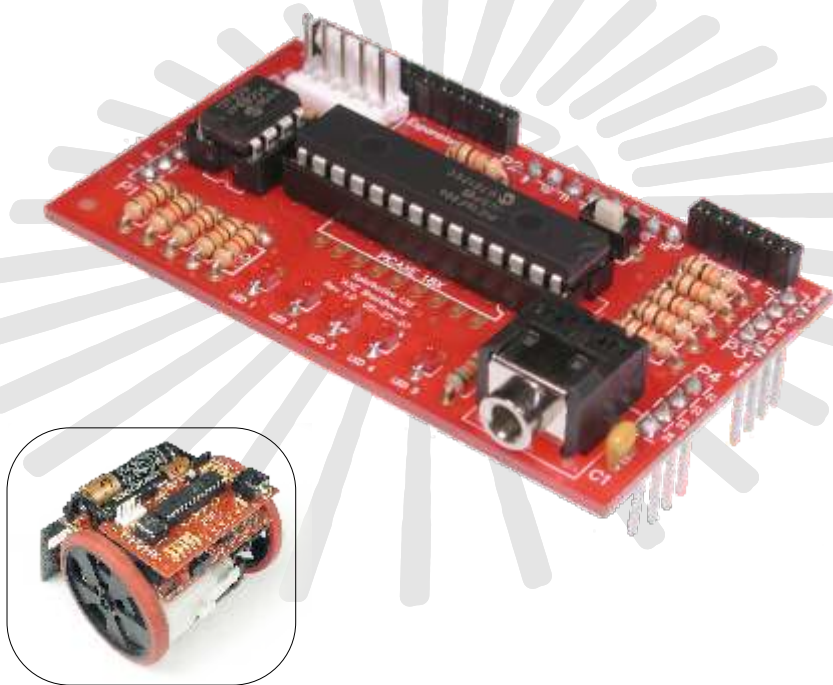


The Solarbotics SUMOVORE

PICAXE Brainboard Add-on
(PICAXE-28X1 Included!)



The NEXT step up from the Discrete Brain:
Build your own programs with BASIC & Flowchart
Programming!

The PICAXE series of microcontrollers from Revolution Technology Education are PIC microcontrollers with special programming that lets you program an inexpensive but powerful microcontroller in a simple and convenient way!

Use the included PICAXE-28X1 microcontroller to add your own personality to your Sumovore!

It's a fast, inexpensive, and simple-to-use upgrade for your
Solarbotics Sumovore Robot Kit!

(Sumovore Sumo robot kit and PICAXE programming cable reqd.)

Produced by



Document Release: Nov 5, 2008

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

Solarbotics Ltd. is not responsible for any special, incidental, or consequential damages resulting from any breach of warranty, or under any legal theory, including lost profits, downtime, good-will, damage to or replacement of equipment or property, and any costs or recovering of any material or goods associated with the assembly or use of this product. Solarbotics Ltd. reserves the right to make substitutions and changes to this product without prior notice. Trademarks mentioned are property of their respective owners. (Sorry, gotta make the lawyer happy!)



The PICAXE™ Brainboard

Parts List

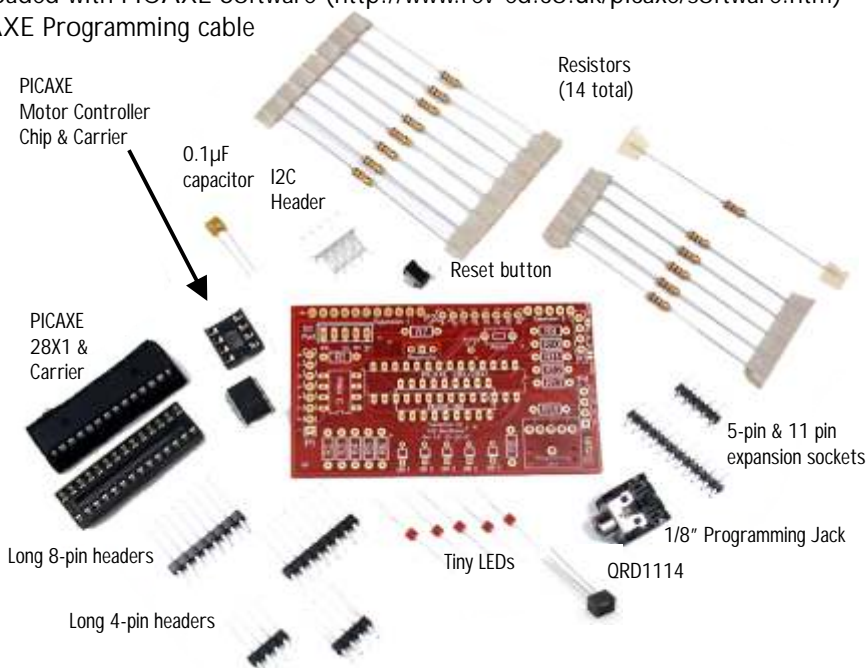


PICAXE Brainboard Components

- 1 - Printed Circuit Board (PCB)
- 1 - PICAXE 28X1 Microcontroller & carrier
- 1 - 28 pin chip carrier
- 1 - PICAXE PWM IC (for motor control)
- 1 - 8 pin chip carrier
- 1 - 1/8" 3-conductor programmer jack
- 1 - Reset Button
- 5 - Tiny red LEDs (sensor indicators)
- 1 - 0.1 μ F capacitor (labeled '104')
- 5 - 1k Resistors (Brown/Black/Red) for Positions R2 to R6
- 8 - 10k Resistors (Brown/Black/Orange) for Position R1, R7 and R9 to R14
- 1 - 22k Resistor (Red/Red/Orange) for Position R8
- 2 - 4-Pin Sumovore interface headers
- 2 - 8-Pin Sumovore interface headers
- 1 - 5-Pin Low-profile Socket for Breadboard expansion board
- 1 - 11-Pin Low-profile Socket for Breadboard expansion board
- 1 - Polarized 5-Pin I²C interface header
- 1 - QRD1114 edge sensor (for Sumovore's middle sensor)

Items Required

- Assembled Sumovore Robot
- Soldering equipment
- Side-cutters or fine snips
- PC loaded with PICAXE Software (<http://www.rev-ed.co.uk/picaxe/software.htm>)
- PICAXE Programming cable





Looking for more flexibility out of your Sumovore, but you're not too up on programming? Let's introduce you to PICAXE™ microcontrollers, by Technology Revolution Education.

The PICAXEs are based on MicroChip "PIC" microcontrollers, with custom code added to make them very easy program. You can start by drawing flowcharts of what you want them to do, and then you simply load that flowchart to the PICAXE! When you get comfortable with how code "feels", you can then convert your flowcharts to a different mode of programming where you use a BASIC-like language that gives you more control.

We designed the PICAXE Brainboard to be compatible with three types of PICAXE chips - the PICAXE-18X, 28X, and 28X1 (which we include). All will support the Sumovore, but the 28X and 28X1 offer more memory and have enough I/O lines to fully support all the front line sensors.

As with all our brainboards, 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 to figure out where the problem is. Now, wouldn't that be a useful feature in humans? Or at least in pesky little brothers?

This brainboard features:

- Support for the PICAXE-18X, 28X/28X1 microcontrollers
- Easy PICAXE 1/8" jack programmer interface
- 5 indicator LEDs
- Official PICAXE PWM Interface IC to drive motors
- Microprocessor reset switch
- Standard 0.1" expansion interface holes for breadboard add-ons
- Spot for optional resonator for more accurate timing



The PICAXE™ Brainboard

Building It - Steps 1, 2

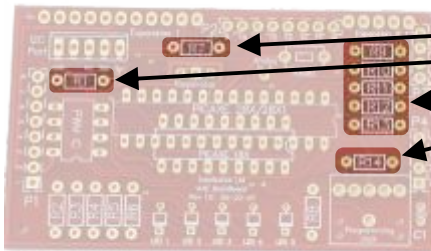


When building this kit, you *must* bend the resistors down right near the resistor body. This PCB is designed on the tight side, so being compact counts!

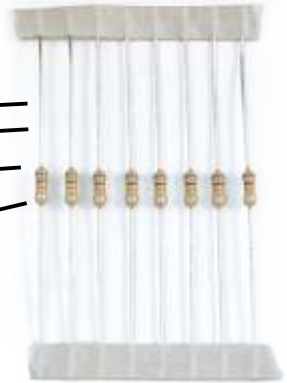
Step 1 - 8 x 10k Resistors (Brown / Black / Orange): The 10k resistors are used for many things on this brainboard, and are installed at positions R1, R9, R10, R11, R12, R13, R14. We always are asked "Um... so what do they do?"

R1 is a motor signal pull-down. R7 is the reset-switch pull-up.

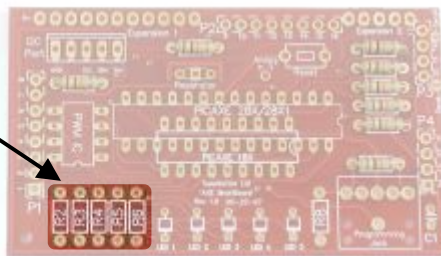
R9 through R13 are PICAXE input pull-ups, and R14 is a programming line safety current limiter.



Step 1: 8 x 10k resistors



Step 2 - 5 x 1.0k Resistors (Brown / Black / Red): The 1.0k resistors are installed in locations R2 through to R6. These are simple current-limiting resistors for the tiny LED indicators.



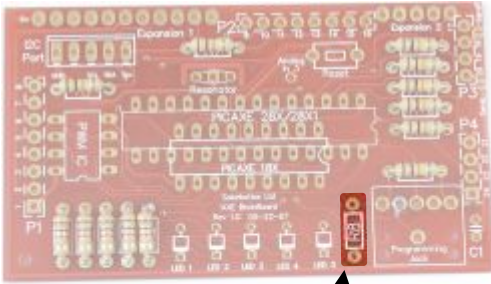
Step 2:
5 x 1.0k resistors



The PICAXE™ Brainboard



Steps 3, 4



Step 3 - 1 x 22k Resistor (Red / Red / Orange): This programming signal-conditioning resistor is installed in location R8.

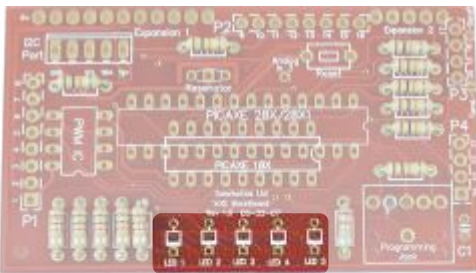
Step 3:
1 x 22k Resistor



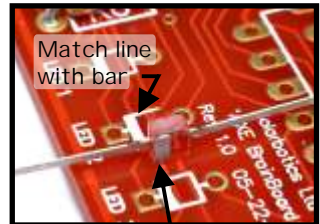
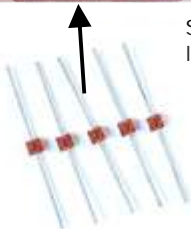
Step 4 - Tiny Red Indicator LEDs: You can't have a robot without blinky lights. Really. Besides, they truly are useful for figuring out what your robot is thinking at any moment.

Unlike resistors, these have to be installed the right-way-around. Look underneath the LED to see which side has the painted bar. That's the side that goes nearest to the bar symbol on the PCB.

Put the red ones in positions LED 1 through LED 5.



Step 4:
Indicator LEDs



Note side with
painted line

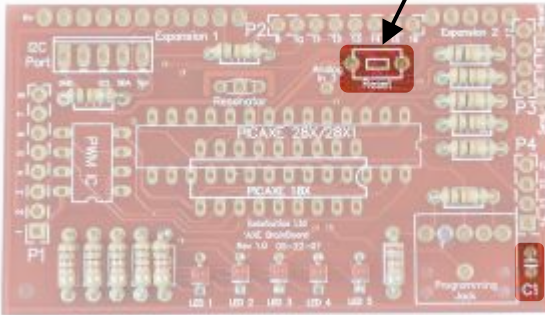


The PICAXE™ Brainboard



Steps 5, 6, 7, 8

Step 5: Reset Switch



Step 5 - Reset Switch:
Install the reset switch in the location marked "Reset".

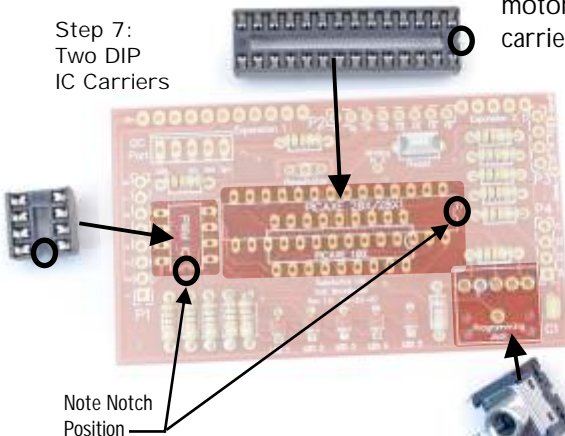
Step 6:
0.1 μ F Capacitor
(marked '104')

Step 6 - 0.1 μ F Capacitor (Labeled '104'): Install the 0.1 μ F capacitor into the location marked C1. This capacitor is part of the power-smoothing for the microcontroller.

Step 7 - DIP Carriers: Yes, it's time to find some people to carry out that dippy little brother of yours so you can finish your project in peace. That, or you'll now install the chip carriers for your Brainboard..

We've got a 8-pin carrier for the motor-control IC, and an 28-pin carrier for the PICAXE-28X

Step 7:
Two DIP
IC Carriers



Install them just as shown, and try to get the notches at the end to line up with the notch printed on the circuit board.

Step 8:
Programming
Jack

Step 8 - The Programming Jack: Yes, it looks like a headphone jack - because it is! Install it into the "Programming Jack" location, and avoid the temptation to connect your earbuds to it.



The PICAXE™ Brainboard

Steps 9, 10



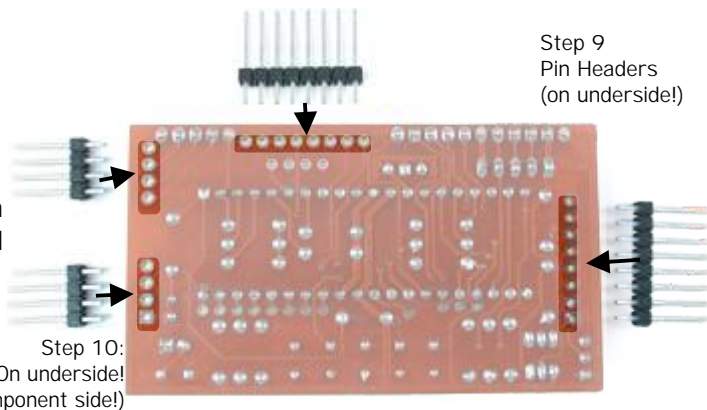
Step 9 - 8 Pin Headers (x 2): To attach your new Brainboard to the robot, you'll need to solder the two 8-pin headers in positions P1 and P2, but on the underside. I don't think you heard me, so...

NOTE / IMPORTANT / READ ME, DARN IT: Install all these pins on the bottom of the PCB. See the dashed outline around P1, P2, P3, and P4 on the top of the PCB? That means "This is where they go, but on the bottom." There. Hope we've made that clear! (Once more: "Install them on the bottom!")

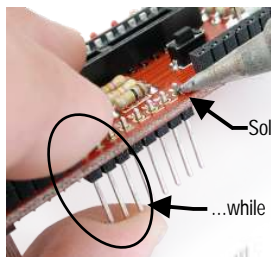
Step 10 - 4 Pin Headers (x 2):

Just like with the 8-pin headers, install these on the underside, in locations P3 and P4.

Step 9
Pin Headers
(on underside!)



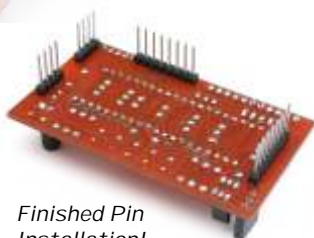
Another important note! Yes, ANOTHER one!: As these pins will mate with the sockets on the main robot body, you should try to get them installed as straight as possible. If you don't get them straight, you'll be fighting to match up all the pins to all the sockets! Here's what we suggest you do:



Hold in the pins with your fingers, and solder just one on the other end of the strip.

...while holding here!

Bend the strip until it sits perfectly upright (like shown here), then solder the rest of the pins!





The PICAXE™ Brainboard



Steps 11, 12, 13

Step 11 - I²C Header: Going to interface to other I²C peripherals?

This header will be of some help!

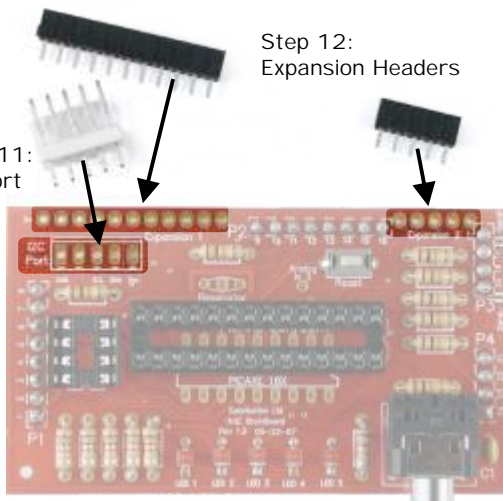
Make sure the flat tab is nearest the top of the PCB, where the long line is shown on the symbol.

Install it in the position marked I²C Port.



Step 11:
I²C Port

Step 12:
Expansion Headers

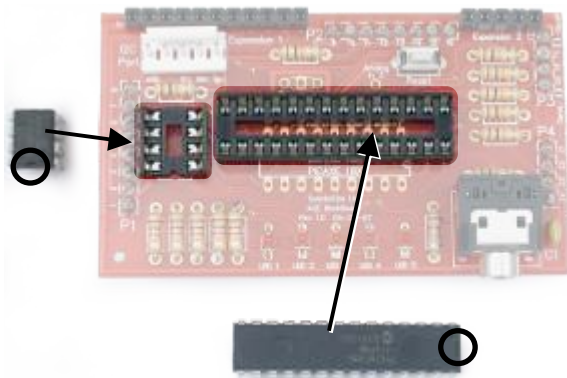


Step 12 - Expansion Headers:

Solder them into the ports shown. You'll use them if you ever want to add a custom circuit board.

Step 13 - Installing the ICs: These are static-sensitive parts, so if you frequently "zap" people, you'll have to be careful. Do this near a sink, and touch the metal faucet just before doing this, as it will remove any static charge.

You've got 2 chips, the 8-pin motor controller and the PICAXE chip. They have to go in the right-way, but you already know this from assembling the Sumovore, right? Note the notch positions, and you'll be fine.



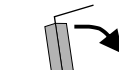
If the chip has legs that angle out a bit you may need to push them inward a bit to make insertion easier.

Step 13:
Motor IC and PICAXE chip
Note: Watch notch positions!

Having trouble getting the Microcontroller installed in the carrier? Try this: Gently bend all the chip pins inwards on a flat surface (like the edge of a metal sink).



Starts like this...



(repeat for each side)



...ends like this!



The PICAXE™ Brainboard



Step 14, Brainboard Enhancements

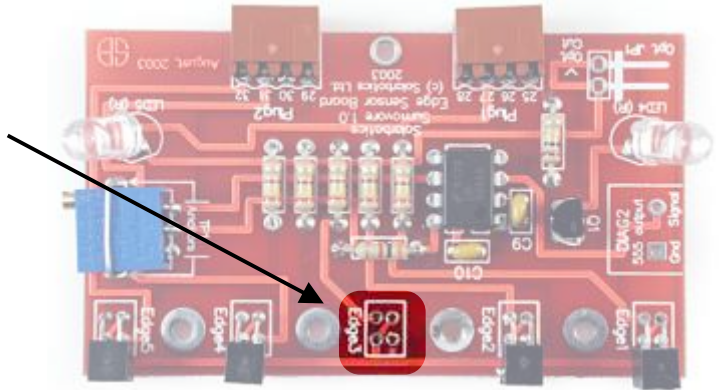
On the Sumovore, you have to add the center edge-sensor to make full use of the Brainboard. This gives you the ability to read a line in the very middle of the sensor array, which can be used to make your Sumovore a better line-follower. See the Brainboard schematics page to see which pin this sensor connects to your PICAXE-18 and -28X1.

Step 14 - Installing the 5th line sensor:

Yank the edge-sensor board out of your Sumovore, and install the included line sensor in position 'Edge3', just like you did when you originally built your Sumovore.



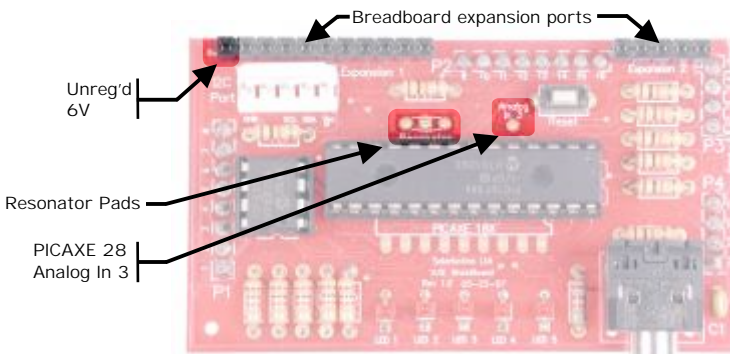
Step 14: Add the 5th line sensor



The Brainboard has some pretty cool additional features which you may never need to use, but they're here if needed:

- Unregulated 6V power from the main 4-cell battery pack
- I²C for peripheral (sensors/networking) communication
- Tap point for 28X1 unused Analog In 3
- Mounting point for a Resonator for more accurate timing (or overclocking)

As usual with our Sumovore brainboard, you can add extra circuit room by plugging a breadboard to the front of the brainboard.





The people at Revolution Education Ltd. (who make the PICAXE) have written very detailed instructions on how to setup your computer to talk to a PICAXE, and general ins-and-outs of using a PICAXE are here at:

http://www.rev-ed.co.uk/docs/picaxe_manual1.pdf

For a summary of general questions (the “Frequently Asked Questions”), see this link:

http://www.rev-ed.co.uk/docs/axe001_faq.pdf

Programming / Reviewing the Code:

The Sumovore demonstration code documents what ports control which functions. Download it from Solarbotics at:

http://www.solarbotics.com/products/k_sv-axe/resources/

1) Download and install the PICAXE programming software from:

<http://www.rev-ed.co.uk/picaxe/progedit.htm>

2) Start the program editor (progedit.exe), and click on “File / Open”

3) Here you decide what you want to open:

FOR BASIC:

Select “Sumo_Chart.bas”

For Flowchart:

Click on the pulldown list at the bottom “Files of type:”

Select “Flowchart (*.cad)”. Select “Sumo_Chart.cad”

Running the Robot:

Assuming you load up the Sumo code, plug the cable into the Sumovore PICAXE Brainboard, turn on the robot (disable the motors), and press “F5” to load the code.

Unplug the robot, re-enable the motor switch, press reset, and watch the indicator LEDs. The lights will show the 5-second count-down, and will start to chase a huge Japanese guy around the ring*!

Next, try loading the line-following code and using your Sumovore on a white surface with a black line (electrical tape works well!).

Experiment and Improve:

Our code is just a starting point. Modify the behavior to make it more aggressive, or make the line-following code tighter - there’s lots of different strategies for both events. Have fun!

*Huge Japanese Guy not included with kit. Too costly to ship - build your own at home!



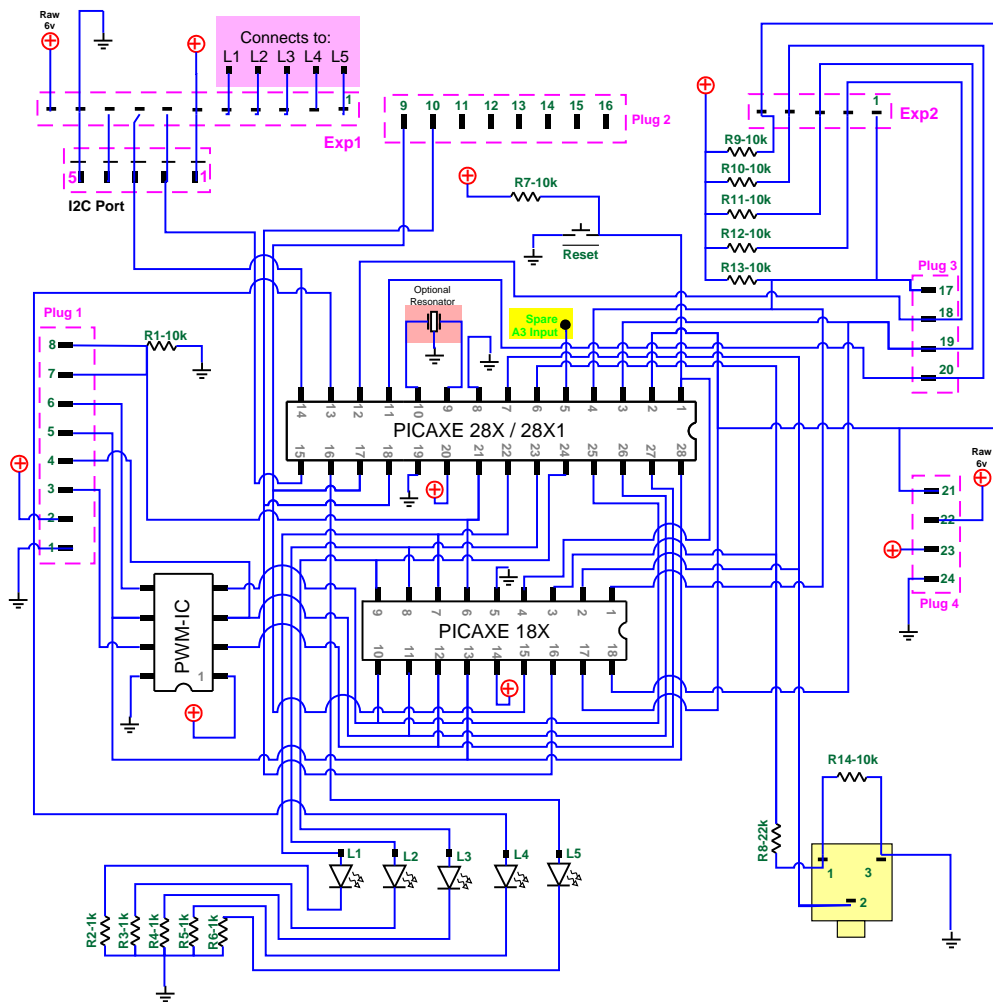
The PICAXE™ Brainboard

Brainboard Technical Information



Brainboard Schematic

(drawn with approximate component placement)





Microcontroller Pin Usage

PICAXE Brainboard Plug / Pin	Pin Function	PWM IC Pin	18X Pin	28X1 Pin
Plug1 / Pin 1	Gnd	MOT-8	5	8 & 19
Pin 2	Vcc	MOT-1	14	20
Pin 3	Left Mot PWM A	MOT-7	-	-
Pin 4	Left Mot PWM B	MOT-3	11	26
Pin 5	Right Mot PWM A	MOT-6	13	28
Pin 6	Right Mot PWM B	MOT-5	-	-
Pin 7	Left Mtr Enable	-	6	21
Pin 8	Right Mtr Enable	-	6	21
-	PWM Select Right	MOT-2	12	27
-	PWM Select Left	MOT-4	10	25

Plug 2 / Pin 9	Left IR sensor	-	15	17
Pin 10	Right IR sensor	-	16	18
Pin 11	NC	-	-	-
Pin 12	NC	-	-	-
Pin 13	Inverted Mot Dir Left	-	-	-
Pin 14	Non-Inverted Mot Dir Left	-	-	-
Pin 15	Inverted Mot Dir Right	-	-	-
Pin 16	Non-Inverted Mot Dir Right	-	-	-

Plug 3 / Pin 17	R-Edge sensor	-	1	4
Pin 18	RC-Edge sensor	-	-	12
Pin 19	C-Edge sensor	-	18	3
Pin 20	LC-Edge sensor	-	-	11

Plug 4 / Pin 21	L-Edge sensor	-	17	2
Pin 22	Raw 6v	-	-	-
Pin 23	Regulated 5v (Vcc)	-	18	20
Pin 24	Gnd	-	5	8 & 19

LED-1	Blinky	-	7	22
LED-2	Blinky Blinky	-	8	23
LED-3	Even more blinky	-	9	24
LED-4	Blinky only for 28X1	-	-	13
LED-5	Blinky 2 only for 28X1	-	-	16



Microcontroller Pin Usage (Continued)

PICAXE Brainboard Plug / Pin	Pin Function	18X Pin	28X1 Pin
Vcc	Vcc	14	20
Gnd	Gnd	5	8 & 19
Spare A3 Input	PortA Input	-	5
Reset Switch	µController reset	4	1

I2C Port / Pin 1	Vcc	14	20
Pin 2	SDA	-	15
Pin 3	SCL	-	14
Pin 4		-	-
Pin 5	Gnd	5	8 & 19

Prog Jack / Pin 1	Serial Out	2	7
Pin 2	Serial In	3	6
Pin 3	Gnd	5	8 & 19

Exp. Port 1 / Pin 1	LED-5	-	16
Pin 2	LED-4	-	13
Pin 3	LED-3	9	24
Pin 4	LED-2	8	23
Pin 5	LED-1	7	22
Pin 6		14	20
Pin 7	I2C SDA	-	15
Pin 8	I2C SCL	-	14
Pin 9		-	-
Pin 10		5	8 & 19
Pin 11	RAW 6v	-	-

Exp. Port 2 / Pin 1	Far Left Sensor	1	4
Pin 2	Middle Left Sensor	-	12
Pin 3	Middle Sensor	18	3
Pin 4	Middle Right Sensor	-	11
Pin 5	Right Sensor	17	2

Shaded Boxes:

Pin connection is also connected to 2nd pin elsewhere for the same IC
(eg: 18X Plug3/Pin17 is also Exp. Port 2 / Pin 1)

IGOR!

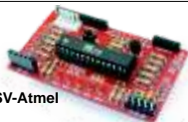
I need BRAINS!



And a shrubbery. One that looks nice. But not too expensive.

SUMOVORE Add-Ons

Note that it's "brains", plural. Do you want to try different microcontrollers on your sumo? We offer Atmel, PIC, and BS2 add-ons. If you're feeling particularly mad-scientistish, there's even a prototyping board for your own design. If you're craving to tweak your Sumovore until it's *just right* - we have just what you're looking for our official site: www.solarbotics.com



K SV-Atmel

Sumovore Atmel ATmega8L Brainboard v2

Use free open-source tools with the ATmega8L add-on brainboard, now with I2C, SPI, and 5 LED process indicators!
K SV-Atmel. \$20.95



K SV-PIC

Sumovore PIC 16F877A Brainboard v2

Like PICs? Use the popular '877a as the brains to your Sumovore! The chip comes pre-programmed with default mini-sumo and line-follower code.
K SV-PIC. \$25.95



K SV-BS2

Sumovore BS2 Brainboard

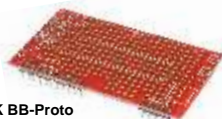
Parallax fans will appreciate adding a BS2 / Stamp Stack / Atom Stack-compatible microcontroller to your Sumovore. Plug this adapter board in, add your own controller, and load your code!
(BS2 shown on board not included)
K SV-BS2 \$15.95



25030

Basic Stamp 2 Stamp Stack

Need the microcontroller to go with your BS2 Brainboard? The HVWTech Stamp Stack II is functionally identical to the Parallax Basic Stamp II but comes on a PCB with a breadboard friendly pin header.
25030 \$35.00



K BB-Proto

Brainboard Prototyping Board

This board can plug into the new "Version 2" expansion ports. This offers easy-to-use features tapped off the main brainboards, such as three servo headers, raw 6v and regulated 5V power, I2C, and transistor & RJII footprints.
K BB-Proto. \$4.95

The Sumovore PICAXE Brainboard

The next step to making your Sumovore do what you want it to do!

The Sumovore's discrete brainboard has won championships, but it is quite rigid in what behaviors it has to offer. If you want to expand your robot's abilities and are not comfortable with hand-coding, the PICAXE Brainboard is your next logical step!

Use convenient flowchart programming symbols to give your Sumovore a unique personality. It is literally "drag-and-drop" programming, with a free Microsoft Windows™ programming interface.

Even more flexibility is available to you by turning your flowchart programs in to BASIC programs, where all the power of the PICAXE microcontroller is available to you!

Download our sample Sumo and line-follower code into your Sumovore, and see what you can make it do!

Solarbotics Ltd.

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Calgary, Alberta, Canada T2E 2K5

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Email: sales@solarbotics.com

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