



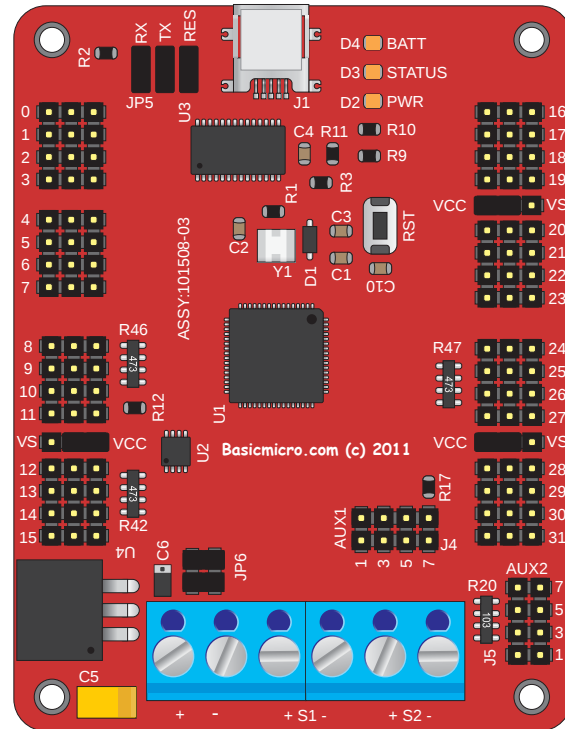
BASIC MICRO

TECHNOLOGY AT WORK

B0010 - ARC32 Robotics and Servo Controller
Data Sheet

Feature Overview:

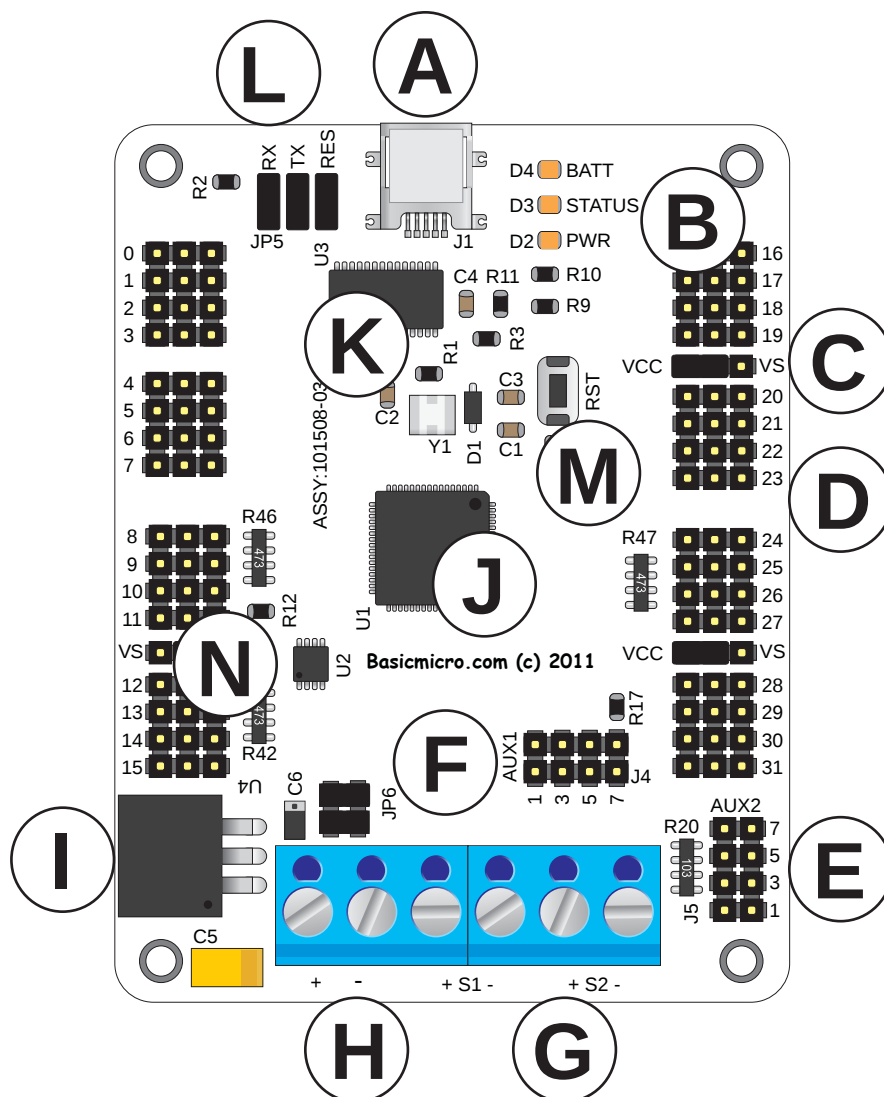
- Complete Robotics Controller
- 32 Servo Controller
- Servos Controlled by Hardware
- BasicATOM Pro Based
- USB Built-in
- 2 UARTS
- 20 Analog Channels
- 56K Code Space
- 32 Bit Hardware Math
- 32K EEPROM
- 1A Regulator
- External Servo Power Capable
- 2 User Controllable LEDs
- 1 Power LED
- Battery Voltage Software Detectable
- Small Foot Print 3" x 2.3"

**Basic Description**

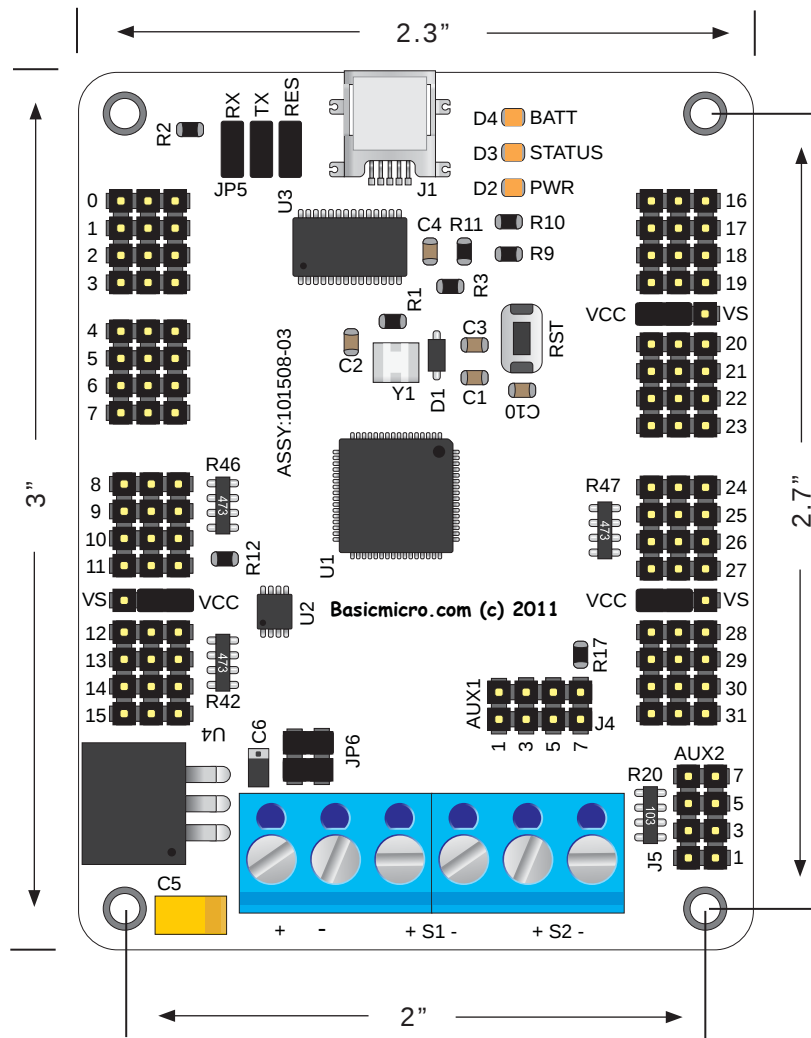
The ARC32 is a robotics controller with advance hardware to control up to 32 servos in the background. The ARC32 uses a hybrid hardware solution to drive the servos with less than 1% CPU time. In addition to being based on a blazing fast 32 bit microcontroller, its the only affordable robotics controller with integrated 32 servo control. The ARC32 is the first to combine an easily programmable robotics controller with a 32 channel servo controller.

The ARC32 is based on the BasicATOM Pro with an increased system clock of 20MHz and 56K of code space. All 32 servo headers have analog capabilities. Each block of 16 servo headers can be powered from a different power source making the ARC32 the perfect solution for high servo count robotics. Its one of the few solutions with many real world example applications.

Hardware Overview:



- A: MiniUSB Connector
- B: User Controllable LEDs
- C: Servo Header Group Power Selection Jumper
- D: Servo Headers
- E: J5 Auxiliary (AUX2) Header
- F: J4 Auxiliary (AUX1) Header
- G: Servo Power 3.5 Screw Terminals
- H: Logic Power 3.5 Screw Terminals
- I: Logic Voltage Regulator
- J: MCU (BasicATOM Pro)
- K: FTDI USB to Serial
- L: UART Access Jumpers
- M: Reset Button
- N: I2C Eeprom

Dimensions:

Board Edge: 2.3"W X 3"L
Hole Pattern: 0.125D, 2"W x 2.7"H

Header 0-15 Assignment Overview

Header	Pin	Description
0	P0	- Servo 0. - Standard I/O Capable. - Interrupt Capable Input Pin (WKP4 low enabled).
1	P1	- Servo 1. - Standard I/O Capable.. - Interrupt Capable Input Pin (WKP5 low enabled).
2	P2	- Servo 2. - Standard I/O Capable.
3	P3	- Servo 3. - Standard I/O Capable.
4	P4	- Servo 4. - Standard I/O Capable.
5	P5	- Servo 5. - Standard I/O Capable.
6	P6	- Servo 6. - Standard I/O Capable.
7	P7	- Servo 7. - Standard I/O Capable.
8	P8	- Servo 8. - Analog Capable (HSERVOSTATE).
9	P9	- Servo 9. - Analog Capable (HSERVOSTATE).
10	P10	- Servo 10. - Analog Capable (HSERVOSTATE).
11	P11	- Servo 11. - Analog Capable (HSERVOSTATE).
12	P12	- Servo 12. - Analog Capable (HSERVOSTATE).
13	P13	- Servo 13. - Analog Capable (HSERVOSTATE).
14	P14	- Servo 14. - Analog Capable (HSERVOSTATE).
15	P15	- Servo 15. - Analog Capable (HSERVOSTATE).

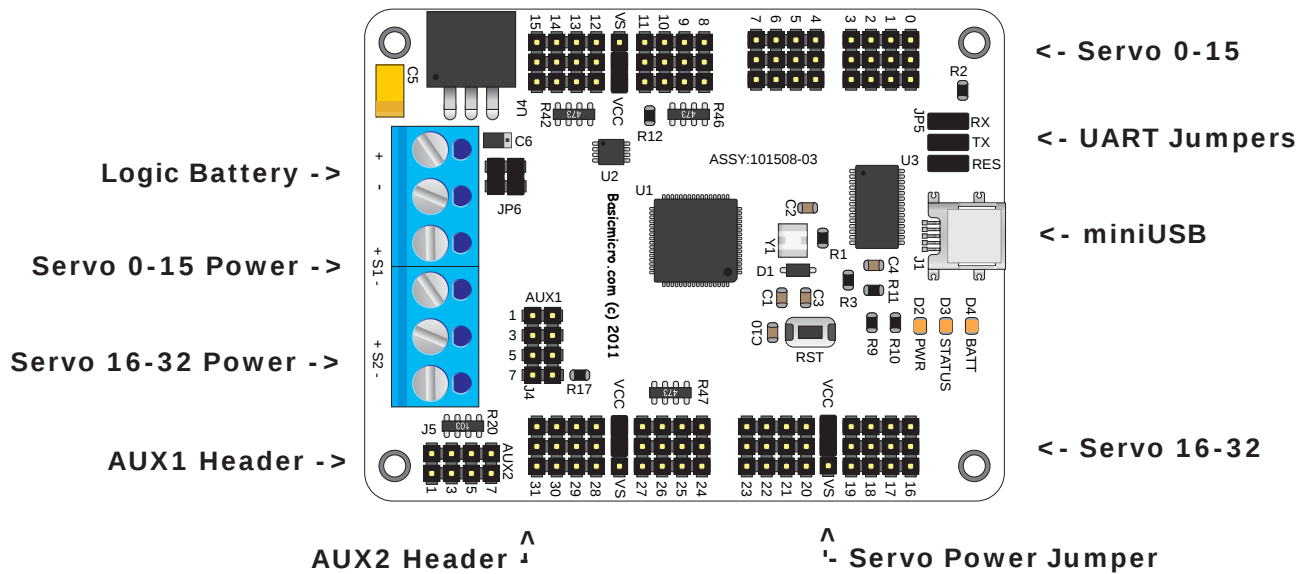
Header 16-31 Assignment Overview

Header	Pin	Description
16	P16	- Servo 16. - Standard I/O Capable. - Interrupt Capable Input Pin (WKP3 low enabled).
17	P17	- Servo 17. - Standard I/O Capable. - Interrupt Capable Input Pin (WKP2 low enabled).
18	P18	- Servo 18. - Standard I/O Capable. - Interrupt Capable Input Pin (WKP1 low enabled).
19	P19	- Servo 19. - Standard I/O Capable. - Interrupt Capable Input Pin (WKP0 low enabled).
20	P20	- Servo 20. - Standard I/O Capable.
21	P21	- Servo 21. - Standard I/O Capable.
22	P22	- Servo 22. - Standard I/O Capable.
23	P23	- Servo 23. - Standard I/O Capable.
24	P24	- Servo 24. - Analog Capable (HSERVOSTATE).
25	P25	- Servo 25. - Analog Capable (HSERVOSTATE).
26	P26	- Servo 26. - Analog Capable (HSERVOSTATE).
27	P27	- Servo 27. - Analog Capable (HSERVOSTATE).
28	P28	- Servo 28. - Standard I/O Capable. - Analog Capable (HSERVOSTATE). - Interrupt Capable Input Pin (IRQ3).
29	P29	- Servo 29. - Standard I/O Capable. - Analog Capable (HSERVOSTATE). - Interrupt Capable Input Pin (IRQ2).
30	P30	- Servo 30. - Standard I/O Capable. - Analog Capable (HSERVOSTATE). - Interrupt Capable Input Pin (IRQ1).
31	P31	- Servo 31. - Standard I/O Capable. - Analog Capable (HSERVOSTATE). - Interrupt Capable Input Pin (IRQ0).

Internal Pin Assignment Overview

Pin	Description
P32	- Analog Pin. - Detects S1 Voltage.
P33	- Analog Pin. - Detects Logic Voltage.
P34	- Analog Pin. - Detects S2 Voltage.
P35	- Analog Pin. - Detects AUX1 Pin 6 Voltage.
S_IN	UART1 RX.
S_OUT	UART1 TX.
P34	- SCL. - AUX1 Pin 1.
P35	- SDA. - AUX1 Pin 2.
P36	- UART2 TX. - AUX1 Pin 3.
P37	- UART2 SCK. - AUX1 Pin 4.
P38	- UART2 RX. - AUX1 Pin 5.
P39	- Analog / Digital Pin. - AUX1 Pin 6.
P40	- Pulled Up - AUX2 Pin 2.
P41	- Pulled Up - AUX2 Pin 4.
P42	- Pulled Up - AUX2 Pin 6.
P43	- Pulled Up - AUX2 Pin 8.
P44	Status LED.
P45	Batt LED.

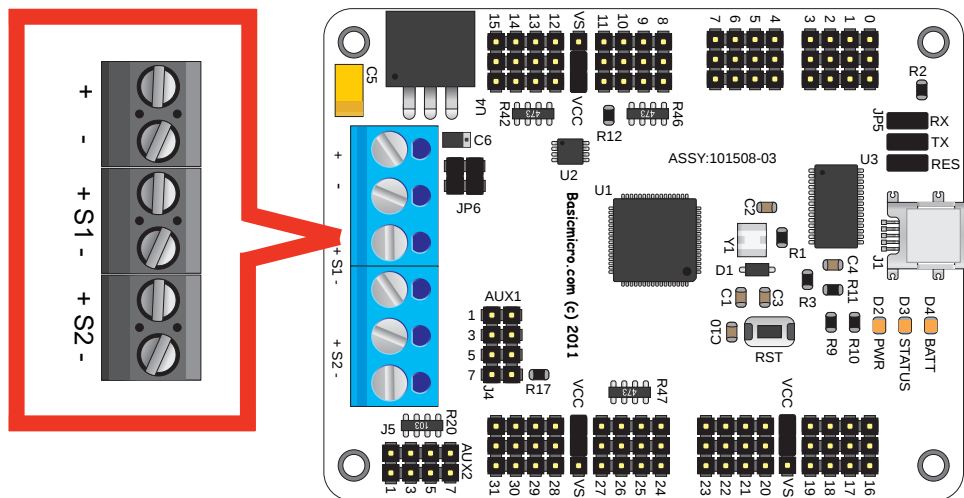
Header Overview



Logic and Servo Battery Screw Terminals

The logic circuits is powered from the main battery. The 32 servo headers are grouped into two blocks of 16. The first group 0-15 can be powered from a separate battery. The second group of 16-32 can be powered from an additional battery. This configuration provides the most flexibility when driving 32 high power servos. All 32 servos and the logic can be powered from the same battery by connecting 1 battery to all 3 sets of terminals.

Logic Battery + ->
 Logic Battery - ->
 0-15 Servo + ->
 0-15 Servo - ->
 16-31 Servo + ->
 16-31 Servo - ->

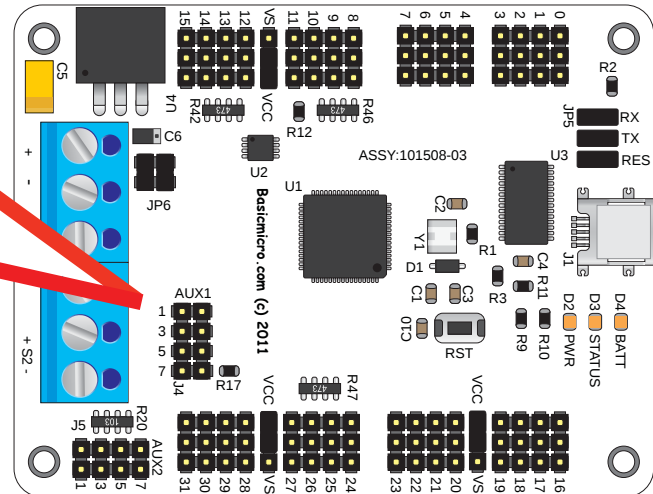
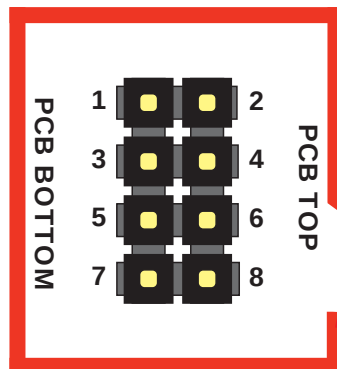


J4 - AUX1 Header

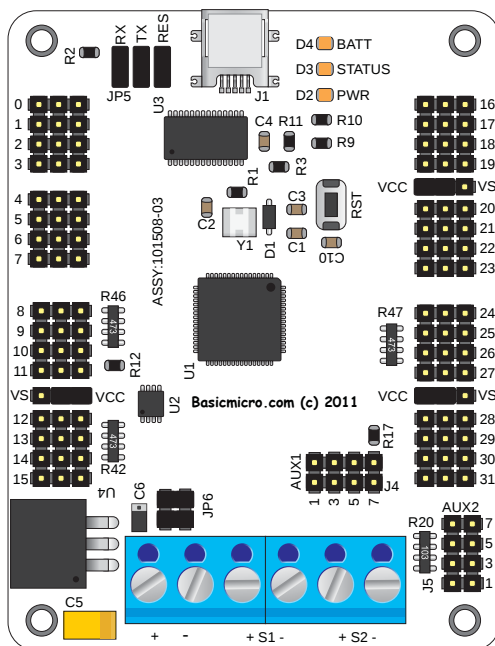
AUX1 is the communications header. This header includes I2C, UART, SPI, Analog, GND and VCC.

Pinouts:

- 1=P34 (SCL)
- 2=P35 (SDA)
- 3=P36 (TXD2)
- 4=P37 (SCK2)
- 5=P38 (RXD2)
- 6=P39 (AN3)
- 7=GND
- 8=VCC

**J5 - AUX2 Header**

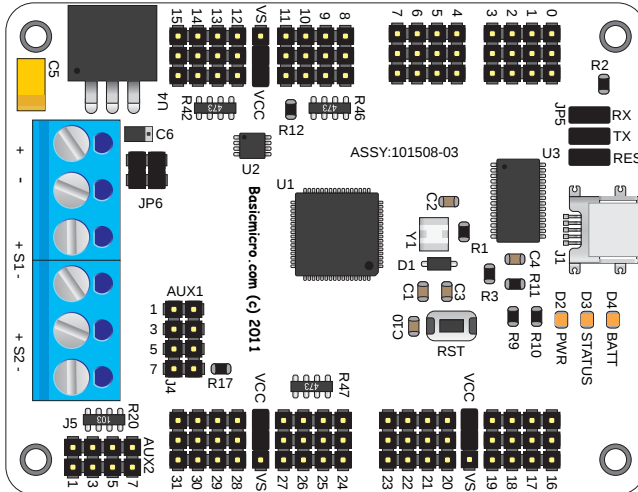
AUX2 is the general I/O header and can be used to interface buttons, sensors or additional LEDs. All 4 I/O on AUX2 header are pulled-up with 47K resistors.

**Pinouts:**

- 1=GND
- 2=P40
- 3=GND
- 4=P41
- 5=GND
- 6=P42
- 7=GND
- 8=P43

JP5 - UART

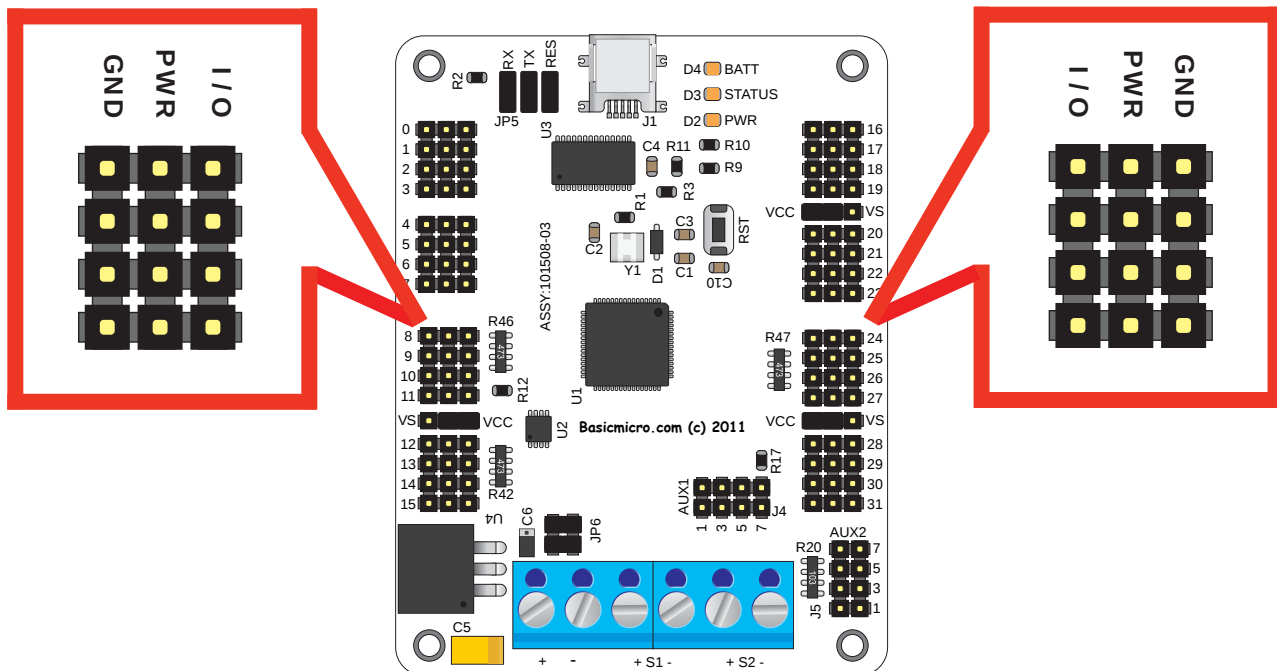
JP5 connects the ATOM Pro to the FTDI USB micro. The 3 jumpers can be removed to access the ATOM Pro second UART or interface directly to the USB micro.

**Pinouts:**

- 1=FTDI -TXD
- 2=BAP -RXD
- 3=FTDI -RXD
- 4=BAP -TXD
- 5=FTDI -RTS
- 6=BAP -RTS

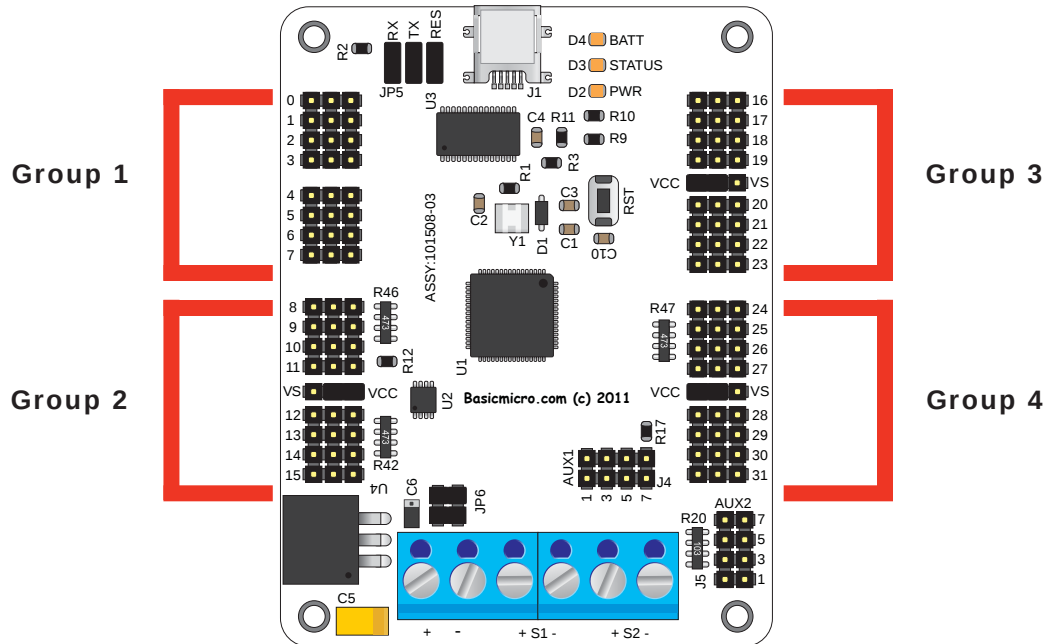
Servo Headers

There are 32 servo headers labeled from 0 - 31. Each header is setup to control one servo. The header is configured for a standard servo pinout. I/O, PWR and GND.



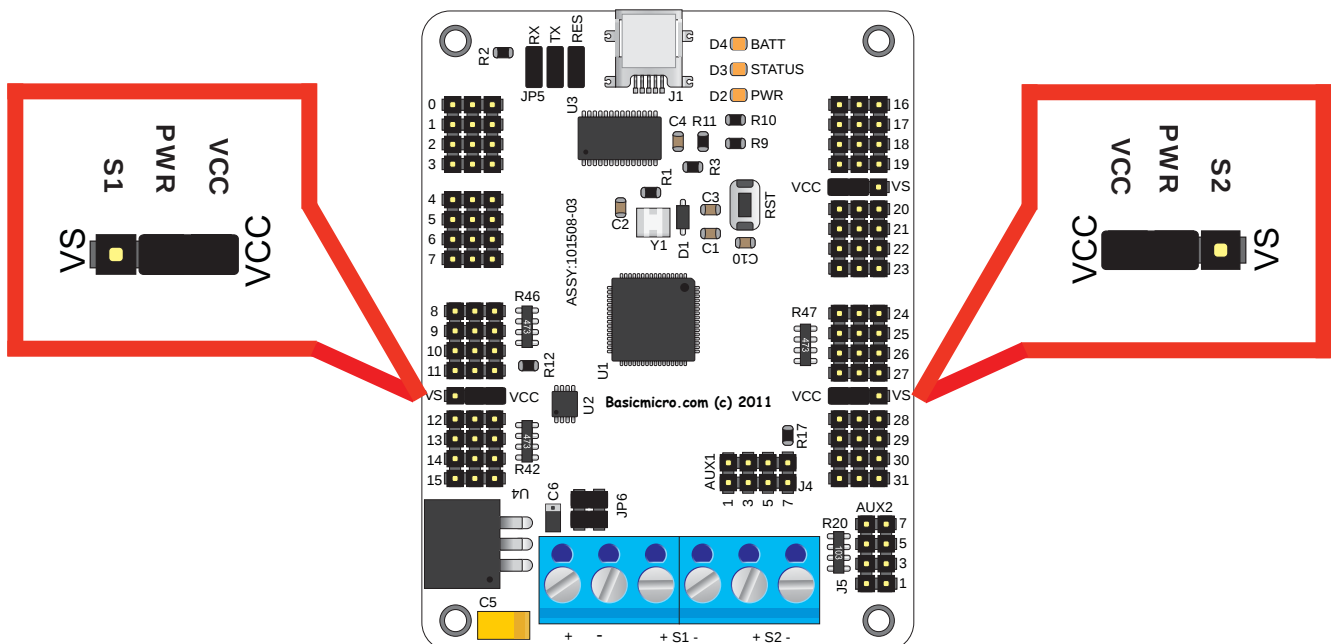
Header Power Groups

The servo headers power is user selectable. It can run directly from the input voltage on S1 and S2 or alternately from the on board 5V power regulator. The headers are split into 4 groups. Each group is user selectable using a 3 position jumper.



Header Power Jumper

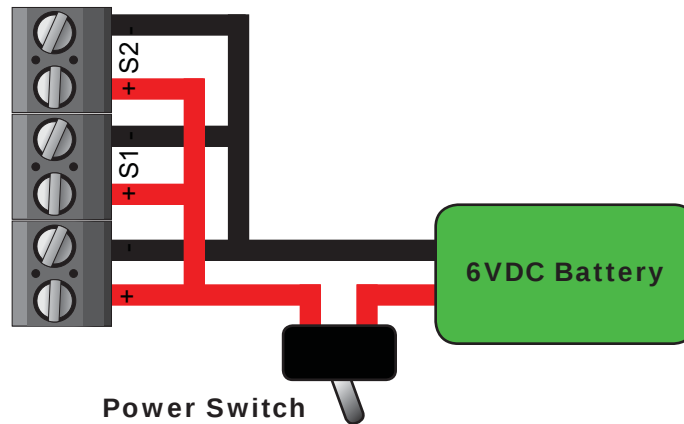
Each group of headers source power is user controlled by a jumper. The jumpers are labeled VS / VCC and control the power for that grouping as shown above. VS is a direct connection from S1 or S2 terminals. VCC selects the on board 5V regulator. Note: If VS is selected caution should be taken as to what device is attached to that group of headers as the voltage will likely be over 5V.



Power Configurations

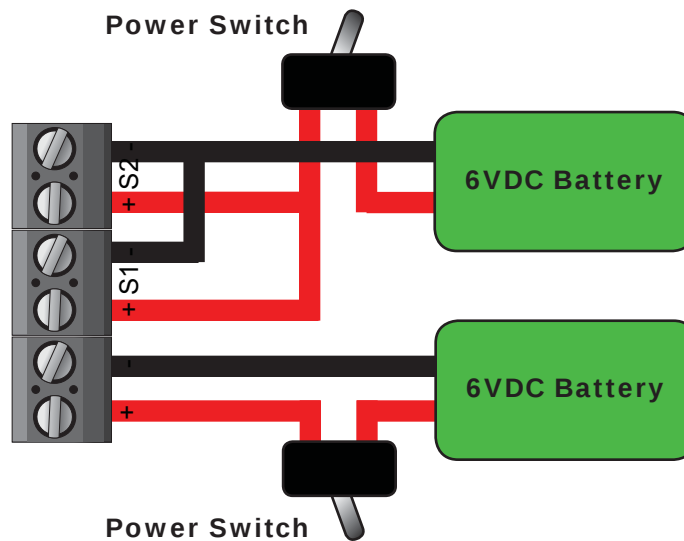
There are 3 power connections on the ARC32. The primary is marked with + and - symbol, these are the logic supply. S1 and S2 indicate the servo power terminals. S1 powers servo headers 0-15 and S2 powers servo header 16-31. The power terminals are not interconnected and must all be powered by separate power sources or connected together.

Single Power Source Configuration



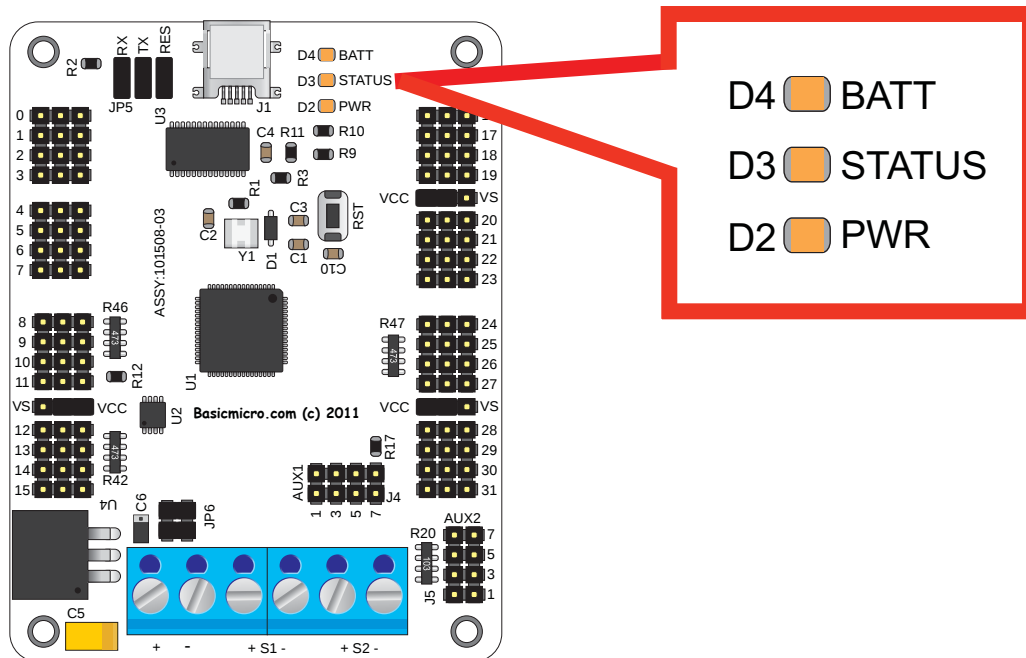
Dual Power Source Configuration

Servo power can be supplied from a separate battery as shown. Optionally a 3 battery configuration can be used to power all servo header groups separately (0-15 and 16-31).



LEDs

The ARC32 has 3 LEDs. 2 of the LEDs are software controlled. They are labeled BATT and STATUS. The PWR label indicates when the ARC32 has logic power. The BATT LED can be controlled by setting P45 HIGH. The STATUS LED can also be controlled by setting P44 HIGH.



ARC32 Specific Commands

The ARC32 has a unique hardware setup to control all 32 servos in the background with almost no MCU time used. To support this unique feature, several special commands were created. Most of the servo headers are multiplex with additional pins and analog functionality. The following section explains how all the special hardware and servo functionality is accessed.

The servos are controlled using a custom hardware system (HSERVO2) that runs in the background. Servos can not be controlled by any other method. Standard Pulseout or Servo command as shown in the BasicATOM Pro Syntax Manual will not work with the ARC32.

ENABLEHSERVO2

To activate the hservo2 system you must use the command ENABLEHSERVO2 at the beginning of your program. ENABLEHSERVO2 instructs the compiler to load the required interrupt driven library during compile time.

HSERVO

The HSERVO command is used to position a servo on any of the 32 headers. HSERVO can be used to update one servo at a time of several servos depending on usage. The following code snippet centers a servo connected to header position 31.

```
Hservo [P31/0]
```

Hservo can move a servo incrementally. In the following code snippet the servo will move toward position 10000 in 100 steps every 20ms. 20ms is the fastest a standard servos position can be updated.

```
Hservo [P31\10000\100]
```

Hservo can move more than one servo at a time. The following code snippet will move 3 servos to their center positions. The servos are connected to headers 1,2 and 3.

```
Hservo [P1\0, P2\0, P3\0]
```

HSERVOWAIT

HSERVO is a background task. If the optional speed value is used the program will continue to run while HSERVO is executing in the background. To halt the program until the given position value is reached, HSERVOWAIT can be used. The following code snippet will wait until HSERVO has reach 10000 in increments of 100 before continuing program execution.

```
Hservo [P31\10000\100]  
HSERVOWAIT [P31]
```

HSEVOPOS

All 32 servo position values are stored. HSEVOPOS is used to retrieve the current position value for a particular servo. If a speed value was used HSEVOPOS will return the current position being executed not the total position value used. The following code snippet will conditional execute a group on commands until 10000 is reached.

```
ENABLEHSERV02
```

```
HSERVO [P31\10000\100]
  while(hservopos(P31)<>10000) ;loop until the servo reaches 10000
    ;do stuff here
  wend
```

HSEVOIDLE

To determine if a servo is idle without knowing the last position specified HSEVOIDLE can be used. HSEVOIDLE will return a 0 value if the servo is not idle. A servo not currently moving would return a value of 0. If the servo is still moving a value other than 0 is returned. This would be the case if the optional speed value is set and the servo is active. The following code snippet will execute a group of commands until the servo is idle.

```
ENABLEHSERV02
```

```
HSERVO [P31\10000\100]
  while(hservoidle(P31)=0) ;loop until the servo becomes idle
    ;do stuff here
  wend
```

HSEVOSTATE

The servo headers pins can be read. Several of the pins are analog capable. HSEVOSTATE will return the state or analog value of a given pin. If a pin is not analog HSEVOSTATE will return a 0 for a low and 1023 for a high signal. Otherwise a value of 0 to 1023 is return which represents the voltage applied to the read pin. The following example program will read the analog value from header 8 which is analog capable and print the results to a terminal window.

```
ENABLEHSERV02
```

```
Result Var Byte
```

```
Main
```

```
  Volts = HSEVOSTATE P8
```

```
  serout s_out, i19200, [DEC Result]
```

```
Goto Main
```

HSERVOTIME

The ARC32 has a built in 64 bit timer that counts in clock cycles from power up. The timer is cleared after every reset or power cycle. The returned timer value is 32bits. The bits can be shifted to control the resolution of the value returned. The following code snippet will read the time and blink the status led on the ARC32 every half second.

```

ENABLEHSERV02

starttime var long
stoptime var long
main
  starttime = hservotime 0 ;get current time
  do
    stoptime = (hservotime 0)-starttime
  while stoptime < 10000000
  toggle p44
  goto main

```

Voltage Level Detection

The ARC 32 is capable of detecting the voltage level on all three power inputs. The voltages are read using the HSERVOSTATE command. The command will return an analog value from 0 to 1023. The analogs pins are accessed by using there pin names. P33 will return the logic voltage. P32 returns S1 voltage. P34 returns S2 voltage. The following code snippet will read the logic voltage level and display it to the terminal window.

```

ENABLEHSERV02

Volts Var Byte

Main
  Volts = HSERVOSTATE P33
  serout s_out, i19200, [REAL (TOFLOAT Volts/51.2)\2]
  Goto Main

```

Analog Pins

All analog capable pins list in the pin overview charts are read with HSERVOSTATE which will return the value of any analog capable pin. The returned value will be 0 to 1023. The following code snippet will return the analog value and store the result in a variable. Any analog capable pin can be read by changing the pin number.

```

ENABLEHSERV02

Temp = HSERVOSTATE P8

```

ARC32 Servo Example

The sample program will loop through all 32 servo headers moving each connected servo through its full swing. If connected to a terminal window all voltage inputs S1, S2 and logic will be displayed.

```
;Basic Micro ARC32 test code. Set terminal window to 9600 baud.

ENABLEHSERV02

ENABLEHSERIAL
SetHSerial H9600,H8DATABITS,HNOPARITY,H1STOPBITS

servopin var byte
for servopin = 0 to 31
    hservo [servopin\0]      ;default all servos to center position
next

pause 1000

main
    for servopin = 0 to 31
        hserout [0," Moving servo: ",dec servopin,13,13]
        hserout ["VS1 voltage is: ",real (TOFLOAT hservostate 32)/1024.0*20.0\2,"v",13]
        hserout ["VL voltage is: ",real (TOFLOAT hservostate 33)/1024.0*20.0\2,"v",13]
        hserout ["VS2 voltage is: ",real (TOFLOAT hservostate 34)/1024.0*20.0\2,"v",13]
        if(hservostate 33 < 281)then
            hserout ["Battery voltage is low!"]
            high p45      ;turn battery warnign LED on
        else
            low p45
        endif

        hservo [servopin\ -5000\100] ;move to -5000 position in 1 second
        while(hservo idle(servopin)=0)
            toggle p44
            pause 100
        wend

        hservo [servopin\5000\100] ;move from -5000 to 5000 position in 2 seconds
        while(hservo idle(servopin)=0)
            toggle p44
            pause 100
        wend

        hservo [servopin\0\100] ;move to 0 position in 1 second
        while(hservo idle(servopin)=0)
            toggle p44
            pause 100
        wend

        low p44
        pause 500
    next
    goto main
```

Electrical Characteristics

Characteristic	Rating	Min	Max
Logic Regulator Input Voltage	VDC	6	12
S1 / S2 Input Range	VDC	0	12
Current Draw	mA	100	10A
I/O Voltages	VDC	0	5
Tempature Range	C	-40	+125

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Contacts

Email: sales@basicmicro.com
Tech support: support@basicmicro.com
Web: <http://www.basicmicro.com>

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Technical Support

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