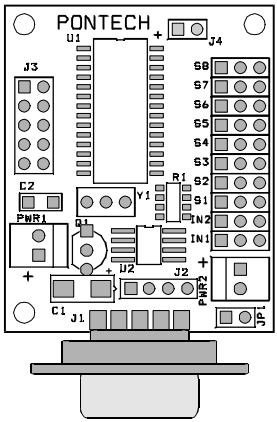
SV203

Servo Motor Controller Board



User's Manual

Rev. 1.20

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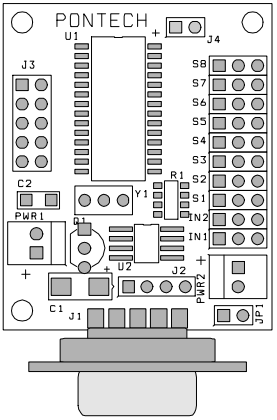
SV203 - Servo Motor Controller Board



The SV203 is a PIC16C73 microcontroller based servo motor controller board that accepts RS-232 serial data from a host computer and outputs PWM (pulse-width-modulated) signals to control up to eight RC (radio-controlled, i.e. model airplanes, cars, etc.) servo motors. Unused servo pins can be reconfigured as digital outputs for controlling on/off devices. LED displays can be driven directly by the pins but devices such as relays and solenoids may need a simple transistor driver circuit.

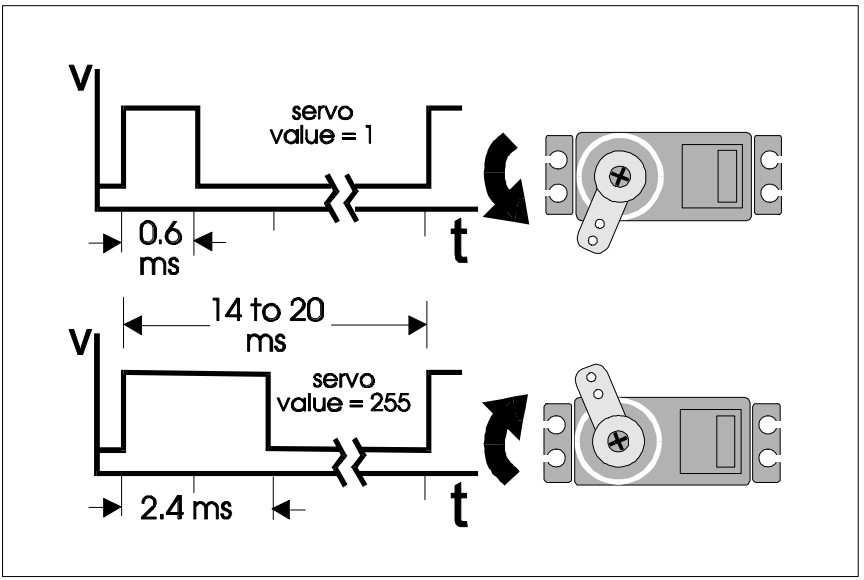
There is also a 5-channel A/D port for reading analog voltage between 0-5 volts, and a SPI (synchronous peripheral interface) port which allows data to be shifted in or out serially.

The SV203B/C has the added feature of being able to run a standalone BASIC program stored on board an 8K EEPROM. An optional IR-Receiver/Transmitter (IR100) is also available to allow Infrared Serial Communications.

SV203 - Servo Basics

RC servos operate using feedback to compare the current position to an input pulse width, which typically repeats every 14 to 20 ms (milliseconds). If the pulse width lasts for approximately 0.6 ms, the servo will rotate to a maximum position. If the pulse width is increased to approximately 2.4 ms, the servo will rotate to the opposite maximum position (Figure 1). A 1.5 ms pulse will set the servo in the middle (neutral) position.

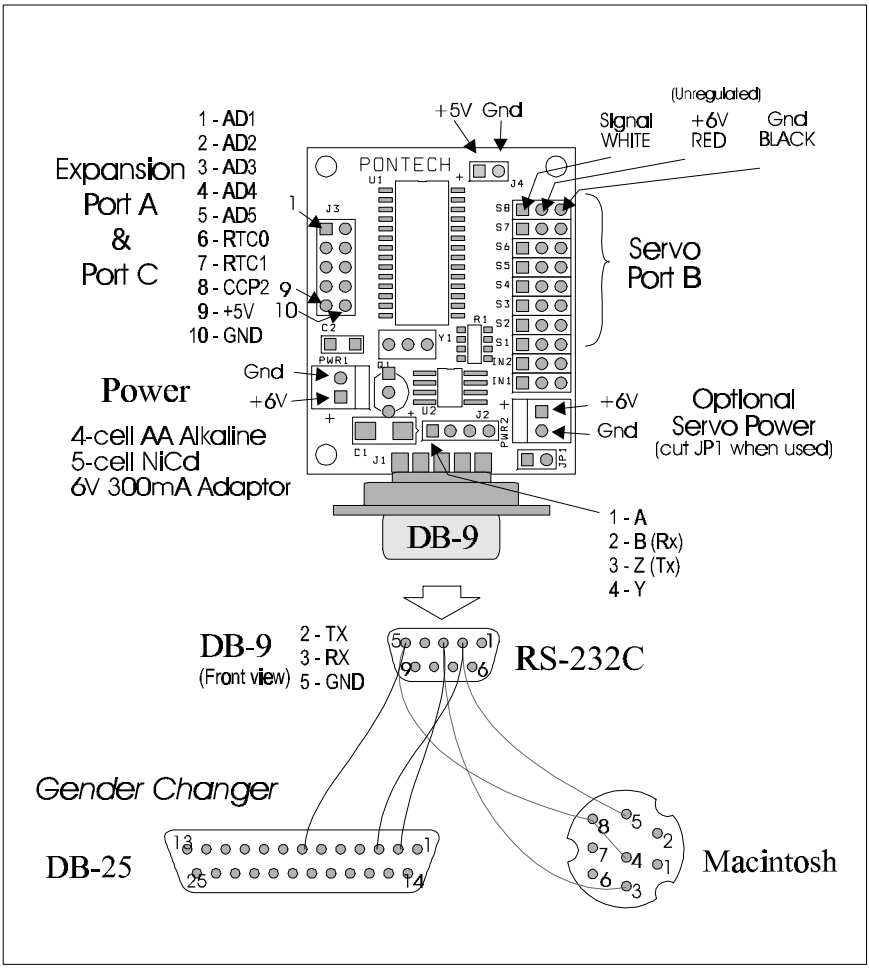
The SV203 controller is designed to the specifications of a Futaba servo model FP-S148. These servos have a neutral position at 1.52 ms. -90 degrees at 0.6 ms, and 90 degrees at 2.4 ms. Other servos may have slightly different values for these positions.



(Figure 1 - servo timing diagram)

SV203 - Power Supply and Pin-out

A 6-Volt DC source powers the board, either from 4 alkaline batteries or 5 NiCad cells. An AC adapter can also be used: 6VDC, at 300mA. If using NiCads, a 4-cell pack might be easier to find than a 5-cell pack. The board will operate fine with 4 cells, but may not last as long as 5 cells.



(Figure 2 - pin-out for SV203)

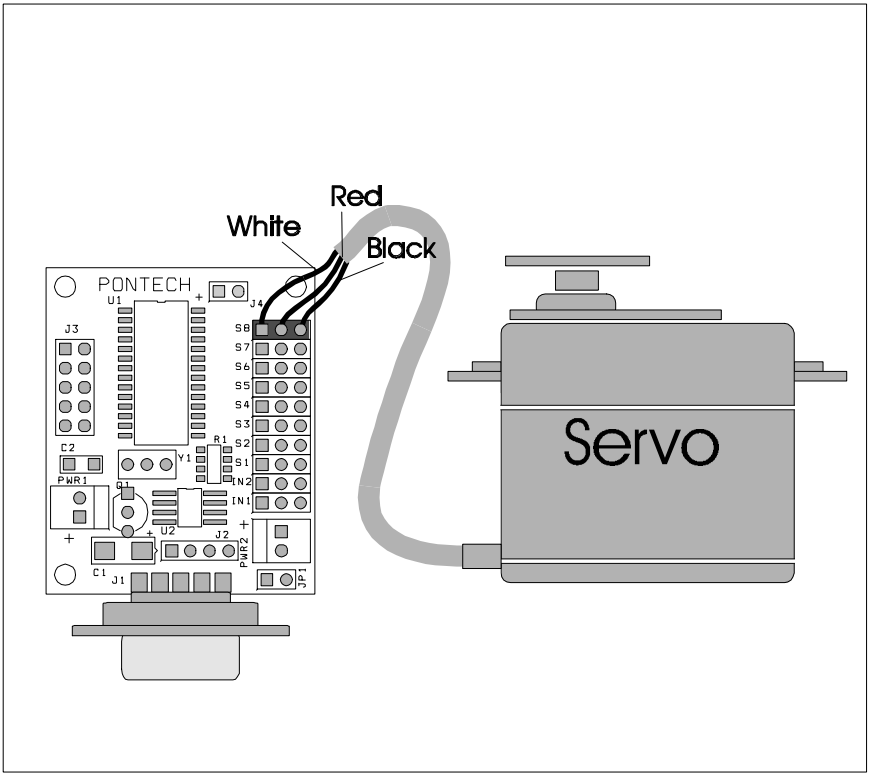
DB-9	DB-25	Macintosh	DB-9
1	--	3	1
2	5	2	2
3	3	--	3
4	--	--	4
5	8 , 4	7	5
6	--	--	6
7	--	--	7
8	--	--	8
9	--	--	9

(Figure 2a – DB cross-referenced chart)

SV203 - Servo Connections

The servo port connectors use a 3-pin male sip (single inline pin) connector (0.1-inch spacing). The servo connector is designed to be used with Futaba-type servos with J-type connectors. The servos have three colored wires, Black for ground, Red for power, and White for signal.

Connect the cable with the White wire pointing to S1…S8, and the Black wire toward the outside edge of the board.



(Figure 3 - servo connected to SV203)

```
OPEN "COM1:9600,N,8,1,CD0,CS0,DS0" FOR OUTPUT AS #1
DO
   PRINT:PRINT "*****SV203 Servo Controller *****"
   INPUT "Enter Board ID Number:
   INPUT "Enter Servo # to control:   Servo$
   INPUT "Enter Position of Servo:   Pos$

   PRINT #1, "BD";ID$;"SV";Servo$;"M";Pos$
   INPUT "Quit (y/n)"; Q$: IF Q$ = "y" THEN EXIT DO
LOOP
```

(Listing 1 - Sample interface program using QBASIC)

```
***** SV203 Servo Controller *****"
Enter Board ID Number:? 1            Board width ID = 1
Enter Servo # to control:? 2         move servo #2 to
Enter Position of Servo:? 200        position 200
Quit (y/n):? n

***** SV203 Servo Controller *****"
Enter Board ID Number:? 0            Any Board regardless of
Enter Servo # to control:? 4         ID, move Servo #4 to
Enter Position of Servo:? 254        position 254
Quit (y/n):? n

***** SV203 Servo Controller *****"
Enter Board ID Number:? 1            Board with ID = 1
Enter Servo # to control:? 2         Turn off Servo #2
Enter Position of Servo:? 0
Quit (y/n):? n

***** SV203 Servo Controller *****"
Enter Board ID Number:? 1            This command is invalid because
Enter Servo # to control:? 9         there is no Servo #9 and also
Enter Position of Servo:? 256        256 is out of the range of the
Quit (y/n):? y                       servo position.
```

(Listing 2 - Example screen of when program in Listing 1 is running)

Listing 1 is a simple program written in QBASIC that requests the user to input a board ID number, a servo number to control, and the position of the servo.

SV203 - Operation of Board

Connect the servos to the board, plug in the RS-232 cable to a COM port of a PC and the other end to the SV203. Power the board and the servos should return to the neutral position. Run the example programs.

The SV203 processes information one ASCII string command at a time. Each command string follows the format:

```
L n L n … <enter>
```
(maximum of 20 characters/line)

Where *L* is the command letter(s) in caps, *n* is a decimal integer number(s), and <*enter*> is ASCII 13. Please refer to Command Listing Page (p.26) for a complete listing.

For example, the commands to select a board, select a servo and move to a position are BD, SV, and M, respectively. If your want to move servo #3 of a board with an ID number equal to 1 to position 85, you would send the flowing command string.

```
BD1SV3M85 <enter>
```

The commands can also be separated by spaces or commas for ease of reading.

```
BD1 SV3 M85 <enter>
```
or
```
BD1,SV3,M85 <enter>
```
or
```
BD 1 SV 3 M 85 <enter>
```

A terminal program may be used to test the functions of the board. The default setting on the board is 9600 baud, N81, with echo off. (A program called TERM.EXE is provided as a simple terminal like software to test the SV203 functions).

Once a board or servo is selected, it will stay selected until power is removed or another select command is received. For example, if the following commands were sent:

```
BD1 SV2 M100 <enter>
```

The next command will still move servo #2:

```
M150 <enter>
```

More then one servo can be moved at the same time in one line of a command string, just make sure you don't exceed the 20 characters per line limit, including spaces and commas:

```
BD1 SV1 M30 SV2 M104 SV3 M25 <enter>
```

The commands above will select Board #1, Move servo #1 to position 30, then move servo #2 to position 104 and move servo #3 to position 25 all at about the same time.

Any parameter value for the command not in the range of the command will be ignored. (see Command Listing Page – p.26.)

The board will start processing the command string when it receives the <enter> or ASCII 13 character. The host computer talking to the board should insert a delay of about 3 milliseconds between each command string to allow time to process the commands.

BDn **Select Board**

Before the board will accept any commands, it must first be enabled. To enable the board, you must send the BD command followed by the board ID number (*n*). The default ID number of the board is 1. So simply send the following to enable the board:

```
BD1 <enter>
```

The board ID number can be user-redefined by using the WE command (see Commands Descriptions Page – p.20). This allows multiple boards of different ID number to be connected to the same serial port.

You can enable the board in two other ways: You can pre-enable the board at power-up by changing the default settings. (see Changing Default Settings Page – p.22); or you can enable the board by sending an ID number 0, such as:

```
BD0 <enter>
```

This will override the ID number checking and any boards connected to the port will be enabled regardless of the ID number of the board.

SVn **Select Servo**

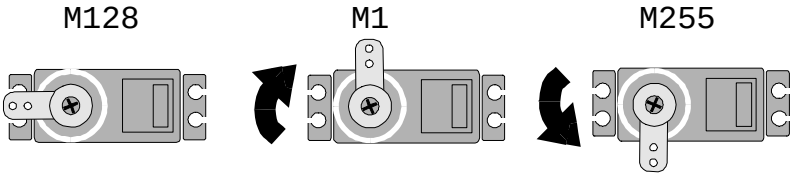
On power-up, servo #1 is pre-selected. To select another servo or to make sure the servo is selected, send “SV” followed by the servo number. The servo number must be between 1 and 8 because there is a maximum of eight servos that the board can control.

i.e. `SV3 <enter>`

servo #3 will be selected. Any move commands that follow will operate on servo #3.

Mn **Move to absolute position**

This command will move the selected servo to an absolute position. The range of the position is between 1 and 255. On a RC-type servo, the maximum mechanical movement is about 180 degrees. The 1 to 255 position ranges gives a precision of a little under one degree. The figure below shows what position the servo will be in given the value of position.



Sending a zero to the servo can turn off the pulse-width command signal to the servo, which causes the servo to remove power from the motor:

```
M0 <enter>
```

In Incremental move relative to current position

This command will move the servo relative to the current position of the servo by adding or subtracting the value entered to the current servo position.

i.e.
```
M100 <enter>
I10 <enter>
I-20 <enter>
```
The selected servo will first move to position 100, then to position 110 (100+10), and then finally to position 90 ((100+10) - 20).

Dn **Delay/Pause in milliseconds (ms)**

Delay commands may be added to the string to pause between movements:

```
SV1 M20 D1000 M100 <enter>
```

servo #1 will move to position 20. There is a one-second (1000 ms) pause, and then servo #1 will move to position 100.

Caution: When using the Delay command, the board will not receive input from the serial port during the delay state. The host computer that is talking to the board has to wait at least the same amount of time before another command string can be sent. Any commands sent during the delay will be ignored.

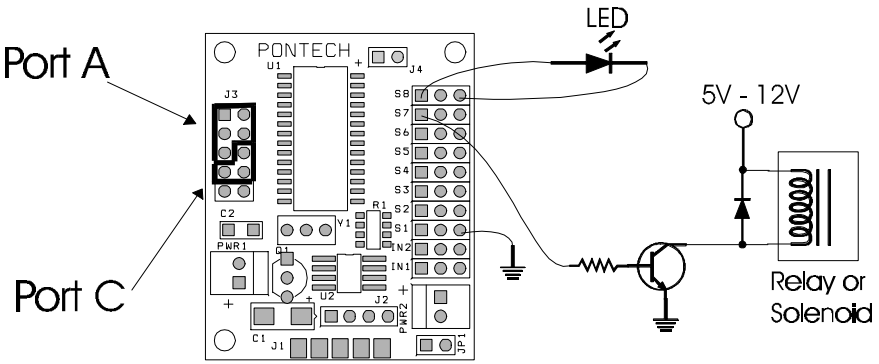
PSn **Pin Set**
PCn **Pin Clear**
PTn **Pin Toggle**

These commands allow you to use the servo port as a digital output by setting, clearing or toggling individual bits of the servo port. In order to use the port as a digital output, the servo PWM must first be turned off by sending a M0 command to each servo pin that you want to use as digital output.

i.e. `SV7 M0 PS7 <enter>`
Pin S7 of the servo port will be set high (5 Volts).

i.e. `SV8 M0 <enter>`
`PT8 <enter>`
Pin S8 of the servo port will be toggled/flipped
(set high if pin was low, or cleared if pin was high).

The pins can drive and sink up to 25 mA, a driver circuit such as the one below may be required to drive anything that uses more current such as a relay or a solenoid.

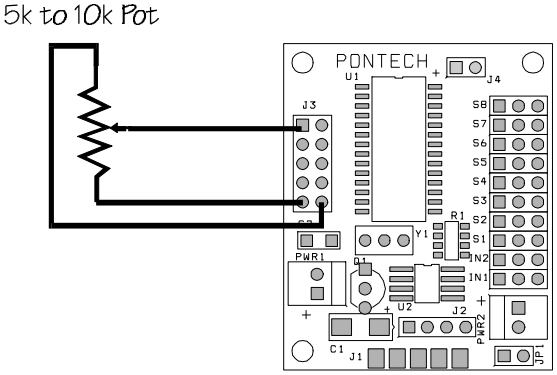


ADn **Read a voltage on the A/D port**

Port A (see figure on previous page) is a 5-Channel, 8-bit A/D input that can read an analog voltage. The *n* is a number between 1 to 5, which tells which pin on the A/D port to request. When the board receives this command, it will read the specified voltage on the pin and return a value between 0 to 255, which represents a voltage between 0 to 5 Volts.

i.e. `AD1 <enter>`

If wires were connected as in the figure below and the potentiometer as in the middle position, the board would return a value close to 28 followed by <ASCII 13>, which is about 2.5 Volts.



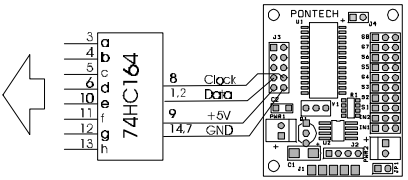
SI, SOn **Shift byte In/Out the SPI port**

These commands allow you to use Port C (see figure on p.14) on the board as a synchronous serial port to shift in or out a byte of data. The figure below shows how to connect shift register chips (74HC164 or 74HC165) to the board to make a serial-to-parallel or parallel-to- serial converter.

Use the **SO** command to make a serial-to-parallel converter

i.e. `SO3 <enter>`

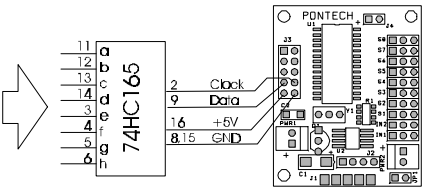
pins 3 and 4 of the '164 will be set high, while all others are low (3 decimal → 00000011 binary).



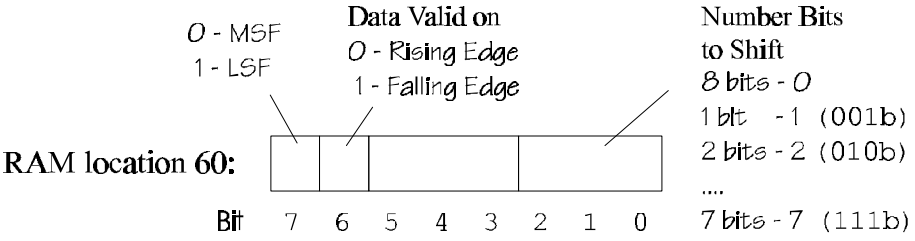
Use the **SI** command to make a parallel-to-serial converter

i.e. `SI <enter>`

the board will return a number between 0 to 255.



There is a configuration register at location 60 in RAM. The value of the register is initialized by the contents of EEPROM in location 11. The register configures the shift function for MSF (most significant first) or LSF (least significant first), data valid on clock going high or low, and the number of bits to shift in/out.



WRm n **Write to RAM**
RRm **Read from RAM**

where *m* is the memory address (see table on next page),
n is the value to be stored.

These commands allow you to modify and read the contents of the internal register or RAM of the processor. The internal RAM is a volatile memory storage, so when power is removed the contents will be erased.

i.e. `WR51 20 <enter>`
servo #1 will move to position 20, this command is equivalent to SV1 M20 <enter>

i.e. `RR52 <enter>`
the position of servo #2 will be returned.

RAM Memory Map:

Address (m)	Usage	Note
5	Port A	
6	Port B	
7	Port C	
14	TMR1L	
15	TMR1H	
16	T1CON	
27	CCPR2L	
28	CCPR2H	
29	CCP2CON	
51 to 58	**Current Servo Position**	
59	**Servo Select**	
60	**Shift Config Register**	
133	TRIS A	
134	TRIS B	
135	TRIS C	

Note: All other RAM locations not listed are used by the system and should not be used.

WEm n **Write to EEPROM**
REm **Read from EEPROM**

where *m* is the memory address (see table on next page),
n is the value to be stored.

These commands allow you to modify and read the contents of the external EEPROM connected to the processor. The EEPROM is a non-volatile memory storage, so any information written to it will stay even when power is removed.

i.e. `WE0 2 <enter>`
change the board ID number to #2

i.e. `RE1 <enter>`
the SV203 returns the initial servo value of servo #1

EEPROM Memory Map:

Address (m)	Usage	Factory default	Note
0	Board ID #	1	
1	Initial Servo #1 Value	128	0 - off or Digital
2	Initial Servo #2 Value	128	0 - off or Digital
3	Initial Servo #3 Value	128	0 - off or Digital
4	Initial Servo #4 Value	128	0 - off or Digital
5	Initial Servo #5 Value	128	0 - off or Digital
6	Initial Servo #6 Value	128	0 - off or Digital
7	Initial Servo #7 Value	128	0 - off or Digital
8	Initial Servo #8 Value	128	0 - off or Digital
9	Baud Rate	50 (9600 baud)	24 (19200 baud) 100(4800 baud) 200(2400 baud)
10	Pre Enable Flag	1	1-Yes 0-No
11	Shift Config Register	0	MSB, valid on Rising, 8-bit

SV203 - Changing Default Settings

When the board is powered-up, it first reads the external EEPROM to get its Board ID number, Initial positions for the servo, Baud rate, and some other initial flags. These initial settings can be changed by using the WE command (for WE command see p.20).

To change ID:

i.e. `WE0 3 <enter>`

#3 is the new ID number

To have the board be pre-enable on power-up:

i.e. `WE10 1 <enter>`

To change Servo initialization:

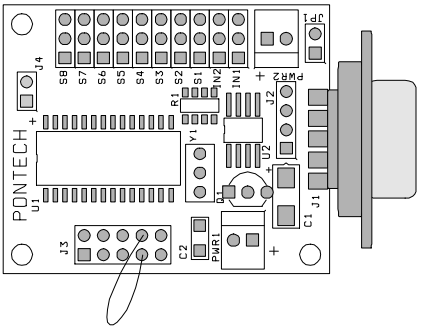
i.e. `WE2 0 <enter>`

Servo #2 will be off when the board is turned on.

See the Memory Map on previous page for other default settings.

SV203 – Changing Default Settings

The board can be reset to its factory default settings by tying pins 7 and 8 of Port C together, power-up the board, and wait for about 3 seconds.



- Turn off board
- Tie Pin 7 and 8 together
- Turn on board
- wait 3 seconds

The board will be restored with its factory default.

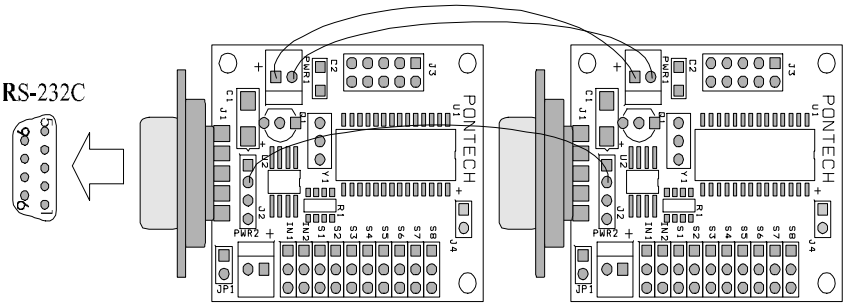
You can also use the enclosed program on disk called DEFAULT.EXE to reset the default settings of the board.

If the baud rate of the SV203 has been altered, either on purpose or inadvertently, the DEFAULT.EXE program cannot be used. In this case, the above method of shorting pins 7 and 8 of connector J3 is preferred.

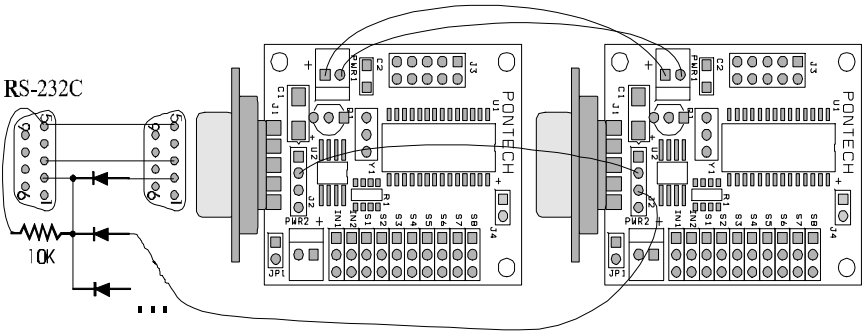
SV203 - Controlling Multiple Boards

You can connect multiple boards to the same serial line by reassigning different ID numbers to each board.

If you are using the second board for output only, the wiring below will work just fine.



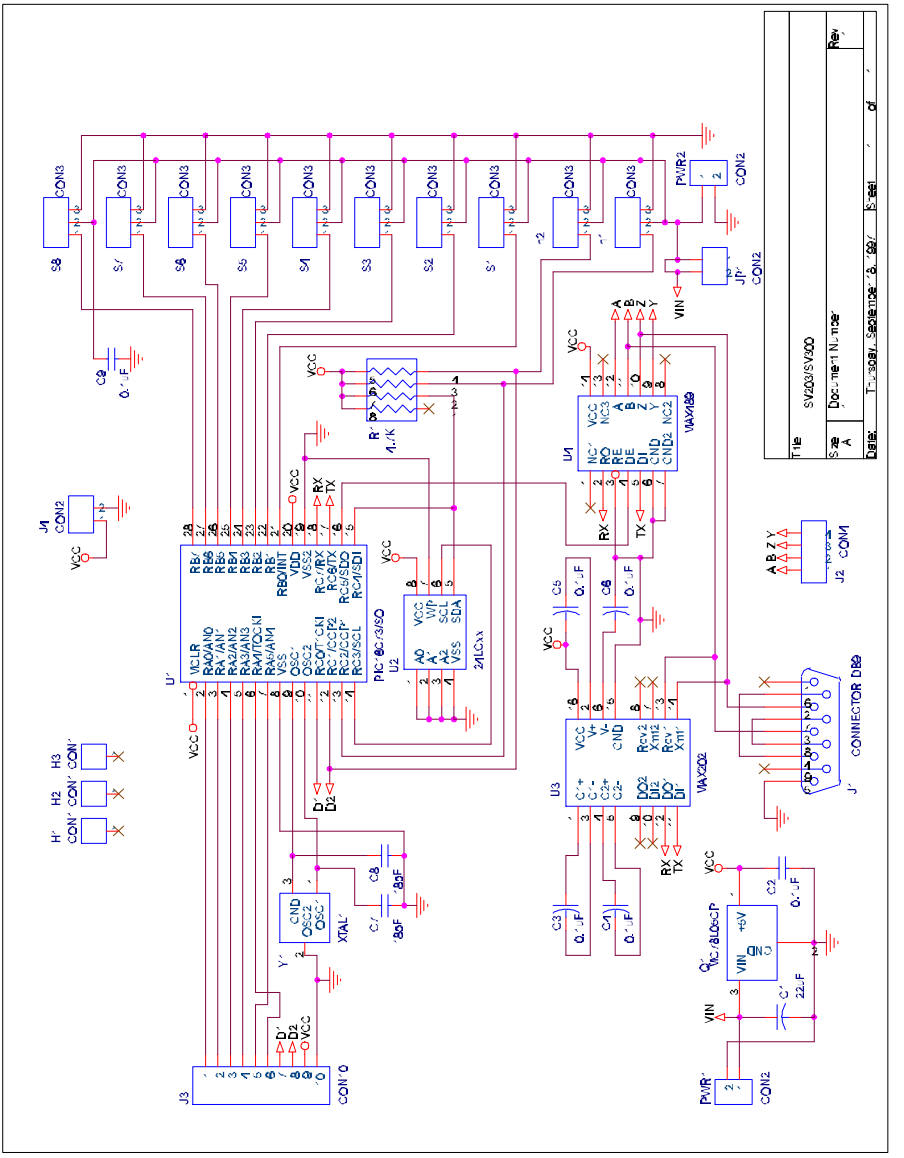
If the other boards need to be used for both input and output then use the wiring below. Since the RS232C standard is designed for a single peripheral, the output pin of the boards cannot be tied directly together.



SV203 - Commands Listing

Commands	Parameter (n)	Description
BDn	0 to 255	Board Select
SVn	1 to 8	Servo Select
Mn	0 to 255	Move to an absolute location
In	-128 to 127	Move relative to current position
Dn	1 to 65535	Delay (ms)
PSn **PC**n **PT**n	1 to 8	Put, set single pin of servo port **b** is a number between 1 and 8, which tells what pin on the port is being used. If n = 0 → clear Bit n = 1 → Set Bit n = 2 → Toggle Bit
ADn	1 to 5	Get A/D value, the board will return a value between "0" to "255" followed by ASCII 13 which represent a voltage between 0 to 5 Volts.
SOn	0 to 255	Shift a byte out to the SPI port
SI	None	Shift a byte in form the SPI port
WRm n	m = 0 to 255 n = 0 to 255	Write to internal RAM **m** is the memory location **n** is the value to write
RRm	m = 0 to 255	Read the contain of internal RAM **m** is the memory location to read
WEm n	m = 0 to 8190 n = 0 to 255	Write to external EEPROM **m** is the memory location **n** is the value to write
REm	m = 0 to 8190	Read the contents of external EEPROM **m** is the memory location to read
?	None	Help, return summary of command listing
V?	None	Returns the firmware version

SV203 - Schematic



Warranty

Pontech warrants its products against defects in materials and workmanship for a period of 90 days.

If you discover a defect, Pontech will, at its option, repair, replace, or refund the purchase price. Simply return the product with a description of the problem and a copy of your invoice (if you do not have your invoice, please include your name and telephone number).

The warranty does no apply if product has been damaged by accident, abuse, or misuse.

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