16 SERVO DRIVER

USER MANUAL

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Servo motors are an integral part of all kind of robotic structures. Hexapod, spider robot all requires servo motors. But when the number of servo motors increases it becomes really difficult to control them. The new **Servo controller board** by Elementz can be used to control a total of 16 servos at the same time. Well not just 16 servos, if necessary you can connect multiple boards and use them together by "*board addressing"* feature introduced in these boards. Well that's good news.

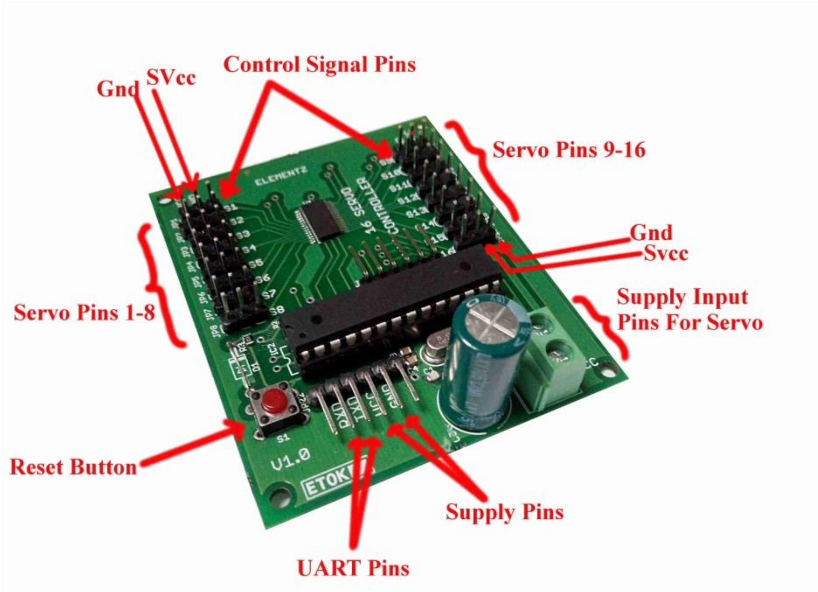
The input for the Servo controller board is given serially using UART communication. The design of the board enables the user to plug in the servos directly to the board.

Features

- Offers a resolution less than 0.5^{o}.
- Can connect and control 16 Servo motors at the same time.
- Board addressing feature is introduced for use of multiple boards at the same time.
- The input is given serially (UART: baud rate 9600, 8 Data bits, 1 Stop bit, No Parity.)
- Servos with any time range can be connected to the same board.
- Servos can be controller individually or as a block.
- Block commands and independent commands can be mixed together for efficient coding.

Pin out and Description

- Supply pins: Power supply input pins for the controller. 5V DC supply is to be given
- Supply input pins for servo: This is the supply pins for servo motor. 5V DC supply is to be given.



- Servo Pins 1-16: This is where we connect the servo motors. They can be directly plugged in to the board. The servo pins consists of a set of three pins and they are
  - SVcc: The VCC pin of servomotor is connected here
  - Gnd: The Ground pin of servo motor is connected here
  - Control signal pins: The signal pin of servo motor is connected here.

  These pins are arranged such that the servo motor can be directly connected to the board.
- UART pins: These are the pins used for giving input to the servo board.
- Reset Button: Used for resetting the board. Resetting does not change the address set and the last output written to the servo.

How to use the Servo Control Board

Some commands are used for setting up the Servo Control board. The format of the command used for giving instructions is as below

Independent Servo Control Command

ADDR<Address of the Board>C<Servo number>P<Required position>cr	
ADDR	Address of the board. Can vary from 0 To 254. Default value is 0. N.B: Values more than 254 is not encouraged. How to change the address of the servo.
C	Channel or Servo number. Can vary from 1-16 E.g.:- C1 means the first servo
P	Position to which the servo to be moved. Specified in microseconds (µs). Depends upon the servo being used. Giving position values out of the servo range could damage the servo N.B: For more details see the Appendix
cr	Carriage return (Enter character) (in hex either 0x0D or 0x0A)
If the values given to the board are correct, the scorpion board replies with an “OK” response.	

Examples

E.g.1**:** For rotating the 7th servo (channel 7) to 90°

ADDR0C7P1500cr

E.g.2**:** To move the 13th servo to 180°

ADDR0C13P2400cr

E.g.3**:** Instructions to control “multiple” servos at the same time. Move the 1st servo 180° and the 9th servo 90° and 15th servo also to 90°

ADDR0C1P2400C9P1500C15P1500cr

NB: We only need to call the address of the board once. The servo used for examples is TOWER PRO MICRO SERVO SG90.

Controlling the Servos as a block

The servo pins are divided in to four blocks. This helps when multiple servos are required to move together.

The blocks are:

Block number	Servo Pins
1	1-4
2	5-8
3	13-16
4	9-12

The command is given as below

<table>
<tr><th colspan="2">ADDR<Address of the Board>B<Block number>P<Required position>cr</th></tr>
<tr><td>ADDR</td><td>Address of the board. Can vary from 0 To 254.
Default value is 0.
N.B: Values more than 254 is not encouraged. How to change the address of the servo</td></tr>
<tr><td>B</td><td>Block number. Can vary from 1-4
E.g.:- B1 means the first block (i.e. servo pins 1-4)</td></tr>
<tr><td>P</td><td>Position to which the servo to be moved. Specified in microseconds (µs).
Depends upon the servo being used.
Giving position values out of the servo range could damage the servo
N.B: For more details see the Appendix</td></tr>
<tr><td>cr</td><td>Carriage return (Enter character)
(in hex either 0x0D or 0x0A)</td></tr>
<tr><td colspan="2">If the values given to the board are correct, the scorpion board replies with an “OK” response.</td></tr>
</table>

E.g.4: To move servos 13-16 to 180^{o} (Four servos at the same time)

ADDR0B3P2400cr

E.g.5: To move servos 1-4 to 180^{o} and servos 9-12 to 90^{o}

ADDR0B1P2400B4P1500cr

E.g.6: To move all the servos to 90^{o}

ADDR0B1P1500 B2P1500 B3P1500B4P1500cr

Mixing the commands:

In some cases mixing the block and independent commands together can use for ease of coding.

E.g.7: To move servos 1-7 to 180^{o} and servo 8 to 90^{o}

ADDR0B1P2400B2P2400C8P1500cr

E.g.8: To move the third servo to 90^{o} while all other servos to 180^{o}

ADDR0B1P2400B2P2400B3P2400B4P2400C3P1500cr

N.B: The Block command should precede the independent command for the mixing to be effective.

Changing the address of a Servo Controller Board

Use the following AT command to change/set the address of the board.

AT+ADDR=<Address to be set>cr	
Address to be set	The address value can vary from 0-254
cr	Carriage return (Enter character) (in hex either 0x0D or 0x0A)
If the address value is correct an “OK” response will be obtained from the board	

E.g.4: Setting an address 15 for a board.

AT+ADDR=15cr

Now the address of the board changes to 15.

N.B: Once an address value is set there is no need to repeat the process unless you want to change the address (even if the power is lost).

Using multiple boards at the same time

The board addressing feature enables us to connect and communicate to more than one board at the same time. Some important instructions in this mode are

- Change the address of the servo controller board individually by connecting one board at a time.

- While using multiple boards the usual responses obtained from the board will not be available, i.e. the board acts only as a receiver.

E.g.9**:** Using two servo controller boards with addresses 0 and 15 for the same function in e.g.3.

ADDR0C1P2400C9P1500C15P1500cr

ADDR15C1P2400C9P1500C15P1500cr

Note: The instruction for each board should be given in separate lines.

The block movement command can also be given in this mode.

Appendix

The control of a servo motor

Servo motors are controlled by giving pulses of certain pulse width (PWM). The pulse width is varied depending upon the position to which the servo motors knob is to be rotated. This pulse width varies from servo to servo (i.e. for different manufacturers). An out of range pulse width could damage the servo motor. The value of the pulse width can be obtained from the datasheet of the corresponding servo motor. But most of the time there will be some tolerance. It is advised to the user to check the value range by first giving the average pulse width value and then find the lower value by slowly decreasing the pulse width and the upper value by slowly increasing the pulse width from there. Consider the following example.

E.g.:- TOWER PRO MICRO SERVO SG90 has an input pulse range of 600µs to 2400µs. This means the servo rotates 180^{o} when the input pulse (control signal) width is 2400µs and rotates 0^{o} when the input pulse width to the servo is 600µs. If we want the servo to rotate 90^{o} we need to give the position as 1500µs and so on.

Note: for all the examples the address of the board is set to be ‘0’ and we are using TOWER PRO MICRO SERVO SG90.

Note: Entering a position value out of the range for any servo could damage the servo. So care must be taken while entering the position data

Power Considerations

Most servos are designed to run on about 5 or 6v. Keep in mind that a lot of servos moving at the same time (particularly large powerful ones) will need a lot of current. Even micro servos will draw several hundred milli amperes (mA) when moving. Some High-torque servos will draw more than 1A each under load. So select the power source wisely. The supply used to power the servos (i.e. the supply connected to servo supply pins) must have enough current rating. Otherwise the servos may behave abnormally.