

18 Channel Servo Driver Shield

for Arduino™ and Raspberry-PI™

Technical Data

DS-SCX18.S

Features

- **Arduino™ UNO Shield standard form factor for simple integration into any Arduino project**
- **Frees up the Arduino™ IO lines normally used for servo control**
- **I²C interface for simple connection to Arduino or Raspberry-PI**
- **Dual on-board 5Volt 3Amp regulators, with heatsinking, for servo power with enable jumpers**
- **Sixteen (16) level speed control for each servo**
- **Movement complete and soft-start complete status for each servo**
- **Global activation control ensures all servos start moving together, important for multi-legged robots**
- **I²C address links allow up to four [4] shields to be used together to provide up to 72 servos**
- **LVD, RoHS and WEEE compliant product**

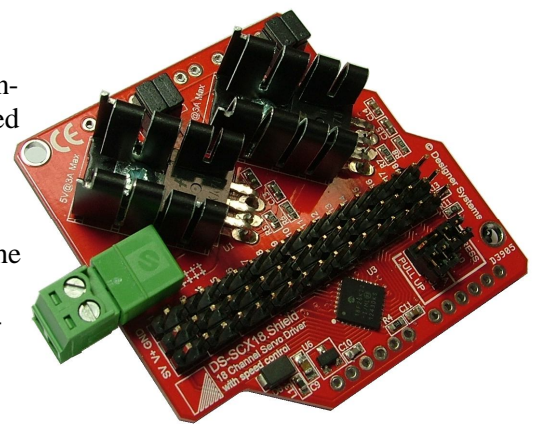
Description

The Designer Systems DS-SCX18.S is an eighteen [18] channel RC servo driver with advanced servo control features. Specifically targeted at the Arduino UNO board user [all other Arduino boards supported] and the Raspberry-PI the SCX18.S features high speed I²C communication for easy project integration and smooth speed control.

Once connected each servo can be positioned (with speed control), enabled, reversed and soft-started by simply writing a value to an internal register over the connected I²C interface.

The SCX18.S caters for the majority of servos by providing a wide pulse width range of 0.50mS to 2.50mS with 8uS per step accuracy and also provides global activation of new servo position, soft-start & movement complete registers for superior control.

The SCX18.S provides dual high power regulators capable of supplying 5V @ 3A to the connected servos from an external Li-Pol or



Ni-MH battery pack of 7.2 to 8.4V and features a disable link to allow the use of low voltage battery packs of 3.6 to 4.8V.

The on-board I²C pull-ups are jumper configurable to allow disconnection when connecting to the Raspberry-PI, which has its own pull-ups.

Applications

The SCX18.S has applications in robotics, including quadruped, hexapod and octopod robots, process control & sensor manipulation when used in conjunction with standard RC servos.

CONTROL MODULES

Selection Guide

Description	Part Number
18 Channel Servo Driver Shield	DS-SCX18.S
HS311 Standard hobby servo	DS-HS311

Raspberry-PI, Arduino, NANO, UNO & MEGA are trademark.

Power requirements

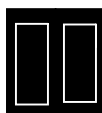
The DS-SCX18.S takes the power necessary for operation (approx. 2-25mA) from an external battery or power adaptor or power from the Arduino or Raspberry-PI board. The SCX18 provides three PCB pads, two marked 'GND' and one marked 'Vin' in the same format as that present on the UNO board, which should be connected to negative and positive battery/power supply terminals respectively. The input voltage range is 4.75 - 16VDC with the internal circuitry being protected against power supply reversal.

The two on-board servo regulators provide a clean regulated 5V supply for the connected servos at a maximum current of 3Amps each, the left hand regulator powering servos 1 to 9 and the right hand regulator servos 10-18. The following table indicates if a regulator needs to be enabled or disabled dependant on supply voltage:

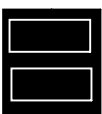
Status	Battery pack/supply voltage
Disabled	3.6V to 4.8V
Enabled	7.2V to 8.5V

The servo regulators are enabled or disabled with on-board double links just above the regulator heat-sinks which can be configured as follows:

Enabled (ON):



Disabled (OFF):



Refer to the voltage rating of the servos you wish to use before configuring the servo regulator.

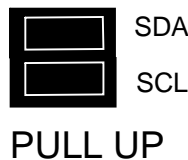
Connection of the external supply - battery / mains adaptor - to the SCX18 module is through a two (2) way pluggable screw terminal block marked '3-8.5VDC @ 6A Max'.

Note: This supply is NOT reverse connection protected but is marked with a series of '+++++' signs to denote positive.

I²C connection

The I²C connections are marked 'SDA' and 'SCL' and allow connection to the Arduino UNO board 'ANALOG IN' pins 4 and 5 or the Raspberry-PI GPIO port pins 3 and 5 (see Fig. 2.0) or another I²C Master device.

The DS-SCX18.S is fitted with pull-up jumpers that can be configured to provide the source current necessary for I²C communication. The following jumpers should normally be set when using the UNO board, as long as the I²C bus does not have existing pull-up's provided by another device. **These jumpers MUST be removed when using the Raspberry-PI:**



I²C communication

Up to four DS-SCX18.S modules may be connected to the same UNO / Raspberry-PI board or I²C bus and accessed individually using their own individual address.

The address is configured with the following jumpers:



The following table shows how the jumpers are placed for the different binary addresses:

Address xx	A0	A1
00 (default)	ON	ON
01	OFF	ON
10	ON	OFF
11	OFF	OFF

The binary address (xx) above is used in conjunction with the device ID 11101xxD to form the complete device address i.e. if both jumpers are left connected (default) then the device address would be 1110100D_{binary}.

The 'D' bit determines if a read or a write to the SCX18 is to be performed. If the 'D' bit is set '1' then a register read is performed or if clear '0' a register write.

To access individual registers a device write must be undertaken by the I²C Master which consists of a Start condition, device ID ('D' bit cleared), register to start write, one or more bytes of data to be written and a stop condition (see Figure 1.0 for I²C write protocol).

There are 37 individual registers that can be written within the SCX18 that control output as follows:

N ₇	N ₆	N ₅	N ₄	N ₃	N ₂	N ₁	N ₀
SCX I2C address							
1.	1	1	1	0	1	X	X
XX = SCX18 address							

Register address							
R0	U	U	B	B	B	B	B
B..B = 0 to 37							
U..U = unused on this implementation							

Servo 1 position							
R1	P	P	P	P	P	P	P
P..P = Servo position 0 to 255 (0.5mS to 2.50mS)							

Servo 1 control							
R2	A	B	C	D	S	S	S
A = Operate (0 - Servo disabled 1 - Servo enabled)							
B = Reverse (0 - Servo normal 1 - Servo reversed)							
C = Soft-start control (0 - Disabled 1 - Enabled)							
D = Speed control (0 - Disabled 1 - Enabled)							
S..S = Servo speed value 0 to 15 (0 = slowest)							

Servo 2 position							
R3	P	P	P	P	P	P	P
P..P = Servo position 0 to 255 (0.5mS to 2.50mS)							

Servo 2 control							
R4	A	B	C	D	S	S	S
A = Operate (0 - Servo disabled 1 - Servo enabled)							
B = Reverse (0 - Servo normal 1 - Servo reversed)							
C = Soft-start control (0 - Disabled 1 - Enabled)							
D = Speed control (0 - Disabled 1 - Enabled)							
S..S = Servo speed value 0 to 15 (0 = slowest)							

Servo 3 position							
R5	P	P	P	P	P	P	P
P..P = Servo position 0 to 255 (0.5mS to 2.50mS)							

Servo 3 control							
R6	A	B	C	D	S	S	S
A = Operate (0 - Servo disabled 1 - Servo enabled)							
B = Reverse (0 - Servo normal 1 - Servo reversed)							
C = Soft-start control (0 - Disabled 1 - Enabled)							
D = Speed control (0 - Disabled 1 - Enabled)							
S..S = Servo speed value 0 to 15 (0 = slowest)							

Servo 4 position							
R7	P	P	P	P	P	P	P
P..P = Servo position 0 to 255 (0.5mS to 2.50mS)							

Servo 4 control							
R8	A	B	C	D	S	S	S
A = Operate (0 - Servo disabled 1 - Servo enabled)							
B = Reverse (0 - Servo normal 1 - Servo reversed)							
C = Soft-start control (0 - Disabled 1 - Enabled)							
D = Speed control (0 - Disabled 1 - Enabled)							
S..S = Servo speed value 0 to 15 (0 = slowest)							

Servo 5 position							
R9	P	P	P	P	P	P	P
P..P = Servo position 0 to 255 (0.5mS to 2.50mS)							

Servo 5 control							
R10	A	B	C	D	S	S	S
A = Operate (0 - Servo disabled 1 - Servo enabled)							
B = Reverse (0 - Servo normal 1 - Servo reversed)							
C = Soft-start control (0 - Disabled 1 - Enabled)							
D = Speed control (0 - Disabled 1 - Enabled)							
S..S = Servo speed value 0 to 15 (0 = slowest)							

Servo 6 position							
R11	P	P	P	P	P	P	P
P..P = Servo position 0 to 255 (0.5mS to 2.50mS)							

Servo 6 control							
R12	A	B	C	D	S	S	S
A = Operate (0 - Servo disabled 1 - Servo enabled)							
B = Reverse (0 - Servo normal 1 - Servo reversed)							
C = Soft-start control (0 - Disabled 1 - Enabled)							
D = Speed control (0 - Disabled 1 - Enabled)							
S..S = Servo speed value 0 to 15 (0 = slowest)							

Servo 7 position
 R13

P	P	P	P	P	P	P	P	P
---	---	---	---	---	---	---	---	---

 P..P = Servo position 0 to 255 (0.5mS to 2.50mS)

Servo 7 control
 R14

A	B	C	D	S	S	S	S
---	---	---	---	---	---	---	---

 A = Operate (0 – Servo disabled 1 – Servo enabled)
 B = Reverse (0 – Servo normal 1 – Servo reversed)
 C = Soft-start control (0 – Disabled 1 – Enabled)
 D = Speed control (0 – Disabled 1 – Enabled)
 S..S = Servo speed value 0 to 15 (0 = slowest)

Servo 8 position
 R15

P	P	P	P	P	P	P	P	P
---	---	---	---	---	---	---	---	---

 P..P = Servo position 0 to 255 (0.5mS to 2.50mS)

Servo 8 control
 R16

A	B	C	D	S	S	S	S
---	---	---	---	---	---	---	---

 A = Operate (0 – Servo disabled 1 – Servo enabled)
 B = Reverse (0 – Servo normal 1 – Servo reversed)
 C = Soft-start control (0 – Disabled 1 – Enabled)
 D = Speed control (0 – Disabled 1 – Enabled)
 S..S = Servo speed value 0 to 15 (0 = slowest)

Servo 9 position
 R17

P	P	P	P	P	P	P	P	P
---	---	---	---	---	---	---	---	---

 P..P = Servo position 0 to 255 (0.5mS to 2.50mS)

Servo 9 control
 R18

A	B	C	D	S	S	S	S
---	---	---	---	---	---	---	---

 A = Operate (0 – Servo disabled 1 – Servo enabled)
 B = Reverse (0 – Servo normal 1 – Servo reversed)
 C = Soft-start control (0 – Disabled 1 – Enabled)
 D = Speed control (0 – Disabled 1 – Enabled)
 S..S = Servo speed value 0 to 15 (0 = slowest)

Servo 10 position
 R19

P	P	P	P	P	P	P	P	P
---	---	---	---	---	---	---	---	---

 P..P = Servo position 0 to 255 (0.5mS to 2.50mS)

Servo 10 control
 R20

A	B	C	D	S	S	S	S
---	---	---	---	---	---	---	---

 A = Operate (0 – Servo disabled 1 – Servo enabled)
 B = Reverse (0 – Servo normal 1 – Servo reversed)
 C = Soft-start control (0 – Disabled 1 – Enabled)
 D = Speed control (0 – Disabled 1 – Enabled)
 S..S = Servo speed value 0 to 15 (0 = slowest)

Servo 11 position
 R21

P	P	P	P	P	P	P	P	P
---	---	---	---	---	---	---	---	---

 P..P = Servo position 0 to 255 (0.5mS to 2.50mS)

Servo 11 control
 R22

A	B	C	D	S	S	S	S
---	---	---	---	---	---	---	---

 A = Operate (0 – Servo disabled 1 – Servo enabled)
 B = Reverse (0 – Servo normal 1 – Servo reversed)
 C = Soft-start control (0 – Disabled 1 – Enabled)
 D = Speed control (0 – Disabled 1 – Enabled)
 S..S = Servo speed value 0 to 15 (0 = slowest)

Servo 12 position
 R23

P	P	P	P	P	P	P	P	P
---	---	---	---	---	---	---	---	---

 P..P = Servo position 0 to 255 (0.5mS to 2.50mS)

Servo 12 control
 R24

A	B	C	D	S	S	S	S
---	---	---	---	---	---	---	---

 A = Operate (0 – Servo disabled 1 – Servo enabled)
 B = Reverse (0 – Servo normal 1 – Servo reversed)
 C = Soft-start control (0 – Disabled 1 – Enabled)
 D = Speed control (0 – Disabled 1 – Enabled)
 S..S = Servo speed value 0 to 15 (0 = slowest)

Servo 13 position
 R25

P	P	P	P	P	P	P	P	P
---	---	---	---	---	---	---	---	---

 P..P = Servo position 0 to 255 (0.5mS to 2.50mS)

Servo 13 control
 R26

A	B	C	D	S	S	S	S
---	---	---	---	---	---	---	---

 A = Operate (0 – Servo disabled 1 – Servo enabled)
 B = Reverse (0 – Servo normal 1 – Servo reversed)
 C = Soft-start control (0 – Disabled 1 – Enabled)
 D = Speed control (0 – Disabled 1 – Enabled)
 S..S = Servo speed value 0 to 15 (0 = slowest)

Servo 14 position
 R27

P	P	P	P	P	P	P	P	P
---	---	---	---	---	---	---	---	---

 P..P = Servo position 0 to 255 (0.5mS to 2.50mS)

Servo 14 control
 R28

A	B	C	D	S	S	S	S
---	---	---	---	---	---	---	---

 A = Operate (0 – Servo disabled 1 – Servo enabled)
 B = Reverse (0 – Servo normal 1 – Servo reversed)
 C = Soft-start control (0 – Disabled 1 – Enabled)
 D = Speed control (0 – Disabled 1 – Enabled)
 S..S = Servo speed value 0 to 15 (0 = slowest)

Servo 15 position
 R29

P	P	P	P	P	P	P	P	P
---	---	---	---	---	---	---	---	---

 P..P = Servo position 0 to 255 (0.5mS to 2.50mS)

Servo 15 control
 R30

A	B	C	D	S	S	S	S
---	---	---	---	---	---	---	---

 A = Operate (0 – Servo disabled 1 – Servo enabled)
 B = Reverse (0 – Servo normal 1 – Servo reversed)
 C = Soft-start control (0 – Disabled 1 – Enabled)
 D = Speed control (0 – Disabled 1 – Enabled)
 S..S = Servo speed value 0 to 15 (0 = slowest)

Servo 16 position
 R31

P	P	P	P	P	P	P	P	P
---	---	---	---	---	---	---	---	---

 P..P = Servo position 0 to 255 (0.5mS to 2.50mS)

Servo 16 control
 R32

A	B	C	D	S	S	S	S
---	---	---	---	---	---	---	---

 A = Operate (0 – Servo disabled 1 – Servo enabled)
 B = Reverse (0 – Servo normal 1 – Servo reversed)
 C = Soft-start control (0 – Disabled 1 – Enabled)
 D = Speed control (0 – Disabled 1 – Enabled)
 S..S = Servo speed value 0 to 15 (0 = slowest)

Servo 17 position
 R33

P	P	P	P	P	P	P	P	P
---	---	---	---	---	---	---	---	---

 P..P = Servo position 0 to 255 (0.5mS to 2.50mS)

Servo 17 control
 R34

A	B	C	D	S	S	S	S
---	---	---	---	---	---	---	---

 A = Operate (0 – Servo disabled 1 – Servo enabled)
 B = Reverse (0 – Servo normal 1 – Servo reversed)
 C = Soft-start control (0 – Disabled 1 – Enabled)
 D = Speed control (0 – Disabled 1 – Enabled)
 S..S = Servo speed value 0 to 15 (0 = slowest)

Servo 18 position
 R35

P	P	P	P	P	P	P	P	P
---	---	---	---	---	---	---	---	---

 P..P = Servo position 0 to 255 (0.5mS to 2.50mS)

Servo 18 control
 R36

A	B	C	D	S	S	S	S
---	---	---	---	---	---	---	---

 A = Operate (0 – Servo disabled 1 – Servo enabled)
 B = Reverse (0 – Servo normal 1 – Servo reversed)
 C = Soft-start control (0 – Disabled 1 – Enabled)
 D = Speed control (0 – Disabled 1 – Enabled)
 S..S = Servo speed value 0 to 15 (0 = slowest)

Servo global enable register
 R37

X	X	X	X	X	X	X	X	X
---	---	---	---	---	---	---	---	---

 X..X = Any value

Each control register consists of four control bits and a four bit speed control value defined as follows:

Bit (A) 128_{decimal} is the operate bit which when set activates the servo being controlled.

Bit (B) 64_{decimal} is the reverse bit which reverses the position value for the servo being controlled.

Bit (C) 32_{decimal} is the soft-start bit which when set on servo first activation, see operate bit above, feeds position pulses to the servo in a ramping manner until position is attained.

Bit (D) 16_{decimal} is the speed control enable bit which when set applies the speed value 0 to 15, contained in the four bits (SSSS) 1,2,4,8_{decimal}, to the servo being controlled.

Once all the required position & control registers have been set a write to the R37 (Global enable register) must be made to activate all the new positions.

Example.

To set the first nine servos to new positions with servos 1 to 4 running at speed 0 and servos 5 to 8 running at speed 5 in reverse mode, first write:

Byte 1 (SCX18 Adr) 11101000_{binary}
 Byte 2 (Register 0) 0_{decimal}

Byte 3 (Register 1) 30_{decimal}
 Byte 4 (Register 2) 144_{decimal}, 90_{hex}
 Byte 5 (Register 3) 35_{decimal}
 Byte 6 (Register 4) 144_{decimal}, 90_{hex}
 Byte 7 (Register 5) 40_{decimal}
 Byte 8 (Register 6) 144_{decimal}, 90_{hex}
 Byte 9 (Register 7) 45_{decimal}
 Byte 10 (Register 8) 144_{decimal}, 90_{hex}
 Byte 11 (Register 9) 127_{decimal}
 Byte 12 (Register 10) 213_{decimal}, D5_{hex}
 Byte 13 (Register 11) 130_{decimal}
 Byte 14 (Register 12) 213_{decimal}, D5_{hex}
 Byte 15 (Register 13) 140_{decimal}
 Byte 16 (Register 14) 213_{decimal}, D5_{hex}
 Byte 17 (Register 15) 150_{decimal}
 Byte 18 (Register 16) 213_{decimal}, D5_{hex}

then to activate write:

Byte 1 (SCX18 Adr) 11101000_{binary}
 Byte 2 (Register 0) 37_{decimal}
 Byte 3 (Register 37) 0_{decimal}

To read the status registers a device write then read must be undertaken by the OOPic / I²C Master. The write consists of a Start condition, device ID ('D' bit cleared), register to start read and a Stop condition. This is followed by a read, which consists of a Start condition, device ID ('D' bit set), followed by data from the status register and terminated with a Stop condition (see Figure 1.1 for I²C read protocol).

Status registers

There are 18 registers that can be read within the SCX18 as follows:

N₇ N₆ N₅ N₄ N₃ N₂ N₁ N₀

SCX I2C Address
 1.

1	1	1	0	1	X	X	1
---	---	---	---	---	---	---	---

 XX = SCX18 address

Servo 1 status
 R0

A	B	C	D	0	0	0	0
---	---	---	---	---	---	---	---

 A = Operation (0 – Servo disabled 1 – Servo enabled)
 B = Reverse (0 – Servo normal 1 – Servo reversed)
 C = Soft-start (0 – Complete 1 – In-progress)
 D = Movement (0 – Complete 1 – In-progress)

Servo 2 status
 R1

A	B	C	D	0	0	0	0
---	---	---	---	---	---	---	---

 A = Operation (0 – Servo disabled 1 – Servo enabled)
 B = Reverse (0 – Servo normal 1 – Servo reversed)
 C = Soft-start (0 – Complete 1 – In-progress)
 D = Movement (0 – Complete 1 – In-progress)

Servo 3 status
 R2

A	B	C	D	0	0	0	0
---	---	---	---	---	---	---	---

 A = Operation (0 – Servo disabled 1 – Servo enabled)
 B = Reverse (0 – Servo normal 1 – Servo reversed)
 C = Soft-start (0 – Complete 1 – In-progress)
 D = Movement (0 – Complete 1 – In-progress)

Servo 4 status
 R3

A	B	C	D	0	0	0	0
---	---	---	---	---	---	---	---

 A = Operation (0 – Servo disabled 1 – Servo enabled)
 B = Reverse (0 – Servo normal 1 – Servo reversed)
 C = Soft-start (0 – Complete 1 – In-progress)
 D = Movement (0 – Complete 1 – In-progress)

Servo 5 status
 R4

A	B	C	D	0	0	0	0
---	---	---	---	---	---	---	---

 A = Operation (0 – Servo disabled 1 – Servo enabled)
 B = Reverse (0 – Servo normal 1 – Servo reversed)
 C = Soft-start (0 – Complete 1 – In-progress)
 D = Movement (0 – Complete 1 – In-progress)

Servo 6 status
 R5

A	B	C	D	0	0	0	0
---	---	---	---	---	---	---	---

 A = Operation (0 – Servo disabled 1 – Servo enabled)
 B = Reverse (0 – Servo normal 1 – Servo reversed)
 C = Soft-start (0 – Complete 1 – In-progress)
 D = Movement (0 – Complete 1 – In-progress)

Servo 7 status
R6

A	B	C	D	0	0	0	0
---	---	---	---	---	---	---	---

A = Operation (0 – Servo disabled 1 – Servo enabled)
B = Reverse (0 – Servo normal 1 – Servo reversed)
C = Soft-start (0 – Complete 1 – In-progress)
D = Movement (0 – Complete 1 – In-progress)

Servo 8 status
R7

A	B	C	D	0	0	0	0
---	---	---	---	---	---	---	---

A = Operation (0 – Servo disabled 1 – Servo enabled)
B = Reverse (0 – Servo normal 1 – Servo reversed)
C = Soft-start (0 – Complete 1 – In-progress)
D = Movement (0 – Complete 1 – In-progress)

Servo 9 status
R8

A	B	C	D	0	0	0	0
---	---	---	---	---	---	---	---

A = Operation (0 – Servo disabled 1 – Servo enabled)
B = Reverse (0 – Servo normal 1 – Servo reversed)
C = Soft-start (0 – Complete 1 – In-progress)
D = Movement (0 – Complete 1 – In-progress)

Servo 10 status
R9

A	B	C	D	0	0	0	0
---	---	---	---	---	---	---	---

A = Operation (0 – Servo disabled 1 – Servo enabled)
B = Reverse (0 – Servo normal 1 – Servo reversed)
C = Soft-start (0 – Complete 1 – In-progress)
D = Movement (0 – Complete 1 – In-progress)

Servo 11 status
R10

A	B	C	D	0	0	0	0
---	---	---	---	---	---	---	---

A = Operation (0 – Servo disabled 1 – Servo enabled)
B = Reverse (0 – Servo normal 1 – Servo reversed)
C = Soft-start (0 – Complete 1 – In-progress)
D = Movement (0 – Complete 1 – In-progress)

Servo 12 status
R11

A	B	C	D	0	0	0	0
---	---	---	---	---	---	---	---

A = Operation (0 – Servo disabled 1 – Servo enabled)
B = Reverse (0 – Servo normal 1 – Servo reversed)
C = Soft-start (0 – Complete 1 – In-progress)
D = Movement (0 – Complete 1 – In-progress)

Servo 13 status
R12

A	B	C	D	0	0	0	0
---	---	---	---	---	---	---	---

A = Operation (0 – Servo disabled 1 – Servo enabled)
B = Reverse (0 – Servo normal 1 – Servo reversed)
C = Soft-start (0 – Complete 1 – In-progress)
D = Movement (0 – Complete 1 – In-progress)

Servo 14 status
R13

A	B	C	D	0	0	0	0
---	---	---	---	---	---	---	---

A = Operation (0 – Servo disabled 1 – Servo enabled)
B = Reverse (0 – Servo normal 1 – Servo reversed)
C = Soft-start (0 – Complete 1 – In-progress)
D = Movement (0 – Complete 1 – In-progress)

Servo 15 status
R14

A	B	C	D	0	0	0	0
---	---	---	---	---	---	---	---

A = Operation (0 – Servo disabled 1 – Servo enabled)
B = Reverse (0 – Servo normal 1 – Servo reversed)
C = Soft-start (0 – Complete 1 – In-progress)
D = Movement (0 – Complete 1 – In-progress)

Servo 16 status
R15

A	B	C	D	0	0	0	0
---	---	---	---	---	---	---	---

A = Operation (0 – Servo disabled 1 – Servo enabled)
B = Reverse (0 – Servo normal 1 – Servo reversed)
C = Soft-start (0 – Complete 1 – In-progress)
D = Movement (0 – Complete 1 – In-progress)

Servo 17 status
R16

A	B	C	D	0	0	0	0
---	---	---	---	---	---	---	---

A = Operation (0 – Servo disabled 1 – Servo enabled)
B = Reverse (0 – Servo normal 1 – Servo reversed)
C = Soft-start (0 – Complete 1 – In-progress)
D = Movement (0 – Complete 1 – In-progress)

Servo 18 status
R17

A	B	C	D	0	0	0	0
---	---	---	---	---	---	---	---

A = Operation (0 – Servo disabled 1 – Servo enabled)
B = Reverse (0 – Servo normal 1 – Servo reversed)
C = Soft-start (0 – Complete 1 – In-progress)
D = Movement (0 – Complete 1 – In-progress)

Firmware version
R18

M	M	M	M	V	V	V	V
---	---	---	---	---	---	---	---

M..M = Firmware major revision number 1-15
V..V = Firmware minor revision number 1-15

Bit (A) 128_{decimal} is the operate bit which when set indicates that the servo is operational.

Bit (B) 64_{decimal} is the reverse bit which when set indicates that position values written to the servo will be reversed.

Bit (C) 32_{decimal} is the soft-start bit which when set indicates that soft-start is in progress.

Movement complete determination
Bit (D) 16_{decimal} is cleared to indicate if the current servo movement has completed.

This indication is not derived from mechanical or electrical feedback from the servo being controlled but is a function of the current servo speed selected and position.

When the slowest servo speed (0) is selected the determination of movement completion is at its best.

This is because the positional change of the servo between its current and final position has been split into many sub-positions which must be attained before the final position is reached. These many sub-positions ensure that the mechanical position closely relates to the position requested by the pulse width and therefore the determination of final position (movement complete) will closely relate to mechanical position. As servo speed is increased the error between mechanical position and pulse width position increases and movement completion accuracy is degraded.

Electrical Characteristics (T_A = 25°C Typical)

Parameter	Minimum	Maximum	Units	Notes
Supply Voltage (Servo power)	3.8	12	V	1,2
Supply Current (Servo power)	1	2x 2800	mA	3
Supply Voltage (on-board VCC)	4.75	16	V	
Supply Current (on-board VCC)	2	25	mA	4
I ² C pull-up resistance	-	4700	Ω	
I ² C speed	-	400	kHz	

Absolute Maximum Ratings

Parameter	Minimum	Maximum	Units	Notes
Supply Voltage (Servo power)	-0.5	+30	V	5
Supply Current (Servo power)	0	4.5	A	

Environmental

Parameter	Minimum	Maximum	Units
Operating Temperature	0	70	°C
Storage Temperature	-10	80	°C
Humidity	0	80	%
Dimensions	Length 56.25mm, Width 53.5mm, Height 15mm		
Weight	25g		
Immunity & emissions	See statement on page 8		

Notes:

- Servo voltage below 5V requires that the servo regulator be disabled (see above).
- Voltages above 6-12V may require force cooling of the heat-sinks if servo load is high.
- Values given are based on maximum and minimum loading for each regulator.
- Values given are for servos being not driven and driven.
- Value given is based on maximum and minimum loading.

Calculating binary bit values:

The registers used above use the binary notation to allow the control of servo operation, reversal, soft-start & speed selection. Each register is made up of eight (8) bits, which can be set or cleared to produce the desired operation, the individual bits having a value associated with them as follows:

128	64	32	16	8	4	2	1
-----	----	----	----	---	---	---	---

If we take for example one of the servo control registers we can see it is made up of four (4) separate bits A, B, C & D plus a four bit value SSSS:

Servo 1 control

R1	A	B	C	D	S	S	S	S
----	---	---	---	---	---	---	---	---

A = Operate (0 – Servo disabled 1 – Servo enabled)

B = Reverse (0 – Servo normal 1 – Servo reversed)

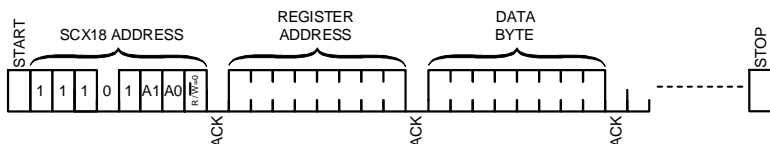
C = Soft-start control (0 – Disabled 1 – Enabled)

D = Speed control (0 – Disabled 1 – Enabled)

S..S = Servo speed value 0 to 15 (0 = slowest)

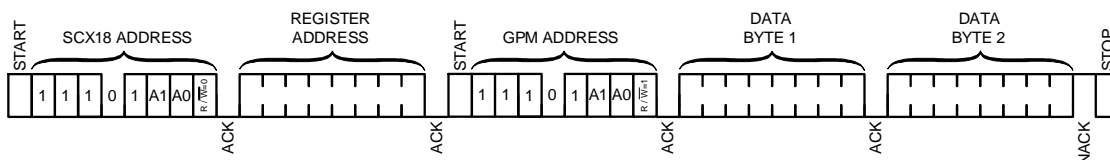
Each bit is defined to control a particular function for the servo it controls, so if for example we wanted to enable servo 1 we would need to set bit 'A' which controls the servo operation. We know from the bit values defined above that the value associated with the 'A' bit is 128, so by writing this value to register 1 we can enable servo 1. If we need to enable additional functions such as the speed control - 'D' - as well as the servo enable, the value of this bit is added to the value written to the register i.e. $128 + 16 = 144$. In addition we could also add a speed value of 5 that would make the total value $128 + 16 + 5 = 149$.

Figure 1.0 (I²C write protocol)



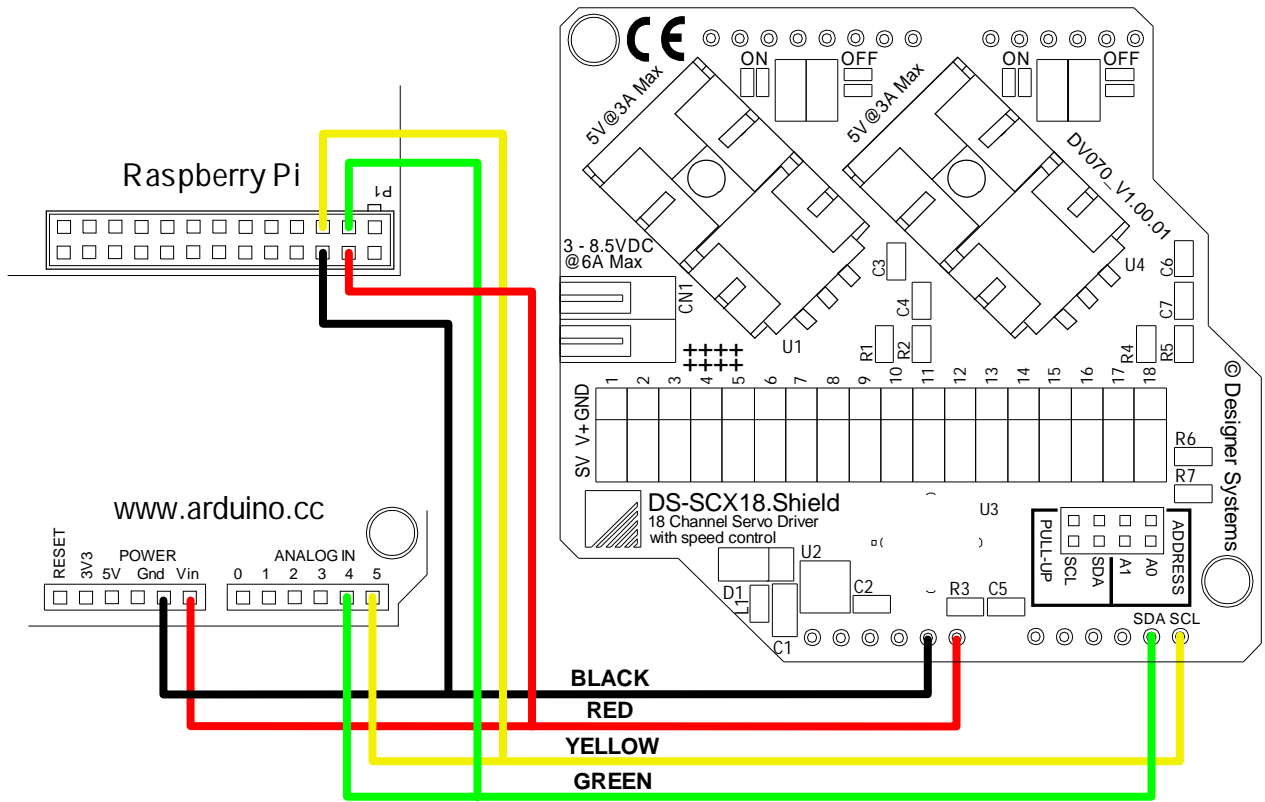
Multiple bytes may be written before the 'STOP' condition. Data is written into registers starting at 'REGISTER ADDRESS', then 'REGISTER ADDRESS' +1, then 'REGISTER ADDRESS' +2 etc. Each byte transfer is acknowledged 'ACK' by the SCX18 until the 'STOP' condition.

Figure 1.1 (I²C read protocol)

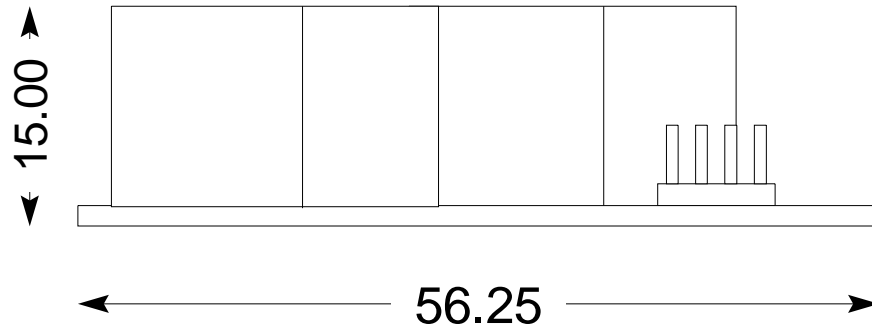
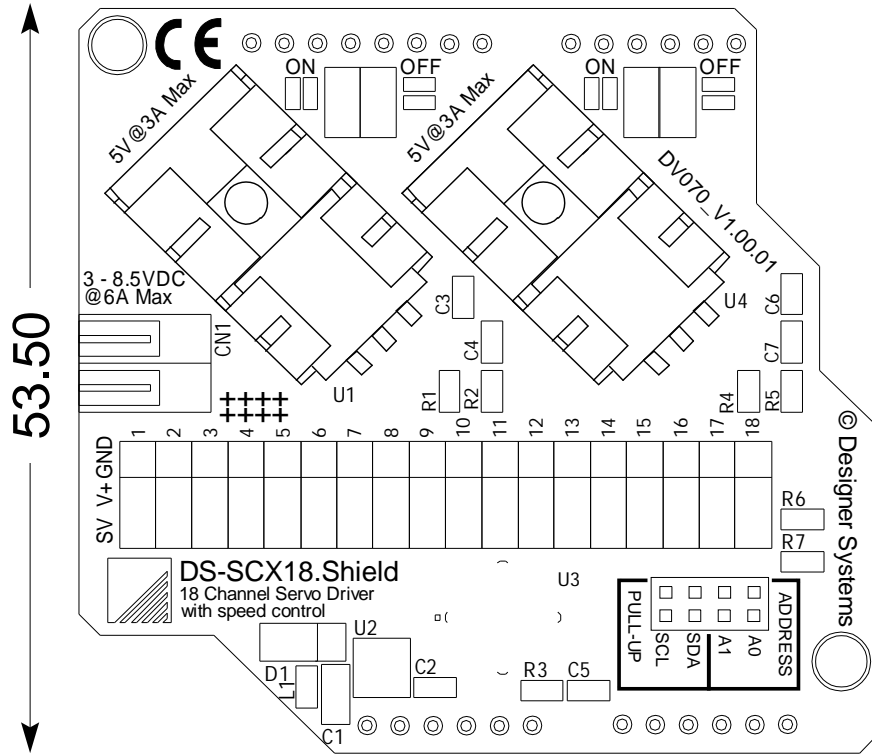


'DATA BYTE 1 & 2' are register values returned from the SCX18. Each byte written is acknowledged 'ACK' by the SCX18, every byte read is acknowledged 'ACK' by the I²C Master. A Not-acknowledge 'NACK' condition is generated by the I²C Master when it has finished reading.

Figure 2.0 (Connection Schematic for Arduino UNO or Raspberry-Pi I²C communication)

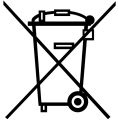


Mechanical Specifications – Units millimetres



Revision History:

1.00 Release version



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Declaration of Conformity

Apparatus name / model number DS-SCX18.S

Conformity via Generic Standard EN61000-1
Generic Standard EN61000-3

Conformity criteria For use only within commercial, residential and light industrial applications

We certify that the apparatus identified above conforms to the requirements of Council Directive 2004/108/EC & 2006/95/EC

Signed.

Date 20/6/13

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Description of apparatus Robotic interface peripheral

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