

Intelligent servo SCS15 Serial

Bus User Manual

Revision History

Date	version	update content
2016.8.19	V1.01	1. Errata revision 2. Increase the speed control parameters



The first chapter outlines components

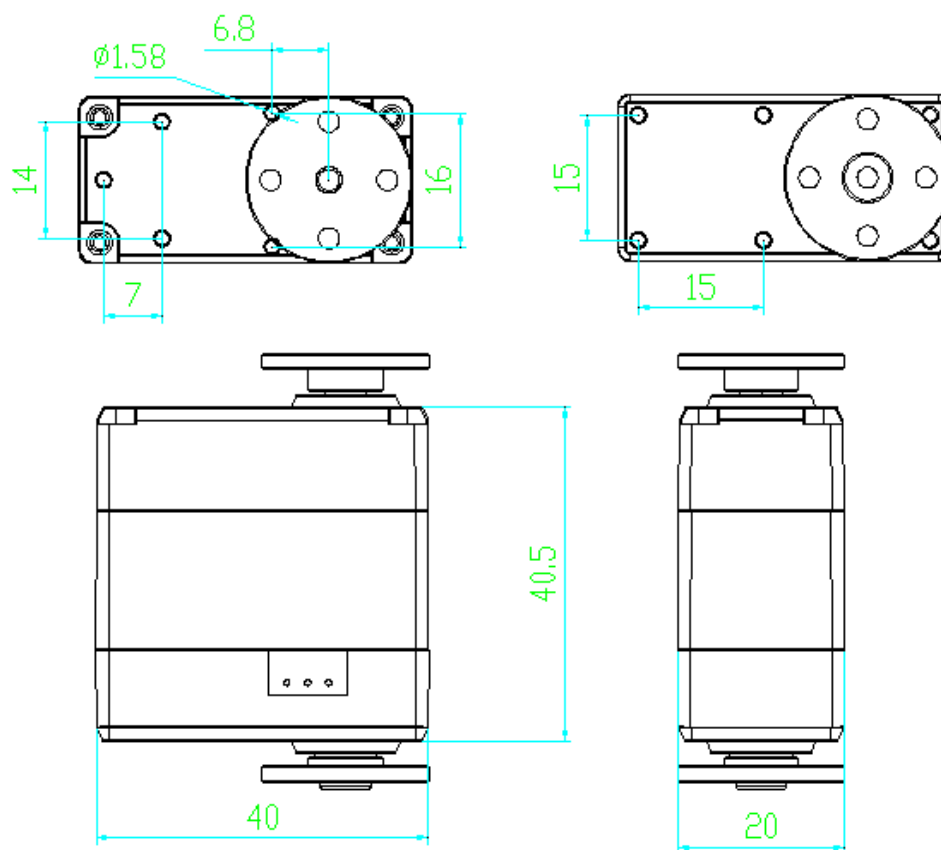
1.1 Product Features

SCS15 set serial bus intelligent servo motor, servo drive, the serial bus type communication interface, and a sensor integrated into one of the servomechanism, mainly for joints, wheel, track drive the micro robot can also be used other simple position control applications.

SCS15 characteristics are as follows:

- Torque: 15Kg.cm
- Wide voltage range power supply DC 6V ~ 9V
- Resolution 0.19 °
- Biaxial installation, suitable for installation in robot joint
- Precision full metal gear set, double ball bearing
- Dual-port cabling easily Chrysanthemum
- Rotational position of the servo control mode range 0-200 °
- A motor mode can be set to the entire circumference of the rotation, the open-loop speed control
- Theory can be serially connected to the bus ID No. 253
- Communication baud rate up to 1M
- 0.25KHz servo update rate
- SCS using serial bus communication protocol
- It includes a position, temperature, speed, voltage feedback

1.2 Structure Size



1.3 Electrical connections

1.3.1 Pin definition

SCS15 intelligent servo serial bus electrical interface below, consistent with the definition two pin terminals may be connected in series one by one servo.



1.3.2 Servo Communication

SCS15 using asynchronous serial communication bus, can be connected to up to 253 theoretical robot servo. Each servo node address can be set different, a plurality of servo control can be unified to be a single independent control.

SCS15 instruction set of communication open, through an asynchronous serial interface with the user's PC (controller or PC) communications, which you can then set the parameters, function control. Asynchronous serial interface transmission command, SCS15 may be provided to the motor control mode or position control mode. In the motor control mode, SCS15 as a DC motor speed can be reduced using adjustable speed; in the position control mode, SCS15 has a rotation range of 0-200 °, in this context includes a position control performance with high accuracy, the rotational speed can be controlled.

As long as a half-duplex protocol-compliant UART asynchronous serial interface can communicate and SCS15, SCS15 variety of control. There are two main forms:

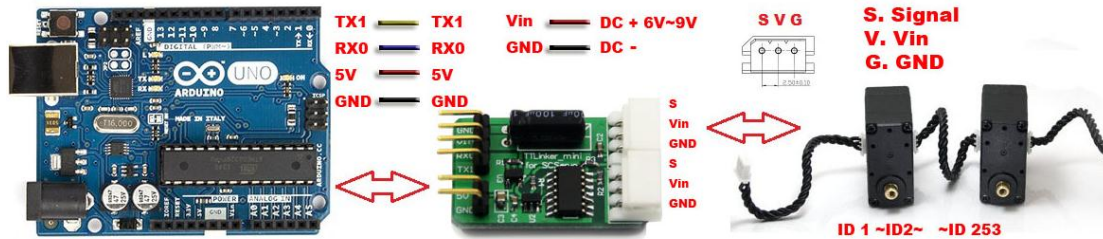
Embodiment 1: The SCM-1 and PC control SCS15

The PC will recognize SCM-1 is a serial device (driver properly installed), the PC software will send the packet through the serial port protocol-compliant format, it is forwarded to SCS15 by SCM-1. SCS15 performs command packet, and returns the response packet. SCServoDebug.exe is recommended to use debugging software, you can also design a dedicated PC software protocol according to the manual.



Embodiment 2: via a dedicated controller SCS15

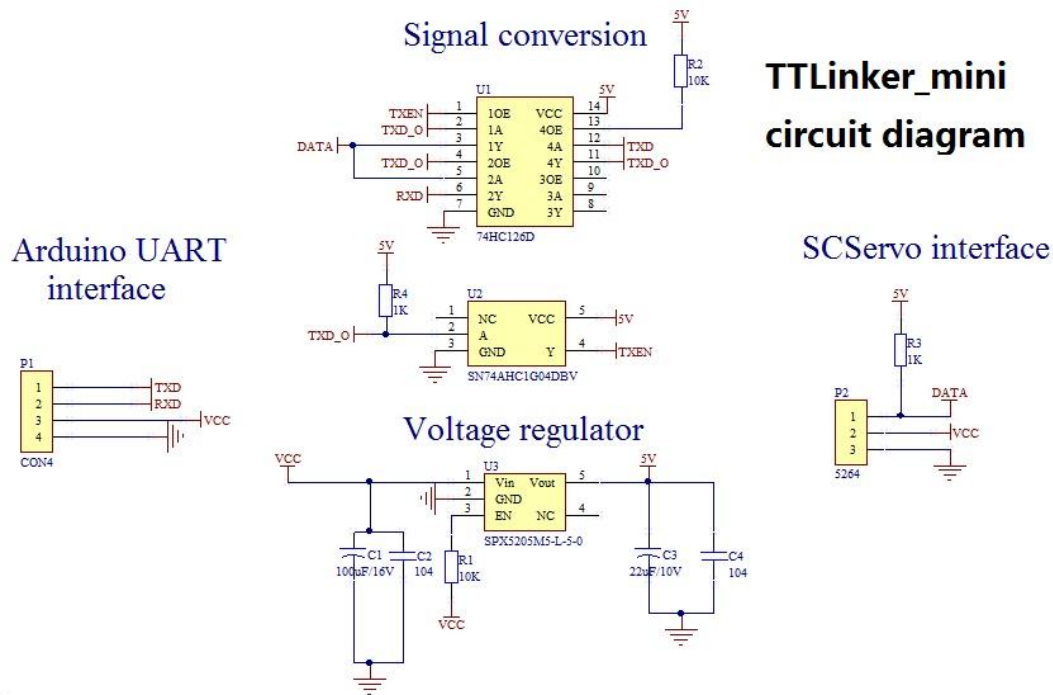
1 can be quick and easy way to debug and serial bus control SCS series of intelligent servo, modify various performance and functional parameters. However, this approach can not do without a PC, can not be combined with sensors set up as an independent robot control. As can be designed as a dedicated controller or using universal controller Arduino, by controlling servo controller UART port, subsection 1.3.3 UART interface controller is given in FIG signal conversion principle, you can design their own controller so .



1.3.3 UART interface schematic diagram

SCS15 Serial Bus intelligent servo half-duplex asynchronous serial communication bus, communication speeds up to 1Mbps, and a simple interface, streamlined protocol.

Your own controller designed, UART port is used to refer to SCS15 communication processing shown below.



Chapter II protocol

2.1 communication protocol summary

Question and answer mode communication between the controller and the servo controller issues a command packet, a response packet to return steering. A network allowing a plurality of servos, each servo is assigned an ID number. Controller sends a control command contained in the ID information, the servo can be matched to the ID number of the complete reception of this instruction, and returns a response message.

Asynchronous serial communication mode, data of one frame is divided into a start bit, 8 data bits and 1 stop bit, no parity bit, a total of 10 bits.

2.2 instruction packet

Instruction packet format:

Prefix	ID number	data length	instructions	parameter	Checksum
0XFF 0XFF	ID	Length	Instruction	Parameter1 ... Parameter N	Check Sum

Prefix: two consecutive received 0XFF, represents packet arrives.

ID: Each servo has an ID number. ID numbers 0 to 253, converted to hexadecimal 0X00 ~ 0XFD. Broadcast ID: ID number 254 of a broadcast ID, ID number is issued when the controller 254 (0XFE), all steering commands are received, in addition to other instructions are not returned to the PING command response information (a plurality of connected bus servos No broadcast PING command).

Data length: the parameter to be transmitted is equal to N plus the length of 2, i.e., "N + 2".

Parameters: In addition to the need to add control instruction information. Checksum: Checksum

Check Sum, calculated as follows:

Check Sum = ~ (ID + Length + Instruction + Parameter1 + ... Parameter N) If the calculation in the brackets 255 and beyond, the lowest line of a byte, "~" indicates inversion.

2.3 response packet

The response packet is to control servo system An answer , Response packet format Formula is as follows:

Prefix	ID data	length of the current	state parameter		Checksum
0XFF 0XFF	ID	Length	ERROR	Parameter1 ... Parameter N	Check Sum

Returns the response packet contains the current state ERROR steering gear, steering gear if the current operating state is not normal, this will be

reflected by byte, everyone of information represented as under:

BIT	name	detailed
BIT7	0	- - -
BIT6	0	- - -
BIT5	overload	The output torque is set smaller than the load mode when the position
BIT4	0	- - -
BIT3	0	- - -
BIT2	overheat	Set temperature exceeds the specified range
BIT1	0	- - -
BIT0	Over-voltage	Voltage exceeds the specified range is set

If ERROR is 0, then no servo error message.

If the command is a read command READ DATA, the Parameter1 ... Parameter N is read information.

2.4 Instruction Type

Useable instructions as follows:

instruction	Features	value	Parameter length
PING (query)	Querying the operating status	0x01	0
READ DATA (read)	Control of the character table query	0x02	2
WRITE DATA (write)	To write a character control table	0x03	Not less than 2
REGWRITE DATA (asynchronous write)	Similar WRITE DATA, but not immediately after the write operation control characters, until the instruction reaches ACTION	0x04	Not less than 2
ACTION (asynchronous write)	REG WRITE write trigger action	0x05	0
SYCNWRITE DATA (synchronous write) for simultaneously controlling a plurality of servos		0x83	Not less than 2
RESET (Reset)	The control table is reset to default values	0x06	0

2.4.1 Write command WRITE DATA

Features	Write data to the control table bus steering gear
length	N + 3 (N is the length of the write data)
instruction	0X03
Parameter 1	Data is written to the first address segment
Parameter 2	Writing the first data
Parameter 3	The second data
Parameter N + 1	N-th data

example 1 The ID number is set to an arbitrary one.

In the address control table storing the ID number 3 (see below table control), the writing at the address 1 to 3. ID transmitted using a broadcast command packet ID (0xFE).

Frame Instruction: 0XFF 0XF F 0XFE 0 X 04 0X03 0X03 0X 0 1 0XF6

Prefix	ID	Valid data length	Command parameters	Checksum
0XFF 0XFF	0XFE	0X04	0X03	0X03 0X01
				0XF6

Because the ID of broadcast transmission instruction, the data will not be returned

2.4.2 Read command READ DATA

Features	Read from the servo control table
length	0X04
instruction	0X02
Parameter 1	The first address data read-out section
Parameter 2	Length of the data read

Example 2 Current position servo read ID 1.

Two bytes read from the address control table at 0X38.

Frame Instruction: 0XFF 0XFF 0X01 0X 0 4 0X02 0X38 0X0 2 0XBE

Prefix	ID	Valid data length	instruction	parameter	Checksum
0XFF 0XFF	0X01	0X04	0X02	0X38 0X02	0XBE

Returns the data frame: 0XFF 0XF F 0X01 0X03 0X0 0 0X20 0XD A

Prefix	ID	Valid data length	Working state parameters	Checksum
0XFF 0XFF	0X01	0X04	0X00	0X00 0X20
				0XDA

Data read is 0x0020, to indicate the current position 32 (0x0020).

2.4.3 asynchronous write command REG WRITE

REG WRITE command is similar to the WRITE DATA, just performed at different times. Upon receiving the REG WRITE command frame, the received data is stored in the backup buffer, and the Registered Instruction register (Address 0x40) is set. After receiving ACTION command, storage command is finally executed.

length	N + 3 (N is the number of data to be written)
instruction	0X04
Parameter 1	Data to be written to the first address area
Parameter 2	The first data to be written
Parameter 3	Second data to be written
Parameter N + 1	To write data of the N

2.4.4 Asynchronous write instruction ACTION

Features	Trigger REG WRITE command
length	0X02
instruction	0X05
parameter	no

ACTION command is useful when simultaneously controlling a plurality of servos.

When a plurality of servo control using ACTION instructions may cause the first and last while performing a servo operation of each of the middle without delay.

When a plurality of servo transmission ACTION instruction, to use the broadcast ID (0xFE), therefore, send this command will not return to the data frame.

2.4.5 Synchronization write command SYNC WRITE

Features	For simultaneously controlling a plurality of servos.
ID	0XFE
length	$(L + 1) * N + 4$ (L: length of data sent to each servo N,: number of servos)
instruction	0X83
Parameter 1	The first address to write data
Parameter 2	Writing data length (L)
Parameter 3	A first servo ID number
Parameter 4	Writing a first servo data of a first
Parameter 5	Writing a first servo data of the second
. . .	
Parameter L + 3	Writing a first servo data of the L
Parameter L + 4	The second steering gear ID numbers
Parameter L + 5	Write the second servo of the first data
Parameter L + 6	A second servo write the second data
"	
Parameter 2L + 4	The second servo write L data of
"	

Unlike REG WRITE + ACTION command it is higher than its real-time, once a SYNC WRITE instruction can modify the contents of a plurality of servo control table, and REG WRITE + ACTION command is done step by step. Nevertheless, when using the SYNC WRITE instruction, the first address and the data length stored in the same data must be written which must perform the same operation.

example Write the following position and speed of the servo 4

ID0: location: 0X010; Time: 1000 (0X3E8) ID1:
positions: 0X220; Time: 1000 (0X3E8) ID2: positions:
0X030; Time: 1000 (0X3E8) ID3: positions: 0X220;
Time: 1000 (0X3E8)

Frame Instruction: 0XFF 0XFF 0XFE 0X18 0X83 0X38 0X04 0X00 0X00 0X10 0X03 0XE8 0X01 0X02 0X20 0X03 0XE8 0X02 0X00

0X30 0X03 0XE8 0X03 0X02 0X2 0 0X03 0XE8 0X02

Prefix	ID	Valid data length	Command parameters	Checksum
0XFF 0XFF	0XFE	0X18	0X83 0x2A 0X04 0X00 0X00 0X10 0X03 0XE8 0X01 0X02 0X20 0X03 0XE8 0X02 0X00 0X30 0X03 0XE8 0X03 0X02 0X20 0X03 0XE8	0X02

Because the ID of broadcast transmission instruction, so no data is returned.

2.4.6 Reset command RESET

Features The control data table value is reset to factory
length 0X02
instruction 0X06
parameter no

example Reset servo, ID number 0.

Frame Instruction: 0XFF 0XFF 0X00 0X 02 0X06 0XF7

Prefix	ID	Valid data length	instruction	Checksum
0XFF 0XFF	0X00	0X02	0X06	0XF7

Returns the data frame: 0X F F 0XFF 0X00 0X02 0X00 0 XFD

Prefix	ID	Valid data length	And check work	status
0XFF 0XFF	0X00	0X02	0X00	0XFD

2.4.7 Check status command PING

Features Read operating status of the steering gear
length 0X02
instruction 0X01
parameter no

Example 3 Read the ID number of a servo operating state

Frame Instruction: 0XFF 0XFF 0X01 0X 02 0X01 0XFB

Prefix	ID	Valid data length	instruction	Checksum
0XFF 0XFF	0X01	0X02	0X01	0XFB

Returns the data frame: 0 X FF 0XFF 0 X01 0X02 0X00 0XFC

Prefix	ID	Valid data length	And check work	status
0XFF 0XFF	0X01	0X02	0X00	0XFC

Chapter III memory control table

Table 3.1 Memory Control

Robot servo information and control parameters itself is formed a table, which is stored in RAM and EEPROM control chip area. We modified in real time table of contents, you can achieve real-time control servos. This table is called memory control table, as follows:

address	Command items	The initial value	of the write	Storage area
0 (0x00)	--	--	--	EEPROM
1 (0x01)	--	--	--	
2 (0x02)	--	--	--	
3 (0x03) software	version (H)	read	--	
4 (0x02) software	version (L)	read	--	
5 (0x05)	ID	Read / Write	00 (0x00)	
6 (0x06) baud rate		Read / Write	00 (0x00)	
7 (0x07) returns the	delay time	Read / Write	00 (0x00)	
8 (0x08) answer state	level	Read / Write	01 (0x01)	
9 (0x09) limiting the	minimum angle (H) read / write		00 (0x00)	
10 (0x0A) limiting the	minimum angle (L) read / write		00 (0x00)	
11 (0x0B) maximum	angle limit (H) read / write		03 (0x03)	
12 (0x0C) limit the	maximum angle (L) read / write		255 (0xFF)	
13 (0x0D) maximum	temperature limit	Read / Write	80 (0x50)	
14 (0x0E) maximum	input voltage	Read / Write	250 (0xFA)	
15 (0x0F) minimum	input voltage	Read / Write	50 (0x32)	
16 (0x10) maximum	torque (H)	Read / Write	03 (0x03)	
17 (0x11) maximum	torque (L)	Read / Write	255 (0xFF)	
18 (0x12) -		--	--	
19 (0x13) unloading	conditions	Read / Write	00 (0x00)	
20 (0x14) -		--	--	
21 (0x15) P		Read / Write	15 (0x0F)	
22 (0x16) -		--	--	
23 (0x17) -		--	--	
24 (0x18) minimum	PWM (H)	Read / Write	00 (0x00)	
25 (0x19) minimum	PWM (L)	Read / Write	00 (0x00)	
26 (0x1A) clockwise	dead zone read / write		02 (0x02)	
27 (0x1B) counterclockwise	dead zone read / write		02 (0x02)	
28 (0x1C) -		--	--	
29 (0x1D) -		--	--	
30--39	--	--	--	
40 (0x28) Torque	switch	Read / Write	00 (0x00)	RAM

41 (0x29) -		--	--
42 (0x2A) target position (H)		Read / Write	--
43 (0x2B) target position (L)		Read / Write	--
44 (0x2C) run time (H)		Read / Write	00 (0x00)
45 (0x2D) run time (L)		Read / Write	00 (0x00)
46 (0x2E) speed (H)		Read / Write	00 (0x00)
47 (0x2F) speed (L)		Read / Write	00 (0x00)
48 (0x30) lock flag		Read / Write	00 (0x00)
49--55	--	--	--
56 (0x38) current position (H)		read	?
57 (0x39) current position (L)		read	?
58 (0x3A) of the current speed (H)		read	?
59 (0x3B) the current speed (L)		read	?
60 (0x3C) current load (H)		read	?
61 (0x3D) current load (L)		read	?
62 (0x3E) Current Voltage		read	?
63 (0x3F) the current temperature		read	?
64 (0x40) REG WRITE flag		read	00 (0x00)

If the control parameters "L", "H" command points, ranging 0x00-0x3FF; only one byte command parameter, the range of 0x00-0xFE.

Parameters stored in RAM after power failure will not be saved, stored in EEPROM parameters after power-down can be saved. "-" indicates that the parameter can not be modified.

Detailed below:

0x05:

Saving servo ID number.

0x06:

Address6 default is 0, the baud rate represented by 1m, the following table can be modified for other baud rate the baud rate required by the user, other baud rate will be restored to 1M.

0x06 is the address of the formula Address6 Saved data, wave And the corresponding bit rate meter Count parameter Controls in the following table:

Address4	Hex	The actual baud rate	baud rate target	error
0	0x00	1000000.0	1000000.0	0.000%
1	0x01	500,000.0	500,000.0	0.000%
2	0x02	250,000.0	250,000.0	0.000%
3	0x03	128,000.0	128,000.0	0.000%
4	0x04	115,107.9	115200	0.079%
5	0x05	76923.0	76800	- 0.160%
6	0x06	57553.9	57600	0.008%
7	0x07	38461.5	38400	- 0.160%

0x07:

Set return delay time, that is, when a command is received servos need to answer, and how long delay your response can be set. Time: parameter (0 ~ 254) * 2US, if the parameter 250, that is, after 500us response; however, the parameter is 0, represents the shortest response time.

0x08:

Response level Set rudder Whether to return data to the data receiving machine.

Address 16	Returns the response packet
0	In addition to the PING command read instruction with other instructions does not return a response packet
1	All instruction returns a response packet

0x09 ~ 0x0C:

Steering angle range is set to run, the minimum angle limit = <= target angle value <= maximum angle limit value.



Note that, the minimum value must be less than the maximum limiting angle limit angle value. If the value exceeds the target angle range, etc.

The limit value.

0x0D

Maximum working temperature, such as the maximum temperature is set to 80 to 80 degrees from an accuracy of 1 °

0x0E

Maximum operating voltage as high as 85 set the maximum operating voltage of 8.5V to 0.1V setting accuracy

0x0F

Minimum operating voltage as high as 45 set minimum operating voltage of 4.5V to 0.1V setting accuracy

0x10 ~ 0x11

Set the maximum output torque of the steering gear. 0X03FF corresponding to the maximum output capacity of SCS15.

0x13:

Setting uninstall condition.

BIT	Features
BIT7	- -
BIT6	- -
BIT5	If set to 1, the load reduction occurred when the force output
BIT4	- -
BIT3	- -
BIT2	If 1 when overheating occurs disposed uninstall
BIT1	- -
BIT0	If set to 1, the voltage range exceeds the unloading occurs

If the above occurs simultaneously, or to comply with the principles of logic.

0x18 ~ 0x19:

The minimum output value of the PWM duty cycle

0x1A ~ 0x1B:

Position closed loop deadband size, both clockwise and counterclockwise dead zone is set to a large degree at least about 0.38

0x28:

Torque output switch, "1" on, "0" off.

0x2A ~ 0x2B:

Command to the servo operation position range 0x0000-0x03FF, 0x0000 corresponds to 0 degrees, 200 degrees corresponding to 0x03FF deviation ± 2%.

0x2C ~ 0x2F:

Is provided to a target position servo operation time and speed (speed priority parameter than the time parameter, while the write time and speed parameters, speed parameter is selected as a control parameter), parameter units of time (milliseconds), in units of velocity parameter (0.19 deg / sec) as a speed of 1000 (1000 * 0.19) deg / sec. When set to 0, corresponding to the maximum speed SCS15 62RPM.

0x30:

Lock position. If this bit is set to 0 lock protection off, the region of the EEPROM may be powered down to save parameter changes.



Note that the lock bit is set to 0, SCS15 write speed will slow down, frequently writing to the EEPROM zone parameters

Action will affect SCS15 life.

0x40:

If REG WRITE instructions waiting for execution, is displayed as 1, when the instruction completes REG WRITE 0 is displayed.

3.2 motor speed control mode

SCS series robot servo motors can be switched to speed control mode, the actuator may be used wheels, crawler belt turnover. The minimum angle

limit and the maximum limit angle (0x09 ~ 0x0C) are set to 0, to give a velocity (0x2C ~ 0x2D) , Steering it With motor Tone Speed mode turn Moving. speed degree

Have Big small with square To control square formula , Such as under table The it shows:

BIT	11 to 15	10	9	8	7	6	5	4	3	2	1	0
VALUE	0	0/1	SPEED VALUE									

address 0x2C ~ 0x2D: BIT10 bit direction, counterclockwise rotation is 0, 1 rotates clockwise. BIT0 ~ BIT9 the size.