proMotion CDS55xx User Manual

Doc. Ver.	Update	Rev.	Authorized by	Remarks
1.0	2010-3-22	何裕德	徐俊辉	
1.1	2010-3-27	计海锋	徐俊辉	Add Chapter 5
1.2	2010-4-22	何裕德		
1.3	2010-8-17	Cid	徐俊辉	Revise

Thanks for purchasing ProMotion CDS55xx series robot servo. This document is currently a trial version. If you have any errors or suggestion, please send Email to us or post at our web forum:

http://robot.up-tech.com/bbs/index.asp?boardid=1

Service dept.：86-10-82114870/4887/4890

Service Email：robot_service@up-tech.com

1 General Introduction

1.1 Features and profile

ProMOTION CDS series robot servo is a robot actuator which integrated motor, sensor, servo algorithm and serial bus port. It's an ideal actuator for small robots and other simple position control equipment.

- High torque:
  - 16Kgf.cm (CDS5516/5500)
  - 6Kgf.cm (CDS5506)
- High speed:
  - 0.18s/60°(CDS5516/5500)
  - 0.16s/60°(CDS5506)
- DC 6.0V~16V power supply
- 0.32° position resolution
- Double-side output shaft
- Alloy gearbox, dual ball-bearing (CDS5516/5500)
- Resin gearbox, dual ball-bearing (CDS5516/5500)
- Rubber O-ring at output shaft
- Position control range: 0-300°
- 1023 step speed control, continuous rotation
- Up to 30-50 servos serial bus link
- 1Mbps High baud rate
- 250Hz servo refresh rate
- Position/Temperature/Voltage/Speed feedback
- Interface and protocol mostly compatible to Robotis Dynamixel AX12+

CDS55xx robot servo uses advanced control algorithm and high-speed micro controller, with fast response and high position accuracy.

The CDS55xx robot servo integrated a continuous rotation position sensor with 330° measure range for position control, and it enables the continuous rotation.

The CDS55xx use a half-duplex UART as communication bus port. User can assign a address for each servo, and control single servo or broadcast instruction to each servo.

The communication protocol of CDS55xx is opened to users; please refer to this document. The bus port is compatible to Robotis' Dynamixel AX12+, and the protocol is mostly compatible to it.

There are two work modes of CDS55xx: Position mode and gear motor mode. User can change mode with instructions.

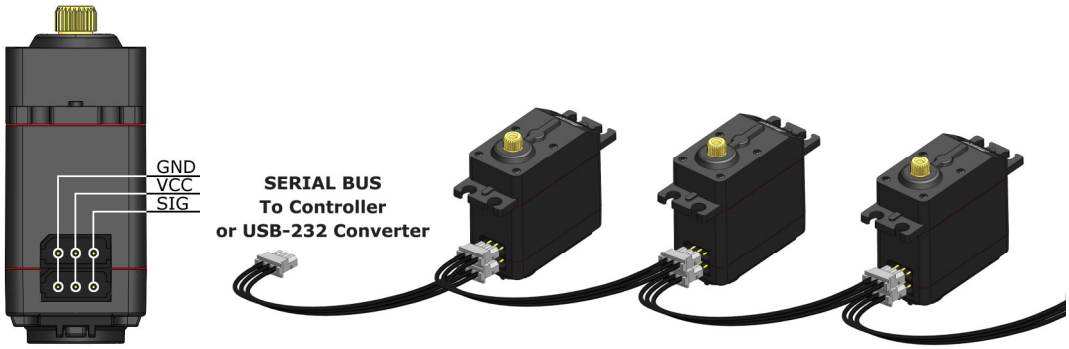
The profile and mount flange is compatible to most off-the-shelf standard R/C servos.

Please refer to the "CDS55xx robot servo Datasheet" for more Details.

1.2 Electrical Connection

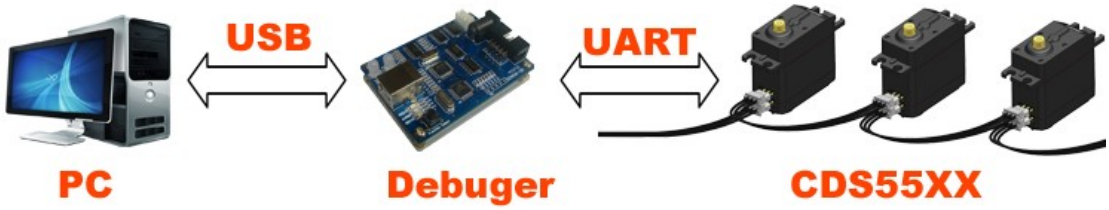
1.2.1 Bus port

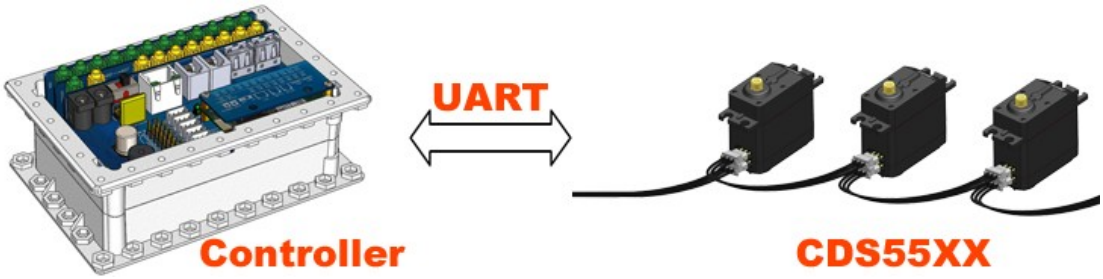
The bus port and typical connection diagram of proMOTION CDS55xx series robot servo is as shown below:



1.2.2 Serial connection

CDS55xx robot servo uses a half-duplex UART bus for serial communication.
There are two main methods to connect a CDS55xx servo:





Method One：Control CDS55xx via a UP-debugger (or Robotis' USB2Dynamixel)

The UP-debugger will be recognized as a virtual RS-232 serial port device. User can send instruction packet with RS-232 communication software(Such as Hyper Terminal or UPTECH Robotics' RobotServoTerminal), the instruction packet will be send to the UP-debugger and transferred to the CDS55xx robot servo. The servo will execute the instruction packet and return a response packet.

The RobotServoTerminal software is designed for tuning or setting up CDS55xx robot servos. This method is a convenient method to set up and tune your servos. If you use a PC as the robot' s main controller, this method enables you to control servos with only a UP-debugger board.

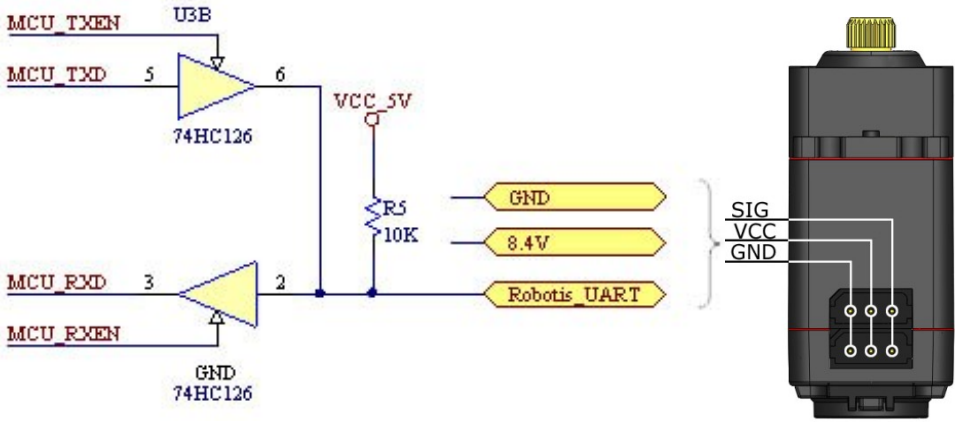
Method Two：Control CDS55xx via Microcontroller

Method One needs a PC running Windows XP or Windows Vista system. If you do not want to use PC, you can design a microcontroller to interface the CDS55xx servos. You only need a UART port on the MCU, and make little interface circuit. the sub paragraph 1.2.3 gives a sample interface schematic using a AVR MCU's UART port. Chapter 5 of this document gives a sample controller, including schematic and some sample C code.

1.2.3 Interface schematic

The serial bus interface of CDS55xx servo is a half-duplex UART, with 3 wires. To control the CDS55xx servos, the main controller needs to convert its UART signals to the half duplex type.

The schematic of a CDS55xx servo interface is shown below.



The power is supplied to the CDS55xx servo from the main controller through Pin 1 and Pin 2 of the Molex3P connector.

The direction of data signals on the TTL level MCU_TXD and MCU_RXD depends on the MCU_TXEN and MCU_RXEN level as the following.

MCU_TXEN	MCU_RXEN	Status
1	0	the signal from MCU_TXD is output as SIG
0	1	the signal from SIG is input as MCU_RXD
0	0	high-impedance

2 Communication protocol

2.1 Summary

The CDS55xx serial bus has a master device and multiple slave devices. The controller (or the PC) acts as master device, the CDS55xx servos act as slave devices. The communication sequence is:

- The master sends an instruction packet;
- The slave receive the instruction packet，execute it, and then send an answer packet to the master.

There are two types of packets; the "Instruction Packet" (sent from the main controller to the servos) and the "Status Packet" (sent from the servos to the main controller.)

There can be multiple CDS55xx servos on the bus; each servo should be assigned an unique ID. The instruction packet contains the ID info, only the corresponding servos will response the instruction packet when other servos will ignore them.

2.2 Instruction packet

Instruction packet format:

HEADER	ID	LENGTH	INSTRUCTION	PARAMETER	CHECK SUM
0XFF 0XFF	ID	Length	Instruction	Parameter1 ... N	0x??

The meanings of each packet byte definition are as the following.

Header: two 0xFF in sequence indicates the start of a incoming instruction packet.

ID: The unique ID of a CDS55xx unit. There are 254 available ID values, ranging from 0X00 to 0XFD.
Broadcasting ID ID 0XFE is the Broadcasting ID which indicates all of the connected CDS55xx units. Packets sent with this ID apply to all CDS55xx units on the network. Thus packets sent with a broadcasting ID will not return any status packets.

LENGTH: The length of the packet where its value is "Number of parameters (N) + 2"

INSTRUCTION: The instruction for the CDS55xx servo to perform.

PARAMETER0…N Used if there is additional information needed to be sent other than the instruction itself.

CHECK SUM The computation method for the 'Check Sum' is as the following.
Check Sum = ~ (ID + Length + Instruction + Parameter1 + ... Parameter N).If the calculated value is larger than 255, the lower byte is defined as the checksum value.
~ represents the NOT logic operation.

2.3 Status packet

The Status Packet is the response packet from the CDS55xx servos to the Main Controller after receiving an instruction packet. The structure of the status packet is as the following.：

HEADER	ID	LENGTH	ERROR	PARAMETER	CHECK SUM
0XFF 0XFF	ID	Length	Status	Parameter1 ...Parameter N	Check Sum

The meanings of each packet byte definition are as the following.

HEADER The two 0XFF bytes indicate the start of the packet.

ID The unique ID of the CDS55xx unit returning the packet. The initial value is set to 1.

LENGTH The length of the packet where its value is "Number of parameters (N) + 2"

ERROR The byte representing errors sent from the CDS55xx unit. The meaning of each bit is as the following.

BIT	Name	Details
BIT7	0	---
BIT6	Instruction Error	Set to 1 if an undefined instruction is sent or an action instruction is sent without a Reg_Write instruction.
BIT5	Overload Error	Set to 1 if the specified maximum torque can't control the applied load.
BIT4	Checksum Error	Set to 1 if the checksum of the instruction packet is incorrect.
BIT3	Range Error	Set to 1 if the instruction sent is out of the defined range.
BIT2	Overheating Error	Set to 1 if the internal temperature of the CDS55xx unit is above the operating temperature range as defined in the control table.
BIT1	Position Limit Error	Set as 1 if the Goal Position is set outside of the range between CW Angle Limit and CCW Angle Limit.
BIT0	Input Voltage Error	Set to 1 if the voltage is out of the operating voltage range as defined in the control table.

PARAMETER0…N Used if additional information is needed.

CHECK SUM The computation method for the 'Check Sum' is as the following.
Check Sum = ~ (ID + Length + Instruction + Parameter1 + ... Parameter N)
If the calculated value is larger than 255, the lower byte is defined as the checksum value.
~ represents the NOT logic operation.

2.4 Instruction Set

The following Instructions are available.

Instruction	Function	Value	Number of parameter
PING	No action. Used for obtaining a Status Packet	0x01	0
READ DATA	Reading values in the Control Table	0x02	2
WRITE DATA	Writing values to the Control Table	0x03	Not less than 2
REG WRITE	Similar to WRITE_DATA, but stays in standby mode until the ACION instruction is given	0x04	Not less than 2
ACTION	Triggers the action registered by the REG_WRITE instruction	0x05	0
RESET	Changes the control table values of the CDS55xx servos to the Factory default values	0x06	0
SYNC WRITE	Used for controlling multiple CDS55xx servos simultaneously	0x83	Not less than 4

2.4.1 WRITE DATA

Function: To write data into the control table of the CDS55xx servo
Length: N+3 (N is the number of data to be written)
Instruction: 0X03
Parameter1: Starting address of the location where the data is to be written
Parameter2: 1st data to be written
Parameter3: 2nd data to be written
Parameter N+1: Nth data to be written
Example 1 Setting the ID of a connected CDS55xx servo to 1
Write 1 to address 3 of the control table. The ID is transmitted using the Broadcasting ID(0xFE).

Instruction Packet： 0XFF 0XFF 0XFE 0X04 0X03 0X03 0X01 0XF6

HEADER	ID	LENGTH	NSTRUCTION	PARAMETERS	CHECKSUM
0XFF 0XFF	0XFE	0X04	0X03	0X03 0X01	0XF6

Because it was transmitted with a Broadcast ID (0XFE), no status packets are returned.

2.4.2 READ DATA

Function Read data from the control table of a CDS55xx servo
Length 0X04
Instruction 0X02
Parameter1 Starting address of the location where the data is to be read
Parameter2 Length of the data to be read
Example 2 Reading the internal temperature of the CDS55xx servo with an ID of 1
Read 1 byte from address 0x2B of the control table.

Instruction Packet：0XFF 0XFF 0X01 0X04 0X02 0X2B 0X01 0XCC

HEADER	ID	LENGTH	NSTRUCTION	PARAMETERS	CHECKSUM
0XFF 0XFF	0X01	0X04	0X02	0X2B 0X01	0XCC

The returned Status Packet will be as the following.
Status Packet : 0XFF 0XFF 0X01 0X03 0X00 0X20 0XDB

HEADER		ID	LENGTH	NSTRUCTION	PARAMETERS	CHECKSUM
0XFF	0XFF	0X01	0X03	0X00	0X20	0XDB

The data read is 0x20. Thus the current internal temperature of the CDS55xx servo is approximately 32°C (0X20).

2.4.3 REG WRITE

Function	The REG_WRITE instruction is similar to the WRITE_DATA instruction, but the execution timing is different. When the Instruction Packet is received the values are stored in the Buffer and the Write instruction is under a standby status. At this time, the Registered Instruction register (Address 0x2C) is set to 1. After the Action Instruction Packet is received, the registered Write instruction is finally executed.
Length	N+3 (N is the number of data to be written)
Instruction	0X04
Parameter1	Starting address of the location where the data is to be written
Parameter2	1st data to be written
Parameter3	2nd data to be written
Parameter N+1	Nth data to be written

2.4.4 ACTION

Function	Triggers the action registered by the REG_WRITE instruction
Length	0X02
Instruction	0X05
Parameter	NONE
	The ACTION instruction is useful when multiple CDS55xx servos need to move simultaneously. When controlling multiple CDS55xx servo units, slight time delays can occur between the 1st and last units to receive an instruction. The CDS55xx servo handles this problem by using the ACTION instruction.
Broadcasting	The Broadcast ID (0XFE) is used when sending ACTION instructions to more than two CDS55xx servos. Note that no packets are returned by this operation.

2.4.5 PING

Function	Does not command any operations. Used for requesting a status packet or to check the existence of a CDS55xx servo with a specific ID.
Length	0X02
Instruction	0X01
Parameter	NONE
Example 3	Obtaining the status packet of the CDS55xx servo with an ID of 1

Instruction Packet : 0XFF 0XFF 0X01 0X02 0X01 0XFB

HEADER	ID	LENGTH	NSTRUCTION	PARAMETERS

0XFF	0XFF	0X01	0X02	0X01	0XFB

The returned Status Packet is as the following

Status Packet : 0XFF 0XFF 0X01 0X02 0X00 0XFC

HEADER		ID	LENGTH	NSTRUCTION	PARAMETERS
0XFF	0XFF	0X01	0X02	0X00	0XFC

Regardless of whether the Broadcasting ID is used or the Status Return Level (Address 16) is 0, a Status Packet is always returned by the PING instruction.

2.4.6 RESET

Function Changes the control table values of the CDS55xx servo to the Factory Default Value settings

Length 0X02

Instruction 0X06

Parameter NONE

Example 4 Resetting the CDS55xx servo with an ID of 0

Instruction Packet : 0XFF 0XFF 0X00 0X02 0X06 0XF7

HEADER		ID	LENGTH	NSTRUCTION	PARAMETERS
0XFF	0XFF	0X00	0X02	0X06	0XF7

The returned Status Packet is as the following

Status Packet : 0XFF 0XFF 0X00 0X02 0X00 0XFD

HEADER		ID	LENGTH	NSTRUCTION	PARAMETERS
0XFF	0XFF	0X00	0X02	0X00	0XFD

Note the ID of this CDS55xx servo is now changed to 1 after the RESET instruction

2.4.7 SYNC WRITE

Function Used for controlling many CDS55xx servos at the same time. The communication time decreases by the Synch Write instruction since many instructions can be transmitted by a single instruction. However, you can use this instruction only when the lengths and addresses of the control table to be written to are the same. Also, the broadcasting ID needs to be used for transmitting.

ID 0XFE

Length (L + 1) * N + 4 (L: Data length for each CDS55xx servo, N: The number of CDS55xx servos)

Instruction 0X83

Parameter1 Starting address of the location where the data is to be written

Parameter2 The length of the data to be written (L)

Parameter3 The ID of the 1st CDS55xx servo

Parameter4 The 1st data for the 1st CDS55xx servo

Parameter5 The 2nd data for the 1st CDS55xx servo Data for the 1st CDS55xx servo

...

Parameter L+3 The Lth data for the 1st CDS55xx servo

Parameter L+4 The ID of the 2nd CDS55xx servo

Parameter L+5 The 1st data for the 2nd CDS55xx servo

Parameter L+6 The 2nd data for the 2nd CDS55xx servo Data for the 2nd CDS55xx servo

...

Parameter 2L+4 The Lth data for the 2nd CDS55xx servo

....

Example 5 Setting the following positions and velocities for 4 CDS55xx servos
CDS55xx servo with an ID of 0: to position 0X010 with a speed of 0X150
CDS55xx servo with an ID of 1: to position 0X220 with a speed of 0X360
CDS55xx servo with an ID of 2: to position 0X030 with a speed of 0X170
CDS55xx servo with an ID of 0: to position 0X220 with a speed of 0X380
Instruction Packet : 0XFF 0XFF 0XFE 0X18 0X83 0X1E 0X04 0X00 0X10 0X00 0X50 0X01 0X01 0X20 0X02 0X60 0X03 0X02 0X30 0X00 0X70 0X01 0X03 0X20 0X02 0X80 0X03 0X12

HEADER	ID	LENGTH	NSTRUCTION	PARAMETERS	HEADER
0XFF 0XFF	0XFE	0X18	0X83	0X1E 0X04 0X00 0X10 0X00 0X50 0X01 0X01 0X20 0X02 0X60 0X03 0X02 0X30 0X00 0X70 0X01 0X03 0X20 0X02 0X80 0X03	0X12

No status packets are returned since the Broadcasting ID was used.

3 Memory contents

3.1 Control Table

Address	Item	Access	Initial	Memory
0(0X00)	--	--	--	EEPROM
1(0X01)	Model Number	RD	?	
2(0X02)	Version of Firmware	RD	?	
3(0X03)	ID	RD,WR	1(0x01)	
4(0X04)	Baud Rate	RD,WR	1(0x01)	
5(0X05)	Return Delay Time	RD,WR	0(0x01)	
6(0X06)	CW Angle Limit(L)	RD,WR	0(0x00)	
7(0X07)	CW Angle Limit(H)	RD,WR	0(0x00)	
8(0X08)	CCW Angle Limit(L)	RD,WR	255(0xFF)	
9(0X09)	CCW Angle Limit(H)	RD,WR	3(0x03)	
10(0x0A)	(Reserved)	-	0(0x00)	
11(0X0B)	The Highest Limit Temperature	RD, WR	80(0x50)	
12(0X0C)	the Lowest Limit Voltage	RD,WR	60(0X3C)	
13(0X0D)	the Highest Limit Voltage	RD, WR	160(0XA0)	
14(0X0E)	Max Torque(L)	RD,WR	255(0XFF)	
15(0X0F)	Max Torque(H)	RD,WR	3(0x03)	
16(0X10)	Status Return Level	RD,WR	2(0x02)	
17(0X11)	Alarm LED	RD,WR	5(0x25)	
18(0X12)	Alarm Shutdown	RD,WR	5(0x04)	
19(0X13)	(Reserved)	RD,WR	0(0x00)	
20(0X14)	Down Calibration(L)	RD	?	
21(0X15)	Down Calibration(H)	RD	?	
22(0X16)	Up Calibration(L)	RD	?	
23(0X17)	Up Calibration(H)	RD	?	
24(0X18)	Torque Enable	RD,WR	0(0x00)	RAM
25(0X19)	LED	RD,WR	0(0x00)	
26(0X1A)	CW Compliance Margin	RD,WR	2(0X02)	
27(0X1B)	CCW Compliance Margin	RD,WR	2(0X02)	
28(0X1C)	CW proportion	RD,WR	32(0x20)	
29(0X1D)	CCW proportion	RD,WR	32(0x20)	
30(0X1E)	Goal Position(L)	RD,WR	[Addr36]value	
31(0X1F)	Goal Position(H)	RD,WR	[Addr37]value	
32(0X20)	Moving Speed(L)	RD,WR	0(0x00)	
33(0X21)	Moving Speed(H)	RD,WR	0(0x00)	
34(0X22)	Acc	RD,WR	32(0x20)	
35(0X23)	Dcc	RD,WR	32(0x20)	
36(0X24)	Present Position(L)	RD	?	
37(0X25)	Present Position(H)	RD	?	
38(0X26)	Present Speed(L)	RD	?	
39(0X27)	Present Speed(H)	RD	?	

40(0X28)	Present Load(L)	RD	?
41(0X29)	Present Load(H)	RD	?
42(0X2A)	Present Voltage	RD	?
43(0X2B)	Present Temperature	RD	?
44(0X2C)	Registered Instruction	RD,WR	0(0x00)
45(0X2D)	(Reserved)	--	--
46[0x2E)	Moving	RD	0(0x00)
47[0x2F)	Lock	RD,WR	0(0x00)
48[0x30)	Punch(L)	RD,WR	90(0x5A)
49[0x31)	Punch(H)	RD,WR	0(0x00)

Control Table The Control Table contains information on the status and operation of the CDS55xx servo. The CDS55xx servo is operated by writing values to its control table and its status is checked by reading values off its control table.

RAM and EEPROM The data values for the RAM area will be set to the default initial values whenever the power is turned on. However, the data values for the EEPROM area are non-volatile and will still remain even after the power is turned off.

Initial Value The Initial Value column on the right side of the control table shows the Factory Default Values for the case of EEPROM area data, and shows the initial value when the power is turned on for the case of RAM area data.

The following explains the meaning of data stored in each of the addresses in the control table.

Address 0x01 **Model Number**. For CDS5516 this value is 0X01 (1).

Address 0x02 **Firmware Version**.

Address 0x03 **ID**. The unique ID number assigned to each CDS55xx servos for identifying them.Different IDs are required for each CDS55xx servos that are on the same network.

Address 0x04 **Baud Rate.** Determines the communication speed. The computation is done by the following formula.

Speed (BPS) = 2000000 / (Address4 + 1)

Data Value for each Major Baud Rate

Adress4	Hex	Set	BPS	Goal
1	0X01	1000000.0	1000000.0	0.000%
3	0X03	500000.0	500000.0	0.000%
7	0X07	250000.0	250000.0	0.000%
16	0X10	117647.1	115200.0	-2.124%
34	0X22	57142.9	57600.0	0.794%
103	0X67	19230.8	19200.0	-0.160%

Other baud rate is still available, but not saved after power off.

Note A maximum Baud Rate error of 3% is within the tolerance of UART communication.

Caution The initial value of Baudrate is set to 1(1000000bps).

Address 0x05 **Return Delay Time.** The time it takes for the Status Packet to return

after the Instruction Packet is sent. The delay time is given by 2uSec * Address5 value.

Address 0x06,0x07,0x08,0x09

Operating Angle Limit. Sets the CDS55xx servo’ s operating angle range. The Goal Position needs to be within the range of: CW Angle Limit <= Goal Position <= CCW Angle Limit. An Angle Limit Error will occur if the Goal Position is set outside this range set by the operating angle limits.

Address 0x0B

the Highest Limit Temperature. This value is fixed .The upper limit of the CDS55xx servo’ s operating temperature. If the internal temperature of the CDS55xx servo gets higher than this value, the Over Heating Error Bit (Bit 2 of the Status Packet) will return the value 1, and
an alarm will be set by Address 17, 18. The values are in Degrees Celsius.

Address 0x0C,0x0D

the Lowest (Highest) Limit Voltage. The upper and lower limits of the CDS55xx servo’ s operating voltage. If the present voltage (Address 42) is out of the specified range, a Voltage Range Error Bit (Bit 0 of the Status Packet) will return the value 1,and an alarm will be set by Address 17, 18. The values are 10 times the actual voltage value. For example, if the Address 12 value is 80, then the lower voltage limit is set to 8V.

Address 0x0E,0x0F, 0x22,0x23

Max Torque. The maximum torque output for the CDS55xx servo. When this value is set to 0, the CDS55xx servo enters the Free Run mode. There are two locations where this maximum torque limit is defined; in the EEPROM (Address 0X0E, 0x0F) and
in the RAM (Address 0x22, 0x23). When the power is turned on, the maximum torque limit value defined in the EEPROM is copied to the location in the RAM. The torque of the CDS55xx servo is limited by the values located in the RAM (Address 0x22,0x23).

Address 0X10

Status Return Level. Determines whether the CDS55xx servo will return a Status Packet after receiving an Instruction Packet.

Address16	Returning the Status Packet
0	Do not respond to any instructions
1	Respond only to READ_DATA instructions
2	Respond to all instructions

In the case of an instruction which uses the Broadcast ID (0XFE) the Status Packet will not be returned regardless of the Address 0x10 value.

Address 0X11

Alarm LED. If the corresponding Bit is set to 1, the LED blinks when an Error occurs.

Bit	Function
Bit7	0

Bit6	If set to 1, the LED blinks when an Instruction Error occurs
Bit5	If set to 1, the LED blinks when an Overload Error occurs
Bit4	If set to 1, the LED blinks when a Checksum Error occurs
Bit3	If set to 1, the LED blinks when a Range Error occurs
Bit2	If set to 1, the LED blinks when an Overheating Error occurs
Bit1	If set to 1, the LED blinks when an Angle Limit Error occurs
Bit0	If set to 1, the LED blinks when an Input Voltage Error occurs

This function operates following the "OR" logical operation of all bits. For example, if the value is set to 0X05, the LED will blink when an Input Voltage Error occurs or when an Overheating Error occurs.

Address 0X12

Alarm Shutdwon. If the corresponding Bit is set to 1, the CDS55xx servo' s torque will be turned off when an Error occurs.

Bit	Function
Bit7	0
Bit6	If set to 1, torque off when an Instruction Error occurs
Bit5	--
Bit4	If set to 1, torque off when a Checksum Error occurs
Bit3	If set to 1, torque off when a Range Error occurs
Bit2	If set to 1, torque off when an Overheating Error occurs
Bit1	If set to 1, torque off when an Angle Limit Error occurs
Bit0	If set to 1, ttorque off when an Input Voltage Error occurs

This function operates following the "OR" logical operation of all bits. However, unlike the Alarm LED, after returning to a normal condition, it maintains the torque off status.To recover, the Torque Enable (Address0X18) needs to be reset to 1.

BIT5 overload signs is invalid, when CDS55XX overload, the torque is automatically reduced to a security value, but not completely torque of.

The following (from Address 0x18) is in the RAM area.

Address 0x18

Torque Enable. When the power is first turned on, the CDS55xx servo enters the Torque Free Run condition (zero torque). Setting the value in Address 0x18 to 1 enables the torque.

Address 0x19 LED. The LED turns on when set to 1 and turns off if set to 0.

Address 0x1A~0x1B

compliance Margin. If difference of the target location and the physical location is smaller than compliance Margin,the position control will be insensitive.

Address 0x1C~0x1D

CW /CCW proportion. Adjust the position Position loop

Address 0X1E,0x1F

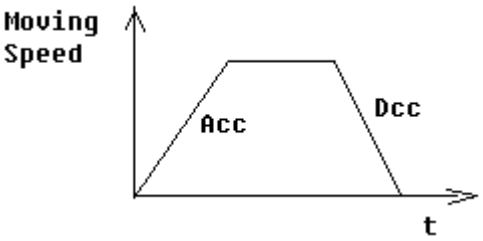
GoalPosition.Requested angular position for the CDS55xx servo output to move to. Setting this value to 0x3ff moves the output shaft to the position at 300°.

Address 0x20,0x21

Moving Speed. Sets the angular velocity of the output moving to the Goal Position.Setting this value to its maximum value of 0x3ff moves the output with an angular velocity of 62 RPM, provided that there is enough power supplied (The lowest velocity is when this value is set to 1. When set to 0, the velocity is the largest possible for the supplied voltage, e.g. no velocity control is applied.)

Address 0x20,0x21

Acc,Dcc. Those are the Acceleration and Deceleration of the CDS55xx servo move to GoalPosition



Address 0x24,0x25

Present Position. Current angular position of the CDS55xx servo output.

Address 0x26,0x27

Present Speed. Current angular velocity of the CDS55xx servo output.

Address 0x28,0x29

Present Load. The magnitude of the load on the operatin CDS55xx servo. Bit 10 is the direction of the load.

Address 0x2A

Present Voltage. The voltage currently applied to the CDS55xx servo. The value is 10 times the actual voltage. For example, 10V is represented as 100 (0x64).

Address 0x2B

Present Temperature. The internal temperature of the CDS55xx servo in Degrees Celsius.

Address 0x2C

Registered Instruction. Set to 1 when an instruction is assigned by the REG_WRITE command. Set to 0 after it completes the assigned instruction by the Action command.

Address 0x2E

Moving. Set to 1 when the CDS55xx servo is moving by its own power.

Address 0x2F

Lock. If set to 1, only Address 0x18 to 0x23 can be written to and other areas cannot. Once locked, it can only be unlocked by turning the power off.

Address 0x30,0x31

Punch. The minimum current supplied to the motor during operation. The initial value is set to 0x20 and its maximum value is 0x3ff.

3.2 Endless Turn

If both values for the CW Angle Limit and the CCW Angle Limit are set to 0, an Endless Turn mode can be implemented by setting the

Goal Speed. This feature can be used for implementing a continuously rotating wheel.

Goal Speed Setting

BIT	15~11	10	9	8	7	6	5	4	3	2	1	0
Value	0	Turn Direction	Speed Value									

Turn Direction = 0 : CCW Direction Turn, Load Direction = 1: CW Direction Turn

4 Example

Example 6 **Changing the ID to 0 for a CDS55xx servo with an ID of 1**

Instruction Packet Instruction = WRITE_DATA, Address = 0x03, DATA = 0x00

Communication ->in: FF FF 01 04 03 03 00 F4 (LEN:008)

<out: FF FF 01 02 00 FC (LEN:006)

Status Packet Result NO ERROR

Example7 **Changing the Baud Rate of a CDS55xx servo to 1M bps**

Instruction Packet Instruction = WRITE_DATA, Address = 0x04, DATA = 0x01

Communication ->in: FF FF 00 04 03 04 01 F3 (LEN:008)

<-out: FF FF 00 02 00 FD (LEN:006)

Status Packet Result NO ERROR

Example8 **Resetting the Return Delay Time to 4 uSec for a CDS55xx servo with an ID of 0**

A Return Delay Time Value of 1 corresponds to 2uSec.

Instruction Packet Instruction = WRITE_DATA, Address = 0x05, DATA = 0x02

Communication ->in: FF FF 00 04 03 05 02 F1 (LEN:008)

<-out: FF FF 00 02 00 FD (LEN:006)

Status Packet Result NO ERROR

It is recommended to set the Return Delay Time to the minimum value allowed by the Main Controller.

Example 9 **Limiting the operating angle range to 0°~150° for a CDS55xx servo with an ID of 0**

Since the CCW Angle Limit of 0x3ff corresponds to 300°, the angle 150° is represented by the value 0x1ff

Instruction Packet Instruction = WRITE_DATA, Address = 0x08, DATA = 0xff, 0x01

Communication ->in: FF FF 00 05 03 08 FF 01 EF (LEN:009)

<-out: FF FF 00 02 00 FD (LEN:006)

Status Packet Result NO ERROR

Example 10 **Resetting the upper limit for the operating temperature to 80°C for a CDS55xx servo with an ID of 0**

Instruction Packet Instruction = WRITE_DATA, Address = 0x0B, DATA = 0x50

Communication ->in: FF FF 00 04 03 0B 50 9D (LEN:008)

<-out: FF FF 00 02 00 FD (LEN:006)

Status Packet Result NO ERROR

Example 11 **Setting the operating voltage to 10V ~ 17V for a CDS55xx servo with an**

ID of 0

10V is represented by 100 (0x64), and 17V by 170 (0xAA).

Instruction Packet Instruction = WRITE_DATA, Address = 0x0C, DATA = 0x64, 0xAA

Communication ->in: FF FF 00 05 03 0C 64 AA DD (LEN:009)

<-out: FF FF 00 02 00 FD (LEN:006)

Status Packet Result NO ERROR

Example 12 **Setting the maximum torque to 50% of its maximum possible value for a CDS55xx servo with an ID of 0**

Set the MAX Torque value located in the ROM area to 0x1ff which is 50% of the maximum value 0x3ff.

Instruction Packet Instruction = WRITE_DATA, Address = 0x0E, DATA = 0xff, 0x01

Communication ->in: FF FF 00 05 03 0E FF 01 E9 (LEN:009)

<-out: FF FF 00 02 00 FD (LEN:006)

Status Packet Result NO ERROR

To verify the effect of the adjusted Max Torque value, the power needs to be turned off and then on.

Example 13 **Set the CDS55xx servo with an ID of 0 to never return a Status Packet**

Instruction Packet Instruction = WRITE_DATA, Address = 0x10, DATA = 0x00

Communication ->in: FF FF 00 04 03 10 00 E8 (LEN:008)

<-out: FF FF 00 02 00 FD (LEN:006)

Status Packet Result NO ERROR

The Status Packet is not returned starting with the following instruction.

Example 15 **Set the Alarm to blink the LED and Shutdown (Torque off) the actuator when the operating temperature goes over the set limit**

Since the Overheating Error is Bit 2, set the Alarm value to 0x04.

Instruction Packet Instruction = WRITE_DATA, Address = 0x11, DATA = 0x04, 0x04

Communication ->in: FF FF 00 05 03 11 04 04 DE (LEN:009)

<-out: FF FF 00 02 00 FD (LEN:006)

Status Packet Result NO ERROR

Example 16 **Turn on the LED and Enable Torque for a CDS55xx servo with an ID of 0**

Instruction Packet Instruction = WRITE_DATA, Address = 0x18, DATA = 0x01, 0x01

Communication ->in: FF FF 00 05 03 18 01 01 DD (LEN:009)

<-out: FF FF 00 02 00 FD (LEN:006)

Status Packet Result NO ERROR

You can verify the Torque Enabled status by trying to move the output of the actuator by hand.

Example 18 **Position the output of a CDS55xx servo with an ID of 0 to 180° with an angular velocity of 31RPM**

Set Address 0x1E (Goal Position) to 0x200 and Address 0x20 (Moving Speed) to 0x200.

Instruction Packet Instruction = WRITE_DATA, Address = 0x1E, DATA = 0x00, 0x02, 0x00, 0x02

Communication ->in: FF FF 00 07 03 1E 00 02 00 02 D3 (LEN:011)

<-out: FF FF 00 02 00 FD (LEN:006)

Status Packet Result NO ERROR

Example 19 **Position the output of a CDS55xx servo with an ID of 0 to 0° and Position the output of a CDS55xx servo with an ID of 1 to 300°, and initiate the movement at the same time.**

If the WRITE_DATA is used, the movement of the two actuators cannot be initiate at the same time, thus the REG_WRITE and ACTION instructions should be used instead.

Instruction Packet ID=0, Instruction = REG_WRITE, Address = 0x1E, DATA = 0x00, 0x00

ID=1, Instruction = REG_WRITE, Address = 0x1E, DATA = 0xff, 0x03

ID=0xfe(Broadcasting ID), Instruction = ACTION,

Communication

->in: FF FF 00 05 04 1E 00 00 D8 (LEN:009)

<-out: FF FF 00 02 00 FD (LEN:006)

->in: FF FF 01 05 04 1E FF 03 D5 (LEN:009)

<- out: FF FF 01 02 00 FC (LEN:006)

-> in: FF FF FE 02 05 FA (LEN:006)

<- out: //No return packet against broadcasting ID

Status Packet Result NO ERROR

Example 20 **Lock all addresses except for Address 0x18 ~ Address0x23 for a CDS55xx servo with an ID of 0**

Set Address 0x2F (Lock) to 1.

Instruction Packet Instruction = WRITE_DATA, Address = 0x2F, DATA = 0x01

Communication

->in: FF FF 00 04 03 2F 01 C8 (LEN:008)

<-out: FF FF 00 02 00 FD (LEN:006)

Status Packet Result NO ERROR

Once locked, the only way to unlock it is to remove the power. If an attempt is made to access any locked data, an error is returned. Range Error:0x08.

->in: FF FF 00 05 03 30 40 00 87 (LEN:009)

<-out: FF FF 00 02 08 F5 (LEN:006)

Example 21 **Set the minimum power (Punch) to 0x40 for a CDS55xx servo with an ID of 0**

Instruction Packet Instruction = WRITE_DATA, Address = 0x30, DATA = 0x40, 0x00

Communication

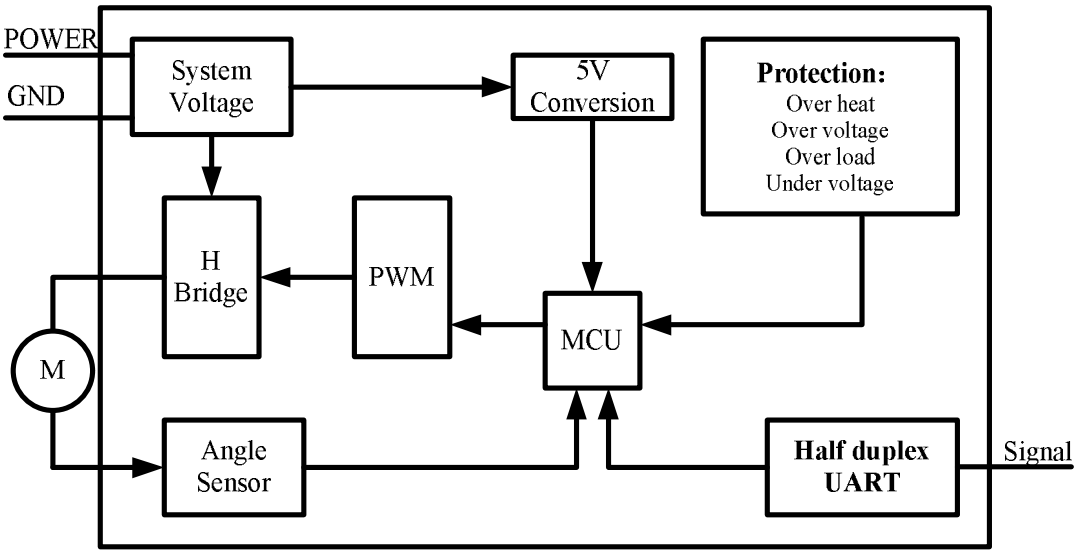
->in: FF FF 00 05 03 30 40 00 87 (LEN:009)

<-out: FF FF 00 02 00 FD (LEN:006)

Status Packet Result NO ERROR

Appendix

CDS55xx Electrical Block Diagram



IMPORTANT NOTICE

1. "Windows", "Windows XP", "Windows Vista" are trademarks of Microsoft Inc.
2. "Robotis", "Dynamixel", "USB2Dynamixel", and "AX-12" are trademarks of Robotis Inc.
3. UPTECH Robotics reserves the right to make changes to its products or to discontinue any product or service without notice, and advises its customers to obtain the latest version of relevant information to verify, before placing orders, that the information being relied on is current and complete.
4. UPTECH Robotics warrants performance of its products and related software to the specifications applicable at the time of sale in accordance with UPTECH Robotics' standard warranty. Testing and other quality control techniques are utilized to the extent UPTECH Robotics deems necessary to support this warranty. Specific testing of all parameters of each device is not necessarily performed, except those mandated by government requirements.

LIFE SUPPORT POLICY

UPTECH ROBOTICS' PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS.

As used herein:

5. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
6. A critical component in any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.