

User's Manual 2005-11-16

Closer to Real. **ROBOTIS**

Manual of **Cycloid II**



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1. The Start of Cycloid II

1-1. Product Components

Basic product

Cycloid II

Cycloid II is one of humanoid robot series using Dynamixel. The followings were characteristics of Cycloid II



- Height : 415mm
- Weight : 2.4Kg(except battery)
- Degree of freedom : 23 joints
- Actuator : Dynamixel series
- Actuator Network : RS-485
- Controller : CM-2

Robot Stand

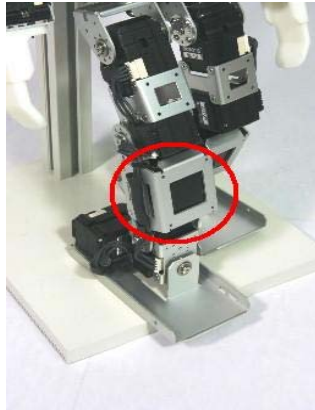
Robot stand is provided to lean the cycloid. You can control the height of robot stand provided and can use it when display Cycloid.



Battery

Battery is basically attached to Cycloid. Battery pack provided is composed of

twelve rechargeable battery can supply 14.4 voltage. 2300mAh, 800mAh are two kinds of battery pack capacity. 800mAh is made of AAA size rechargeable battery located to the shin and 2300 mAh is located to the top of the foot because 2300 mAh is made of AA size rechargeable battery, it weights more and height is taller. Basically 800mAh is attached when it sells

**Battery charger**

A charger is provided to charge the battery of Cycloid

**PC connection cable**

Small computer, CM-2 board, is attached to Cycloid. PC is used as serial communication for processing the input/output of CM2. PC connection cable is needed for it.



Robot SMPS

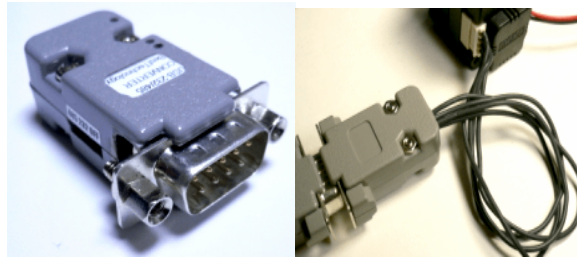
Cycloid can supply power by battery or exterior power. SMPS(12v,5A) is provided even if exterior power can generally use power supply.

**Remote controller**

Provide remote controller to control Cycloid. Wireless communication of Cycloid use basically PAN(Personal Area Network) method. Nowadays, it does wireless communication using Blue tooth. Cycloid and wireless controller is a pair so that you can charge it at a pair at once.

**USBto485**

CM-2 basically controls Dynamixel in Cycloid. There is the merit the beginner can use it if Dynamixel application range is not wide. But to high grade developer, it can reduce the application range. USBto485 module is provided for it connecting between pc and Dynamixel.

**User Manual**

Provide manual to apply the Cycloid. The followings were Manual' s mix

- **Cycloid II manual**: product explanation and application
- **Motion data manual**: manual about motion data format called motion page
- **CM2 manual**: Dynamixel controller and Cycloid controlling system. Manual for its application
- **Visual Editor Manual**: Motion Editor Manual based on graphic
- **Dynamixel manual**: Dynamixel is one of controlling system. This manual is directly using this part
- **Frame manual**: Assembly drawing for Cycloid

Software

Software is provided for Cycloid' s application. The following were the software architecture

- **Robot Terminal**: Input/output of CM-2 at PC
- **Visual Editor**: the program editing motion of Cycloid at PC
- **Direct access API**: the API for developing Dynamixel control program
- **Robot program**: Operating program on CM2
- **Drivers**: the provided driver of device connecting to PC

Selective product**Wireless Camera System**

USB 2.0 wireless receiver which can connect PC and micro wireless camera is provided. This wireless camera system can be used various way. This product is selective so that in case you don't select, it can not be provided. Main product is basically attached at the head of Cycloid

**Gripper**

Gripper is a robot hand among multi-joint robot series that Degree of freedom is one. User can make various application robots using it.



1-2. Power Supply

Battery Battery is basically attached in Cycloid without additional connecting operation. Cycloid can be operated using CM-2 power switch.

Battery Charge The charger provided can be used to charge Cycloid' s battery. When you have problems incase which happens using battery charger not provided, manufacturing company doesn' t have a responsibility so that user need to notice it. Battery type of Cycloid is Nimh(litume-hydrogen) and hpw to use battery charger can be referred attached product manual

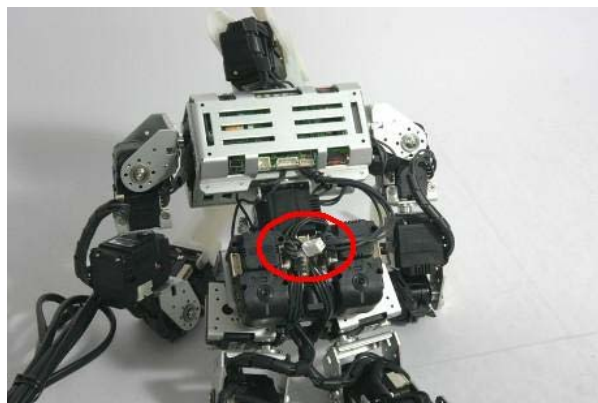
< The charging procedure >

- connect the power supply to the charger
- connect the Cycloid to a charger.
- When the battery is fully charged, disconnect it



Exterior Power Cycloid can be operated using exterior power. Exterior power Supply is SMPS provided or general power supply. When you use exterior power, battery connection can be has to be released. This is so important that a user need to be extremely careful. If you connect the CM-2 to power connector at the state battery is disconnected, you can operate Cycloid.

In the case using other power except provided SMPS, refer to CM-2 manual



< Rechargeable battery disconnection >



< Exterior power connection >

1-3. Remote controller operation

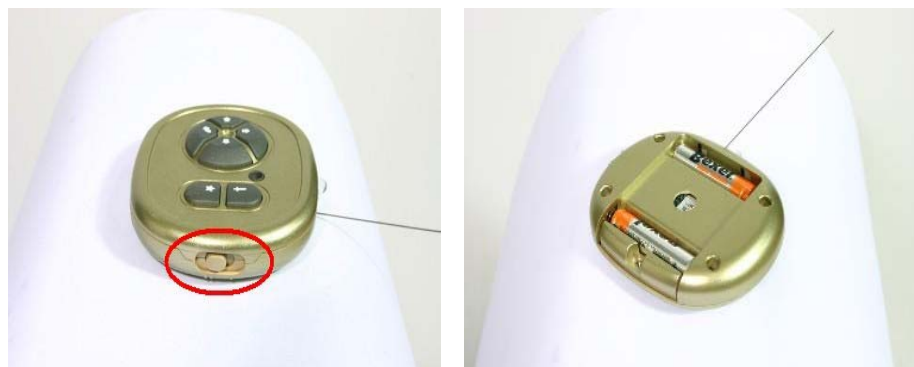
Cycloid drive

At first, turn on the CM-2 switches to drive Cycloid. The power being connected, Led in CM-2 board is twinkling and Cycloid can stand up while the energy flows into the Dynamixel. If the LED is not twinkling, check that the battery is charged. If the Dynamixel doesn' t move the power being on, check the CM-2 motor switch is on. If it doesn' t work, reset the CM-2 board. Inquire of the Robotis about problems if you can not drive cycloid.





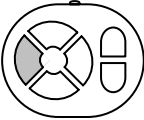
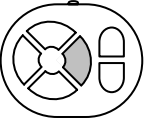
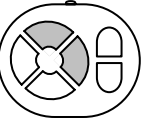
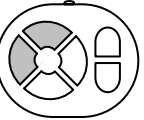
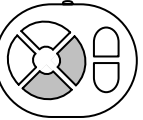
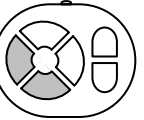


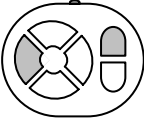
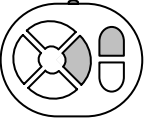
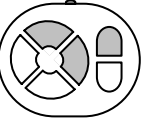
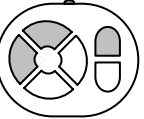
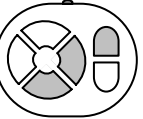
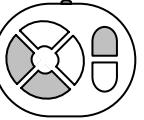
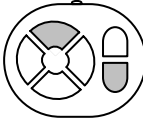

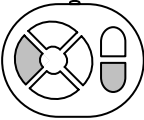
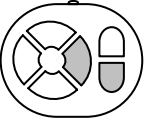
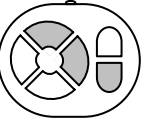
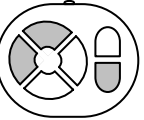
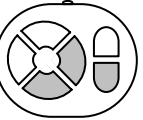
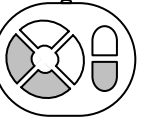
Remote controller operation

Turn on the power of remote controller if cycloid is operating. If the power is on, check the power supply through LED' s twinkling when pushing switch. If the power is not on, replace the battery. Remote controller' s battery is general 1.5V. General rechargeable battery of 1.2V can drive malfunction of remote controller so that you need to be careful.



**Remote controller
Operation**

if Cycloid and remote controller is working normally, various motion embedded as a demo version can be operated through controlling switch. Referencing to the next remote controller key allocation, operate the Cycloid

							
Move forward	Move backward	Move to the left	Move to the right	Right turn	Left turn	RESERVED	RESERVED
							
Stand backward	Stand forward	Lie down forward	Lie down back	RESERVED	RESERVED	RESERVED	RESERVED
							
Greeting(demo)	Stand on hands	Hand clap	cheers	RESERVED	RESERVED	RESERVED	RESERVED

1-4. Camera Image

Mini wireless camera the camera attached on the head of cycloid is CMOS camera. This is a module which can transmit the image of Cycloid' s camera. Wireless camera can operate when 5V power is supplied. If Cycloid power is on, wireless camera automatically operate.

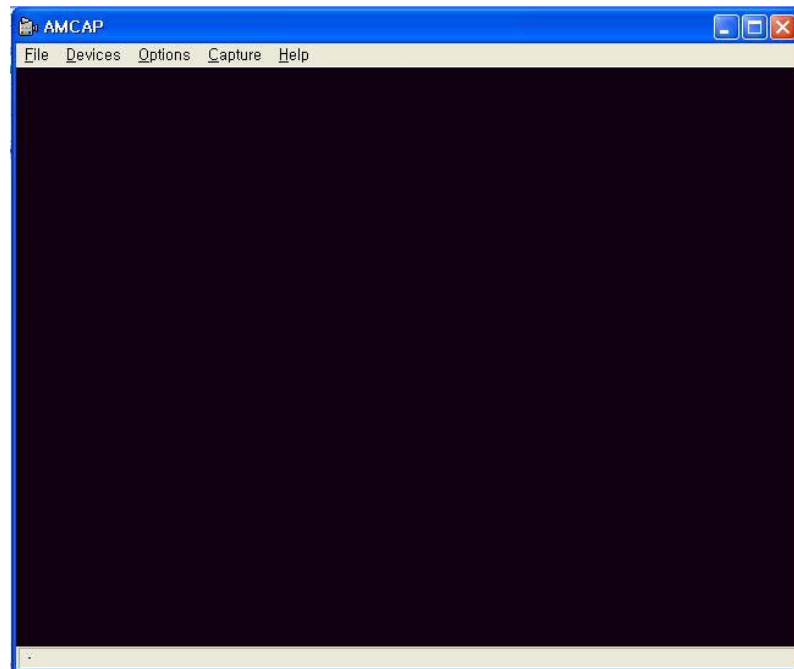


Wireless receiver is the device which receives the image transmitted to camera. It transmits to PC through USB after analog image of camera is transformed to digital image. This receiver which has four channels can receive at most four wireless camera images. In other words, it can check images of four Cycloids. To use this function, set up the wireless camera' s ID at first. After removing Cycloid' s head using Dip switch of camera, set up the ID. Cycloid' s camera basically set up as channel 1.



Seeing Image at PC To see the image at PC, set up the wireless receiver driver at first. Driver is included in provided software
< Driver set-up process >
 - turn the wireless receiver power on

- Connect USB of the wireless receiver to PC.
 - New hardware set-up menu appears on Window
 - indicate the folder which driver provided (select the indicated folder search)
 - set the driver up.
 - confirm whether the set-up is done or not through Hardware manager of PC
- If set-up is completed, confirm the image executing Amcap.exe. Check the power of Cycloid and wireless receiver is on and the channel is right as the image doesn't show up. If it can't still see, check the Amcap program device is USB2821. If not, select it.

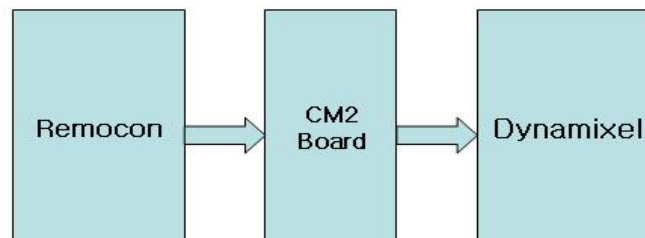


2. Cycloid II Application

2-1. System Architecture

Cycloid basic Components

Cycloid's basic system provided consists of Dynamixel as a smart actuator which control efficiently each joint, CM2 board as a main system of Cycloid which control Dynamixels, and remote controller which select Cycloid's motions through signal from CM-2 board.



< Components of Cycloid system >

Cycloid application Method

The application method is divided as motion page mode using CM-2 board and direct access mode not using it. Each mode will be explained later.

Remote controller

Is a system component which command to CM-2 board. It controls Cycloid by giving signal to CM-2. At present, the code allotted to remote controller will refer to recomon code table of Dynamixel robot manual. The user can make a new command using remocon code properly.

CM-2 board

CM-2 board application is very important to use motion page mode among the application method of cycloid. Cm-2 is like a small computer which we use everyday. In PC, there are main body, monitor as an output device, keyboard and mouse as a input device. If a PC is at least composed of them, we can use PC. Comparing it to CM-2 board, CM-2 board is main body without input/output device. It needs an input/output device for user to use it. Robot terminal replace the role instead of input/output device. To apply CM-2 board, refer to CM-2 manual

Dynamixel

Dynamixel is the most basic module making multi-joint Robot. Because it contains the components which need to control multi-joint robot, it is so easy that control multi-joint robot in comparison with other actuator. Even if CM-2 board controls Dynamixel, the user has to know its structure for application of Dynamixel . Refer to Dynamixel manual for Dynamixel function and structure.

2-2. Communications with CM-2 board

CM-2 and PC

Personal computer we generally use is a typical computer feature. Many devices are connected to apply various purposes in PC. But if you simplify the computer structure, there are CPU as a processor, memory and input/output which communicate with the outside. CM-2 is a computer made for special purpose to control Cycloid. So the devices mentioned already exist. But there is not an input/output device like monitor, keyboard and mouse in PC. User needs a PC as a role of input/output device to use CM-2

Robot Terminal

Terminal means the classical network concept which connects between system and system. Terminal program means the program connecting system among communication method between systems, the serial and parallel communication are the most basic one and modem and internet communications like TCP/IP is the its developed formation. Nowadays, computer peripheral devices often use USB communication. CM-2 communicates with PC through serial communication. Robot terminal is a program connecting between CM-2 and PC. Using robot terminal, you can input data on CM-2 through keyboard and check the output through monitor. CM-2 and PC use PC connection cable provided



< Serial port >

Boot loader

in case of PC, although operating system wasn't set up there is a program called Rom Bios which can use keyboard and monitor. Because its role is booting the system and loading set-up of another program, it's called booting loader. There is boot loader in CM-2 which can help the way to deal with CM-2 boot loader of CM-2 helps system booting, program loading and memory, monitoring. In the early version of Cycloid, there is boot loader Cycloid. Hex was loading cycloid operation beside Boot loader. Because the boot loader automatically runs the program the application is already set-up, go to the boot loader state to make initial state after resetting CM-2 using Robot Terminal

**CM-2 and PC
Communication**

to communicate between CM-2 board and PC, go through the following procedure

< CM-2 and PC communication procedure >

- Step 1. CM-2 will be connected to PC with PC connection cable
- Step 2. Run robot terminal.exe at PC.
- Step 3. Boot CM-2 by boot loader.
- Step 4. Apply CM-2 Robot Terminal.

Robot program

There must be application program to use CM-2 beside Boot loader in CM-2. The main purpose of Application program is robot, so it's called Robot program. There are basically various Robots program provided but the followings are main programs.

- Monitor. hex: the program which set up and checks the state of Dynamixel
- Edit. hex : the program which edit the motion of Cycloid
- Play.hex : the program control cycloid by remote controller
- Cycloid.hex : gathering programs (including above programs)

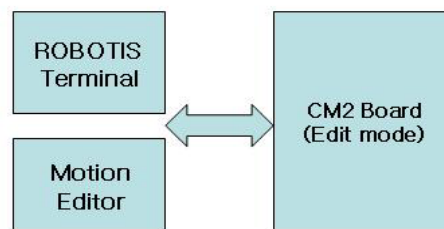
To Apply CM-2, set up or run robot program using boot loader which coincides with the purpose wanted. All procedures mentioned above also use Robot terminal. Basically, Most programs needed are gathered in Cycloid.hex and being already set-up through boot loader. Users just apply the program wanted running in CM-2 using Robot terminal.

CM-2 application

Refer to CM-2 board in case you want to know the details and various methods about CM-2

2-3. Motion page mode application

- Motion** Motion means the results which are shown as mechanical movement by controlling each actuator in multi joint Robot. In case Humanoid Robot, motion means the movement like walking. If you controlling multi joint robot, application of this motion is very important. What makes Cycloid move is because made this movement editing this motion by wireless controller
- Motion page mode** Motion page mode means the way which use CM-2 among Cycloid applications without any components change of Cycloid system provided. All processing run at this mode when user apply Cycloid. Many procedure of Motion page mode is to produce the various movement of cycloid through motion editor
- Motion page** Motion page means the data format on memory of CM-2 which motions transformed to data. All of Cycloid's motions are saved and managed by transforming into motion page. Refer to the motion data manual about details of motion page
- Edit program** Edit.hex which is Robot program, robot termini in CM-2, robot terminal or visual editor are used to edit motions. In other word, after Edit.hex runs in CM-2 and robot terminal or visual editor run in PC, can edit motion. In case Cycloid.hex can go into the edit mode directly. Motion edit methods are text-based and graphic based methods. Robot terminal is based on text and visual editor is based on graphic based method.



< Editing Motion data >

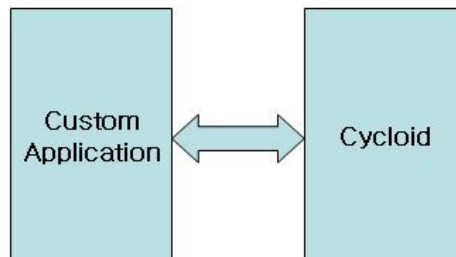
Motion page mode application

Please refer to motion data manual, CM-2 manual and visual editor manual about the various applications information for motion page mode

2-4. Direct access mode application

Direct access

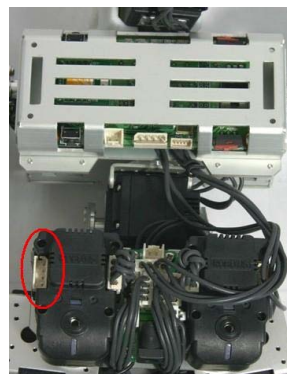
What control Dynamixels directly without using CM-2 means direct access. Applications program which control Cycloid already exists in CM-2. So users can apply Cycloid using this application programs. This method is motion page mode. But it's not appropriate to high grade users, when they develop applications programs controlling Cycloid. Of course, users can develop applications for CM-2 board referring CM-2 manual but the resource of CM-2 are not enough. That is, its function is not good comparing to computer. Program development at low grade computer is not easy. So direct access mode is the method that develop applications program at the well-function PC environment for the convenience of application program developer



< Direct Access Mode >

USBto485

it needs a device which can help to connect PC and Dynamixel to develop application programs for direct access mode USBto485 is a transformation device which is able to communicate between Dynamixel of RS485 and USB485 of PC. The device can be used to connect between Cycloid and PC

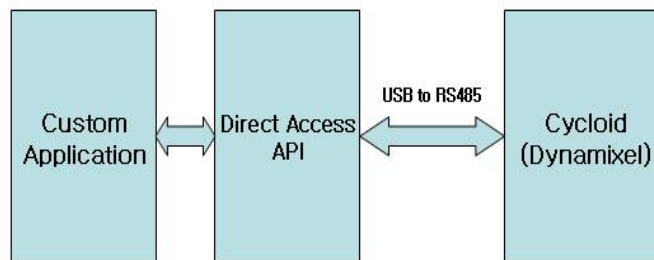


USBto485 driver

set up the driver to use USBto485 at PC. Driver is included in Software provided and refer Dynamixel Robot control manual how to set up

Direct access API

programs based on window system can be made to develop applications program based on direct access mode, library which must be used to control Dynamixel through USBto485. The library is called Direct access API refers to Dynamixel Robot control manual about direct Access API.



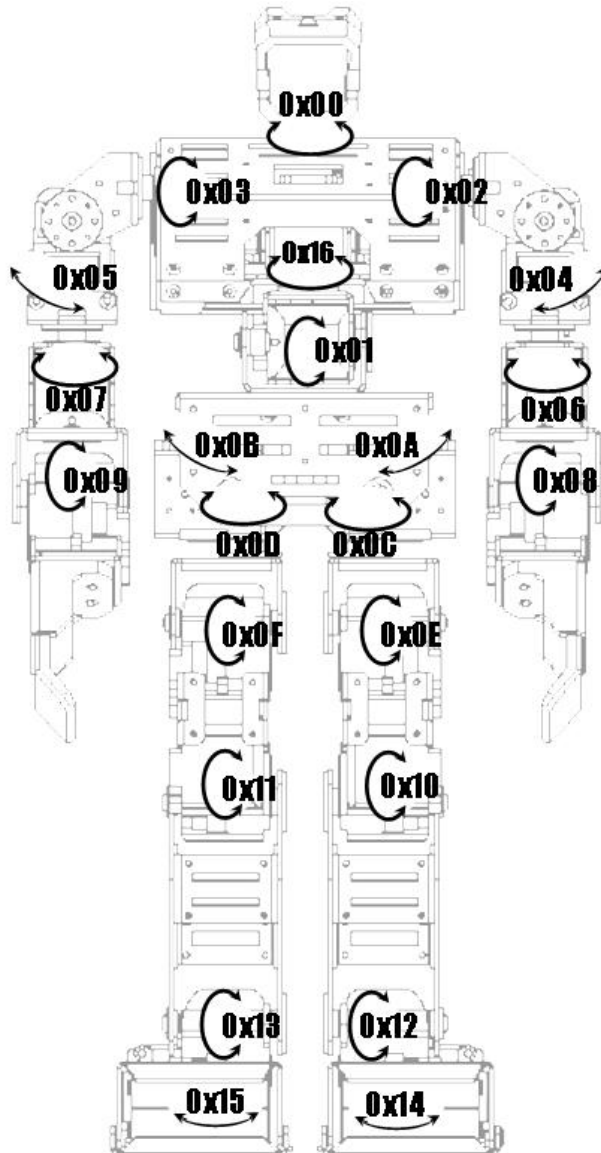
< Direct Access API >

2-5. Image processing using wireless camera

- Vfw Capture driver** Image data can be received to process image through wireless camera. Windows supply Vfw capture driver to approach to exterior image device. If you use Vfw windows Api program, you can process image data received from wireless receiver. You can have details information referring to MSDN corner in Microsoft Homepage because Vfw window API is often used in image processing using general web camera.
- YUY2 Image format** Wireless receiver provided doesn't support RGB24 format which is often supported in general web camera, so image processing routine using web camera can not run. In support, YUY2 Format which is a kind of YUV format instead of RGB24 format. You must use image processing routine for YUY2 format or transform YUV into RGB24. Refer to the document related to other image data format transformation because the method that transforms YUV into RGB24 format is general wireless receiver specification
- Wireless receiver Specification** Provided wireless receiver has the following specification
- The maximum image resolution : 640 * 480
 - Image data format: YUY2, 1420
 - Maximum fps(Frame Per Second): 30fps
 - USB version: 2.0

Appendix

A. Dynamixel ID



B. Remocon code

Remocon code

Remocon code exists from 0x00 to 0xFF as the 255 pieces value. Each code value which is allocated by key mixture of wireless controller can be used to command to robot. In theory, 255 pieces codes can be made by six buttons but key mixture which user can operate easily are used because there are impossible cases people control. In appendix B, code table shows up this key mixture. In reference, remocon code is divided to key down code which can be used as a concept of mode and key up code.

Key down code: 0x00~0xFE

Mode1: 0x00~0x3F

Mode2: 0x40~0x7F

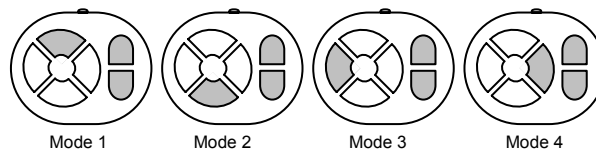
Mode3: 0x80~0xBF

Mode4: 0xC0~0xFE

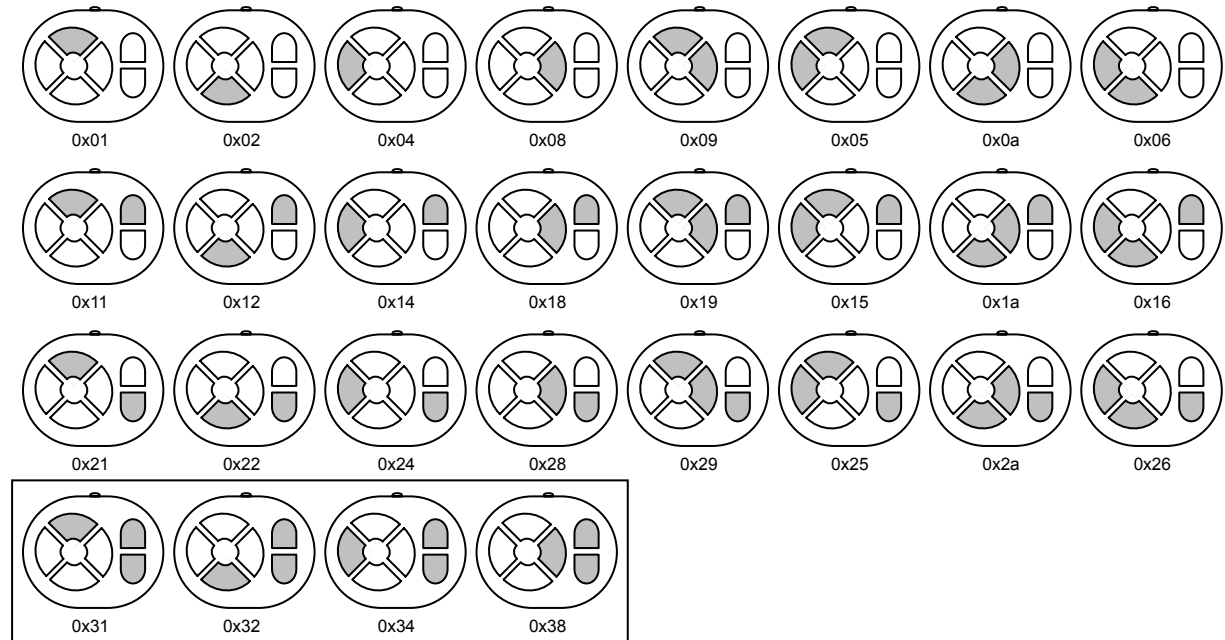
Key up code: 0xFF

Mode conversion

Remocon operate to four modes. The following are each mode conversion. In other words, it means that four type codes can be allocated to each key. Each mode conversion key has remocon code so that it link to motion page wanted

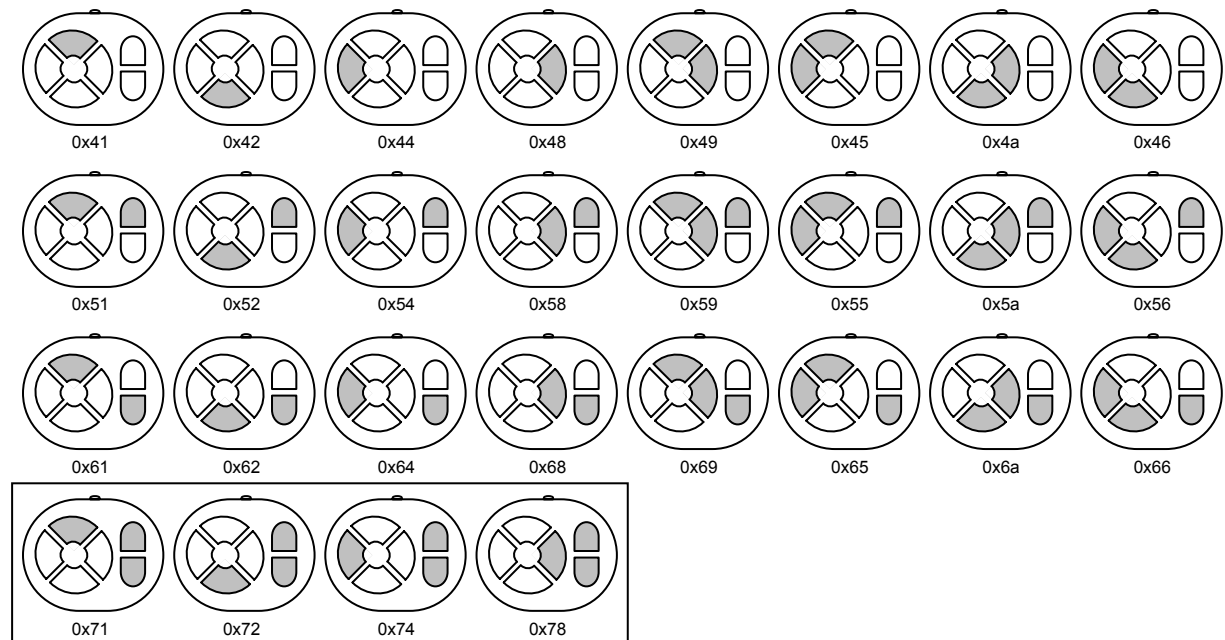


Mode1 (Up key)



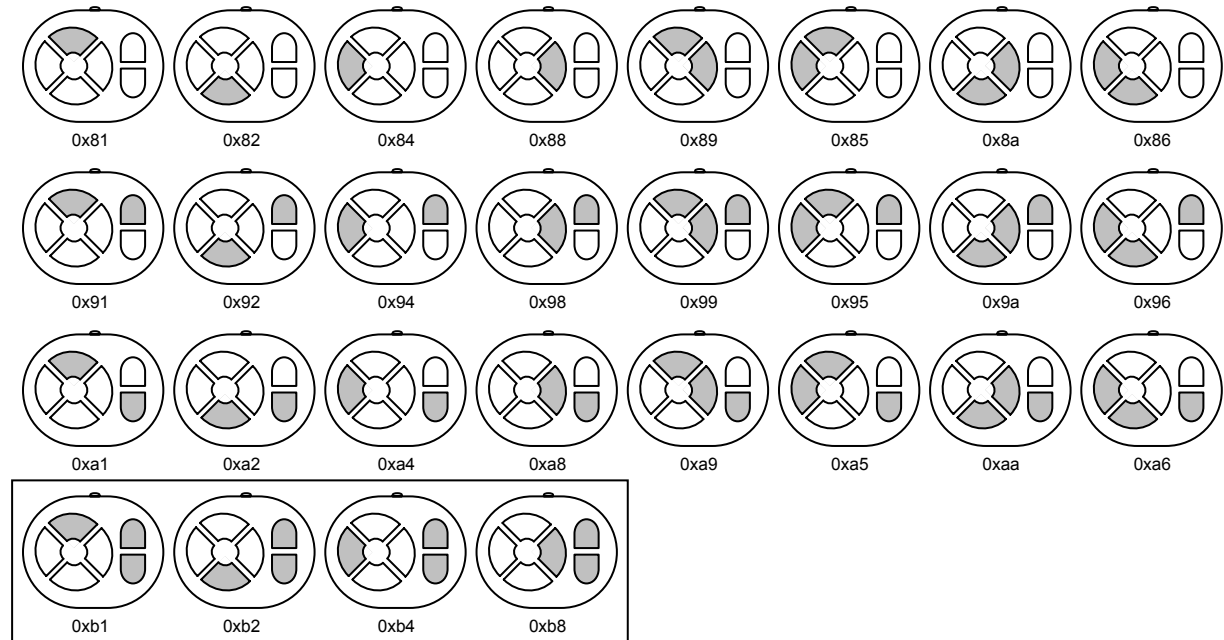
After motion playing, mode is changed.

Mode2 (Down key)



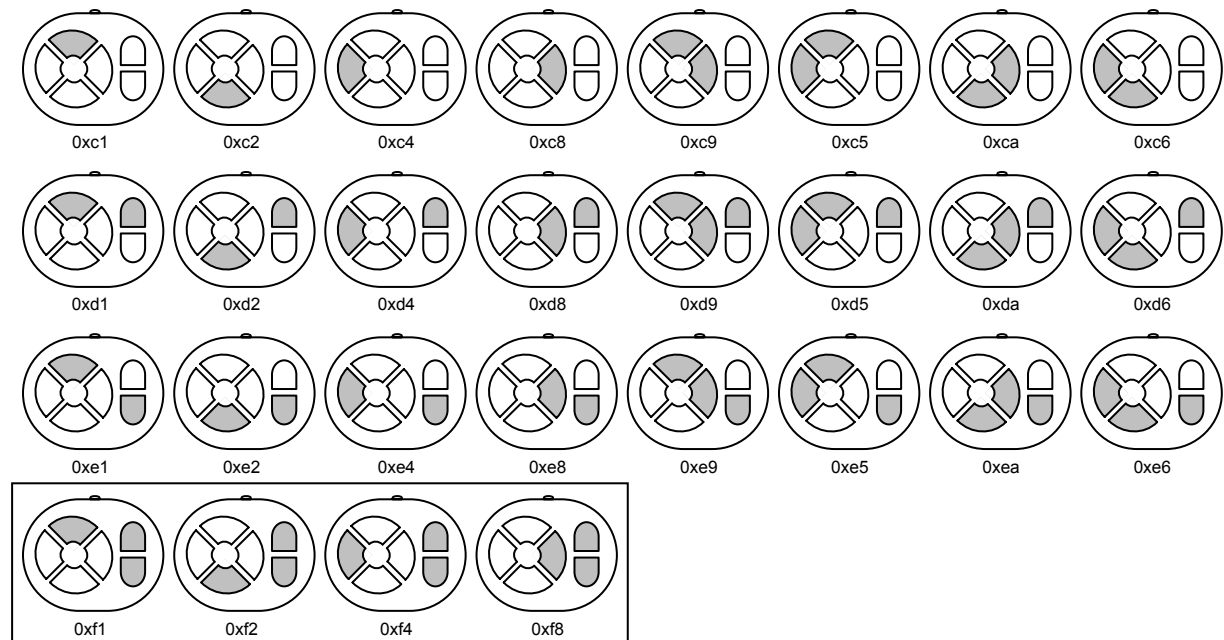
After motion playing, mode is changed.

Mode3 (Left key)



After motion playing, mode is changed.

Mode4 (Right key)



After motion playing, mode is changed.