DH-3 Short Manual

Content

1 Overview

The electric gripper of DH-3 has three adaptive parallel mechanical joint fingers evenly distributed, as shown in Figure 1.1. The main structure of the gripper is a triangle structure, the bottom is matched with the standard flange, and is equipped with a 4-Pin communication interface. It has the following characteristics:

Controllable force/position/speed: The gripper can program and adjust the clamping position, clamping force and angle.

Multiple communication modes: Support CAN2.0A, USB2.0, TCP / IP, RS485, IO, EtherCAT (optional).

Clamping judgment: The combination of force control and position control is adopted in the clamping process.

Clamping feedback: The status of the gripper can be read by programming, and can also be judged according to the indicator light of the gripper.

Various clamping methods: The clamping angle of gripper can be modified adaptively. Then it can produce three kinds of clamping methods: centering clamping, parallel clamping and vertical clamping, which can achieve the most appropriate clamping position and angle for the clamping objects.

Fingertips can be customized: Fingertips can be replaced according to real-time situation, which is suitable for precision machining, parts assembly and other fields.

Figure 1.1 DH-3 Gripper appearance

1.1 Specifications

The specific parameters of DH-3 electric gripper are listed in Table 1.1.

Specifications	
Maximum recommended load	1-2kg
Finger opening stroke	0-106/122mm
Gripper force	10-65N
Finer rotations angle	0-90°
Supply voltage	24V DC±10%
Positioning accuracy	0. 05mm
Minimum closing time	0.7s
IP Rating	IP40
Communication protocol	TCP/IP, USB2.0,RS485, CAN2.0A, EtherCAT(optional)

Note: Depend on the shape of the grip object and the friction of the contact surface. The object's center of gravity deviation can also affect the load. If you have any questions, please contact us.*

In the actual gripping, you should take the gripping angle and gripping position into account.

The following right-angle coordinate system is established, and the corresponding directions of the X-axis, Y-axis, and Z-axis are shown in Figure 1.2 below. The force perpendicular to the gripped flat surface is used as Fz, the x-axis direction torque is Mx, the y-axis direction torque is My, and the z-axis direction torque is Mz. The PGC-140 finger load table is shown in Table 1.2:

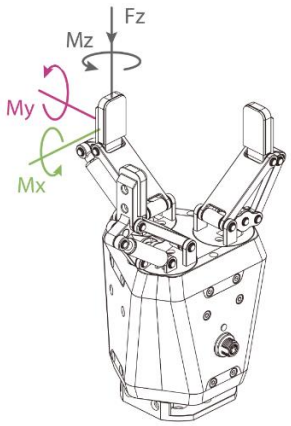


Figure 1.2 Torque diagram

Table 1.2 DH-3 Torque Table .

DH-3 Torque	
Maximum static load of Fz	150N
Maximum torque of x-axis	2 N·m
Maximum torque of y-axis	1.5 N·m
Maximum torque of z-axis	2.5 N·m

1.2 Meanings of Gripper Indicators

The gripper can feed back the state of the gripper in real time. In addition to the command reading, it can also be judged on the color of the indicator:

Color description of indicator light
·**Uninitialized state:** Red light blinks, other lights are off.
·**Initialized State:** The blue light is always on, indicating that it is in the operable state.
·**Received command state**: The red light blink once quickly (because the blue light is always on at this time, the gripper indicator light will looks like a purple light).
·**Object Caught state:** Green light is always on, other lights are off.
·**Object dropped state:** Green light blinking.

1.3 Dimensions

The gripper hardware parameters contain the specific size of the gripper, as shown in Figure 1.3(a) .According to different clamping angles, it can be divided into three clamping methods, as shown in Figure 1.3(b) .

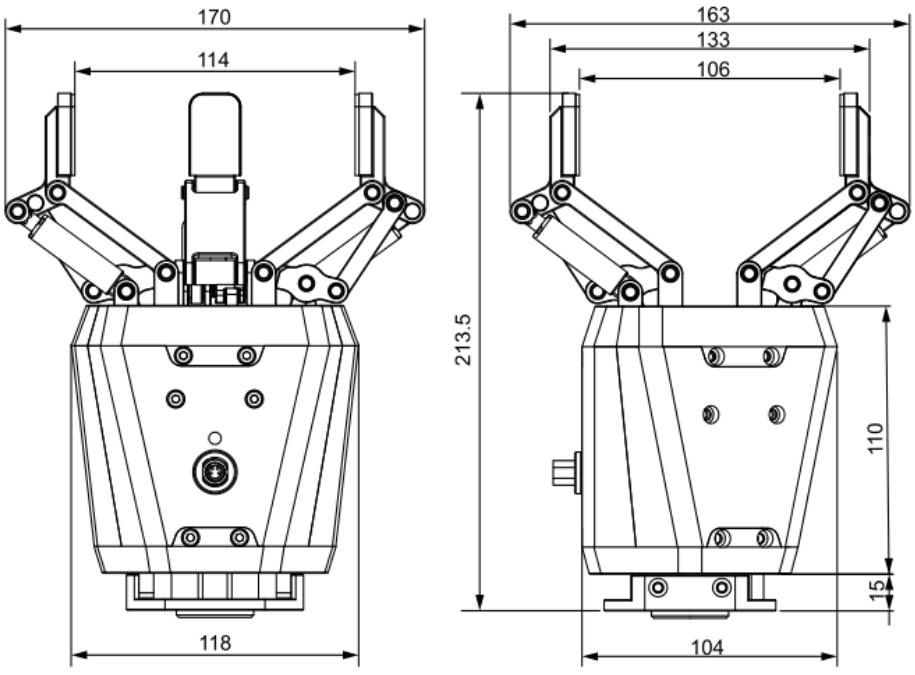


Figure 1.3 (a) Dimensions drawing of DH-3

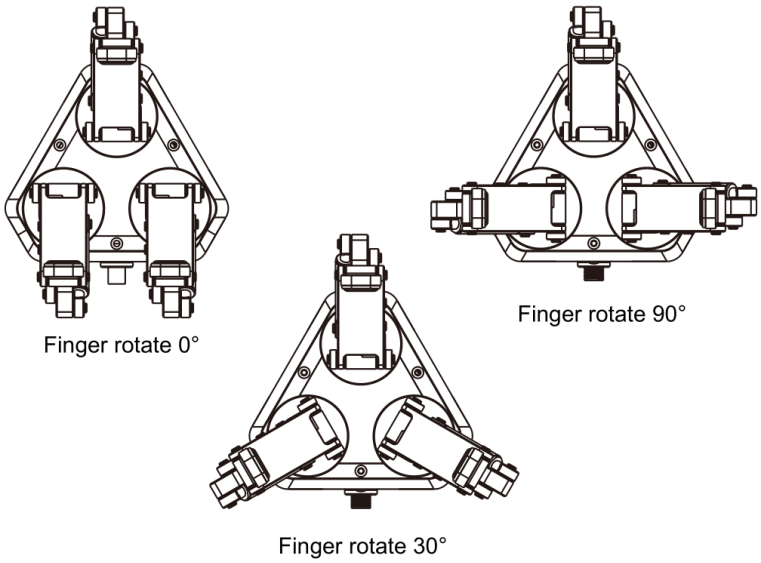


Figure 1.3 (b) Three clamping methods of DH-3

1.4 Standard Flange

The flange is used for the connection between DH-3 electric gripper and robot. We provides standard flange, as shown in Figure 1.4. The gripper also supports custom flanges.

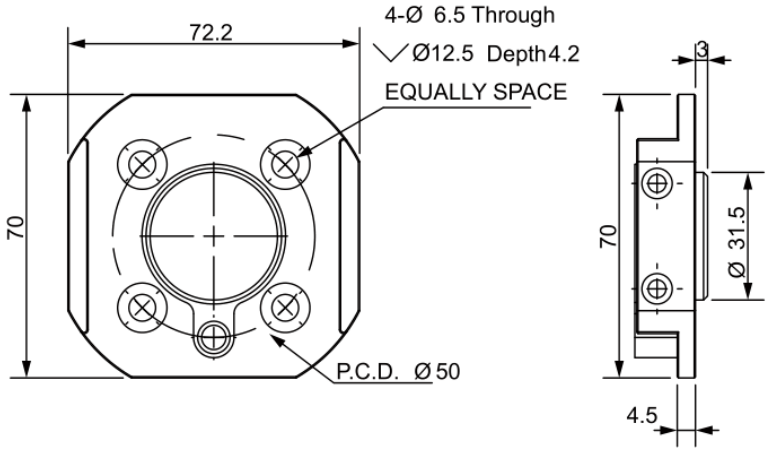


Figure 1.4 Standard flange according to ISO 9409-1-50-4-M6

1.5 Pin definition of gripper

The gripper uses CAN 2.0A/RS485 for communication and 4 pin (standard configuration) connection. The pin definition is shown in Figure 1.6, and the specific pin text description is shown in table 1.2.

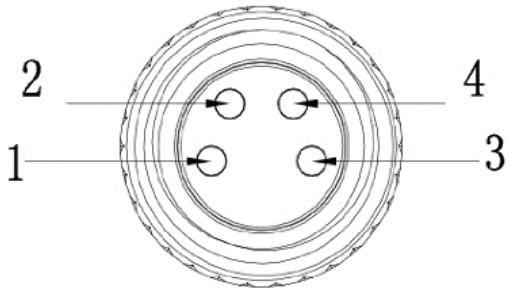


Figure 1.5 Gripper Pin number

Table 1.3 Gripper pins definition

Pins number	Description
1	CAN_L/485_B
2	GND
3	CAN_H/485_A
4	24V

2 Connection methods

The electric gripper of DH-3 use CAN for communication, which supports CAN2.0A version. In order to communicate with other protocols, we develop protocol converter to support other communication protocol, such as TCP/IP , USB , RS485 .If the system itself supports CAN , you can also connect the gripper directly to the system without using a communication protocol converter.

Description of connection of gripper
·Use the aviation plug cable provided by our company to connect the gripper and communication protocol converter.
·Insert the bent end of the cable into the gripper end; insert the straight end of the cable into the converter.6
·The interfaces of Ethernet, RS485, USB, IO, can and power supply have been marked on the side plate of protocol converter respectively. Users can connect the corresponding ports with the controller according to the requirements.

You can refer to the electrical connection diagram for communication connection of the gripper (as shown in Figure 2.1)

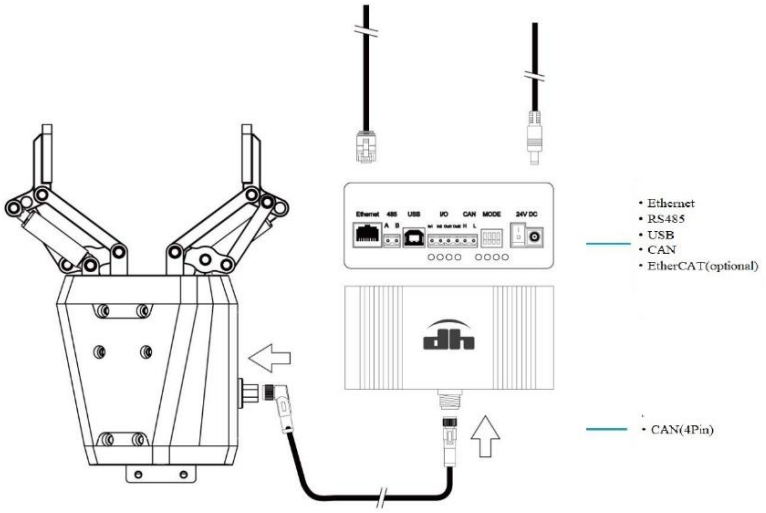


Figure 2.1 The electrical connection diagram

Taking Ethernet connection as an example, we connect the protocol converter, as shown in Figure 2.2.

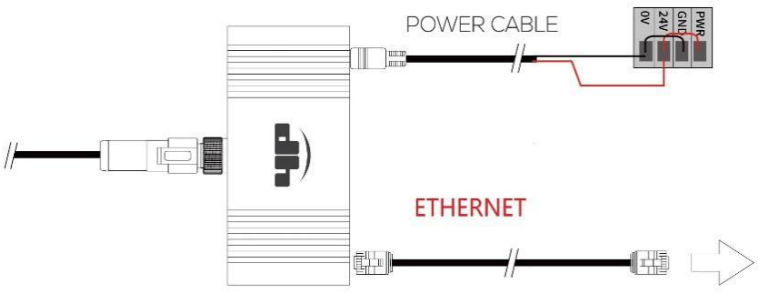


Figure 2.2 Ethernet connection diagram

3 Connect and control

3.1 Introduction

The DH-3 adaptive Gripper use aviation connector to connect the CAN network. It supports the CAN protocols version 2.0A.

For environments without a CAN network, we have provided a protocol converter to transfer other interfaces (like USB, TCP/IP, RS485, I/O) to CAN2.0A.

You can also connect it directly to the CAN network without the protocol converter.

The communication system block diagram is as follows

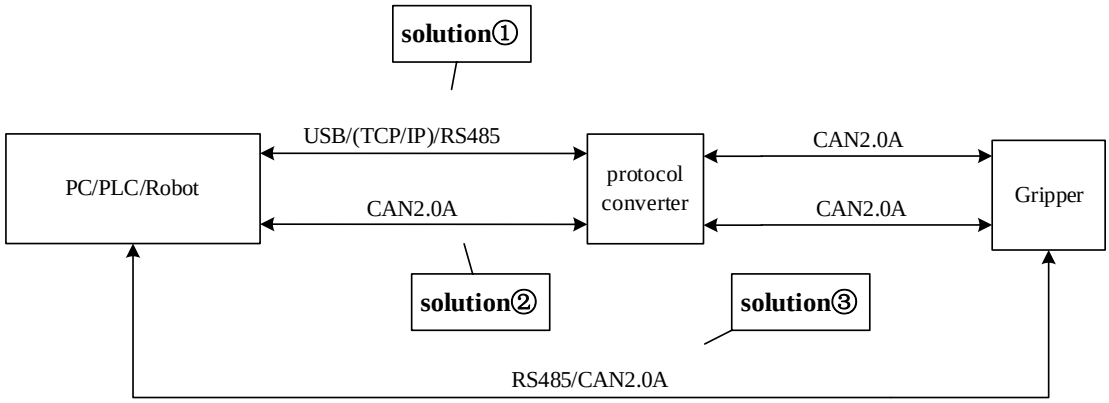


Figure 3.1 The communication system

3.2 Communication logic

1. **Successfully receive feedback：** The gripper will return the same data after successfully receiving the command.

2. **Initialization success automatic feedback：** After the initialization is successful, the success flag will be returned automatically.

3. **Initialization can be interrupted：** The initialization process can be interrupted by a new initialization command, and start a new initialization process. It is recommended to check the relevant flags to avoid frequent interruptions.

4. **Position command can be interrupted：** The moving process can be interrupted by a new position command, and gripper will move to the new position. It is recommended to check the relevant flags to avoid frequent interruptions.

5. **Guaranteed setting successfully：** The setting command (CAN ID, CAN Baud rate, I/O Mode) will return after the setting is successful, so gripper will not return the same data immediately.

6. **Command interval：** It is recommended that the send interval between the command and the command is above 20 milliseconds.

7. **Drop detection：** The diameter of the object needs to be greater than 5mm.

3.3 Protocol format

(For TCP/IP, USB, RS485)

All external communication interfaces (except CAN and I/O interfaces) send commands to the protocol converter in the following format (a total of 14 bytes).

Table 3.1 data format

Frame header	Gripper ID	Data Segment（8 Bytes）					Frame End
		Function Re gister	Sub-Function register	Read/Write	Reserve	Data	
4 Bytes (0xFFFEFDFC)	1 Byte	1 Byte	1 Byte	1 Byte	1 Byte （0x00）	4 Bytes	1 Byte (0xFB)

(For CAN2.0A)

The CAN ID is the gripper ID. The 8 bytes data is as follows:

Table 3.2 CAN data format

Function register	Sub-Function register	Read/Write	Reserve	Data
1 Byte	1 Byte	1 Byte	1 Byte （0x00）	4 Bytes

The command consists of four parts: frame header, Gripper ID, data segment, and the end of the frame. the frame header and the end of the frame are fixed。

1. **Frame header：** The command starts with 0xFFFEFDFC, and the protocol converter will recognize this field to determine the start of the command.

2. **Gripper ID:** The Gripper ID in the command is the actual CAN ID of the gripper（The default is 1），range : 0-255.（The “Gripper ID” in the following example is the default value of 1）

3. **Data segment：** It is the actual command, the data segment is also the CAN data segment, when using the CAN interface as the communication interface, the command has 8 bytes, and there is no need to add a frame header and end.

Function register： It is used to identify the main function of the command

Sub-Function register： It is used to identify the use function of the command

Read/Write： Only 0x00 and 0x01 are allowed,0x00 indicates that the command is a read command, and 0x01 indicates that the command is a write command.

Reserve： unused, default is 0x00

Data： 32-bits signed integer，value range: 0x00000000 – 0xFFFFFFFF，little endian mode，For example, 1 = 01 00 00 00, -1 = FF FF FF FF.（The data has no effect during the read operation.）

4. **Frame End：** The command starts with 0xFB and the protocol converter will recognize this field to determine the end of the command.

example：Initialization --- FF FE FD FC 01 08 02 01 00 00 00 00 00 FB

3.4 Command Overview

Function	Function register	Sub-Function register	REMARK
Initialization	0x08	0x01-0x02	Initialize related commands
Force	0x05	0x02-0x03	Read/ Write opening/closing Force
Postion	0x06	0x02	Read/ Write Position
Feedback	0x0F	0x01	Read current status
CAN ID	0x12	0x01	Read/ Write Gripper CAN ID
Version	0x13	0x01	Read Current Gripper firmware version
CAN BAUDRATE	0x14	0x01	Read/ Write Gripper CAN Baud Rate
Drop detection	0x15	0x01/0x02	Related to the drop detection

3.5 Detailed command

3.5.1 Initialization

Function register	Sub-Function register	Read/Write	Reserve	Data	Function
0x08	0x01	0x00/0x01	0x00	Integer	Read/Write Initialization feedback
	0x02	0x00/0x01		Integer	Read/Write

When the Sub-Function register value is 0x01, the function of this command is to read and write whether feedback after finish initialization.

Example：

Set Initialization feedback：

Send ： FF FE FD FC 01 08 01 01 00 00 00 00 00 FB

Receive ： FF FE FD FC 01 08 01 01 00 A5 00 00 00 FB

Read whether feedback ：

Send ： FF FE FD FC 01 08 01 00 00 00 00 00 00 FB

Receive ： FF FE FD FC 01 08 01 00 00 A5 00 00 00 FB （YES）

OR:

Receive ： FF FE FD FC 01 08 01 00 00 00 00 00 00 FB （NO）

When the Sub-Function register value is 0x02, the function of this command is to initialize gripper or read whether finish initialization.

initialization ：

Send ： FF FE FD FC 01 08 02 01 00 00 00 00 00 FB

Receive ： FF FE FD FC 01 08 02 01 00 00 00 00 00 FB

After set Initialization feedback：

Receive ： FF FE FD FC 01 08 02 00 00 00 00 00 00 FB

read whether finish initialization ：

Send ： FF FE FD FC 01 08 02 00 00 00 00 00 00 FB

Receive ： FF FE FD FC 01 08 02 00 00 01 00 00 00 FB （Finished）

OR:

Receive ： FF FE FD FC 01 08 02 00 00 00 00 00 00 FB （Not finished）

3.5.2 Force

Function register	Sub-Function register	Read/Write	Reserve	Data	Function
0x05	0x02/0x03	0x00/0x01	0x00	Integer	Read/Set Opening/Closing Force

The function of this command is to read and write the gripper Force (internal and external grip):
Data range:20-100 (14 00 00 00 – 64 00 00 00)

Example：(0x1E = 30)

Set 30% closing grip force：

Send：FF FE FD FC 01 05 02 01 00 1E 00 00 00 FB

Receive ： FF FE FD FC 01 05 02 01 00 1E 00 00 00 FB

Read current closing grip force：

Send ： FF FE FD FC 01 05 02 00 00 00 00 00 00 FB

Receive ： FF FE FD FC 01 05 02 00 00 1E 00 00 00 FB

3.5.3 Position

Function register	Sub-Function register	Read/Write	Reserve	Data	Function
0x06	0x02	0x00/0x01	0x00	Integer	Read/Write Position

The function of this command is to read and write the gripper position:
Data range: 0-100 (00 00 00 00 – 64 00 00 00)
Example： (0x3C = 60)
Set 60% position：

Send ： FF FE FD FC 01 06 02 01 00 3C 00 00 00 FB
Receive ： FF FE FD FC 01 06 02 01 00 3C 00 00 00 FB

Read current position：
Send：FF FE FD FC 01 06 02 00 00 00 00 00 00 FB
eceive：FF FE FD FC 01 06 02 00 00 3C 00 00 00 FB

3.5.4 Feedback

Function register	Sub-Function register	Read/Write	Reserve	Data	Function
0x0F	0x01	0x00	0x00	Integer	Read current status

The function of this command is to read and write the gripper current status.
00 00 00 00 ： default or moving
02 00 00 00 ： Arrive positon/rotation but not catch object
03 00 00 00 ： Catch the object but not arrive position/rotation
Example：
Read current status：
Send：FF FE FD FC 01 0F 01 00 00 00 00 00 00 FB
Receive default：FF FE FD FC 01 0F 01 00 00 00 00 00 00 FB OR:
Arrive positon ： FF FE FD FC 01 0F 01 00 02 00 00 00 00 FB
OR:
Catch the object ： FF FE FD FC 01 0F 01 00 03 00 00 00 00 FB

3.5.5 I/O Mode

Function register	Sub-Function register	Read/Write	Reserve	Data	Function
0x10	0x01	0x00/0x01	0x00	Integer	Read/Write Group 1 Position 1
	0x02				Read/Write Group 1 Position 2
	0x03				Read/Write Group 1 Force 1
	0x04	0x01			Control Group 1 grip
	0x05	0x00/0x01			Read/Write Group 2 Position 1
	0x06				Read/Write Group 2 Position 2
	0x07				Read/Write Group 2 Force 1

	0x08	0x01			Control Group 2 grip
	0x09	0x00/0x01			Read/Write Enable I/O Mode
	0x0A	0x00/0x01			Read/Write Group 1 Force 2
	0x0B	0x00/0x01			Read/Write Group 2 Force 2

I/O mode is a simple communication mode. The status of the input pin is detected by the protocol converter with I/O interface, and the command is sent to the gripper according to the current pin status. There are two input pins on the protocol converter, each pin recognizes two input states, and corresponds to four states in total.

Sub-functions 0x01-0x03, 0x05-0x07, 0x0A-0x0B ,These 8 sub-functions are the write force and the target position. For the value range, refer to the force command and position command section above.

(Position 1 is bound to force 1, position 2 is bound to force 2)

Sub-function 0x04 and 0x08, command that the protocol converter sends in I/O mode.

Sub-function 0x09, write/read I/O mode switch status.

Example：

Enable I/O mode：

Send：FF FE FD FC 01 10 09 01 00 01 00 00 00 FB

Receive ： FF FE FD FC 01 10 09 01 00 01 00 00 00 FB

Set I/O mode parameter：

Send：FF FE FD FC 01 10 01 01 00 00 00 00 00 FB (Set Group 1 Position 1 0)

Receive ： FF FE FD FC 01 10 01 01 00 00 00 00 00 FB

Send ： FF FE FD FC 01 10 02 01 00 5A 00 00 00 FB (Set Group 1 Position 2 90)

Receive ： FF FE FD FC 01 10 02 01 00 5A 00 00 00 FB

Send ： FF FE FD FC 01 10 03 01 00 5A 00 00 00 FB (Set Group 1 force 1 90)

Receive ： FF FE FD FC 01 10 03 01 00 5A 00 00 00 FB

Send ： FF FE FD FC 01 10 0A 01 00 3C 00 00 00 FB (Set Group 1 force 2 60)

Receive ： FF FE FD FC 01 10 0A 01 00 3C 00 00 00 FB

Send ： FF FE FD FC 01 10 05 01 00 1E 00 00 00 FB (Set Group 2 Position 1 30)

Receive ： FF FE FD FC 01 10 05 01 00 1E 00 00 00 FB

Send ： FF FE FD FC 01 10 06 01 00 3C 00 00 00 FB (Set Group 2 Position 2 60)

Receive ： FF FE FD FC 01 10 06 01 00 3C 00 00 00 FB

Send ： FF FE FD FC 01 10 07 01 00 3C 00 00 00 FB (Set Group 2 Force 1 60)

Receive ： FF FE FD FC 01 10 07 01 00 3C 00 00 00 FB

Send ： FF FE FD FC 01 10 0B 01 00 5A 00 00 00 FB (Set Group 2 Force 2 90)
Receive ： FF FE FD FC 01 10 0B 01 00 5A 00 00 00 FB

I/O Control：

Send ： FF FE FD FC 01 10 04 01 00 00 00 00 00 FB （gripper grip to Group 1 Position 1）
Receive ： FF FE FD FC 01 10 04 01 00 00 00 00 00 FB

Send ： FF FE FD FC 01 10 04 01 00 01 00 00 00 FB （gripper grip to Group 1 Position 2）
Receive ： FF FE FD FC 01 10 04 01 00 01 00 00 00 FB

Send ： FF FE FD FC 01 10 08 01 00 00 00 00 00 FB （gripper grip to Group 2 Position 1）
Receive ： FF FE FD FC 01 10 08 01 00 00 00 00 00 FB

Send ： FF FE FD FC 01 10 08 01 00 01 00 00 00 FB （gripper grip to Group 2 Position 2）
Receive ： FF FE FD FC 01 10 08 01 00 01 00 00 00 FB

3.5.6 CAN ID

Function register	Sub-Function register	Read/Write	Reserve	Data	Function
0x12	0x01	0x00/0x01	0x00	Integer	Read/Set Gripper CAN ID

The function of this command is to read and write the CAN ID. (default: ID = 1) After the CAN ID has been set successfully, the gripper must be reboot.Data Range: 1-255 (01 00 00 00 – FF 00 00 00)

When user don’t know or forget gripper CAN ID, user can use ID 0 to read or set gripper CAN ID.

Example：

Set CAN ID to 2：

Send：FF FE FD FC 01 12 01 01 00 02 00 00 00 FB （when ID=1，set ID to 2）
Receive ： FF FE FD FC 01 12 01 01 00 02 00 00 00 FB

OR: (when you don’t know current ID)

Send：FF FE FD FC 00 12 01 01 00 02 00 00 00 FB (use ID=0，set ID to 2）
Receive ： FF FE FD FC 00 12 01 01 00 02 00 00 00 FB

Read CAN ID：

Send：FF FE FD FC 02 12 01 00 00 00 00 00 00 FB（when ID=2，read ID）

Receive：FF FE FD FC 02 12 01 00 00 02 00 00 00 FB

OR: (when you don't know current ID)

Send：FF FE FD FC 00 12 01 01 00 00 00 00 00 FB　(use ID=0 to read ID）

Receive：FF FE FD FC 00 12 01 01 00 02 00 00 00 FB

3.5.7 Firmware Version

Function register	Sub-Function register	Read/Write	Reserve	Data	Function
0x13	0x01	0x00	0x00	0x00000000	Read gripper firmware version

The function of this command is to read gripper current firmware version.

Example：

Read firmware version:

Send:FF FE FD FC 01 13 01 00 00 00 00 00 00 FB

Receive:FF FE FD FC 01 13 01 00 00 00 02 01 04 FB

3.5.8 CAN Baud Rate

Function register	Sub-Function register	Read/Write	Reserve	Data	Function
0x14	0x01	0x00/0x01	0x00	Integer	Read/Set Gripper CAN Baud Rate

The function of this command is to read and write the CAN baud rate.

After the CAN baud rate has been set successfully, the gripper must be reboot.

Data range: 0-5 (00 00 00 00 – 05 00 00 00)

Table 3.10 Baud Rate

Index	Baud Rate
0	500Kbps
1	400Kbps
2	250Kbps
3	200Kbps
4	125Kbps
5	100Kbps

Example:

Set CAN bps to 250K ：

Send：FF FE FD FC 01 14 01 01 00 02 00 00 00 FB

Receive：FF FE FD FC 01 14 01 01 00 02 00 00 00 FB

Read CAN bps（Receive 2）:

Send：FF FE FD FC 01 14 01 00 00 00 00 00 00 FB

Receive：FF FE FD FC 01 14 01 00 00 02 00 00 00 FB

3.5.9 Object Dropped

Function register	Sub-Function register	Read/Write	Reserve	Data	Function
0x15	0x01/02	0x00/0x01	0x00	Integer	Object droped feedback

Open object droped feedback function :

FF FE FD FC 01 15 01 01 00 01 00 00 00 FB

close object droped feedback function :

FF FE FD FC 01 15 01 01 00 00 00 00 00 FB

When object dropped，gripper will send automatically：

grip droped：FF FE FD FC 01 15 02 00 00 00 00 00 00 FB

stop feedback :FF FE FD FC 01 15 02 01 00 00 00 00 00 FB

4 Protocol Converter

The protocol converter (CTS-B1.0) is to convert communication protocols between the controller and the DH's gripper, in order to make the gripper compatible with controllers as many as possible. In addition, the protocol converter (CTS-B1.0) has multiple working modes according to the communication protocols to be converted. Users can select a specific communication protocol as needed.

If you need to use the USB mode in the Windows system, please install the USB driver first (see the debugging software installation below).

4.1 Working Mode Selection

A communication protocol is selected and set mainly through the DIP switch of the protocol converter (CTS-B1.0). The protocol converter (CTS-B1.0) has a four-digit DIP switch (as shown in the following figure). The switch numbers are 1, 2, 3 and 4.

The switch is "ON" in the upper status (identified by 1) and "OFF" in the lower status (identified by 0). as shown in Figure 3.1.

Figure 3.1 Dialing diagram

If the mode number is 1, seen from the left (i.e. the bit 1), the switch status is 1, 0, 0 and 0 accordingly.

The working modes corresponding to the DIP switch statuses are as follows:

Table 1 working modes

Switch Status (Mode Number)	Working Mode	Switch Status (Mode Number)	Working Mode
0 0 0 0 (0)	Parameter configuration mode	0 0 1 0 (4)	RS485 mode
1 0 0 0 (1)	USB mode	1 0 1 0 (5)	MODBUS mode of RS485
0 1 0 0 (2)	TCP client mode	0 1 1 0 (6)	IO mode
1 1 0 0 (3)	TCP server mode	1 1 1 0 (7)	CAN2.0A mode

After changing the working mode of the DIP switch, the user needs to restart the protocol converter (CTS-B1.0) without connecting the USB cable to apply this mode.

When using the gripper, the user needs to connect the cable to the controller and then turn on the protocol converter (CTS-B1.0). (The protocol converter (CTS-B1.0) search for the gripper at the startup process.)

All modes have their own default parameters. The gripper can be quickly set up according to

the default parameters.

4.2 Parameter Configuration Mode

Switch Status (Mode Number)	Working Mode
0 0 0 0 (0)	Parameter configuration mode

In this mode, parameters of other modes of the protocol converter can be set by the software, such as modifying the IP address of the protocol converter used as a TCP server.

The procedures of setting the parameter configuration mode of the protocol converter are as follows. (Accessories needed in this mode: USB cable, DC power cable, and protocol converter)

1. Connect the 24V power supply to the protocol converter through the DC power cable.
2. Make sure that the protocol converter is turned off and the USB cable is not connected to the computer.
3. Set the red DIP switches of the protocol converter to 0000 (all four DIP switches are in the lower position).
4. Turn on the protocol converter, and connect it to the computer via the USB cable.
5. If the setting is successful and the USB driver has been installed in the computer, the COM device will be displayed in the COM category under Windows System Device Manager, starting with “STMicroelectronics Virtual COM Port”.
6. If the setting fails, check whether the operation is correct.

After successfully entering the setting mode, you can configure the parameters through the host software. For the specific configuration process, refer to the related contents of the debugging software below.

4.3 USB Mode

Switch Status (Mode Number)	Working Mode
1 0 0 0 (1)	USB mode

In this mode, the gripper can be controlled via USB.

Set the USB mode of the protocol converter as follows,
(Accessories needed in this mode: USB cable, aviation plug cable, DC power cable, and protocol converter)
1. Connect the protocol converter to the gripper through the aviation plug cable and the 24V power supply through the DC power cable.

2. Make sure that the protocol converter is turned off and the USB cable is not connected.

3. Set the red DIP switches of the protocol converter to 1000 (with the DIP switch 1 in the upper position, and the DIP switches 2, 3 and 4 in the lower position).

4. Turn on the protocol converter, and connect it with the controller via the USB cable.

5. If the setting is successful and the USB driver has been installed in the computer, the COM device will be displayed in the COM category under Windows System Device Manager, starting with "STMicroelectronics Virtual COM Port". In the Linux system, the "ttyACM" device will be displayed, and the gripper indicator will flicker in red.

6. If the setting fails, check whether the operation is correct.

After successfully entering the USB mode, the gripper can be set with the host computer or other control devices.

The USB mode is virtualized as a serial port device on the application layer, so the protocol converter in the USB mode can be operated by operating the serial port.

For how to control the gripper in USB mode, you can refer to the aforesaid communication protocol or the debugging software below.

4.4 TCP Client Mode

Switch Status (Mode Number)	Working Mode
0 1 0 0 (2)	TCP client mode

In this mode, the protocol converter works as a TCP client and the controller can control the gripper via the TCP/IP protocol.

Default parameters of the TCP client:

Default protocol converter IP: 192.168.1.30
Default protocol converter gateway: 192.168.1.1
Default remote server IP: 192.168.1.60
Default remote server port: 8888

Set the protocol converter to TCP client as follows:
(Accessories needed in this mode: network cable, aviation plug cable, DC power cable and protocol converter)

1. Connect the protocol converter and gripper through the aviation plug cable, and the 24V power supply to the protocol converter through the DC power cable.

2. Make sure that the protocol converter is turned off and the USB cable is not connected to the controller.

3. Set the red DIP switches of the protocol converter to 0100 (with the DIP switch 2 in the upper position, and the DIP switches 1, 3 and 4 in the lower position).

4. Turn on the protocol converter.

5. If the setting is successful, the network port of the protocol converter will light up or flicker and the gripper indicator will flicker in red.

6. If the setting fails, check whether the operation is correct.

After successfully entering the TCP client mode, the protocol converter will attempt to connect the remote server. When connection is built successfully, the remote server can send commands to control the gripper. Refer to the aforesaid communication protocol or debugging software instructions for gripper control below.

Recommendations for use of the TCP client mode:

1. Make sure that the server is turned on normally.
2. Ping the address of the gripper to test the connection.
3. If the computer is used as a network server, it is recommended to check whether the firewall allows server applications to be networked.
4. If the computer is connected directly, set the IPV4 address of the wired network of the computer to a static IP, and make sure its IP address is within the same network segment as the gripper.

   Example: IP: 192.168.1.60; subnet mask: 255.255.255.0

   If the computer IP is not 192.168.1.60, set or change the remote server IP and port according to the debugging software instructions below.
5. If the gripper is connected to a control device (e.g. computer) through a router or switch, make sure that the IP address of the gripper matches the network segment of the router. If they do not match each other, change the IP of the protocol converter according to the debugging software instructions below.

4.5 TCP Server Mode

Switch Status (Mode Number)	Working Mode
1 1 0 0 (3)	TCP server mode

In this mode, the protocol converter works as a TCP server and the controller can control the gripper according to the TCP/IP protocol.

Default parameters of the TCP server:

Default protocol converter IP: 192.168.1.29

Default protocol converter gateway: 192.168.1.1

Default monitoring port: 8888

Set the protocol converter to TCP server as follows.

(Parts needed in this mode: network cable, aviation plug cable, DC power cable, gripper body and protocol converter)

1. Connect the protocol converter and gripper through the aviation plug cable. Then connect the

24V power supply to the protocol converter through the DC power cable, and the control device through the network cable.

2. Make sure that the protocol converter is turned off and the USB cable is not connected.

3. Set the red DIP switches of the protocol converter to 1100 (with the DIP switches 1 and 2 in the upper position, and the DIP switches 3 and 4 in the lower position).

4. Turn on the protocol converter.

5. If the setting is successful, the network port of the protocol converter will light up or flicker and the gripper indicator will flicker in red.

6. If the setting fails, check whether the operation is correct.

After successfully entering the TCP server mode, the protocol converter will monitor the port and wait for the access of the client.
When connected successfully, the TCP client will send commands to control the gripper. Refer to the aforesaid communication protocol or debugging software instructions for gripper control below.

Recommendations for use of the TCP server mode

1. Conduct the connection test with the ping command of the computer.
2. If the computer is connected directly, set the IPV4 address of the wired network of the computer to a static IP, and make sure that is the IP address is within the same network segment as the gripper.

   Example: IP: 192.168.1.60; subnet mask: 255.255.255.0
3. If the gripper is connected to a control device (e.g. computer) through a router or switch, make sure that the IP address of the gripper matches the network segment of the router. If they do not match each other, change the IP of the protocol converter according to the debugging software instructions below.

4.6 RS485 Mode

Switch Status (Mode Number)	Working Mode
0 0 1 0 (4)	RS485 mode

In this mode, the protocol converter can be connected via RS485 to control the gripper.

Default parameters of the RS485 mode:

Baud rate: 115200, no parity, 1 stop bit

Set the protocol converter to the RS485 mode as follows.
(Accessories needed in this mode: aviation plug cable, DC power cable and protocol converter)
1. Connect the protocol converter and gripper through the aviation plug cable. Then connect the 24V power supply to the protocol converter through the DC power cable, and connect the protocol

converter with the controller through the 485 bus (485-A corresponding to 485-A, and 485-B corresponding to 485-B).

2. Make sure that the protocol converter is turned off and the USB cable is not connected to the controller at the moment.

3. Set the red DIP switches of the protocol converter to 0010 (with the DIP switch 3 in the upper position, and the DIP switches 1, 2 and 4 in the lower position).

4. Turn on the protocol converter. The gripper indicator will flicker in red. Connect the protocol converter with the controller via the USB cable.

5. If the setting fails, check whether the operation is correct.

After successfully entering the RS485 mode, commands can be sent through the RS485 bus. Refer to the aforesaid communication protocol.

Recommendations for use of the RS485 mode

1. Make sure that the parameters match with each other.
2. The user can debug the gripper through the serial port of the computer by a USB-to-485 module.

4.7 CAN2.0A Mode

Switch Status (Mode Number)	Working Mode
1 1 1 0 (7)	CAN2.0A mode

In this mode, the gripper is controlled by CAN2.0A.

The CAN mode is a special mode. Since the gripper body is a CAN interface, the protocol converter does not execute the program, but only works as an interface adapter. That is, commands are directly sent to the gripper body. The CAN interface of the gripper is connected with a 120Ω resistor. The CAN interface of the protocol converter is also connected with a 120Ω resistor. Therefore, the terminal resistors of the CAN bus must match with each other in the CAN mode. When necessary, the 120Ω resistor connected with the protocol converter may be removed.

CAN2.0A default parameters:

CAN ID: 1

CAN baud rate: 500Kbps

Set the protocol converter to the CAN2.0 mode as follows.(Parts needed in this mode: aviation plug cable, DC power cable, gripper body, protocol converter, and green terminal)

1. Connect the protocol converter and gripper through the aviation plug cable, and the 24V power supply to the protocol converter through the DC power cable.

2. Connect the protocol converter with the CAN bus (connect CAN H to CAN H, and CAN L to CAN L).

3. Make sure that the protocol converter is turned off and the USB cable is not connected

4. Set the red DIP switches of the protocol converter to 1110 (with the DIP switches 1, 2 and 3 in the upper position, and the DIP switch 4 in the lower position).

5. Turn on the protocol converter.

After successfully entering the CAN mode, commands can be sent to the CAN bus to control the gripper. Refer to the aforesaid communication protocol for specific commands.

Recommendations on the use of CAN mode

1. Make sure that the commands are standard frames, with the correct ID and baud rate.
2. Be sure that the terminal resistor of the CAN bus is appropriate. When necessary, remove the 120Ω resistor from the CAN interface of the protocol converter.

5 Installation and Use of Debugging Software

5.1 Overview

The software is used to test the gripper of this model, and set the parameters of the gripper and supporting protocol converter.

In the software interface here, “Connect” is to connect the protocol converter. All commands are sent to the protocol converter and converted by the protocol converter into CAN. The data is then sent to the gripper through the aviation plug cable, thus controlling the gripper. The commands of the protocol converter are parsed by the protocol converter but not sent to the gripper (see the previous section for the communication protocol and topology).

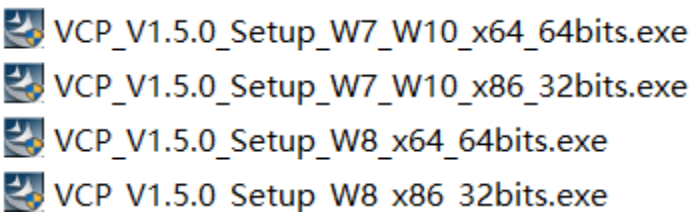
5.2 Software Installation

The debugging software can be run directly without installation. However, it is recommended to install the USB driver first to facilitate subsequent operations.

Installation of the USB driver:

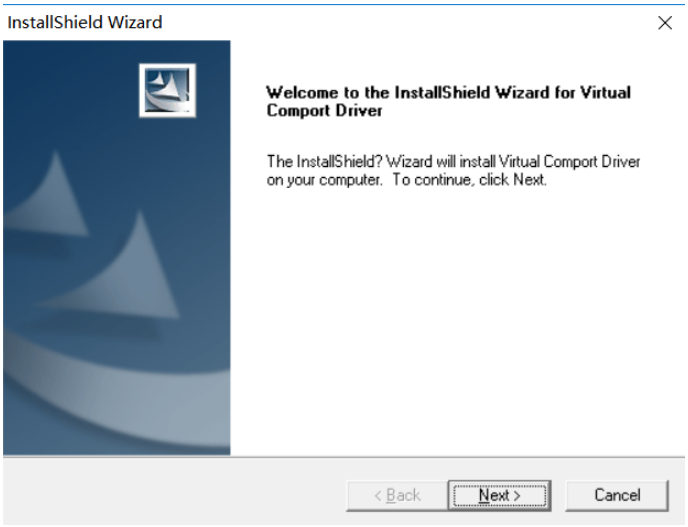
Open the USB disk (data) which is supplied along with the package. The following files are available in the “USB driver installation” folder:

(Some system files are not available in the Win7 system installed using Ghost, so this driver may not be applicable.)

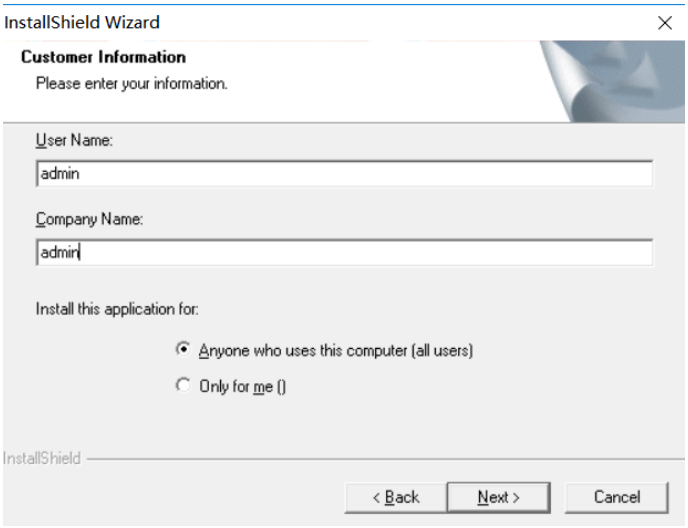


(Name explanation: W7: Windows 7; W10: Windows 10; W8: Winows 8;64bits: 64-bit system; 32bits: 32-bit system)

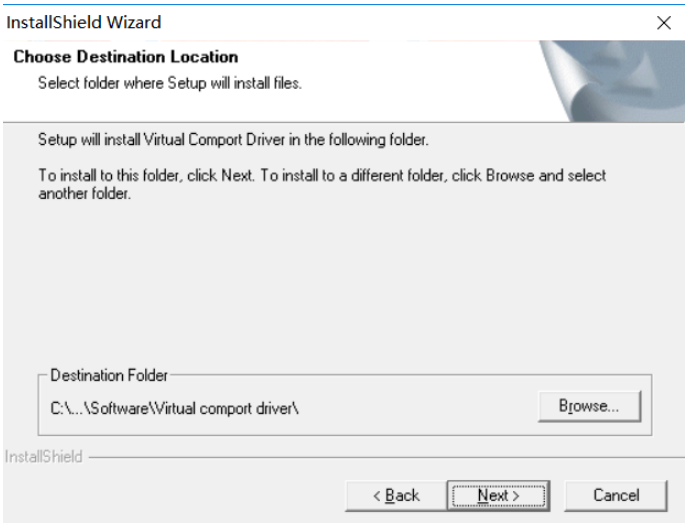
1. Select the appropriate driver version according to the computer system version and bits, and click “Next”.



2. Fill in the registration information and click “Next”.

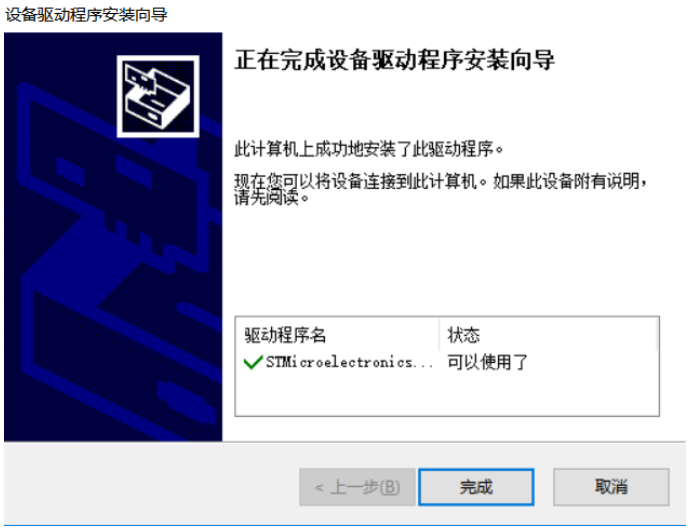


3. Select the directory (or by default), and click “Next”.

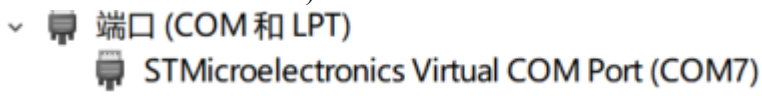


4. The driver installation wizard will pop up. Click “Next”.

5. After the successful installation, the following interface will appear. Click “Finish”.

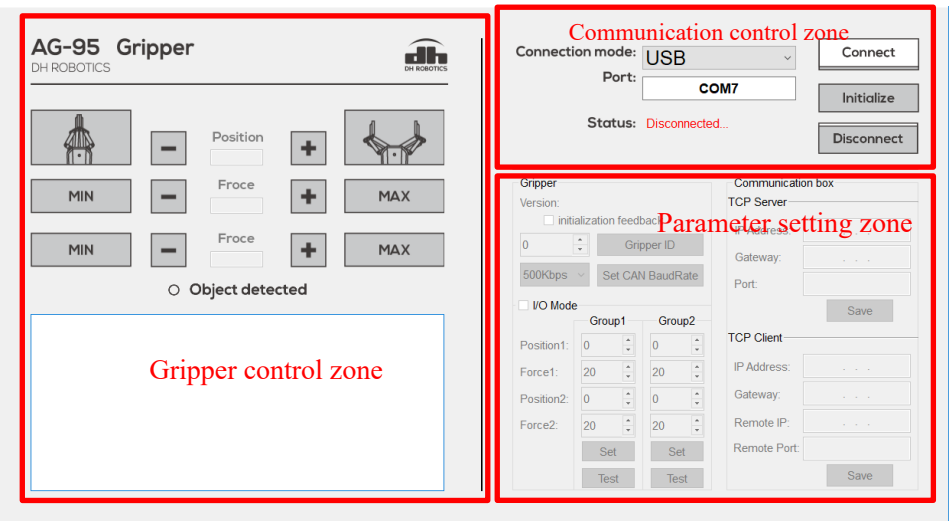


6. Check whether the driver is normal. Set the protocol converter to USB mode, and connect the computer via the USB cable. Check whether the following devices appear in the computer device manager (refer to the USB mode description of the protocol converter for the steps of setting the protocol converter to USB mode).



5.3 User Interface

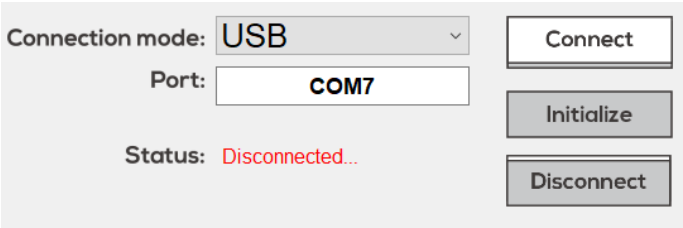
The interface is mainly composed of three parts: gripper control zone on the left, communication control zone in the middle, and parameter setting zone on the right.



1. **Gripper control zone**: for simple gripper control and status display, and command sending and receiving. This zone is to facilitate gripper use, function verification, gripper testing, etc.
2. **Communication control zone**: select the corresponding connection mode for connection and gripper initialization, according to the mode of the protocol converter.
3. **Parameter setting zone**: the user can set the parameters of the gripper and protocol converter here.

5.4 Gripper Connection and Initialization

5.4.1 Composition and Introduction



This figure shows the interface of the communication control zone, which consists of the following parts from top to bottom and from left to right:

Connection mode selection, Port setting, and Status display,
Connect button, Initialize button, and Disconnect button.

Connection mode selection: There are three modes in the drop-down list, i.e. USB, TCP Client (with a computer as the TCP client), and TCP Server (with a computer as the TCP server), as detailed in the following sections.

Port setting: Set the port in the corresponding mode, such as the virtual serial port number in USB mode, remote IP and port in TCP Client mode, and local monitoring port in TCP Server mode.

Status display: Show the current connection status, so that the user can determine the current status. See the following sections for details.

Connect button: This button aims to connect the current port in the current connection mode.

Initialize button: This button can be pressed to initialize the gripper that has been connected successfully.

Disconnect button: This button aims to disconnect the gripper.

5.4.2 Connection Mode and Port Setting

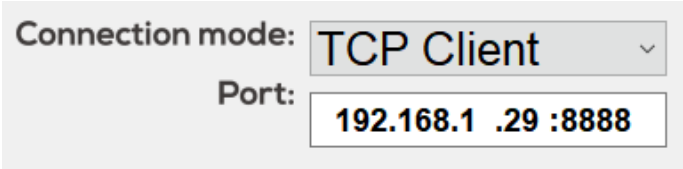
According to the current communication mode of the protocol converter, select the corresponding connection mode and set the port. The modes can be set as follows. (For the setting of the working mode of the protocol converter, refer to the aforesaid sections with respect to the modes of the protocol converter.)

1. **USB:** When the protocol converter is in the USB mode, select the USB mode. Before selecting the USB mode or opening the software, make sure that the protocol converter and gripper have been connected and powered on. The target port number will be automatically identified and displayed in the port column. The software will automatically identify the USB port after it is opened or the USB mode is enabled. If no port is identified after the software is opened, you can also directly click "**Connect**", and then the software will automatically identify and connect the port. See the following section for the connection status.

   Note: If connection fails, check whether the USB driver has been installed and whether the gripper is connected and powered on properly.

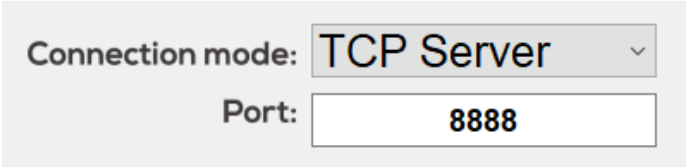
2. **TCP Client:** The computer worker as a TCP client in this mode. The protocol converter should be set to the TCP Server mode. According to the protocol converter IP and port number you set, modify the target IP and port. When the protocol converter is used as the TCP server, the default IP is 192.168.1.29, and the monitoring port is 8888.

   Note: If connection fails, check whether the static IP of the wired network of the computer has been set, whether the IP address and gateway are within the same network segment as the communication, and whether the gripper is connected and powered on properly.



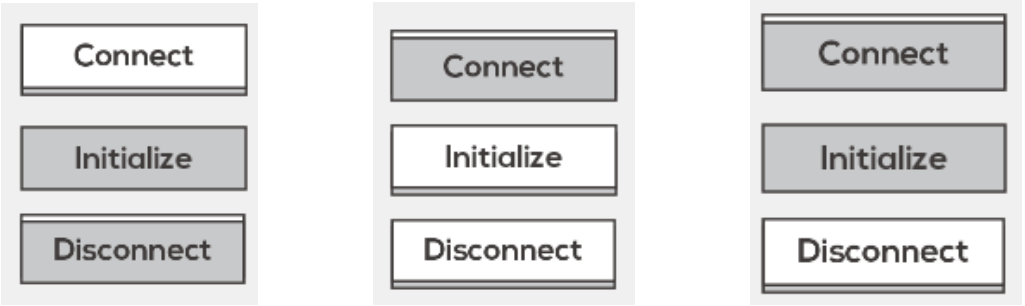
3. **TCP Server:** The computer worker as a TCP server in this mode. The protocol converter should be set to the TCP Client mode. According to the protocol converter IP you set and the remote port connected, modify the monitoring port number. When the protocol converter is used as the TCP client, the default IP is 192.168.1.30, and the remote IP and port are is 192.168.1.60 and 8888, respectively.

   Note: If connection fails, check whether the computer IP is the remote IP of the protocol converter, and whether the firewall of the wired network is disabled or whether the access of software through the firewall is allowed.



5.4.3 Communication Control and Status Display

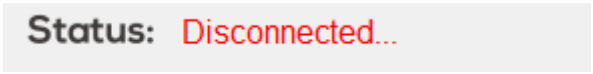
There are three buttons in the communication control zone:
Connect, Initialize and Disconnect.
The three buttons have three statuses as shown below (the buttons cannot be clicked when they are gray):



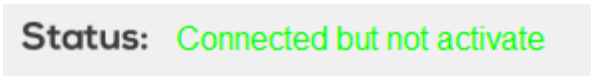
The first status (left): default status (unconnected). Only the "**Connect**" can be clicked. You must perform connection, setting and connection in the previous section before clicking this button.
The second status (middle): when the gripper is successfully connected, the "**Initialize**" button and "**Disconnect**" button will be activated, while the "**Connect**" will be deactivated. The gripper can be initialized or disconnected.
The third status (right): when the gripper is successfully connected, "**Initialize**" cannot be clicked during initialization, and will not be activated until the initialization is completed. Or, in the setting mode of the protocol converter connected separately, the gripper cannot be controlled and "**Initialize**" will be deactivated.

Status display: the corresponding connection status will be displayed to facilitate identification. There are four statuses in total:

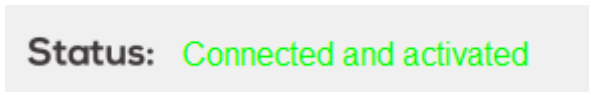
The first status: Disconnected..., i.e. the status of no connection to the protocol converter.



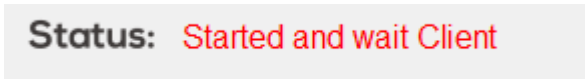
The second status: Connected but not activate, indicating that the software has been successfully connected with the protocol converter.



The third status: Connected and activated, i.e. the status after "**Initialize**" is clicked and the gripper has been successfully initialized.



The fourth status: Started and wait Client, a special status after select the TCP Server connection mode. In this case, the computer works as the TCP server. If you click "**Connect**", the TCP server will be started and wait for the access of the TCP client of the protocol converter.

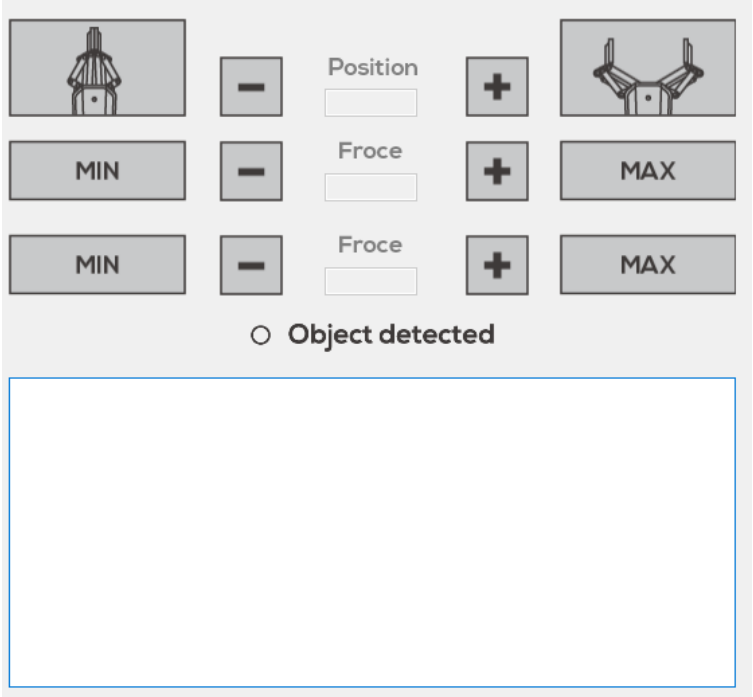


5.5 Gripper Control

This section aims to facilitate the gripper control for testing and experimental use, and also for users to understand command sending and receiving.

The composition is shown below, including four zones from top to bottom:

Position control zone, Close Force control zone, Open Force control, status display zone, and command sending/receiving display zone.



Position control zone: consisting of the **Close button**, **Close control button**, position display bar, **Open control button**, and **Open button**.
Close Force control zone: consisting of the **Min button, - button,** force display bar, **+ button**, and **Max button**.
Open Force control zone: consisting of the **Min button, - button,** force display bar, **+ button**, and **Max button**.
Status display zone: displaying whether a gripped object is detected. The green indicator will be ON if an object is gripped.
Command sending/receiving display zone: displaying the command sent after one button is clicked, and the confirmation command returned by the gripper or protocol converter.

When **"Send"** is displayed at the beginning of the line, the command is sent to the protocol converter, and the function of this command will be displayed at the end of the line.

When **"Receive"** is displayed at the beginning of the line, the software receives the data from the protocol converter.

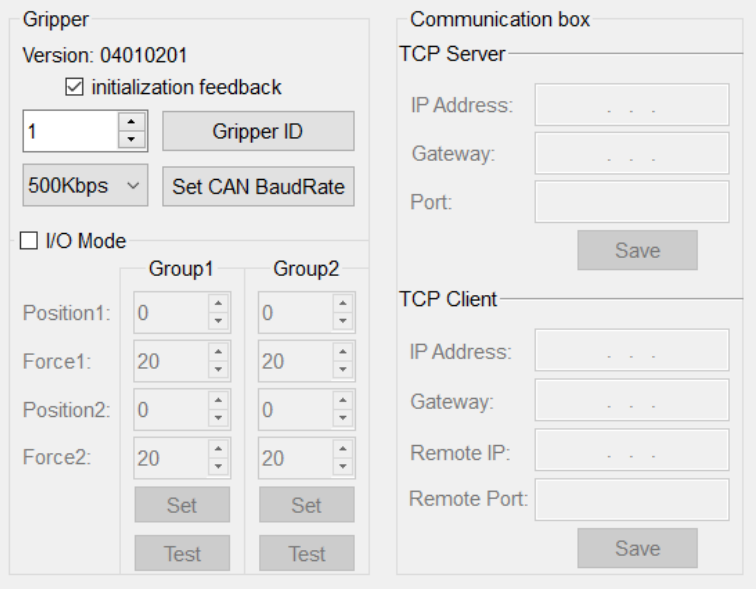
5.6 Parameter Setting Zone

5.6.1 Composition and Introduction

The parameter setting zone is completed, which is mainly used to set relevant parameters of the gripper and protocol converter.

It is divided into the gripper parameter setting zone on the left and protocol converter parameter

setting zone on the right.



Gripper parameter setting zone:

Display the gripper firmware version number, and set whether to initiate feedback after initialization;

Set the gripper ID and CAN baud rate, and enable/disable/set/test the I/O mode.

Protocol converter parameter setting zone:

Display/Set the parameters of the protocol converter as a TCP Server;

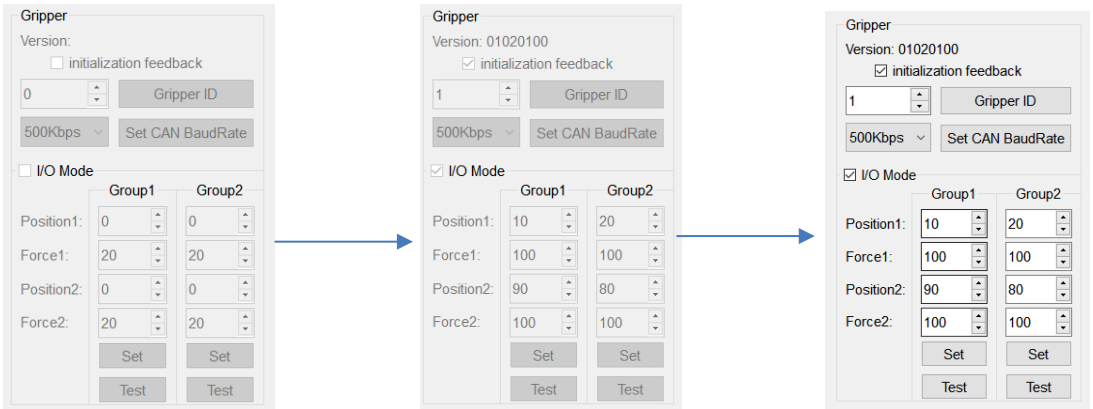
Display/Set the parameters of the protocol converter as a TCP Client.

5.6.2 Gripper Parameter Setting

1. This zone is unavailable during startup, and the default status is displayed.

2. Select and set the connection mode, and click "**Connect**". After the gripper is connected successfully, the software will automatically get the gripper parameters.

3. Click "**Initialize**". This zone will be available after the successful initialization.



During startup　　Get parameters　　After initialization

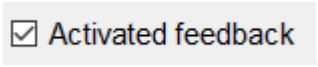
Note: The firmware version of the gripper varies, so the settable functions may be

different.

5.7 Gripper Setting Instructions

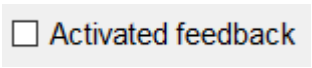
5.7.1 Setting of Activated Feedback of Initialization

This option must be checked when UR and AUBO plug-ins are used. The software will send the command for activated feedback of initialization. After the successful initialization of the gripper, the activated feedback of successful initialization will be provided without active query (see the gripper communication protocol).

Check 

: Enable the activated feedback of successful initialization. Below are the command sent by the software and the feedback command after the successful execution of the gripper.

Send: FFFEFDFC0108010100A5A5A5A5FB--(Set Init_back 165)
Receive: FFFEFDFC0108010100A5A5A5A5FB

Uncheck 

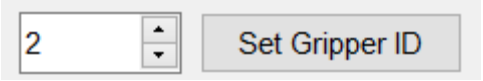
: Disable the activated feedback of successful initialization. Below are the command sent by the software and the feedback command after the successful execution of the gripper.

Send: FFFEFDFC0108010100000000000FB--(Set Init_back 0)
Receive: FFFEFDFC0108010100000000000FB

5.7.2 Gripper ID Setting

The gripper and protocol converter directly use the CAN2.0A protocol for communication. For the setting of multiple grippers connected with the CAN bus, the CAN ID number can be set.

The ID range is 1-254. Set the ID number on the left and click "Set Grippert ID" to send the command.



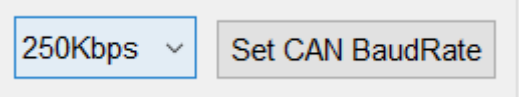
Be sure that the returned command is received. Then restart the gripper to activate the setting.

Send: FFFEFDFC0112010100020000000FB--(Set CANID 2)
Receive: FFFEFDFC0112010100020000000FB

5.7.3 Setting of Gripper CAN Baud Rate

The gripper and protocol converter directly use the CAN2.0A protocol for communication. For different baud rate of the CAN bus, the CAN baud rate number of the gripper can be set.

Set the baud rate via the drop-down list on the left, and click "Set CAN BaudRate" to send the command.

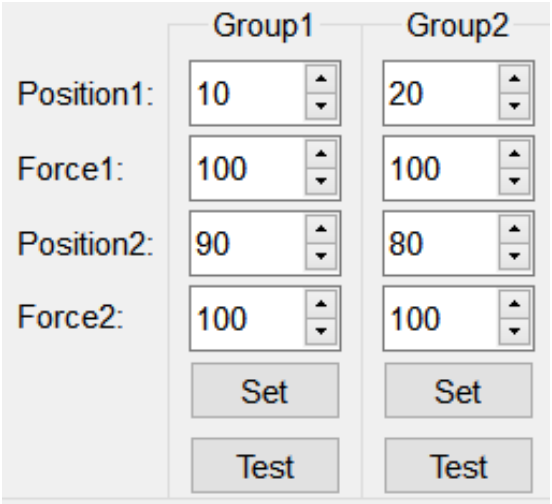


Be sure that the returned command is received. Then restart the gripper to activate the setting.

Send: FFFEFDFC011401010002000000FB--(Set BaudRate 2)
Receive: FFFEFDFC011401010002000000FB

5.7.4 Setting of Relevant Parameters of I/O Mode

Relevant data of the I/O mode is stored in the gripper. The DH-3 gripper has two groups of parameters (two groups of opening and closing) in the I/O mode. The " ☐ I/O Mode " check box in the upper left corner is used to enable/disable the I/O mode. The following input boxes and buttons are not available until the I/O mode is enabled.



The protocol converter has two input pins in the I/O mode, corresponding to two groups of opening and closing. Therefore, the I/O mode setting zone is divided into the Group1 and Group2, including two positions and Close forces.

Note: The Position value ranges from 0 to 100, and the Close/Open force ranges from 20 to 100.

Fill in the parameters, click " Set "and wait for the command sending/receiving zone to automatically send and receive four commands.

Send: FFFEFDFC02100101000A000000FB--(Set IOParam1 10)
Receive: FFFEFDFC02100101000A000000FB

Send: FFFEFDFC02100201001400000FB--(Set IOParam2 20)
Receive: FFFEFDFC02100201001400000FB

Send: FFFEFDFC02100301003C000000FB--(Set IOParam3 60)
Receive: FFFEFDFC02100301003C000000FB

Click "Test" to test the Open/Close position of the corresponding I/O group.

5.8 Parameter Setting of Protocol Converter

For parameter setting, the protocol converter should be in the parameter configuration mode (refer to the aforesaid parameter configuration mode of the protocol converter for specific setting steps). The USB communication is applied in this mode. The protocol converter cannot be set in other communication modes. The protocol converter in the setting mode will run independently. That is, the gripper cannot be controlled, as the gripper control commands cannot be converted.

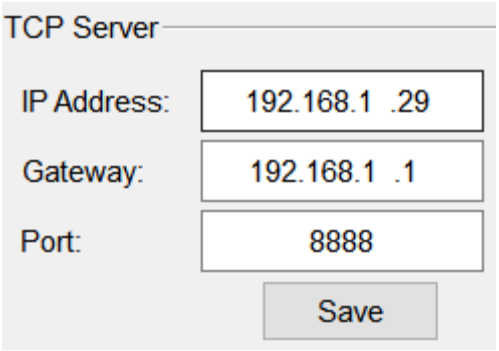
After enabling the setting mode of the protocol converter, the software will automatically obtain the settings saved in the protocol converter.

You can set it according to the actual usage. No matter how you set it, the gripper and the control device should be within the same network segment.

Since the subnet mask is 255.255.255.0 by default, the first three segments of the set IP must be consistent. For example, when the protocol converter IP is 192.168.1.1, the IP of the control device should be between 192.168.1.2 and 192.168.1.255. That is, the three segments must be the same. In addition, the IP of the device must be unique within this network segment.

(Note: The protocol converter may be powered on through the USB cable, so the USB cable must be removed before restarting the protocol converter.)

1) **When the protocol converter is used as a TCP server**: the control device (e.g. computer) works as the TCP client, and the parameters below should be set [default subnet mask (Netmask): 255.255.255.0].

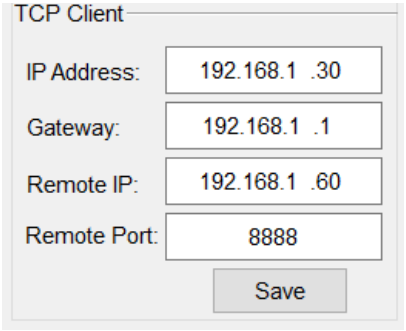


IP Address: static IP address of the protocol converter, 192.168.1.29 in the above figure. It must within the same network segment as the connected router.

Gateway: The gateway of the protocol converter is directly connected with the control device. The last segment is set to 1 by default. When a router is connected, the last segment should be set to the router address, which is usually 1.

Port: Monitoring port of the protocol converter, for access of clients.

2) **When the protocol converter is used as a TCP Client**: the control device (e.g. computer) works as the TCP server, and the parameters below should be set [default subnet mask (Netmask): 255.255.255.0].



I**P Address:** static IP address of the protocol converter, 192.168.1.30 in the above figure. It must within the same network segment as the connected router.

Gateway: The gateway of the protocol converter is directly connected with the control device through the network cable. The last segment is set to 1 by default. When a router is connected, the last segment should be set to the router address, which is usually 1.

Remote IP: server IP. Set it to the computer IP if a computer is connected. The IP address of the server must be within the same network segment as that of the protocol converter.

Remote Port: port monitored by the server.