

AG-95 Protocol

V1.2



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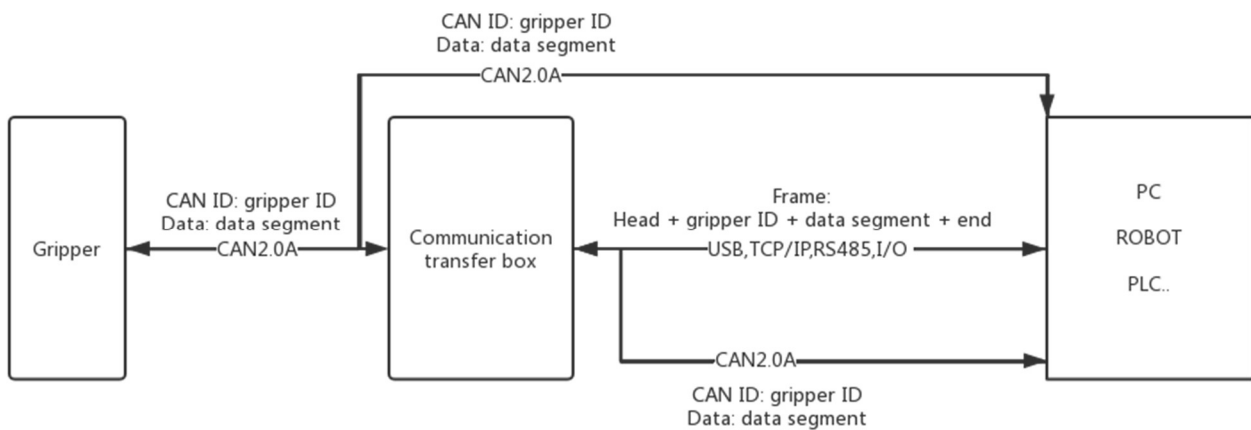
Introduction

The AG-95 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 communication transfer box 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 communication transfer box.

The communication system block diagram is as follows:



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.

Protocol format

(For TCP/IP, USB, RS485)

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

Frame header	Gripper ID	Data Segment (8 Bytes)					Frame End
		Function register	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:

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 communication transfer box 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 communication transfer box 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

Command Overview

FUNCTION	FUNCTION REGISTER	SUB-FUNCTION REGISTER	REMARK
INITIALIZE	0x08	0x01-0x02	Initialize related commands
FORCE	0x05	0x02-0x03	Read/ Write Force
POSTION	0x06	0x02	Read/ Write Position
FEEDBACK	0x0F	0x01	Read current status
I/O MODE	0x10	0x01-0x0B	Read/Write I/O mode
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
DROPED FEEDBACK	0x15	0x01	Object dropped

Detailed command

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 **A5 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 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 01 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)

Force

Function register	Sub-Function register	Read/Write	Reserve	Data	Function
0x05	0x02	0x00/0x01	0x00	Integer	Read/Set internal Force
	0x03				Read/Set external Force
	0x04				Simultaneously Read/Set internal / external Force (after AG95 Version 5)

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% internal 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 internal 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

Set 30% external grip force:

Send : FF FE FD FC 01 05 03 01 00 1E 00 00 00 FB

Receive : FF FE FD FC 01 05 03 01 00 1E 00 00 00 FB

Read current external grip force:

Send : FF FE FD FC 01 05 03 00 00 00 00 00 00 FB

Receive : FF FE FD FC 01 05 03 00 00 1E 00 00 00 FB

Simultaneously set internal and external grip force:

Send : FF FE FD FC 01 05 04 00 00 1E 00 00 00 FB

Receive : FF FE FD FC 01 05 04 00 00 1E 00 00 00 FB

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

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

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 position but not catch object

03 00 00 00 : Catch the object but not arrive position

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 position : FF FE FD FC 01 0F 01 00 00 02 00 00 00 FB

OR:

Catch the object : FF FE FD FC 01 0F 01 00 00 03 00 00 00 FB

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 communication transfer box 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 communication transfer box, 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 communication transfer box 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

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 00 00 00 00 00 00 FB (use ID=0 to read ID)

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

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 01 02 01 FB

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: 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

Object Dropped

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

Open object dropped feedback function :

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

close object dropped feedback function :

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

When object dropped, gripper will send automatically:

grip dropped : 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