Communication Protocol of the Driver

（V1.00）

Catalogue

Change record

version	description
V1.00	Initial draft

Default communication parameters

parameter name	value	indication
Baud rate of the serial port	4	9600bps
Baud rate of CAN	0x0B	500Kbps
Devices add.	0x1	
device type	0x40	

1. CAN communication protocol

1.1. Protocol description

1.1.1. Protocol format

The CAN communication employs the extended data frame format, and the message ID includes the device add, function code (command) and subcommand information.
The complete ID is distributed as below:

Bit 24~28	Bit 16~23	Bit 8~15	Bit 0~7
reserved	subcommand	function code	device add

The ID shield acceptance set only inspects the last 8 bits.
the device only accept the messages whose ID are local address and broadcast address.
Data field with 8 bytes only transmit valid data.
The multi-byte data are transmitted Little-Endian, i.e., the last byte data are saved in the last byte address.

1.2. Command description

1.2.1. Command set

Table1-1 public command set

command word	description	remark
20	to read the device type	
21	to read the device version	software version and Hardware version
22	to read the device serial number	
23	to save the user's parameter	
24	to restore the factory default setting	
25	to restart the device	
29	to read single parameter	parameter as subcommand to transmit 4-byte parameter
30	to set single parameter	
255	go-back response	non-recognition or error command go-back

Table 1-2 special command set

command word	description	remark
41	to set speed for all the wheels	the speed of the 4 wheels could be set at the same time
42	move laterally	command for the robot to move

Note: please note the device address when communicating by the command from the command set. The device address of this driver could be changed by yourself; so when the address in the sample may be different from the one of the device you buy. Please communicate in right device address.

1.2.2. Public command

1.2.2.1 To read the device type

table1-2：Command to read device type

No.	20		
usage	to read device type		
description	No data in the transmit data field back to the data field		
	byte0	device type	

Communication example of the external host and this module: (target device address is 0x01)

direction	frame Type	can Id	data Len	data8
transmit	extended frame	00 00 14 01	0	
receive	extended frame	00 00 14 01	1	40

drawing1-1： Command to read device type

Note: The transmitted and received data are for the host
This device type is 0x40.

1.2.2.2 To read the version information

table1-3： Command to read the version information

No.	21		
usage	command to read the version information		
description	No data in the data field back to the data field		
	byte0	HW[0]	the last bytes of the hardware number
	byte1	HW[1]	
	byte2	SW[0]	the last bytes of the software number
	byte3	SW[1]	
	byte4	SW[2]	
	byte5	SW[2]	

Communication example of the external host and this module: (target device address is 0x01)

direction	frame Type	can Id	data Len	data8
transmit	extended frame	00 00 15 01	0	
receive	extended frame	00 00 15 01	6	01 01 02 00 00 01

drawing1-2： Example command to read the version

Note: The transmitted and received data are for the host
The hardware version and software version could be read at one time. From the reading

data in the example, the hardware version is 1.1, software 1.0.0.2.

1.2.2.3 To read the device serial number

table1-4：Command to read the serial number

No.	22		
usage	to read the device serial number		
description	No data in the data field back to the data field		
	byte0	SN[0]	the last bytes of the serial number
	byte1	SN[1]	
	byte2	SN[2]	
	byte3	SN[3]	

Communication example of the external host and this module: (target device address is 0x01)

direction	frame type	CAN ID	CAN data length	CAN data package
transmit	extended frame	00 00 16 01	0	
receive	extended frame	00 00 16 01	4	20 15 E8 3E

drawing1-3: example command to read serial number

note: The transmitted and received data are for the host

1.2.2.4 To save the user parameter

table1-5： Command to save the user parameter

No.	23		
usage	to save the user parameter		
description	No data in the data field back to the data field		
	Byte 0	Flash operation result	0:success; others: failure

Communication example of the external host and this module: (target device address is 0x01)

direction	frame type	CAN ID	CAN data length	CAN data package
transmit	extended frame	00 00 17 01	0	
receive	extended frame	00 00 17 01	1	80

drawing1-4：Example command to save user parameter

Note: The transmitted and received data are for the host

The command will save the data to the user parameter field. Make sure of the stable power supply when commanding, or the system will be damaged. If the power is off when the parameter is being saved, all the configured parameter is invalid and reverted to the default value. The returned values indicate the operation result.

table1-6：Operation result

data	definition
0x80	parameter saved successfully
0x81	error saving parameter
0x82	parameter loaded successfully
0x83	error loading parameter
0x84	CRC check error

1.2.2.5 To restore factory settings

Table1-7： Command to restore factory settings

No.	24		
usage	to restore factory settings		
description	No data in the data field back to the data field		
	byte0	Flash operation result	0:success; others: failure

Communication example of the external host and this module: (target device address is 0x01)

direction	frame type	CAN ID	CAN data length	CAN data package
transmit	extended frame	00 00 18 01	0	
receive	extended frame	00 00 18 01	1	90

Drawing1-5：To restore factory settings

Note: The transmitted and received data are for the host

The command to restore the factory settings will load the parameters in the factory settings field; the loaded communication parameters at the time don't work. If the user needs to use all the factory settings, please save the parameters to the user parameter field via the command to save the user parameter after this command. Restart the device after the correct response. Now the device is started with the factory settings. If one of the byte in the returned data package is 0x83, the factory settings field is broken, and the parameters will be reverted to the default.

1.2.2.6 To restart the device

Table 1-8： Command to restart the device

No.	25
usage	to restart the device
description	Restore after the device response No datum in the receiving and returning field.

Communication example of the external host and this module: (target device address is 0x01)

direction	frame type	CAN ID	CAN data length	CAN data package
transmit	extended frame	00 00 19 01	0	
receive	extended frame	00 00 19 01	0	

Drawing 1-6：Example command to restart the device

Note: The transmitted and received data are for the host

1.2.2.7 To read individual parameter

Table1-9：Command to read individual parameter

No.	29		
usage	to set the individual parameters		
description	Subcommand is the index of the parameter to read go back to the subcommand and the data field		
	subcommand	N	parameter index
	byte 0	byte [0]	parameter list byte N*4 + 0
	byte 1	byte [1]	parameter list byte N*4 + 1
	byte2	byte [2]	parameter list byte N*4 + 2
	byte3	byte [3]	parameter list byte N*4 + 3

Communication example of the external host and this module: (target device address is 0x01)

direction	frame type	CAN ID	CAN data length	CAN data package
transmit	extended frame	00 2B 1D 01	0	
receive	extended frame	00 2B 1D 01	1	0B

Drawing 1-7： Command to read individual parameter

Note: The transmitted and received data are for the host

In the response package of the command to read individual parameter, those in the data field are the values of the parameter to read; The parameter index number is the subcommand field of the CAN ID. Please refer the section of the parameter list for the parameter index and indication.

1.2.2.8 To set individual parameter

Table 1-10： Command to set individual parameter

No.	30
usage	to set individual parameter
description	Opposite to the command to read individual parameter

Communication example of the external host and this module: (target device address is 0x01)

direction	frame type	CAN ID	CAN data length	CAN data package

transmit	extended frame	00 2B 1E 01	1	0B
receive	extended frame	00 2B 1E 01	0	

Drawing1-8：Command to set individual parameter

Note: The transmitted and received data are for the host
The command to set individual parameter won't come into force immediately at setting the Baud rate of CAN and serial ports. If you need to use the newly set Baud rate parameters, please save the set parameters to the user field via the command to save the user parameter after setting. After the saving response, restart the device. Then the rate is the one the user sets. Please remember to change the communication Baud rate before communication.

1.2.2.9 To response

Table1-11： Command to respond the error packet

No.	0xFF		
usage	Return after receiving unidentified command		
description	go back to the data field		
	byte0	1	NC

Communication example of the external host and this module: (target device address is 0x01)

direction	frame type	CAN ID	CAN data length	CAN data package
transmit	extended frame	00 CC99 01	8	00 00 00 00 00 00 00 00
receive	extended frame	0000FF 01	0	01

Drawing1-9： Example of the error packets response

Note: The transmitted and received data are for the host
The response code is 0xFF after sending the wrong command packet, and the error code is 0x01.

1.2.3. Special command

1.2.3.1 To set the speed of all the motors

To send from the host to the slave device

Table1-12：To send command device from host to the slave device

item	ID	byte	Byte0-Byte7
placeholder	EXTID	len	V1,V2,V3,V4
example	0x2940	8	E8 03 E8 03 E8 03 E8 03

The V1, V2, V3, V4 indicate the speeds of each wheels relatively (the data type is short); each speed takes up 2 bytes, and the last bytes is listed in the front. Please refer the document of the platform for the speed set ranging.

Communication example of the external host and this module: (target device address is 0x01)

direction	frame type	CAN ID	CAN data length	CAN data package
transmit	extended frame	00 00 29 01	8	00 00 00 00 00 00 00 00
receive	extended frame	00 00 29 01	0	
transmit	extended frame	00 00 29 01	8	E8 03 E8 03 E8 03 E8 03
receive	extended frame	00 00 29 01	0	
transmit	extended frame	00 00 29 01	8	00 00 00 00 00 00 00 00
receive	extended frame	00 00 29 01	0	

Drawing 1-10：Example command to set the speeds of all the motors

After receiving the response data packet, if the related parameters are correct and so are the wire connections, the wheels will move at the set speed. If the set speed is (short) (0x03E8)=1000, the actual speed is 1000/10000=0.1m/s,

If the wheels move unusual， the possible reason is:

1. The line number configuration of the coder is incorrect, or the connection of the phase A and B of the coder is incorrect.
2. The bus under voltage or the motor overcurrent protection

If the user wants to stop any one of the motor, set its speed at 0. Please refer the drawings of the motor and wheels for the definition of the motor byte number.

1.2.3.2 To move laterally

Table1-13： The platform to move laterally and rotate

No.	0x2A
usage	to set the individual parameter
description	

Communication example of the external host and this module: (target device address is 0x01)

direction	frame type	CAN ID	CAN data length	CAN data package
transmit	extended frame	00 00 2A 01	8	00 0B 00 0B 00 00 00 00
receive	extended frame	00 00 2A 01	8	00 0B 00 0B 00 00 00 00

Drawing1-11： The platform to move laterally and rotate

Note: The transmitted and received data are for the host

This command is to move the robot platform laterally. The 8 byte in the data packet includes the speeds in X and Y, the acceleration of magnitude, and the autorotation rate. The

description is as below:

Table 1-14

parameters	byte	Mathematic value	meaning
Speed in X	Byte1,byte0	(short) 0x0B00=2816	Speed in X is 0.0001*2816=0. 2816, the unit is M/s
Speed in Y	Byte3,byte2	(short)0x0B00=2816	Speed in Y is 0.0001*2816=0. 2816, the unit is M/s
Autorotation speed	Byte5,byte4	(short)0x0000=0	The autorotation speed is 0.0001*0=0. 0, the unit is Rad/s
acceleration of magnitude	Byte7,byte6	(short)0x0000=0	Nonsupport yet

i.e.

$$\mathrm{V}x = 0.0001 * Value$$
$$\mathrm{Vy} = 0.0001 * \mathrm{Value}$$
$$\mathrm{Rote\ Speed} = 0.0001 * \mathrm{Value}$$

For different structured platform, please refer the drawing of the motor and wheel for the command performance direction.

2. Serial port communication protocol

2.1. Protocol communication

2.1.1. Data packet format

a complete data packet includes the starting character, device type code, device address code, function code, data length, data field, CRC check and the ending character; as below:

Table 2-1：Data packet format

starting character	device type code	device address code	function code	data length	data field（N）	CRC check	ending character
0xAA						（L，H）	0x0D

The meanings of different fields:

starting character： 1 byte, the start of a data packet, is 0xAA.

Device type code: 1 byte, the device type, is defined by the device maker. All the devices are able to receive the broadcast type（0x00）command.

Device address: 1 byte, the address of the device in the system, is defined by the user. All the devices are able to receive the broadcast type（0x00） command.。

Function code: 1 byte is the function command. The user could visit the device with the code offered by the maker, and in the specified format.

Data length: 1 byte, the byte number of the valid data field following, ranging 0~50.

Data field: N bytes, valid data, the length is the byte number defined by the data length in front.。

CRC check: 2 byte, the 16 bit CRC check value from the starting character to the last byte in the data field. The last 8 bit of the checksum locates in the last of the data

packet buffer zone. For the calculation of the CRC, please check the specified chapter and section.
Ending character: 1 byte, the end of the data packet, is fixed as 0x0D.

2.1.2. Response

The response function code is 0xFF, and the length is 1, when the data packet format is incorrect or the CRC check is incorrect.

2.2. Command description

The commands operate the device into different move

table2-2：Public command set

command word	description	备注 remark
20	to read the device type	
21	to read the device version	software version and hardware version
22	to read the device serial number	
23	the save the user parameter	
24	the restore the factory settings	
25	to restart the device	
29	to read the individual parameter	
30	to set the individual parameter	
255	return response	

table2-3： Special command set

command word	description	remark
41	to set the speeds of all the wheels	able to set the speeds of the 4 motors at the same time
42	to move laterally	to command the platform to move laterally

Note: please note the device address when communicating by the command from the command set. The device address of this driver could be changed by yourself; so when the address in the sample may be different from the one of the device you buy. Please communicate in right device address.

2.2.1. Public command

2.2.1.1 To read the device type

Table 2-4： to read the device type

No.	20
usage	to read the
description	--

Example Communication between the exterior host and this module: (the target device address is 0x01)

```
[TX] - AA 40 01 16 00 B3 9C 0D
[RX] - AA 40 01 16 04 20 15 E8 3E 5F 76 0D
```

Note: The transmitted and received data are for the host; the device type to read in the example is 0x40.

2.2.1.2 To read the version information

table2-5： To read the version information

No.	21	
usage	to read the version information	
description	details of go-back data field	
	Byte 0	the last 8 bits of the hardware version number
	byte1	the first 8 bits of the hardware version number
	Byte 2	the major version number of the software version
	Byte 3	the less major version number of the software version
	Byte 4	the minor version number of the software version
	Byte 5	the lest version number of the software version

Example Communication between the exterior host and this module: (the target device address is 0x01)

```
[TX] - AA 40 01 15 00 E0 C9 0D
[RX] - AA 40 01 15 06 01 01 02 00 00 01 43 7E 0D
```

The software version and hardware version could be read at the same time. From the example, the hardware edition is 1.1, and the software 1.0.0.2.

2.2.1.3 To read the serial number

Table 2-6： Command to read the serial number

No.	22
usage	to read the serial number
description	the serial number codes are in the previous

Example Communication between the exterior host and this module: (the target device address is 0x01)

```
[TX] - AA 40 01 16 00 B3 9C 0D
[RX] - AA 40 01 16 04 20 15 E8 3E 5F 76 0D
```

Note: The transmitted and received data are for the host; the serial number to read in the example is 0x73EE81520.

2.2.1.4 To save the user parameter

Table 2-7： Command to save the user command

No.	23
usage	to save the present parameter to the user parameter storing field in the processor。
description	--

Example Communication between the exterior host and this module: (the target device address is 0x01)

```
[TX] - AA 40 01 17 00 82 AF 0D
[RX] - AA 40 01 17 01 80 BC 64 0D
```

Note: the received and transmitted data is only for the host

The command will save the data to the user parameter field. Make sure of the stable power supply when commanding to avoid risks. The returned values indicate the operation result.

table2-8： Operation result

data	definition
0x80	parameter saved successfully
0x81	error saving parameter
0x82	parameter loaded successfully
0x83	error loading parameter
0x84	CRC checking error

2.2.1.5 To restore the factory settings

Table2-8： Command to restore the factory settings

No.	24
usage	To restore the user parameter to the factory setting
description	extra command needs to be transmitted to the user parameter field

Example Communication between the exterior host and this module: (the target device address is 0x01)

```
[TX] - AA 40 01 18 00 BC BF 0D
[RX] - AA 40 01 18 01 90 BC 5A 0D
```

Note: the received and transmitted data is only for the host

The command to restore the factory settings will load the parameters in the factory settings field; the loaded communication Baud rate parameters at the time don't work. If the user needs the factory settings to be valid, please save the parameters to the user parameter field via the command to save the user parameter after this command. Restart the device

after the correct response. Now the device is started with the factory settings. If the factory setting is abnormal, it will be restored to the default parameters. 0x82 indicates the success in restoring the factory settings; and 0x83 the parameters will be reverted to the default.

2.2.1.6 To restart the device

Table2-9： Command to restart the device

No.	25
usage	to restart the device
description	no parameters; the software will restart after the response is transmitted

Example Communication between the exterior host and this module: (the target device address is 0x01)

```
[TX] - AA 40 01 19 00 8D 8C 0D
[RX] - 00
```

Drawing 2-1：Example command to restart the device

Note: the received and transmitted data are only for the host. After the command to restart, the device won't go back to the protocol formatted data packet.

2.2.1.7 To read individual parameters

Table2-10：Command to read individual parameters

No.	29
usage	to read the assigned parameters in the list
description	in the return information, the first byte in the data field is index, and the last the parameters

Example Communication between the exterior host and this module: (the target device address is 0x01)

```
[TX] - AA 40 01 1D 01 2B FC A7 0D
[RX] - AA 40 01 1D 02 2B 0B 36 D1 0D
```

Drawing 2-2：Example command to read individual parameters

Note: The received and transmitted data are only for the host.
in the response package of the command to read individual parameter, those in the data field are the values of the parameter to read; The parameter index number is the first byte after the data length byte. The data index number is 2B, and parameter value 0x0B in the example.

2.2.1.8 To set the individual parameter of the device

Table 2-11：Command to set the individual parameter of the device

No.	30
usage	to set to the device assigned parameter

description	in the transmitting data field, the first byte in the data field is index, and the last 4 byte the parameters

Example Communication between the exterior host and this module: (the target device address is 0x01)

```
[TX] - AA 40 01 1E 02 2B 09 A8 6A 0D
[RX] - AA 40 01 1E 01 2B AC FE 0D
```

2.2.1.9 To response

Table 2-12：To response

No.	FF
usage	
description	to Return communication error

Example Communication between the exterior host and this module: (the target device address is 0x01)

```
[TX] - AA 40 01 1E 05 01 09 00 00 00 25 FF 0D
[RX] - AA 40 01 FF 01 06 62 9C 0D
```

Drawing 2-3：To respond command error

0x06 in the go-back data packet is the responding code; because the CRC check is incorrect in the transmitting data packet, go back to the incorrect responding data packet.

2.2.2. Special commands

2.2.2.1 To set the speeds of all the wheels

Transmitted from the host to the slave

Table2-13： Command packet from the host to the slave

item	ID	byte	Byte0-Byte7
take-up code	EXTID	len	V1,V2,V3,V4
example	0x2940	8	E8 03 E8 03 E8 03 E8 03

The V1, V2, V3, V4 indicate the speeds of each wheels relatively (the data type is short); each speed takes up 2 bytes, and the last bytes is listed in the front. Please refer the document of the platform for the speed set ranging.

Example communication: (the target device address is 0x01)

```
[TX] - AA 40 01 29 08 E8 03 E8 03 E8 03 E8 03 69 06 0D
[RX] - AA 40 01 29 00 18 89 0D
```

After receiving the response data packet, if the related parameters are correct and so are the wire connections, the wheels will move at the set speed. If the set speed is (short) (0x03E8) =1000, the actual speed is 1000/10000=0.1m/s, the possible reason is:

- The line number configuration of the coder is incorrect, or the connection of the phase A and B of the coder is incorrect.
- The bus under voltage or the motor overcurrent protection

If the user wants to stop any one of the motor, set its speed at 0. Please refer the drawings of the motor and wheels for the definition of the motor byte number.

2.2.2.2 To move laterally

Table 2-14：to move laterally and auto rotate

No.	0x2A
usage	to set the individual parameter
description	nonsupport the acceleration speed setting

Example communication: (the target device address is 0x01)

```
[TX] - AA 40 01 2A 08 00 00 00 0B 00 00 00 00 91 74 0D
[RX] - AA 40 01 2A 00 4B DC 0D
```

Note: The transmitted and received data are for the host

This command is to move the robot platform laterally. The 8 byte in the data packet includes the speeds in X and Y, the acceleration of magnitude, and the autorotation rate. The description is as below:

Table2-15

parameters	byte	Mathematic value	meaning
Speed in X	Byte1,byte0	(short) 0x0B00=2816	Speed in X is 0.0001*2816=0. 2816, the unit is M/s
Speed in Y	Byte3,byte2	(short)0x0B00=2816	Speed in Y is 0.0001*2816=0. 2816, the unit is M/s
Autorotation speed	Byte5,byte4	(short)0x0000=0	The autorotation speed is 0.0001*0=0. 0, the unit is Rad/s
acceleration of magnitude	Byte7,byte6	(short)0x0000=0	Nonsupport yet

i.e.

$$\mathrm{V}x = 0.0001 * Value$$
$$\mathrm{Vy} = 0.0001 * \mathrm{Value}$$
$$\mathrm{Rote\ Speed} = 0.0001 * \mathrm{Value}$$

For different structured platform, please refer the drawing of the motor and wheel for the command performance direction.

3. Parameter list

The driver parameters:

Table 3-1：

Parameter ID	unit	Number	type	range	default
PARAM_DEVICEADDRESS	NC	0x2A	2(uint16)	NC	0x1
PARAM_CAN_BITRATE	NC	0x2B	1(uchar)	0 to 13	11
PARAM_UART_BITRATE	NC	0x2D	1(uchar)	0 to 8	4

3.1. Serial ports baud rate

Table3-2

Parameter ID	unit	Number	type	range	default
PARAM_UART_BITRATE	NC	0x2D	1(uchar)	0 to 8	4

The value and the rate

Table 3-3：

value	rate(bps)
0	300
1	1200
2	2400
3	4800
4	9600
5	19200
6	38400
7	57600
8	115200

3.2. CAN communication baud rate parameters

Table 3-4

Parameter ID	unit	Number	type	range	default
PARAM_CAN_BITRATE	NC	0x2B	1(uchar)	0 to 13	11

Table3-5 CAN Baud rate and its value

value	Baud rate
0	5K
1	10K
2	20K
3	40K
4	50K
5	80K
6	100K
7	125K
8	200K
9	250K
10	400K
11	500K
12	800K
13	1M

3.3. device address parameter

Table3-6

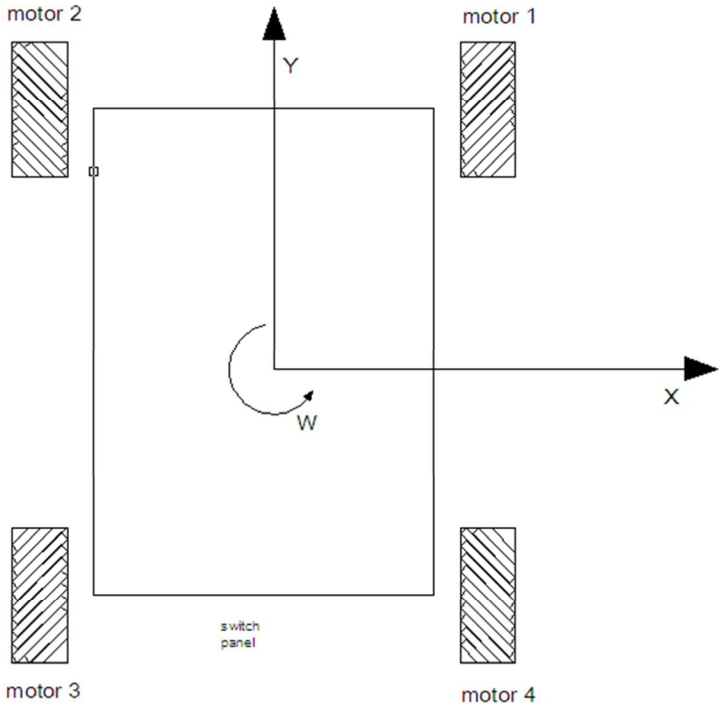
Parameter ID	unit	parameter No.	type	range	default
PARAM_DEVICEADDRESS	NC	0x2B	2(ushort)	NC	0x1

The device address is set at 0x1, which could be changed.
The parameter is 2 byte, the first 8 bit may be useful in the CAN communication; the last 8 bit is necessary.

Note: the user has to memorize the changed address, or the communication will fail; then the user needs to restore the factory setting. Please set the ID of the CAN data packet at restoring the factory settings. Only the host and this device are allowed to connected on the CAN bus, or the other devices that under this protocol will be restored to the factory settings.

4. Drawing motor and wheels

Platform structure



Drawing 1-13： 4-wheeled Omni-directional platform

5. CRC16 calculation procedure

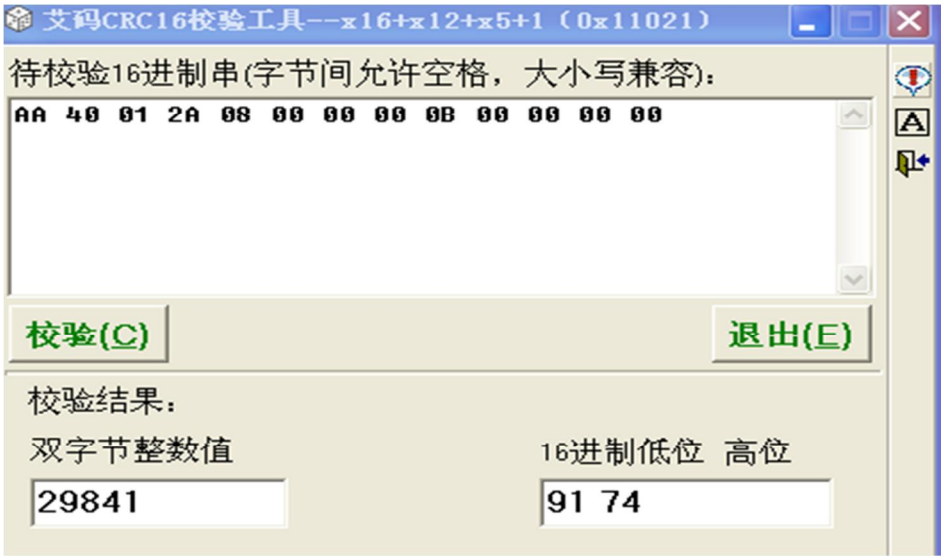
The CRC calculation codes in the serial ports protocol are as below. There are 2 input parameters for the CRC16, the first one is the initial position pointer of the array to be calculated, and the second is the CRC to be calculated after the initial indicator.

```
const unsigned short crc_ta[256] = { /* CRCÓàÊ½±í */
    0x0000, 0x1021, 0x2042, 0x3063, 0x4084, 0x50a5, 0x60c6, 0x70e7,
    0x8108, 0x9129, 0xa14a, 0xb16b, 0xc18c, 0xd1ad, 0xe1ce, 0xf1ef,
    0x1231, 0x0210, 0x3273, 0x2252, 0x52b5, 0x4294, 0x72f7, 0x62d6,
    0x9339, 0x8318, 0xb37b, 0xa35a, 0xd3bd, 0xc39c, 0xf3ff, 0xe3de,
    0x2462, 0x3443, 0x0420, 0x1401, 0x64e6, 0x74c7, 0x44a4, 0x5485,
    0xa56a, 0xb54b, 0x8528, 0x9509, 0xe5ee, 0xf5cf, 0xc5ac, 0xd58d,
    0x3653, 0x2672, 0x1611, 0x0630, 0x76d7, 0x66f6, 0x5695, 0x46b4,
    0xb75b, 0xa77a, 0x9719, 0x8738, 0xf7df, 0xe7fe, 0xd79d, 0xc7bc,
    0x48c4, 0x58e5, 0x6886, 0x78a7, 0x0840, 0x1861, 0x2802, 0x3823,
    0xc9cc, 0xd9ed, 0xe98e, 0xf9af, 0x8948, 0x9969, 0xa90a, 0xb92b,
    0x5af5, 0x4ad4, 0x7ab7, 0x6a96, 0x1a71, 0x0a50, 0x3a33, 0x2a12,
    0xdbfd, 0xcbdc, 0xfbbf, 0xeb9e, 0x9b79, 0x8b58, 0xbb3b, 0xab1a,
    0x6ca6, 0x7c87, 0x4ce4, 0x5cc5, 0x2c22, 0x3c03, 0x0c60, 0x1c41,
    0xedae, 0xfd8f, 0xcdec, 0xddcd, 0xad2a, 0xbd0b, 0x8d68, 0x9d49,
    0x7e97, 0x6eb6, 0x5ed5, 0x4ef4, 0x3e13, 0x2e32, 0x1e51, 0x0e70,
    0xff9f, 0xefbe, 0xdfdd, 0xcffc, 0xbf1b, 0xaf3a, 0x9f59, 0x8f78,
    0x9188, 0x81a9, 0xb1ca, 0xa1eb, 0xd10c, 0xc12d, 0xf14e, 0xe16f,
    0x1080, 0x00a1, 0x30c2, 0x20e3, 0x5004, 0x4025, 0x7046, 0x6067,
    0x83b9, 0x9398, 0xa3fb, 0xb3da, 0xc33d, 0xd31c, 0xe37f, 0xf35e,
```

```
    0x02b1, 0x1290, 0x22f3, 0x32d2, 0x4235, 0x5214, 0x6277, 0x7256,
    0xb5ea, 0xa5cb, 0x95a8, 0x8589, 0xf56e, 0xe54f, 0xd52c, 0xc50d,
    0x34e2, 0x24c3, 0x14a0, 0x0481, 0x7466, 0x6447, 0x5424, 0x4405,
    0xa7db, 0xb7fa, 0x8799, 0x97b8, 0xe75f, 0xf77e, 0xc71d, 0xd73c,
    0x26d3, 0x36f2, 0x0691, 0x16b0, 0x6657, 0x7676, 0x4615, 0x5634,
    0xd94c, 0xc96d, 0xf90e, 0xe92f, 0x99c8, 0x89e9, 0xb98a, 0xa9ab,
    0x5844, 0x4865, 0x7806, 0x6827, 0x18c0, 0x08e1, 0x3882, 0x28a3,
    0xcb7d, 0xdb5c, 0xeb3f, 0xfb1e, 0x8bf9, 0x9bd8, 0xabbb, 0xbb9a,
    0x4a75, 0x5a54, 0x6a37, 0x7a16, 0x0af1, 0x1ad0, 0x2ab3, 0x3a92,
    0xfd2e, 0xed0f, 0xdd6c, 0xcd4d, 0xbdaa, 0xad8b, 0x9de8, 0x8dc9,
    0x7c26, 0x6c07, 0x5c64, 0x4c45, 0x3ca2, 0x2c83, 0x1ce0, 0x0cc1,
    0xef1f, 0xff3e, 0xcf5d, 0xdf7c, 0xaf9b, 0xbfba, 0x8fd9, 0x9ff8,
    0x6e17, 0x7e36, 0x4e55, 0x5e74, 0x2e93, 0x3eb2, 0x0ed1, 0x1ef0
};

Unsigned short CRC16 (unsigned char *ptr, unsigned long len)
{
    Unsigned short crc;
    Unsigned char da;
    crc = 0;
    While (len-- != 0)
    {
        Da = (unsigned char) (crc>> 8);
        crc<<= 8;
        crc ^= crc_ta[da^*ptr];
        ptr++;
    }
    Return (crc);
}
```

Below is the CRC manual calculating tool. Input the hexadecimal characters into the textbox, space them, and click the C button. At the end of the interface, the user will get double-byte integral value and the first and last values of the hexadecimal system.



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