Evo communication protocol description
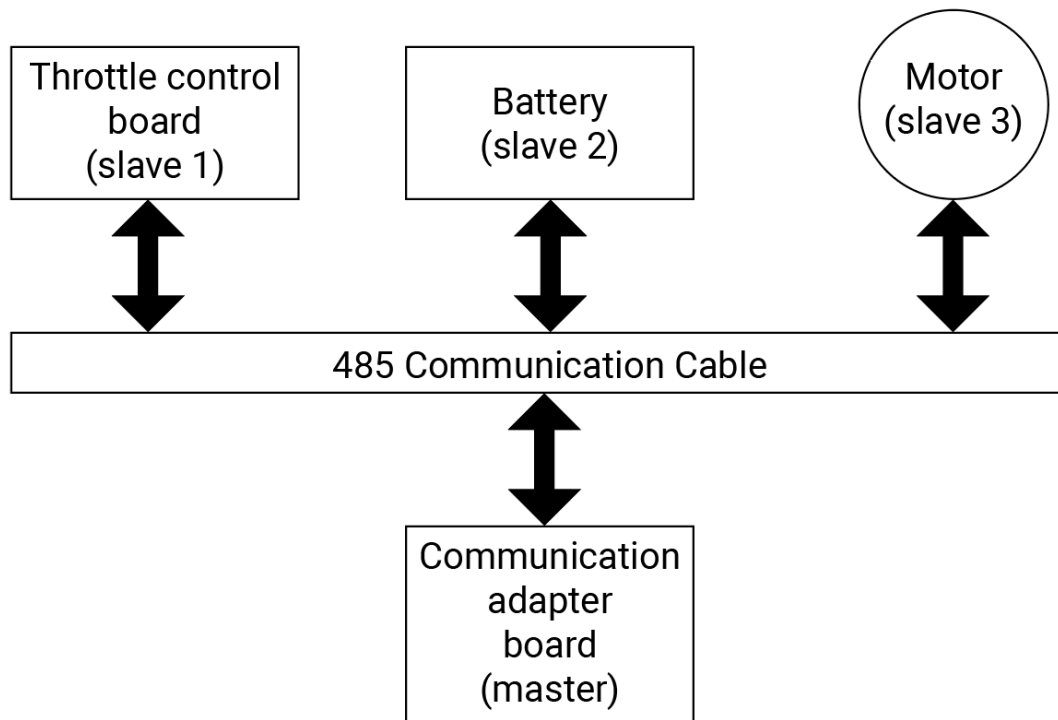
Version Description

Version	Description	Date
VER 1.0	Protocol writing	20210111
VER 1.1	Modify the communication process part and change the steps of the communication process	20210413
VER 1.2	1. Modify the driver version information 2. Modify the byte length of driver operation information 1 and motor operation information 2	20210519
VER 1.3	Increase the command description during the communication	20210809
VER 1.4	1. Optimized adapter board 0x23 battery message 2. Optimized adapter board 0x22 adapter board information message 3. Add GPS message 0x20 information of adapter board 4. Add the version of the adapter board to forward the message 0x24 information 5. Update communication sequence diagram	20220512

TABLE CONTENTS

1 Block diagram of communication module

Description of 485 master and slave in wired mode:

Master	Slave 1	Slave 2	Slave 3
Adapter board	Throttle control board	Battery	Motor

2 Communication bottom layer configuration

Baud rate	38400bit/s
Master sends instruction cycle	50ms
Slave response time	Respond to command within 5ms
Send data mode	Big Endian
Driver address	0x01
Battery address	Factory settings
Throttle control board	0x04
Address of adapter board (wired mode)	0x02

3 Communication Protocol

1. Slave address assignment

Peripheral	Address
Motor driver	0x01
Adapter board	0x02
Throttle control board	0x04

2. Communication format

Head code	Address	Data length	Command	Data 0	Data 1	Data ……	Check	End code

Head code: 0x28

Address: address of slave device, 1 byte

Data length: command bytes + data bytes, 1 byte

Command: represents the meaning of the instruction, 1 byte

Data: the data contained in this command, high-byte first, low-byte after. For example: 0x1234, data 0 = 0x12, data 1 = 0x34

Check: data length ^ command ^ data 0 ^ data 1 ^……^data n, 1 byte

End code: 0x29

3. Communication content

3.1 The throttle control board sends commands to the adapter board (485 communication)

Command summary:

NO.	Command code	Command description	Sending method
1	0x40	Throttle command	Interval sending
2	0x44	Version information reply	Power on and send

Command details

(1) Throttle command

Head code	0x28
Address	0x04 (Throttle control board)
Data length	3 (command bytes + data bytes)
Command	0x40
Data 0	1: forward 0: backward
Data 1	Value range: 0 ~ 127 Value significance: The value 0~127 means the power 0~full power. If the value is 0, it will stop.
Check code	Data length ^ command ^ data 0^data 1^······data n
End code	0x29

(2) Version information reply

Head code	0x28
address	0x04 (throttle control board address)
Data length	2 (command bytes + data bytes)
command	0x44
Data 1	It is the same as the command code sent by the adapter board The command of adapter board version: 0x22 The command of driver version: 0x26
Check code	Data length ^ command ^ data 0^data 1^······data n
End code	0x29

3.2 Adapter board sent to throttle control board

3.2.1 The adapter board sends its own information to the throttle control board

Command summary

NO.	Command code	Command description	Sending method
1	0x22	Adapter board information	Power on and send

Command details

(1) Adapter board information

Head code	0x28
Address	0x04
Data length	8 (command bytes + data bytes)
Command	0x22
Data 0	Product type (3 = spirit 1.0 2 = navy3.0 1 = navy6.0)
Data 1	The software version, for example 25 means v2.5
Data 2	Year, for example 20, means 2020
Data 3	Month, for example 11 means November
Data 4	The hardware version, for example 25 means v2.5
Data 5	Year, for example, 20, means 2020
Data 6	Month, for example 11 means November
Data 7	Battery fault marking, the same as the data 6 of 0x23. If 0x80 is true, it is the E battery. If not, it is Spirit battery plus
Check code	Data length ^ command ^ data 0^data 1^······data n
End code	0x29

3.2.2 The adapter board forwards the motor information to the throttle control board

Command summary

No.	Command code	Command description	Sending method
1	0x25	Motor operation information 1	Reply in turn

2	0x26	Motor version information	Power on and send
3	0x27	Motor operation information 2	Send in turn

Command details

(1) Motor operation information 1(0x25)

Head code	0x28
Address	0x04
Data length	13 (command bytes + data bytes)
Command	0x25
Data 0	Bit0: 1 motor blocked; 0 normal; Bit1: 1 motor over temperature; 0 normal; Bit2: 1 MOS over temperature; 0 normal; Bit3: 1 over current; 0 is normal; Bit4: 8301 fault Bit5: 1 communication fault; 0 normal; Bit6: motor temperature error Bit7: MOS temperature alarm;
Data 1	Bit0: overvoltage Bit1: under voltage Bit2: circuit failure Bit3: charging Bit4: fan fault Bit5 ~ bit7: reserved
Data 2	Motor power data high byte
Data 3	Motor power data low byte
Data 4	Voltage data high byte, unit: 0.1V
Data 5	Voltage data low byte, unit: 0.1V
Data 6	The speed data is 8 bits high in rpm
Data 7	The speed data is 8 bits low in rpm
Data 8	Phase current data high 8 bits, unit: 0.1A

Data 9	Phase current data low 8 bits, unit: 0.1A
Data 10	Motor temperature data high 8 bits, signed 16 digits, unit °C
Data 11	Motor temperature data low 8 bits, signed 16 digits, unit °C
Data 12	MOS temperature data high 8 bits, signed 16 digits, unit °C
Data 13	MOS temperature data low 8 bits, signed 16 bits, unit °C
Check code	Data length ^ command ^ data 0^data 1^······data n
End code	0x29

(2) Motor operation information 2(0x27)

Head code	0x28
Address	0x04
Data length	13(command bytes + data bytes)
Command	0x27
Data 0	MOS temperature data high 8 bits, signed 16 digits, unit °C
Data 1	MOS temperature data low 8 bits, signed 16 bits, unit °C
Data 2	Power supply temperature high byte
Data 3	Power supply temperature low byte
Data 4	Bus current data high byte, unit: 0.1A
Data 5	Bus current data low byte, unit: 0.1A
Data 6	Single operation time high byte (min)
Data 7	Single operation time low byte (min)
Data 8	Total operation time high byte (h)
Data 9	Total operation time low byte (h)
Data 10	Hydrogeneration time high byte
Data 11	Hydrogeneration time low byte
Check code	Data length ^ command ^ data 0^data 1^······data n
End code	0x29

(3) Motor version information(0x26)

Head code	0x28
Address	0x04
Data length	8(command bytes + data bytes)
Command	0x26
Data 0	Product type (3 = Spirit 1.0; 2 = Navy 3.0; 1 = Navy 6.0)
Data 1	The software version, for example 25 means v2.5
Data 2	Year, for example 20 means 2020
Data 3	Month, for example 11 means November
Data 4	The hardware version, for example 25 means v2.5
Data 5	Year, for example, 20, means 2020
Data 6	Month, for example 11 means November
Check code	Data length ^ command ^ data 0^data 1^······data n
End code	0x29

3.2.3 The adapter board forwards the battery information to the throttle control board

Command summary

No.	Command code	Command description	Sending method
1	0x23	Battery status	Reply in turn

Command details

(1) Battery status (0x23)

Head code	0x28
address	0x04
Data length	(command bytes + data bytes)

command	0x23
Data 0	Battery temperature high byte, signed number (Unit: E battery 1°C, other batteries 0.1°C)
Data 1	Battery temperature low byte, signed number (Unit: E battery 1°C, other batteries 0.1°C)
Data 2	Battery voltage high byte 0.1V
Data 3	Battery voltage low byte 0.1V
Data 4	Current high byte (Spirit battery 0.1A; E battery 0.01A)
Data 5	Current low byte (Spirit battery 0.1A; E battery 0.01A) (charging is positive, discharging is negative)
Data 6	Fault alarm high byte Spirit battery plus: 0x6F Bit0: battery cell fault 0: canceled 1: occurred E59 Bit1: hardware fault 0: canceled 1: occurred E58 Bit2: discharging overcurrent alarm 0: canceled 1: occurred E57 Bit3: SOC low alarm 0: canceled 1: occurred E55 Bit5: charging overcurrent alarm 0: canceled 1: occurred E53 Bit6: charging overtemperature alarm 0: canceled 1: occurred E51 E battery: 0x3E Bit0: battery cell fault 0: canceled 1: occurred (don't report) Bit1: discharging undervoltage alarm 0: canceled 1: occurred E54 Bit2: discharging overcurrent alarm 0: canceled 1: occurred E57 Bit3: discharging overtemperature alarm 0: canceled 1: occurred E52 Bit4: discharging low temperature alarm 0: canceled 1: occurred E61 Bit5: charging overvoltage alarm 0: canceled 1: occurred E50 Note: bit7: battery type bit in the system preparation stage 0: Spirit battery 1: E battery

Data 7	Fault alarm low byte
Data 8	Type ()
Data 9	Capacity percentage
Check code	Data length ^ command ^ data 0^data 1^······data n
End code	0x29

3.2.4 The adapter board transfer the GPS information to the throttle control board

Command summary

No.	Command code	Command description	Sending method
1	0x20	GPS information	Reply in turn, valid for the machine with GPS

GPS information (0x20)

Head code	0x28
address	0x04
Data length	15 (command bytes + data bytes)
command	0x20
Data 0	Unsigned. GPS speed high byte, unit: 0.01m/s
Data 1	Unsigned. GPS speed low byte, unit: 0.01m/s
Data 2	Unsigned. Number of satellites, unit: piece
Data 3	Memory alignment byte, invalid
Data 4	Running distance high byte, accuracy: 1m
Data 5	Running distance low byte, accuracy: 1m
Data 6	UTC: bit31-bit24
Data 7	UTC: bit23-bit16
Data 8	UTC: bit15-bit8
Data 9	UTC: bit7-bit0
Data 10	GPS state (0: not connected; 1: connected)

Data 11	Memory alignment byte, invalid
Data 12	reserved
Data 13	reserved
Check code	Data length ^ command ^ data 0^data 1^……data n
End code	0x29

3.2.5 The adapter board transfer the each module information to the throttle control board
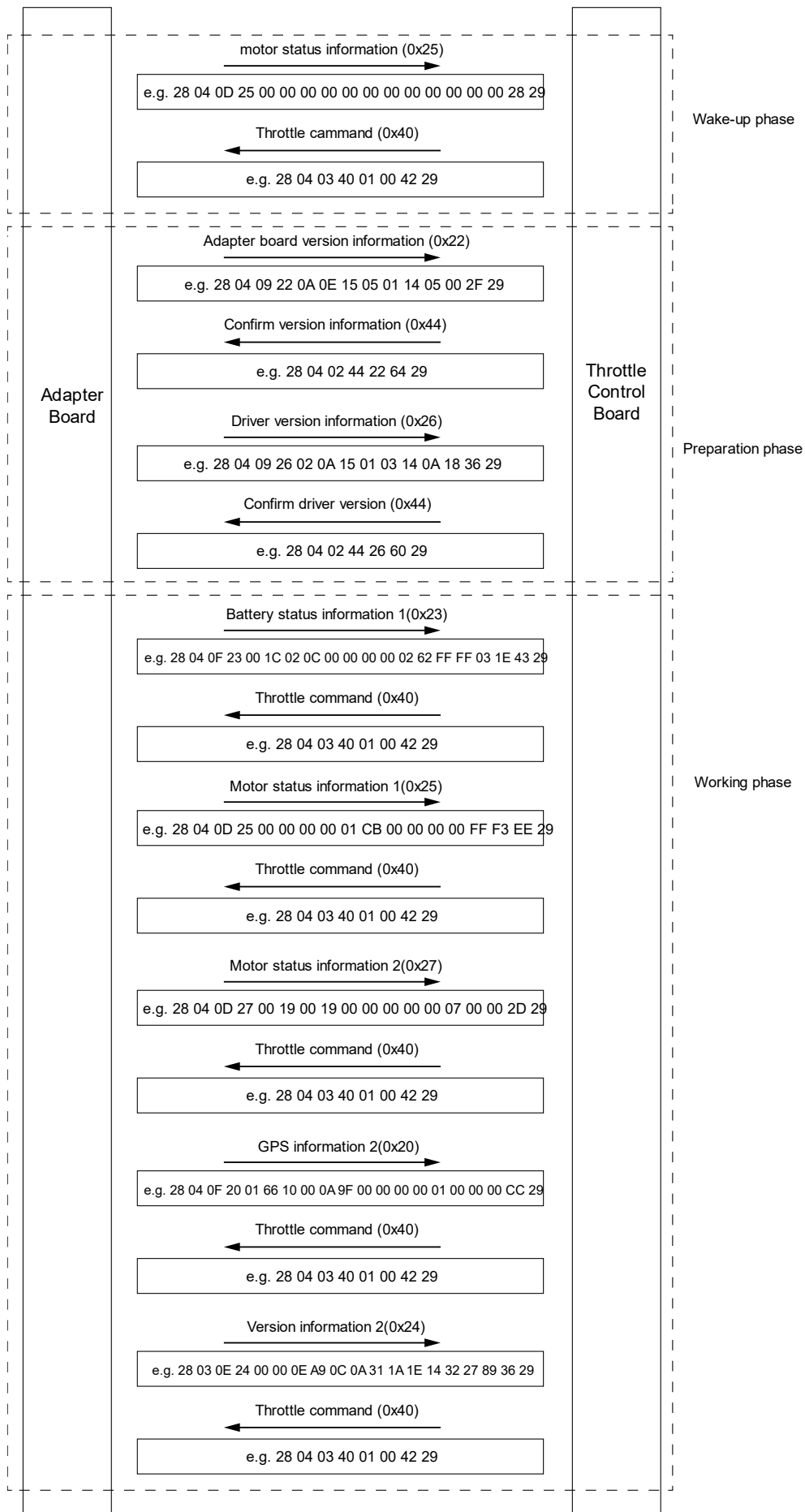
Command summary

No.	Command code	Command description	Sending method
1	0x24	Version information	Reply in turn, reply when the driver isn't running

Head code	0x28
address	0x03 (not 0x04)
Data length	14 (command bytes + data bytes)
command	0x24
Data 0	Total running distance, bit 31-bit24, unit: M
Data 1	Total running distance, bit 23-bit16, unit: M
Data 2	Total running distance, bit 15-bit8, unit: M
Data 3	Total running distance, bit 7-bit0, unit: M
Data 4	Driver software version, 10-1.0
Data 5	Driver hardware version, 10-1.0
Data 6	Driver software year and month, year=(data6 >>4)+2019, month=data 6 & 0x0F
Data 7	Driver hardware year and month, year=(data6 >>4)+2019, month=data 6 & 0x0F
Data 8	Adapter board software version, 10-1.0
Data 9	Adapter board hardware version, 10-1.0

Data 10	Adapter board software year and month, year=(data6 >>4)+2019, month=data 6 & 0x0F
Data 11	Adapter board hardware year and month, year=(data6 >>4)+2019, month=data 6 & 0x0F
Data 12	Adapter board minor version data= (data12 & 0xF8) >>3, times=data12 & 0x07
Check code	Data length ^ command ^ data 0^data 1^······data n
End code	0x29

4 Communication process

Communication sequence:

Adapter Board		Throttle Control Board	

Wake-up phase

motor status information (0x25)
→

e.g. 28 04 0D 25 00 00 00 00 00 00 00 00 00 00 00 00 28 29

Throttle cammand (0x40)
←

e.g. 28 04 03 40 01 00 42 29

Preparation phase

Adapter board version information (0x22)
→

e.g. 28 04 09 22 0A 0E 15 05 01 14 05 00 2F 29

Confirm version information (0x44)
←

e.g. 28 04 02 44 22 64 29

Driver version information (0x26)
→

e.g. 28 04 09 26 02 0A 15 01 03 14 0A 18 36 29

Confirm driver version (0x44)
←

e.g. 28 04 02 44 26 60 29

Working phase

Battery status information 1(0x23)
→

e.g. 28 04 0F 23 00 1C 02 0C 00 00 00 00 02 62 FF FF 03 1E 43 29

Throttle command (0x40)
←

e.g. 28 04 03 40 01 00 42 29

Motor status information 1(0x25)
→

e.g. 28 04 0D 25 00 00 00 00 01 CB 00 00 00 00 FF F3 EE 29

Throttle command (0x40)
←

e.g. 28 04 03 40 01 00 42 29

Motor status information 2(0x27)
→

e.g. 28 04 0D 27 00 19 00 19 00 00 00 00 00 07 00 00 2D 29

Throttle command (0x40)
←

e.g. 28 04 03 40 01 00 42 29

GPS information 2(0x20)
→

e.g. 28 04 0F 20 01 66 10 00 0A 9F 00 00 00 00 01 00 00 00 CC 29

Throttle command (0x40)
←

e.g. 28 04 03 40 01 00 42 29

Version information 2(0x24)
→

e.g. 28 03 0E 24 00 00 0E A9 0C 0A 31 1A 1E 14 32 27 89 36 29

Throttle command (0x40)
←

e.g. 28 04 03 40 01 00 42 29

The adapter board is the master and the throttle control board is the slave. The throttle control board cannot send information to the adapter board. The adapter board sends a command to the throttle control board. The throttle control board will reply to the adapter board immediately after receiving the command.

Wake-up phase:

Step 1: adapter board send the driver information (0x25) to the throttle board to test whether the throttle board exists and works normally.

Step 2: after the adapter board receives any response from the throttle control board, it enters the preparation phase.

Preparation phase:

Step 1: after power on, the adapter board sends "adapter board version information (0x22)" to the throttle control board, and the throttle control board replies "version confirmation information (0x44)" after receiving it.

Step 2: after receiving the version confirmation information, the adapter board sends the "motor driver version information (0x26)" to the throttle control board, and the throttle control board replies to the "version confirmation information (0x44)".

Working phase:

The following information is sent in polling:

The adapter board sends "adapter board, motor, battery status information" to the throttle control board, and the throttle control board replies to "throttle command (0x40)"

……

Start the motor: if the throttle control board returns the throttle command (0x40) with throttle value not 0 to the adapter board, the motor can be started.

Stop the motor: if the throttle control board returns the throttle command (0x40) with the throttle value of 0 to the adapter board, the motor can be stopped.

Special setting command:

Set it when needed, until the corresponding reply instruction is received, it means that the setting is successful.

Start and disable the hydro generation function: the Throttle control board returns to the hydro generation setting command (0x45), which can start or disable the motor hydro generation function.

Notes: Every time the power is turned on again or the throttle control board is disconnected for more than 10 seconds, the wake-up phase and preparation phase must be completed, otherwise the motor cannot be started. The throttle control board receives a command and needs to reply a command within 2 ~ 5ms. If the adapter board does not receive a reply message from the throttle control board within 900ms, the motor will stop automatically.

Decoding method notes:

Strictly follow the communication protocol format to decode.

For example, the throttle control board is used as a 485 slave, and its address is 0x04. Only when the throttle control board receives a command with the address 0x04, it is the command sent by the adapter board to the throttle control board. If the address is not 0x04, it can be discarded without decoding. (Note: in the normal working stage and when the motor driver is not running, the adapter board will send 0x24 version information command, the address is 0x03, which can be decoded to obtain relevant data)