Alpha Motor Inverter

The inverter in question has an MCU = Motor Control Unit, which allows FORWARD, BACKWARD and NEUTRAL GEARS operations, in accordance with the gear position and the accelerator pedal signals.

This unit cooperates with the vehicle's complete electrical system to make switch, drive / brake.

The motor can be controlled in two ways: Torque Control and Speed Control.

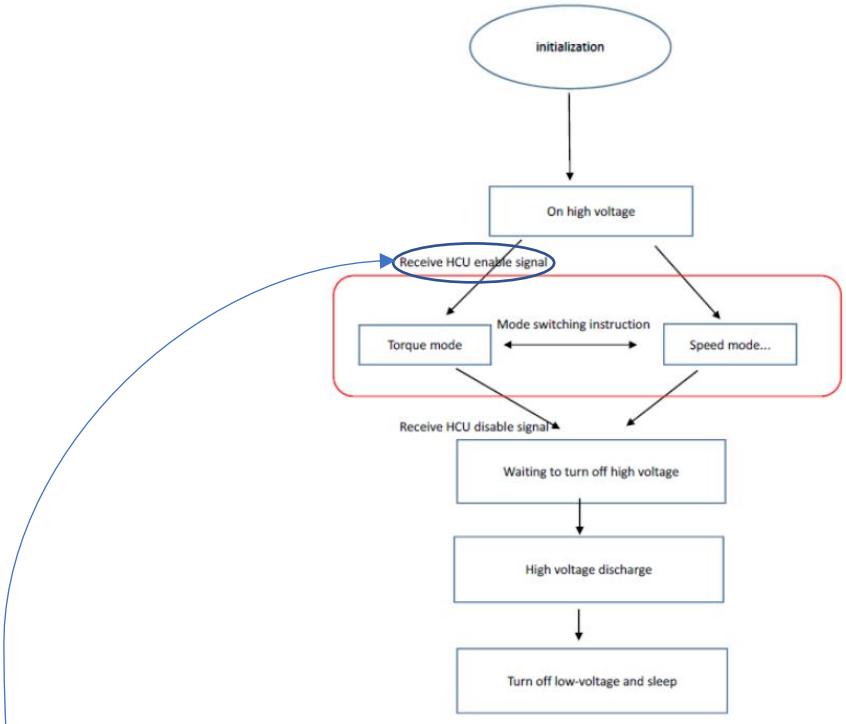


Figure 1. Type of control used

To use torque control, the following unit must be activated:

HCU = Hybrid Control Unit, which receives input signals from the driver such as pedal signals and vehicle speed, the HCU uses these signals to manage system energy, torque, etc ...

Torque Control: the motor is controlled to execute torque commands, according to the energy conversion that the vehicle needs, in this way, the user can make the vehicle work in two states: driving in traction and braking (Brake feed).

The images below describe the interaction between the BMS and the MCU. This works if there is no particular request.

- Power ON MCU (Motor Control Unit)

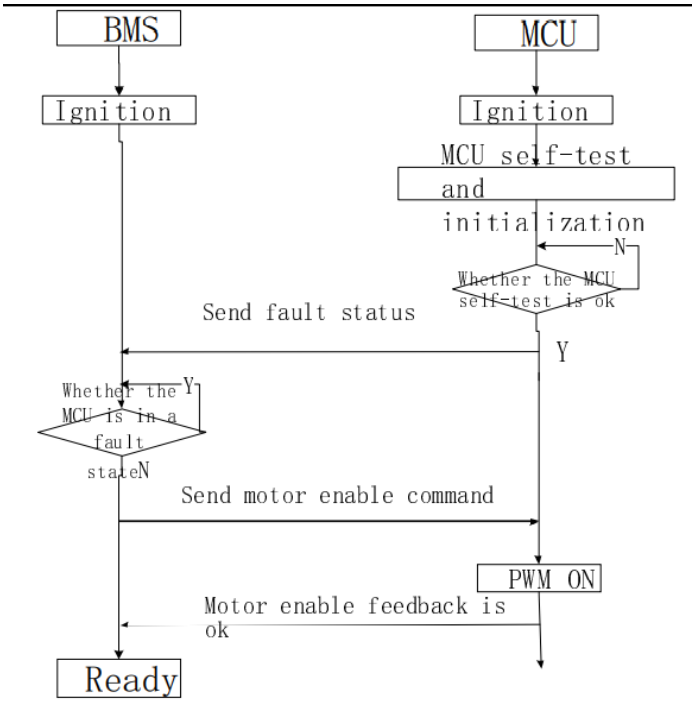


Figure 2.Power on MCU

- Power OFF MCU

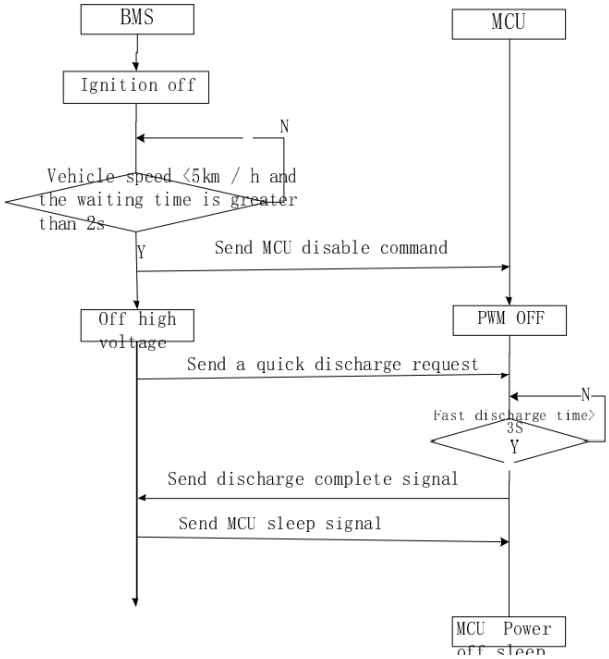


Figure 3.Power OFF MCU

- Error diagnosis

This inverter features an on-board error study.
The errors are divided into three levels, explained in the table below.

The Unified Diagnosis Service (UDS) protocol is used to see what the error is; this protocol allows to communicate the diagnosis of the system with the ECUs (Electronic Control Unit).

The UDS system is based on the OSI (Open System Interconnection), therefore through the UDS protocol it is possible to save the error in the ECU memory and transfer it to the customer's display when requested.

Failure level	description	Fault handling strategy
0	No fault	None
一	General failure (Warning)	None
二	Serious failure	1. Notify the fault code and fault level to reduce the maximum output torque; 2. If the duration of the fault exceeds the threshold, other three serious faults will be triggered;
三	Fatal failure	Automatically turn off PWM Wait for the motor speed to drop below 100rpm, power off the high voltage, and request power off from BMS

Figure 4: Error Diagnosis

- CAN matrix protocol

  The communication method used is the CAN 2.0A type, to exchange information with the vehicle's Power CAN network.
  The diagnostic function is developed on the basis of UDSonCAN.

Please note: The communication between UDS and CAN is encrypted, to know which messages are exchanged between the inverter and the rest of the connected equipment, an algorithm that protects the system should be bypassed.

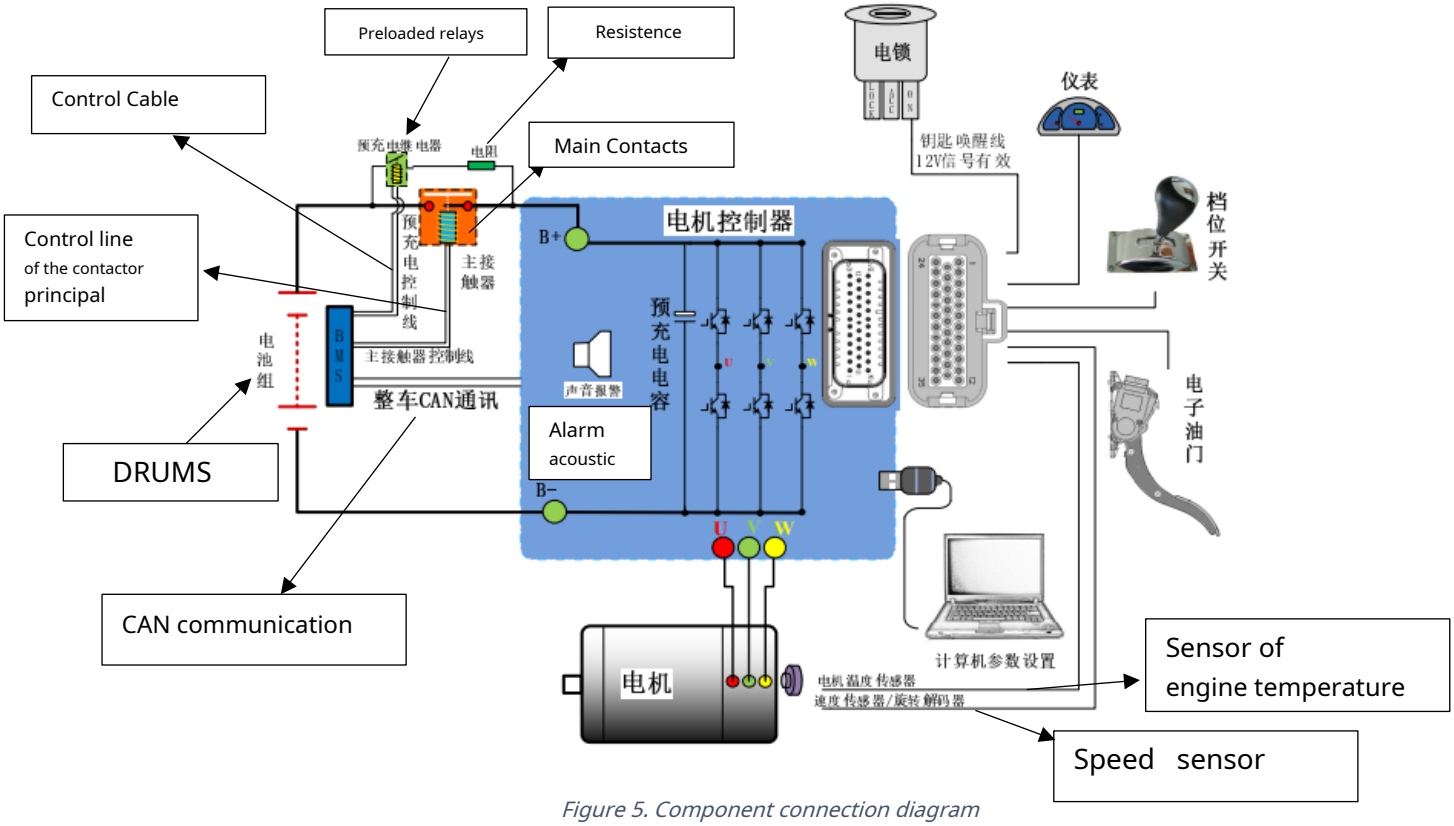
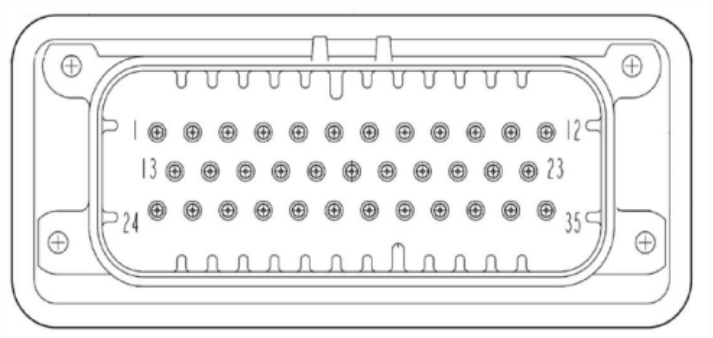


Figure 5. Component connection diagram

5.4.1 Motor controller low voltage connector



型号：776231-1

Figure6. Low voltage connector

Pin No.	Pin definition	signal type	Signal voltage / current range	Remarks
1	/			
2	Resolver excitation negative	Analog signal output	<100mA	Resolver encoder signal
3	Resolver COS +	Analog signal input	/	Resolver encoder signal
4	Resolve SIN-	Analog signal input	/	Resolver encoder signal
5	D signal	Analog signal input	0~12V/10mA	Forward gear signal, 12V high effective
6	R signal	Analog signal input	0~12V/10mA	Reverse gear signal, 12V high effective
7	Throttle power supply negative	Power Output	0V/20mA	Electronic throttle power supply negative
8	/			
9	Fan control output	Digital signal output	0~12V/200mA	Fan control signal is positive, 12V low effective
10	Pump control output	Digital signal output	0~12V/200mA	The pump control signal is positive, 12V is low and effective
11	Continue electricity 12V-	power input	0V/1A	Controller low voltage circuit power supply negative
12	CAN communication low	can communication signal		can communication signal
13	Resolver excitation positive	Analog signal output	<100mA	Resolver encoder signal
14	Resolving COS-	Analog signal input	/	Resolver encoder signal
15	Resolver SIN +	Analog signal input	/	Resolver encoder signal
16	/			
17	N signal	Analog signal input	0~12V/10mA	Neutral signal, 12V high effective
18	Throttle power supply is positive	Power Output	10~14V/20mA	Electronic throttle power supply positive
19	/			
20	Fan control 12V-	Power Output	0V/1A	Fan water pump control signal negative
21	continue electricity 12V-	power input	0V/1A	Controller low voltage circuit power supply negative

Pin No.	Pin definition	signal type	Signal voltage / current range	Remarks
22	Wake up signal	Analog signal input	9~16V	Controller hard-wire wake-up signal
23	CAN communication high	can communication signal	Matching resistance 120Ω	CAN communication signal
24	Motor temperature +	Analog signal input	0~5V/10mA	Motor temperature, matching PT1000
25	Motor temperature-	Analog signal input	0V	Motor temperature, matching PT1000
26	/			
27	/			
28	/			
29	Brake signal	Analog signal input	0~12V/10mA	Brake signal, 12V, low effective
30	Throttle switch signal	Analog signal input	9~16V/10mA	Check signal of electronic throttle switch
31	Throttle acceleration signal	Analog signal input	0~5V/10mA	Accelerator pedal signal input
32	continue electricity 12V+	power input	0~16V/1A	Controller low voltage circuit power supply positive
33	continue electricity 12V+	power input	0~16V/1A	Controller low voltage circuit power supply positive
34	/			
35	/			

Figure 7. Type of input and output signals

From the table, present in the inverter datasheet, it seems that the inverter does not receive any CAN type signal, since all the digital signals are not in input (input), but only in output (output).

From the diagram in figure 6, it can be seen how the BMS system is connected via CAN to the inverter.

At this point I believe that the messages that the inverter receives via CAN are the messages sent by the BMS.

These messages are reported in an excel table, together with other messages relating to the following units present: IPU (Infrastructure Processing Unit), BCM (Body Control Module), EPB (Electric Parking Brake).

The table shows who sends the signal and who receives it, in this case those who send the signals are: BMS, IPU, BCM and EPB.

The receivers can always be the units mentioned above or the following: OBC (on board charger), TMS (Thermal Management System), ICU (Input Capture Unit), EPS (Electric Power Steering).

It is not directly specified which signal the inverter receives, but what can be seen from the diagram in figure 5 is that the messages it receives via CAN arrive from the BMS.