I30 Motor Controller Assembly

Product Manual

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R & D Center

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Catalog

1 Overview

This product manual mainly details the reference standards, terms and definitions, technical requirements, input and output characteristics, assembly precautions, inspection rules and signs, packaging, transportation, storage, fault diagnosis, maintenance and other aspects of the 130 motor controller assembly. Introduction, as the basis for product inspection or product quality internal control.

2 Regulations and general requirements

2.1 Standard basis

GB/T 2423. 17 GB/T 10125-2012 Artificial atmosphere corrosion test salt spray test

GB/T 2423. 22-2012 Environmental Test Part 2: Test Method Test N: Temperature Change

GB/T 2423. 34-2012 Environmental testing of electrical and electronic products Part 2: Test method Test Z-AD: Temperature-humidity combined cycle test

GB/T 4208-2008 Shell protection grade (IP code)

GB/T 18655-2018 Limits and measurement methods of radio disturbance characteristics of vehicles, ships and internal combustion engines used to protect on-board receivers

GB/T 19951-2005 Test method for electrical disturbance caused by electrostatic discharge of road vehicles

IS07637-2:2004 Road vehicle electrical interference caused by conduction and coupling. Part 2: Electrical transient conduction along power lines

IS07637-3:2007 Electrical interference caused by conduction and coupling of road vehicles

QB/YSPL100-2018B drive motor controller for electric vehicles

GB/T 13422-2013 Electrical test method of semiconductor converter

GB/T 18488. H2015 Motors and Controllers for Electric Vehicles Part 1: Technical Conditions

GB/T 18488. 2-2015 Motors and Controllers for Electric Vehicles Part 2: Test Methods

GB/T 18384. 2 Safety Requirements for Electric Vehicles Part 2: Operational Safety and Failure Protection

GB/T 18384. 3 Safety requirements for electric vehicles Part 2: Protection against electric shock

ISO 11898 Road Vehicles-Control Area Network

ISO 14229 Unified Diagnostic Specification

QC/T 413-2002 Basic technical conditions for automotive electrical equipment

QB 14023 Limits and measurement methods of radio disturbance characteristics of vehicles, ships and internal combustion engines used to protect receivers outside vehicles

GB 18387 Limits and measurement methods of electromagnetic field emission intensity of electric vehicles

GB 34660 Electromagnetic compatibility requirements and test methods for road vehicles

GB/T 17619 Electromagnetic radiation immunity limits and measurement methods for electronic and electrical components of motor vehicles

GB/T 4094. 2 Marks of electric vehicle controls, indicators and signal devices

GB/T 29307 Reliability test method of drive motor system for electric vehicles

2. 2 General requirements

2.2. 1 The motor body needs to have four-quadrant capability, and its performance indicators should cooperate with the motor controller to meet the requirements of the entire vehicle.

2.2.2 The motor is a permanent magnet synchronous motor, which is cooled by liquid cooling.

2.2.3 The motor should have the function of measuring the temperature of the stator winding. At least one set of temperature sensors should be embedded in the windings. The range of the temperature sensor: -40°C-250 watts.

2.2.4 Busbar working voltage range 200V-450VDC, full power working voltage range 250V-420VDC, rated working voltage 330VDC/360VDC.

2.2.5 Insulation class: H class.

3 Working principle and characteristics

3.1 working principle

The motor drives the car, and the motor controller drives the motor to work. The motor controller has two major functions: inverter and control. Inverter function: It receives the direct current power from the battery and inverts it into three-phase alternating current to provide power to the car motor. Control function: Receive signals such as motor speed and vehicle control. When braking or acceleration occurs, the controller controls the torque of the motor to achieve the purpose of acceleration or deceleration, and real-time feedback of motor related information to the vehicle.

3.2 Features

(1) High power density: the maximum power density reaches 25kW/L;

(2) High precision control: fast and accurate torque control and speed control;

(5) Highly reliable automotive-grade IGBT power module;

(6) IGBT gate-level driver with integrated protection function;

(7) Safe and reliable fault detection and handling measures;

(8) Architectural design that complies with ISO26262 functional safety requirements;

(9) Using IC-CPLD to realize DSP+CPLD fast protection processing;

(10) The friction welding process is adopted for the water channel, which improves the reliability of the water channel sealing.
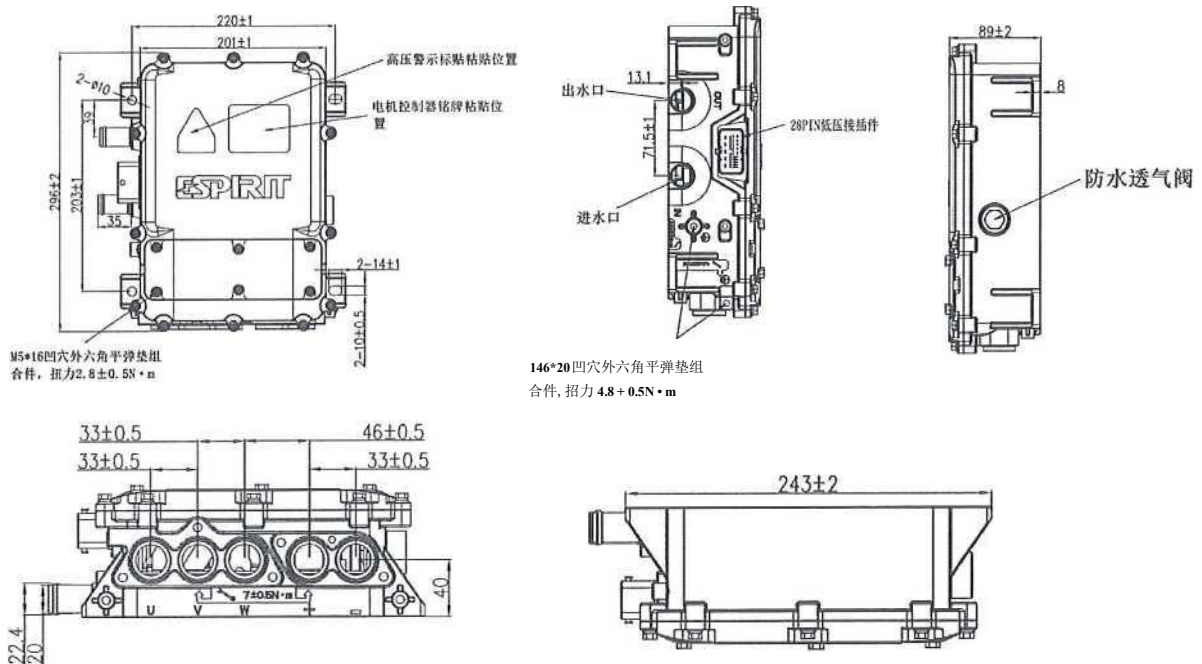
4 Outline drawing

5 Technical Parameters

5.1 Controller

Basic parameters					
Model	KTZ34X22SI30YSPL	KTZ34X30SI30YSPL	KTZ34X40SI30YSPL	KTZ54X22SI30YSPL	KTZ54X34SI30YSPL
Rated input voltage(V)	336	336	336	540	540
Input voltage range(V)	200-450	200-450	200-450	400-750	400-750
Feeding voltage range(V)	200-450	200-450	200-450	400-750	400-750
Rated output current(A)	110	150	200	110	170
rated power(kW)	30	40	55	50	60
Stall current(A)	220	300	400	220	340
Maximum working current of controller(A)	220	300	400	220	340
Controller short-time working current(A), time	220/30S	300/30S	400/30S	220/30S	340/30S
Controller continuous working current(A), time	110/30niin	150/30tnin	200/30min	110/30min	170/30min

Bus capacitor capacity(uF)	220	330	420	220		300	
Y capacitance(nF)	220	220	220	220		220	
cooling method	Liquid cooling	Liquid cooling	Liquid cooling	Liquid cooling		Liquid cooling	
Drive motor controller support capacitor active discharge time (s)	W3	W3	W3	W3		W3	
Drive motor controller support capacitor passive discharge time (min)	W3	W3	W3	W3		W3	
parameter name	condition			Minimum	Typical	Max	Unit
Control parameters							
Input voltage range	Ambient temperature-40°C-85°C			200	330/360	450	VDC
Full load input voltage range	Ambient temperature-40°C-85°C			250	336/360	420	VDC
Torque control accuracy	-				±3N. m, < 100N. m ±3%^100N.m		N.m
Torque response time	0 to 90% maximum torque			-	—	30ms	ms
Speed control accuracy	-			W1000 RPM，±5rpm			rpm
Speed dynamic response time	Speed change W2000RPM			-	-	200ms	ms
IGBT switching frequency	-			1	10	12	KHZ
Low-voltage power supply	Supply voltage14V			—	11	—	W
Maximum controller efficiency(%)	-			98%	-	—	
Safety requirements							
Active release time	Discharge from the highest voltage to 36V			-	—	3	S
Passive release time	Discharge from the highest voltage to 36V			-	—	180	S
AC insulation voltage	50HZ/60HZ, 60S Test			2500	-	-	VAC
Insulation resistance	Cold insulation resistance			20	-	—	MQ
Cooling circuit pressure	The pressure that the cooling circuit can withstand			200		-	Kpa
Environmental requirements							
storage temperature	-			-40	-	85	°C
Relative humidity	40 °C			-	-	95	%
Working temperature	—			-40	-	85	°C
Coolant temperature	Allowable coolant temperature during normal operation			-40	-	65	°C
Altitude	Allowable altitude during work, derating greater than 2000m			-	—	5000	m
IP protection level	-			IP67			
Interface parameters							
Low voltage power supply				9	12	18	VDC
Power-on completion time	From power-on to the first CAN message transmission			—	-	200	ms
CAN communication rate	-			-	250/500	-	Kbps
Terminating resistor	default allocation			-	120	—	Q
Motor interface							
Resolver ratio	-			-	0. 286	-	-
Excitation signal load	Load capacity of excitation circuit signal 10KHZ/20KHZ			40	-	500	Q
Motor temperature sampling	Measuring range			-40	-	200	°C

Motor temperature sampling accuracy	The accuracy of the motor temperature in the range of 130-C-150°C	-5	-	5	°C
Motor temperature resistance	Can match PT100/PT1000 at the same time	50	-	500000	Q
Motor temperature channel	一	-	2	-	-
Internal sample requirements of the controller					
High voltage voltage sampling	High voltage DC voltage sampling range	0	-	1200	VDC
High voltage voltage sampling accuracy	25ju ambient temperature, rated voltage	-2	-	2	VDC
	-40°C-85°C ambient temperature, rated voltage	-5	-	5	VDC
Voltage sampling bandwidth	High voltage voltage sampling circuit bandwidth	20	-	-	KHZ
IGBT module temperature sampling accuracy	60°C-100°C	-5	-	5	°C
Temperature sampling accuracy of cabinet/radiator	60°C-100°C	-5	-	5	°C
Mechanical parameters					
Weight	-	-	5. 5	-	Kg
height	-	87	89	91	mm
width	一	241	243	245	mm
length	-	294	296	298	mm

5. 2 Product environment and electrical requirements

5.2.1 temperature range

Storage temperature

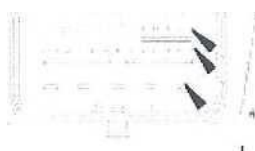| Ambient temperature range	
Tmin （lowest temperature）	Tmax （Maximum temperature）
-40°C	85 °C

Operating temperature

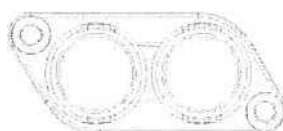| Working temperature range	
Tmin （lowest temperature）	Tmax （Maximum temperature）
-40 °C	85 °C

5. 2.2 Electrical connection
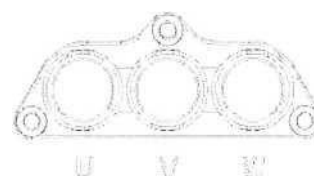

28PIN low voltage connector model：
47745-0100
Manufacturer：MOLE

Positive and negative connectors
Model! 2141784-2
Manufacturer: TE

Three-phase connector
No.: 2141783-2
Manufacturer: TE

Low voltage patch cord

Positive and negative power lines

3 phase cable

5.2.3 Low voltage wiring harness pin definition

Connector name	Pin definition	Signal description
Low voltage 28pin terminal	1-3	NA blind blocking
	4	KL30-battery power negative
	5	KL30-Battery Power Positive
	6	CANBL vehicle CAN low
	7	CANBL vehicle CAN high
	8-9	NA blind blocking
	10	EXC P resolver signal excitation positive
	11	EXC N resolver signal excitation negative
	12	COS N resolver recovers the negative cosine signal
	13	COS P resolver recovers the cosine signal positive
	14	SIN N resolver recovers negative sine signal
	15	SIN P resolver recovers sine signal positive
	16-17	NA blind blocking
	18	KL15 hard wire wake-up signal
	19	MT+Motor temperature resistance+
	20	MT-Motor temperature resistance-
	21-28	NA blind blocking

Note: Please make sure that the positive and negative poles of the connector and the high-voltage connector are correct before powering on the high voltage. Reverse connection will cause irreparable damage instantly!

5. 2. 4 Input and output characteristics

Terminal description：

Terminal	Function
+	Connect the positive electrode of the power battery
—	Connect the negative pole of the power battery
U	Connect the motor U phase
V	Connect the motor V phase
W	Connect motor W phase
Signal terminal	Connect external vehicle and motor
Waterway (two-way)	Dedicated coolant flow> 8L/min

The specifications of the power cord and the motor three-phase wire in the above figure: 16'50mm2; the terminal is a metal waterproof connector type input and output, and the corresponding voltage and current levels are as follows:

(1) Power cord (+, -)

This terminal is connected to the positive and negative poles of the power battery and serves as the high-voltage input terminal of the motor controller. The standard input voltage ranges from 200V to 750V, and the rated input voltage level is 336/540V. High-voltage input takes into account the safety of the system and components, and the input front end needs to be designed with a corresponding pre-charging circuit to avoid the instantaneous influx of high-voltage power and ensure safety.

(2) Motor three-phase wire (U, V, W)

This terminal is connected to the output of three-phase AC voltage, the rated output voltage is 220/380V,

(3) Water cooling box

Coolant flow requirements are greater than or equal to 8L/min, motor controller water inlet temperature requirements are less than 65 degrees, special coolant must be used (ethylene glycol: water = 50%: 50%), water channel volume 117ml, water channel coolant flow and pressure The loss relationship is shown in the figure below.

控制器水道压力损失曲线图
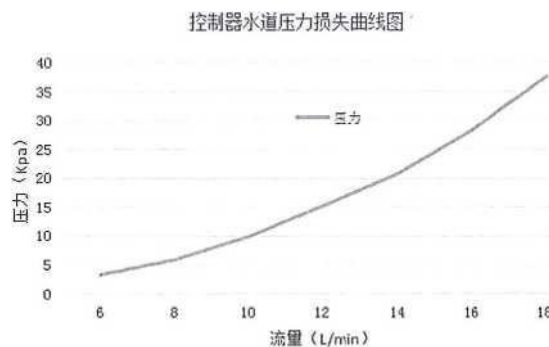
5. 2. 5 Demand regulation

The control algorithm used in the software design of the motor controller is a vector control algorithm.
Collect calculations and current vehicle requirements, locate the motor position, output three-phase voltage, and control the motor torque and speed.

Input item	Output item
Low voltage power signal High voltage power signal Controller working signal	Motor control signal System failure signal

5. 2.6 Self-protection

① In order to respond to internal events (such as over-temperature, over-current, over-voltage, etc.) to protect the motor, implement a self-protection mechanism.

②Self-protection mechanism: divided into two levels, the first level (downgrade level) and the second level (stop level)

（1) Undervoltage protection: When the power supply voltage is too low, the controller protects and shuts down. Without restarting the system, if the power supply voltage returns to the threshold, the system will restart automatically;

(2) Overvoltage protection: When the power supply voltage is too high, the controller will shut down for protection. Without restarting the system, if the power supply voltage returns to the threshold, the system will automatically restart;

(3) Overcurrent protection: When the circuit current exceeds the second level limit (stop limit), the controller will stop immediately. When the current returns to the threshold, the system will restart automatically, but there is a delay of 3s before restarting;

(4) Over-temperature protection: The controller has built-in temperature protection. If the temperature continues to rise and exceeds the threshold, it will stop immediately. When the temperature returns to the threshold, the system will return to normal.

5. 2. 7 Fault types and diagnosis list

Type of failure	cause of issue	Elimination measures
IGBT failure	IGBT is damaged or the driver board is damaged	Replace IGBT or driver board
Hardware overcurrent	Hardware sampling current value is too large	Check the current sensor
Resolver failure	Resolver wiring harness is incorrectly connected or disconnected	Check the resolver harness
Software overcurrent	Software sampling current value is too large	Check the external wiring harness of the controller
Overvoltage fault	The DC bus voltage is too high (470V±10V adjustable)	Measure bus voltage
Undervoltage fault	DC bus voltage is too low (200V±10V adjustable)	Check whether the main contactor is closed, and measure the bus voltage
Motor over temperature fault	Motor temperature is too high (adjustable at 150°C)	Check whether the motor temperature sensor is in good contact, and check whether the cooling system is normal
Motor overspeed fault	Motor speed exceeds threshold	Check whether the motor has a runaway phenomenon
IGBT over temperature fault	IGBT temperature is too high (85°C adjustable)	Check whether the cooling system is normal. The water cooling system checks whether the coolant is full, and the air cooling system checks

Radiator over temperature fault	The radiator temperature is too high (start limit operation at 65°C-75°C, start protection at 75°C)	Check whether the cooling system is normal. The water cooling system checks whether the coolant is full, and the air cooling system checks
CAN communication failure	CAN bus cannot receive other controller messages	Check whether the CAN bus is connected properly, and check the CAN bus terminal resistance.

5.2. 8 Function realization and signal interaction

Can be provided according to customer agreement.

6 Assembly notes

(1) The controller meets the IP67 dust-proof and waterproof standard, but in order to avoid external leakage, the controller should be installed in a clean and dry environment as much as possible;

(2) When installing, you should try your best to keep it upright and avoid places that are prone to splashing water, such as near the tires;

(3) In some cases, it may cause the vehicle to lose control, so when installing, the vehicle should be erected to keep the tires off the ground;

(4) Before installing the electric vehicle controller, be sure to disconnect the battery circuit and bring insulating tools to prevent short circuits;

(5) Before filling the coolant, it must be done after the tank cover and wiring harness are assembled in place to prevent the liquid from entering the inside of the controller.

In order to strengthen heat dissipation and prevent corrosion, antifreeze for automobiles produced by a regular company must be used, and private blending is strictly prohibited. If the controller is damaged due to the use of inferior antifreeze or the addition of tap water or pure water to the cooling system, the warranty will not be available.

7 Product Identification

7.1 Permanent identification
Suppliers code according to parts provided by customers.

7. 2 Packaging logo

When sending samples, the supplier must indicate the name of the part, part number, specification model, quantity, supplier name, production date or batch and other necessary information on the box or packaging. The product packaging method should meet the requirements of product protection. . If the sampled product has no label or the product label is not clear, it will not be accepted.

8 Meet the management requirements for restricting the use of hazardous substances and recycling rates

9 Certification requirements

The design and manufacture of the product comply with the relevant regulations and requirements of the corresponding vehicle sales area, and obtain the necessary type certifications for parts and components;

For parts that do not require certification, their design and manufacturing comply with the relevant regulations of the People's Republic of China;

Product design and manufacturing do not violate national/regional intellectual property and patent protection laws and regulations.

10 Maintenance

(1) There is no part in the motor controller that can be repaired by the user. Self-disassembly and repair may cause damage to the controller. Open the controller shell will not get the warranty service, but the controller shell should be cleaned regularly.

(2) The motor controller has its own power-off and discharge function, that is, within 30 seconds after the controller is powered off, the capacitor in the controller is automatically discharged. Please use a multimeter and other tools to confirm that the voltage is below 36V. It

is strictly forbidden to power off at high voltage. Immediately install, remove or repair the controller.

(3) During the use of the motor controller, regular maintenance is required, including but not limited to: checking the cooling system, ensuring that the wiring is firm, ensuring that the controller is firmly fixed, and cleaning the controller box shell and connectors.

(4) Before the water-cooled controller is filled with coolant, it must be done after the tank cover and wiring harness are assembled in place to prevent the liquid from entering the inside of the controller. In order to strengthen heat dissipation and prevent corrosion, antifreeze for automobiles produced by a regular company must be used, and private blending is strictly prohibited. If the controller is damaged due to the use of low-quality antifreeze or the addition of tap water or pure water to the cooling system, the warranty will not be available.

(5) When installing the motor controller, you should try to keep it upright and avoid water splashing near the tires. If you need to install the controller upside down or the installation location is prone to water splashing, you must contact us and get our consent.

(6) Also need to pay attention to the following matters during use (including but not limited to): proper technical training, wear glasses to protect your eyes, use insulated tools, avoid wearing loose clothes and wearing metal jewelry, etc.

(7) The design of the whole vehicle considers the interference of the replacement or maintenance of the controller assembly.