天津市松正电动科技有限公司

Tianjin Santroll Electric Technology Co., Ltd.

User Manual

M A N U A L

N Series

Santroll Motor Inverter

TIANJIN SANTROLL ELECTRIC TECHNOLOGY CO., LTD.

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SANTROLL

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1. Product overview

Application: Santroll AC motor inverter is applicable to electric vehicles such as aerial work platforms and small tonnage forklifts.

1.1 Product model and parameter list

Product Model	Rated Working Voltage (V)	Peak Current A (2min)	Dimensions (See for inverter dimensions)	Application
SZ7230-N1	24	300	N1	

Note: The specific model is subject to delivery goods, and the final model will be added with customer identification.

1.2 Product features

(1) Advanced pulse width modulation technology ensures that the battery is used efficiently, and reduces the loss of motor energy consumption and torque conversion;

(2) It is compatible with asynchronous and DC brushless motors. With self-developed motor self-learning function, it can adapt to various types of AC asynchronous motors;

(3) The power tube has excellent performance and small parasitic parameters, which improves the switching speed of the power tube, reduces the switching loss and conduction loss, and reduces the heat generation;

(4) Self-developed intelligent calibration current sensor tooling makes current more accurate and motor control more accurate;

(5) The upper computer and handheld unit in English, which makes it more intuitive and convenient to change parameters;

(6) A powerful operating system ensures that the vehicle control, motor control and client programs run simultaneously;

(7) 0 to 300 Hz frequency range, low noise operation;

(8) Battery electrode reverse connection protection, output drive short circuit and open circuit protection, overheat protection, warning and automatic shutdown settings provide protection for electric motor and electric inverter;

(9) Hardware watchdog timer for safety failure power devices is designed;

(10) The online programming function of the inverter can ensure the upgradability of the product;

(11) Adopt the high-speed CAN bus control mode to reduce the wiring of the whole vehicle and the failure rate of the whole vehicle;

(12) IP67 IP Grade meets the requirements of harsh environment;

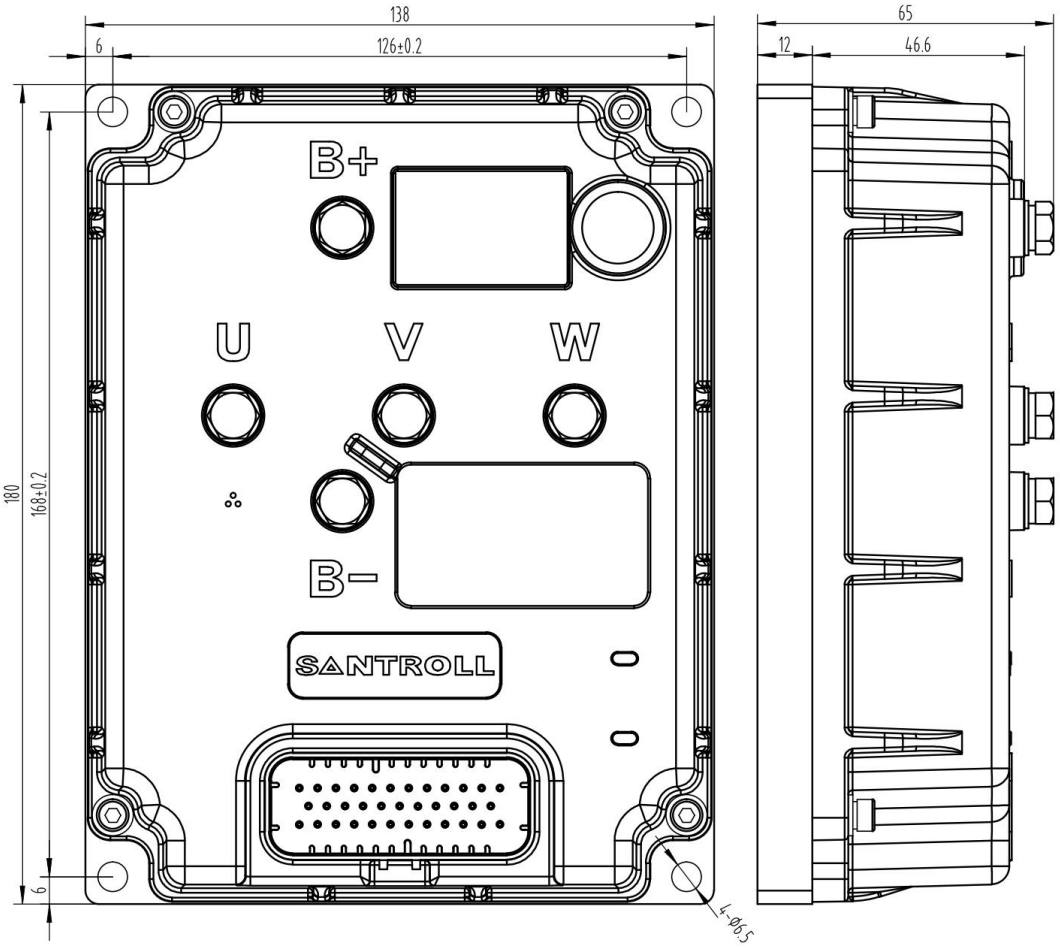
(13) To provide more timely technical support and better after-sales service, Santroll has more than 100 offices all over the country to provide customers with better and more timely service;

(14) More comprehensive product verification. Santroll has its own experimental center and comprehensive equipment for testing, including advanced experimental equipment such as dynamometer, power analyzer, shaking table, high and low temperature box, water spray test box, dust test box, salt spray test box and drop test bench, which can fully guarantee the quality of products.

(15) The product meets the requirements of ENIS0 13849-1:2015, and has obtained TUV CE certification; The product has obtained UL583 certification.

2. Overall dimensions of product

2.1 Overall dimensions of N series inverter



3. Interface definition

3.1 N series inverter installation and matching cable

3.1.1 power line cable selection

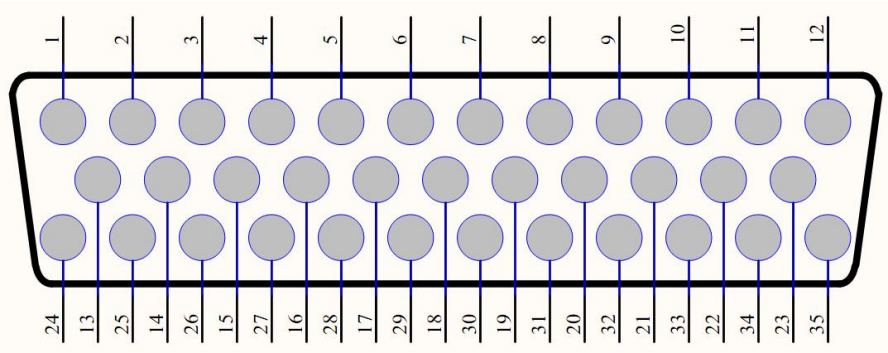
It is recommended to match 20-25mm^2 cable for N series dual drive inverter.

The size of the screw is M6*20, and the installation torque of the screw is 8N±2N.

3.1.2 Definition of inverter wiring

Number	Definition
B+	The positive electrode of the power supply is generally connected to the output of the main contactor.
B-	The negative pole is connected to the negative pole of the battery.
U	Connetc U phase of oil pump motor.
V	Connect V phase of the oil pump motor.
W	Connect W phase of oil pump motor.

3.1.3 N series inverter plug-in terminal model and pin definition



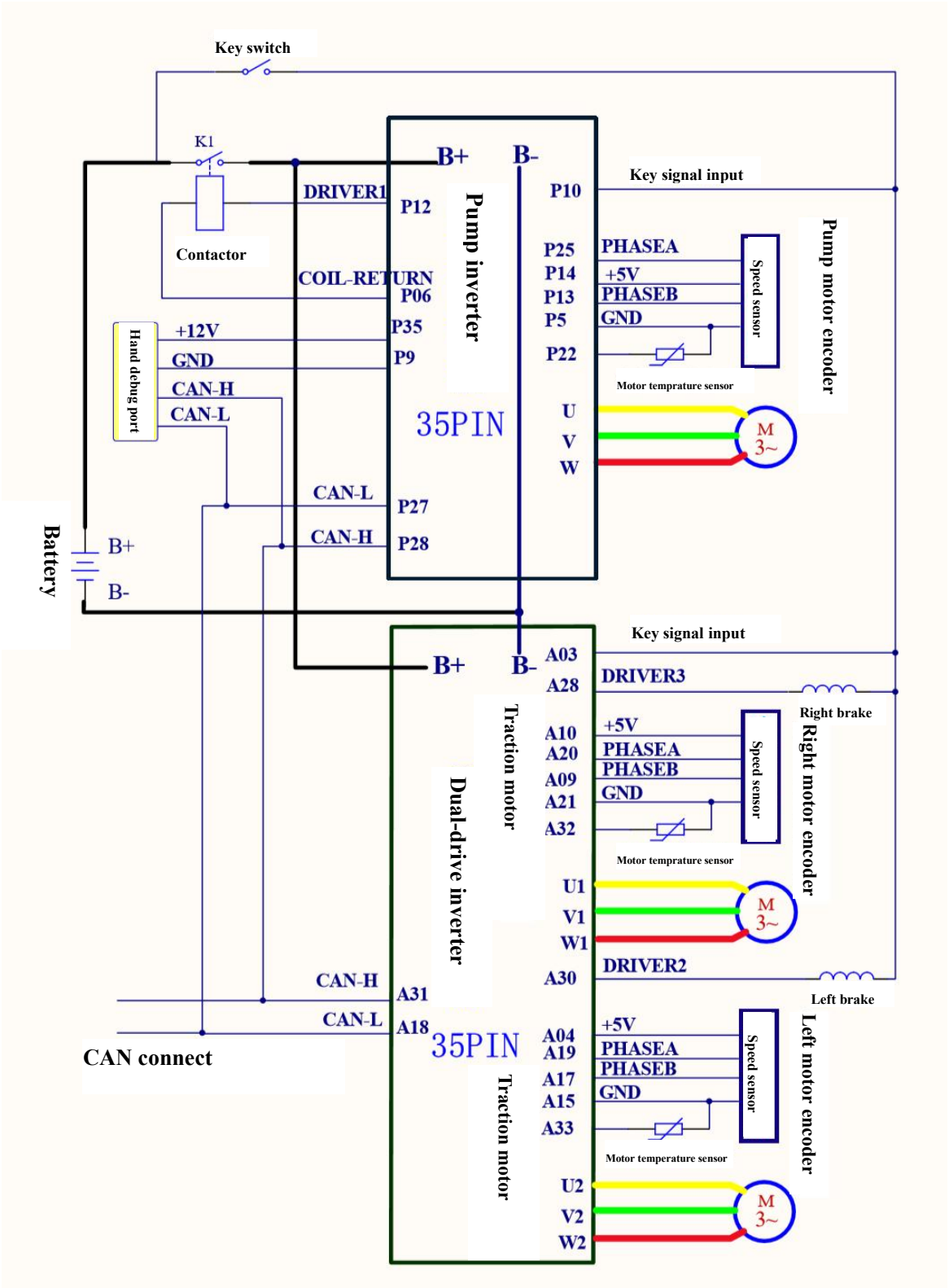
The connector model AMPSEAL-35P(P/n-1-776163-1) and the plug model (P/n-1-776164-1)

Terminal Number	Function Definition	Terminal Number	Function Definition
1	Reserved (AN1)	19	Reserved (SW2)
2	Reserved (AN2)	20	Reserved (SW3)
3	Reserved (AN3)	21	Reserved (SW5)
4	Reserved (AN4)	22	Pump motor temperature signal

5	GND	23	Reserved (SW8)
6	Driving high end (contactor coil)	24	Reserved
7	Reserved (AN6)	25	Pump motor speed encoder A
8	Reserved (AN5)	26	Reserved (CAN-120Ω+)
9	GND	27	CAN_L
10	KSI key input	28	CAN_H
11	GND	29	Reserved (Drive 2)
12	Drive 1 (contactor coil)	30	Reserved (Drive 3)
13	Pump motor speed encoder B	31	Reserved (Drive 4)
14	Speed encoder 5V output	32	Reserved (SW4)
15	Reserved (CAN-120Ω-)	33	Reserved (SW6)
16	Reserved (CAN shield)	34	Reserved (SW7)
17	Reserved (5V output)	35	Reserved (12V)
18	Reserved (SW1)		

4. Typical wiring diagram

4.1 Typical wiring diagram of AC assembly



Note: The wiring diagram will be different according to different models.

5. Configurable parameters of the inverter

5.1 Specification of configurable parameters of N series inverter

Inverter mode selection		
Parameter	Permitted Range	Description
Inverter mode	0-2	0 = Speed mode 1 = Torque mode 2 = Pump control mode
Speed mode		
Parameter	Permitted Range	Description
Max. speed	100-8000rpm	Define the maximum speed of the motor when the accelerator output is full. The accelerator output is proportional to the motor speed, for example, 50% of the accelerator output, and the motor speed is 50% of the maximum speed.
Kp	0-100%	Determine the strength of the speed loop to control the motor speed to match the given speed. The greater the value, the greater the control intensity. If the gain value is set too large, there may be chattering in the process of speed adjustment. If the gain value is set too small, the motor response will appear dull and difficult to control.
Ki	0-100%	The integral gain (Ki) determines the net difference of zero steady state, so the motor will run at a given speed accurately. The larger the value, the tighter the speed adjustment. If the gain value is set too large, there may be chattering in the process of speed adjustment. If the gain value is set too small, it will take a long time for the motor speed to approach the given speed accurately.
Acceleration rate of accelerator	0.1-30.0s	Set the speed at which the motor speed increases when the accelerator is increased. The larger the value, the slower the response.
Throttle deceleration rate	0.1-30.0s	Set the speed at which the motor speed decreases when the accelerator is reduced. The larger the value, the slower the response.
Braking rate	0.1-30.0s	Set the speed at which the motor speed decreases when the brake pedal is depressed or directly reversed. The larger the value, the response. The slower.
Reversing allowable speed	0-1000	When the absolute value of the vehicle speed is less than the parameter range, the reversing command will only respond.
Torque mode		

Parameter	Permitted Range	Description
Max. speed	200-8000rpm	Determine the maximum speed of the motor in the torque control mode. In the torque control mode, the full accelerator output corresponds to 100% of the torque output by the inverter, and the accelerator output is proportional to the torque value. For example, 50% of the accelerator output corresponds to 50% of the torque output by the inverter.
Kp	0-100%	Determine the intensity of the inverter's attempt to limit the motor speed to the maximum speed. The greater the value, the greater the control intensity. If the Kp value is set too large, when the motor speed is limited to the set maximum speed, there may be chattering. If the setting is too small, the motor speed will exceed the set maximum speed during adjustment.
Ki	0-100%	The Ki determines the net difference of zero steady state, so the motor speed will be limited to the set maximum speed. The larger the value, the faster the response. If the gain value is set too large, limit the motor speed to the set maximum speed, there may be chattering. If the setting is too small, it will take a long time to adjust the motor speed from the excessive speed to the maximum speed.
Kd	0-100%	The overshoot of the motor speed can be reduced. If the Kd value is set too high, it may take a long time for the motor to reach the maximum speed. If the setting is too small, the motor speed may exceed the maximum speed, especially when going downhill.
Rate of acceleration	0.1-30s	Set the rate of torque increase when the accelerator output increases. The larger the value, the slower the response.
Release rate of acceleration	0.1-2s	Set the rate of torque reduction when accelerator output decreases. If the value is set too small, the switch from acceleration to deceleration will appear sudden. If the value is large, the switch will be smoother. However, if the value is set too large, when the accelerator is reduced, the vehicle will not slow down for a short time, and it will feel like the vehicle is out of control.
Braking rate	0.1-5s	Adjust the speed at which the braking torque is established when the vehicle transitions from driving to braking. These states include direct commutation, brake pedal depression or neutral. The smaller the value, the faster the response, so the harder the braking. The larger the value, the smoother the braking.
Release rate of brake	0.1-2s	Adjust the rate of brake torque reduction.
Neutral braking force	0-100%	Neutral braking occurs when the accelerator output is reduced to zero or given neutral. The base of this values is limited by the regenerative current.

The speed at which the neutral braking force gradually decreases	200-6000rpm	When the accelerator output decreases and the motor speed is lower than this set value, the regenerative braking current will be adjusted in both positive and negative directions. When the speed of the motor is positive, and the speed drops from this value to 0, the neutral braking current linearly decreases from 100% to the current value at idle torque. When the motor speed is in the reverse direction and the speed increases from 0 to this value, the restraining force current linearly increases from the current value at idle speed to the set restraining force current value. Setting this value too small may cause chattering.
Idle torque	0-100%	Determine the torque at idle speed (with a given direction but no accelerator output). To emulate the function of automatic cars.
Brake setpoint required to offset idle torque	25-100%	Determine how much brake pedal output can completely offset the idle torque value.
The rate at which idle torque is established.	0.1-5s	When the direction is given, the speed at which the idle torque gradually increases.
Idle torque release rate	0.1-5s	The rate at which the idle torque gradually decreases when no direction is given.
Gear softness	0-100%	The establishment process of accelerator output is changed from linear to S-shaped. The larger the value, the greater the curvature of the S curve. When the speed increases to a certain extent, the softening effect will gradually disappear.
The speed at which the braking torque gradually decreases	200-6000rpm	When the motor speed decreases from this value to 0, the maximum braking current decreases from 100% to 0%. When this value is set too small, it may cause the vehicle to shake.
Reverse softness	0-100%	When the speed is close to 0, the larger this value is, the softer the switching from regenerative braking to driving will be.
Max. speed deceleration rate	0.1-30s	When the maximum speed is modified to become larger, the inverter gives the speed increase rate.
Maxi. speed acceleration rate	0.1-30s	When the maximum speed is modified, the inverter gives the speed reduction rate.

Pump control mode

Parameter	Permitted Range	Description
Max. speed	200-8000rpm	Maximum permitted output speed in pump control mode

Speed superposition enable	0/1	0 = prohibit, make each maximun given quantity of pump control (including power steering, lifting, tilting, etc.) the given speed of the inverter. 1 = enable, each given quantity of pump control is superimposed as the given speed of the inverter in turn, but it will not exceed the set maximum speed.
Main contactor enable	0/1	1: Interlocking disconnection delay = sequence delay+disconnection delay; 0: Interlock disconnection delay = sequence delay.
Pump controlled idle speed value	0-4000rpm	After interlocking, the given speed of the inverter without other given conditions.
Power steering speed	0-4000rpm	Only when the power steering signal is given, the given speed of the inverter.
Lifting speed	0-4000rpm	Only when the lifting signal is given, the given speed of the inverter.
Tilting speed	0-4000rpm	Only when the tilt signal is given, the given speed of the inverter.
Standby speed	0-4000rpm	A given speed that can be used as other switching signals.
Power steering stop delay	0-60s	Time for the motor to continue running after the steering signal disappears.
Pump throttle enable	0/1	In some applications, the lifting signal is not a switch value but an analog value. If enabled, analog input is used instead of switch input as the given speed of the inverter. When lifting in this way, the speed of the motor will change continuously with the input of analog quantity.
Suppression menu		
Parameter	Permitted Range	Description
Forward slope velocity restraining force	0-100%	Without the accelerator given, the maximum restraining torque output by the inverter is used to reduce the slope speed of the vehicle when the vehicle slopes forward.
Backward slope speed inhibition force	0-100%	When there is no accelerator given time, the maximum restraining torque output by the inverter is used to reduce the rolling speed of the vehicle.
Flexible parking speed	0-500rpm	When the speed is lower than this set value, the inverter will brake at a smaller deceleration rate. If set to 0, there is no such function. This parameter only applies to speed mode.
Position keeping menu		
Parameter	Permitted Range	Description

Position hold enable	0/1	Enable and disable of slope standing function. 0 = disable 1 = enable
Kp	2 – 100%	Proportional gain value of position adjustment. Increasing this gain value can reduce the backward sliding distance of the vehicle when parking on the slope, but it may cause jitter. If the setting is too small, the distance of the vehicle sliding backwards will become longer when parking on the slope.
Ki	2 – 100%	Reserved items.
Kd	0 – 100%	Differential gain value of position adjustment. If the gain value is set too large, jitter may occur during the position adjustment. If the setting is too small, the vehicle's backward sliding distance will be longer when parking on the slope.

Current limit menu

Parameter	Permitted Range	Description
Driving current limit	5-100%	The maximum driving current allowed by the inverter. Reducing this value will reduce the maximum driving torque of the inverter.
Regenerative current limit	5-100%	The maximum regenerative current allowed by the inverter. Reducing this value will reduce the maximum regenerative torque of the inverter.
Brake current limit	5-100%	When the output is effective, limit the maximum regenerative current given by the brake pedal.
Interlocking braking current limit	5-100%	The maximum regenerative current allowed by the inverter during interlocking braking.
Walking BDI restriction percentage	0-100%	When BDI is low, it will affect the output power limit value of tractor.

Power limit curve menu

Parameter	Permitted Range	Description
Base speed value	100-4000rpm	Basic speed values used for driving limit curve and regeneration limit curve.
Delta step value	50-1000rpm	Δ step value used for driving limit curve and regeneration limit curve.
Base speed driving current	0-100%	These parameters define the driving current limiting ratio at different speeds, in which the speed is determined by the base speed value and the delta step value. This allows the inverter to increase or decrease
Base speed+Δ driving current	0-100%	

Base speed+2Δ driving current	0-100%	the driving current according to the change of speed.
Base speed +4Δ driving current	0-100%	
Base speed+8Δ driving current	0-100%	
Base speed regenerative current	0-100%	These parameters define the regenerative current limiting ratio at different rotating speeds, in which the speed is determined by the base speed value and the delta step value. This allows the inverter to increase or decrease the regenerative current according to the change of speed.
Base speed+Δ regenerative current	0-100%	
Base speed+2Δ regenerative current	0-100%	
Base speed+4Δ regenerative current	0-100%	
Base speed+8Δ regenerative current	0-100%	

Accelerator menu

Parameter	Permitted Range	Description
Accelerator type	1-4	1 = two-wire potentiometer, 5kΩ-0 input 2 = three-wire 1kΩ-10kΩ potentiometer or 0-5v voltage source 3 = Two-wire potentiometer, 0-5k ohms input 4 = No accelerator
Forward starting voltage	0-5v	Given forward, it define the effective threshold voltage of accelerator output. Increasing this value will increase the empty travel range of large accelerator.
Forward midpoint percentage	0-100%	Given forward, it define the output percentage of half of the effective voltage of the accelerator ((forward starting voltage+ Forward terminal voltage)/2).
Forward terminal voltage	0-5v	Given forward, the accelerator output is 100% of the corresponding accelerator voltage. Select appropriate voltage value to ensure that the accelerator can have 100% output.
Forward starting voltage offset	0-100%	Given the offset corresponding to the starting voltage of the accelerator when moving forward.
Backward starting voltage	0-5v	Given backward, it defines the effective threshold voltage of accelerator output. Increasing this value will increase the empty travel range of large accelerator.
Backward midpoint percentage	0-100%	Given backward, it defines the output percentage of half of the effective voltage of the accelerator ((back start voltage+back terminal voltage) /2).

Backward terminal voltage	0-5v	When the accelerator output is set to retreat, it is the accelerator voltage corresponding to 100%. Select appropriate voltage value to ensure that the accelerator can have 100% output.
Backward starting voltage offset	0-100%	Given backward, the offset corresponding to the starting voltage of the accelerator.
High pedal/sequence fault type	0-3	0 = High pedal/sequence fault protection is prohibited. 1 = After the key is closed, check once whether the relevant inputs are operated in the correct order: first close the key, then close the interlock switch, and finally the given direction or throttle input is greater than 25%. When the key is not turned off but the interlock is turned off and the sequential delay time has passed, the inverter will continuously check whether the' interlock switch is closed' is before the' given direction or throttle input is greater than 25%'. 2 = After the key is closed, check whether the primary throttle input is less than 25%. When the vehicle is in a stable state (the vehicle speed is 0 for a short time), the inverter continuously detects whether the' interlock switch closed or given direction' is before the' throttle input is greater than 25%'. Regardless of the sequence of' interlock switch closed' and' given direction'. When the vehicle is in the running state (the vehicle speed is not 0), this sequence fault is not detected. 3 = After the key is closed, check whether the primary throttle input is less than 25%. The inverter continuously checks whether' interlock switch closed or given direction' is before' throttle input is greater than 25%'. Regardless of the sequence of' interlock switch closed' and' given direction'. The difference between Type 3 and Type 2 is that Type 2 only detects the sequence failure when the vehicle is in a stable state, while Type 3 continuously detects whether the input sequence is correct, that is,' the interlock switch is closed or the given direction' must be before' the throttle input is greater than 25%'.
Sequential delay	0-5.0s	Cooperate with the detection of high pedal/sequential fault type 1. It is helpful to prevent inadvertent triggering of high pedal/sequence faults, especially in situations where interlocking switches are frequently opened and closed.
Accelerator output too low voltage		The lowest voltage output when the accelerator pedal is trouble-free.
Accelerator output excessive voltage		The maximum voltage output when the accelerator pedal has no fault.
Brake menu		

Parameter	Permitted Range	Description

Brake pedal enable	0/1	0 = the brake pedal is not enabled. 1 = enable the brake pedal
Type of brake pedal	1-4	1 = two-wire potentiometer, 5KΩ-0 input; 2 = single-ended three-wire 1KΩ-10KΩ potentiometer, 0-5V voltage source or current source; 3 = Two-wire potentiometer, 0-5KΩ input; 4 = On-off braking; Note: Do not change this parameter when the inverter is working. After the change, a parameter change fault will occur, which cannot be cleared until it is reset.
Brake starting voltage	0-5v	Refer to the accelerator configuration parameters, similar to the accelerator curve.
Brake midpoint percentage	0-100%	
Brake terminal voltage	0-5v	
Brake starting voltage offset	0-100%	
Effective level of brake	0/1	When the brake type is set to switch input, the effective level of the brake can be selected. 0 = low level is active 1 = high level is active.
Maximum output torque of brake	0-4096	As the maximum value for reference when calculating the braking rate. By matching with the braking rate, a suitable value can be selected to make the braking effect match different applications.
Low brake voltage output		The lowest voltage output when the brake pedal has no fault.
Excessive brake voltage output		The maximum voltage output when the brake pedal has no fault.

Main contactor menu

Parameter	Permitted Range	Description
Main contactor detection enable	0/1	0 = Turn off contactor detection. 1 = Enable contactor detection. After enabling, the inverter will detect whether the main contactor is stuck or not and the main contactor is not closed, and also enable related fault detection.
Main contactor pull-in voltage	0-100%	The percentage of the voltage of the main contactor when closing to the current battery voltage, closing the main contactor with a higher closing voltage can ensure the complete closing of the main contactor, and the control of the main contactor after 1s. The terminal voltage is reduced to maintain voltage to reduce power consumption and heat generation.

Main contactor holding voltage	0-100%	The voltage that keeps the contactor engaged after the main contactor is engaged, expressed as a percentage of the current battery voltage.
Battery voltage compensation	0/1	0 = No battery voltage compensation is enabled; 1 = Enable battery voltage compensation; After being enabled, the holding voltage of the contactor is the percentage of the current battery rated voltage, which will not change with the change of the battery voltage. For example, the set holding voltage is 80% and the battery rated voltage is 48V. If this item is not enabled, the holding voltage = 80% of the battery voltage; if this item is enabled, the holding voltage = 48 *80% = 38.4VV. If the power supply voltage is higher than 48V, the driving will reduce the duty ratio to maintain the holding voltage.
Interlocking type	0/1	0 = Interlocking state is controlled by switch 3; 1 = The interlocking state is consistent with the key switch.
Interlocking delay	0-40.0s	After the interlock switch is opened, the main contactor will delay this set value before opening.
Unbuckle detection voltage	0-84V	The threshold voltage of the main contactor failure detection is not closed. When the difference between the key terminal voltage and the capacitor voltage is greater than this set value, it is regarded as the main contactor failure.
Precharge enable	0/1	0 = No precharging will be carried out inside the inverter, and the main contactor will be closed when the condition of closing the main contactor is met. 1 = The inverter will be precharged internally, and the main contactor will be closed after the capacitor voltage is charged to a certain value, which will also enable the relevant fault detection.

Fault detection menu

Parameter	Permitted Range	Description
Drive 1 detection enable	0/1	These five parameters can configure whether to detect the five-way drive. When a certain drive detection is enabled, it will detect the open circuit of the corresponding drive circuit. When the fault is detected, the inverter will turn off the corresponding drive circuit and report the failure. If the corresponding load is not connected to the driving circuit, the corresponding fault detection should be turned off to avoid affecting the normal function. For short circuit protection, the inverter is always enabled, regardless of whether the detection is enabled or not.
Drive 2 detection enable	0/1	
Drive 3 detection enable	0/1	
Drive 4 detection enable	0/1	
Drive 5 detection enable	0/1	

Maximum current of auxiliary power supply	0-200mA	Maximum current limit of external +5V and +12V outputs. When this limit is exceeded, the inverter will turn off the output and report a fault.
Minimum current of auxiliary power supply	0-200mA	The minimum current limit of external +5V and +12V outputs, below which the inverter will turn off the output and report a fault.

Motor menu

Parameter	Permitted Range	Description
Maximum speed	100-8000rpm	The acceleration and deceleration rate of the accelerator is calculated with reference to this speed value. For example, if the acceleration rate is set to 5s and the setting value is set to 2000rpm, it means that the motor speed is accelerated to 2000rpm within 5s. If the maximum speed of the speed mode is less than 2000rpm, the time to accelerate to the maximum speed of the speed mode is less than 5s.
Exchange code disk	0/1	When the code wheel A B phase is incorrect, it can be adjusted by this parameter.
Exchange phase line	0/1	When the motor phase line needs to be adjusted, it can be configured by this parameter.
Number of code lines	32-256	This parameter is used to set the number of pulses output by the motor when it rotates a circle of code wheel.
Pole pair of motor	1-4	The pole number of the motor to be matched can be seen on the motor nameplate.
Inverter current limiting value	0-650A	The maximum line current that the inverter can bear, this parameter cannot be changed at will to ensure that the inverter will not be damaged.
Learning speed of motor	0-4000rpm	Speed setting of the inverter during motor self-learning.
Motor learning current	20-100%	When the inverter conducts motor self-learning, set the current percentage. When the current is 100%, it corresponds to the maximum current of the inverter.
Motor excitation current	20-255A	Excitation current obtained after motor adaptation.
Motor time constant	0.01-2.55s	Motor time constant obtained after motor adaptation.
Excitation calibration coefficient	0-32767	The motor controls the parameters needed in calculation, and calibrates the excitation current.

Minimum excitation current	0-32767	Minimum excitation current value.
Motor learning enable	0/1	When the configuration is set to 1 and the main contactor is closed, the inverter starts to match the motor, and the learned parameters will be reflected in the monitoring menu, which needs to be manually input into the configuration parameters.
Motor temperature control menu		
Parameter	Permitted Range	Description
Temperature sensor enable	0/1	When this parameter is set to 1, the inverter will protect the temperature of the motor. When the temperature exceeds the overtemperature point, the output power will be linearly reduced, and the output will be turned off until the severe overtemperature point is reached.
Temperature sensor type	1-5	The five sensor types are as follows: 1 = KTY83-122 2 = Reserved 3 = KTY84-130 or KTY84-150 4 = Reserved 5 = PT1000
Motor temperature compensation	-20-20℃	Through this configuration, the consistency problem of different motor temperature sensors can be corrected to achieve accurate display.
Motor overtemperature value	0-250℃	When the motor temperature reaches the set value, the inverter will give an alarm and start linearly reducing the output power. When the temperature is lower than the set value, the warning will be lifted.
Maximum temperature value of motor	0-250℃	When the motor temperature reaches this set value, the inverter will perform output shutdown protection. Once it enters this shutdown protection, even if the temperature is lower than this set value again, the inverter needs to restart the key to remove the fault.
Turning speed limit function		
Turn speed limit enable	0/1	Whether the turning speed limit function is enabled.
Minimum allowable turning speed limit	0-3000	When the vehicle speed is higher than this value, the turning speed limit function is effective, but it is invalid when the vehicle speed is lower than this value.
Turning voltage midpoint	0-500	The voltage value output by the sensor when the vehicle is not turning.
Limit percentage corresponding to	0-1000	Speed limit ratio within △ angle.

midpoint+△		
Limit percentage corresponding to midpoint +2△	0-1000	Speed limit ratio within 2△ of rotation angle.
Turning left dead angle voltage	0-500	Dead-time voltage value when turning left.
Turning right dead angle voltage	0-500	Dead-time voltage value of right turn.
Turn-up delay	0-300	Recovery time after speed limit is cancelled.
Speed limit delay	0-300	Action time after turning speed limit is triggered.

Battery menu

Parameter	Permitted Range	Description
Nominal voltage	24.0-84.0V	The nominal voltage of the whole vehicle battery, this parameter is very important, which involves the voltage protection of the battery and the electrical system of the whole vehicle. Overvoltage protection will reduce regenerative braking current, which can avoid the damage of batteries and other electrical system parts caused by overvoltage; Under-voltage protection prevents the system from working under the design threshold, and can effectively prevent the battery from over-discharging, thus protecting the battery more effectively. User-defined under-voltage value and user-defined over-voltage value are calculated by nominal voltage. Note: The inverter with low rated voltage can't be used in high voltage system, for example, the inverter with 36-48V can't be used in 60V system, which may cause the capacitor and power tube to be damaged due to overvoltage, while the system with high rated voltage can be properly compatible with low voltage and its power is less than that of the original inverter, otherwise the inverter may not be able to provide the required current due to the limitation of capacitor capacity. Please contact Santroll for details.
User-defined overvoltage value	115-200%	The overvoltage value that can be set by the user is set according to the performance requirements of the battery and the highest voltage that the electrical system of the whole vehicle can bear. The base of the overvoltage value is the nominal voltage of the battery. For example, if it is set to 120% and the nominal voltage is 48V, the protection voltage is 120% * 48 = 57.6V.
User-defined undervoltage value	50-80%	The user-settable undervoltage value is set according to the performance requirements of the battery and the lowest voltage that

		the electrical system of the whole vehicle can bear. The base of the overvoltage value is the nominal voltage of the battery. For example, if it is set to 80% and the nominal voltage is 48V, the protection voltage is 80% * 48 = 38.4V.
Undervoltage power reduction range	2.0-14.0V	The voltage difference corresponding to the inverter's drive current decreasing from 100% to 0%, and the inverter's severe undervoltage value can be set by this parameter. For example, if the power reduction range is set to 10V, the severe undervoltage value = undervoltage value -10V.
Overvoltage power reduction range	2.0-14.0V	When the brake current of the inverter drops from 100% of the set brake current to 0% of the corresponding voltage difference, the severe overvoltage value of the inverter can be set by this parameter. For example, if the power reduction range is set to 10V, the severe overvoltage value = overvoltage value +10V, which must be lower than the maximum voltage of the inverter.
The maximum voltage of the inverter	0-125.0V	The highest voltage that the current inverter can bear.
Monomer reset voltage	0-300	The voltage value at which the battery is fully charged to meet the reset condition.
Monomer full voltage	0-300	The voltage value of the battery when the battery is fully charged.
Monomer empty voltage	0-300	Cell voltage value when the battery is zero.
Minimum discharge time	0-600	When the voltage decreases continuously for more than this value when the battery is discharged, BDI decreases.
Maximum percentage of BDI reset compare	0-100	When the current BDI value is greater than this value, power on again. Even if BDI reaches the reset voltage, it will not perform a reset action.
Low battery warning value	0-100	When BDI power is lower than this value, the inverter reports a fault and sends it to the instrument.

Interlocking brake menu

Parameter	Permitted Range	Description
Interlock brake enable	0/1	Enable the interlocking braking function of the inverter? 1 = When the interlock signal is cancelled, the inverter stops the brake according to the deceleration rate set by the interlock brake; 0 = When the interlock signal is cancelled, the inverter will brake at the normal deceleration rate.
Deceleration rate at high speed	0.1-30.0s	When the interlock switch is turned off, set the deceleration rate (seconds) of the vehicle in the high-speed section. The larger this value is, the slower the response of the system will be.

Deceleration rate at low speed	0.1-30.0s	When the interlock switch is cancelled, set the deceleration rate (in seconds) of the vehicle in the low speed section. The larger this value is configured, the slower the system will respond.
Extra (custom) menu		
Parameter	Permitted Range	Description
Speed/speed ratio coefficient	10.0-3000.0	According to the motor speed, it is converted into the actual vehicle speed. When setting this parameter, you need to know the variable ratio (G) of the vehicle and the diameter (D) of the wheels. Assuming that the unit of wheel diameter is cm, k = （G/d） *530.5.
Vehicle mode type	0 – 3	0 = Custom mode 1 = Economic mode 2 = Power mode 3 = Super Mode
Reverse speed	0 – 100%	Configuration items can reduce the speed of reversing, and can be set to different percentages according to different vehicle requirements. When set to 100%, the maximum reverse speed is same as the forward speed.
The maximum speed displayed by the instrument	200 – 8000rpm	The maximum speed of the speed bar displayed on the corresponding instrument.
Slope inhibition Kp	0-100	Parameters used in the adjustment of the speed loop of the slope are used to adjust the initial torque of the slope, and generally do not change.
Slope inhibition Ki	0-100	Parameters used in the adjustment of the ramp speed loop are used to adjust the ramp maintenance torque, and generally do not change.
Allowable speed of sliding slope	10-3000rpm	Speed of motor when sliding.

6. Common faults and codes of inverters

No.	Breakdown Name	Conditions of fault occurrence and treatment methods	Fault exit condition	Fault phenomenon and fault code
1	Disconnect circuit of motor	Condition: More than one phase of the motor phase line is not connected; Method: Check whether the phase wires of the motor are firmly connected and the motor wires are not damaged.	1. Connect the phase line; 2. Restart key	1. Disconnect the contactor immediately after closing; 2. The fault indicator indicates 3-7 fault codes.
2	Open circuit of main contactor coil or short-circuit	Condition: DRV1 is short-circuited or DRV1 is open-circuited; Method: Check whether the contactor coil harness is in good condition and firmly connected.	1. Connect the DRV1 Coils; 2. Restart interlock switch	1. The main contactor is disconnected; 2. The fault indicator indicates 3-1 fault code.

3	Adhesion of main contactor	Condition: the main contactor is stuck (note: contactor detection is required); Method: When the power is cut off, a multimeter is used to measure if the two contacts of contactor are conductive.	1. Replace the main contactor; 2. Restart key	1. The main contactor does not close; 2. Report 3-8 fault codes within 2 seconds.
4	Pre-charge fault	Condition: Pre-charge failed; Method: First check whether B+B- connection is correct. If there is no problem, measure the diode voltage drops of inverters B-, B+ to inverters U, V and W with red and black probes of multimeter respectively (the motor phase line needs to be disconnected), which is normally between 400 and 600. In case of short circuit and open circuit, the inverter can be directly replaced.	1. Make sure that B+ and B- line connections are correct; 2. Restart the key	1. The main contactor does not close; 2. Report 1-4 fault codes within 2 seconds.
5	HPD High pedal sequence fault	Condition: the key is closed, the given direction or throttle output is > 25%; Method: This fault is a common one. The direction signal of the walking inverter is input when the key is turned on, and the switch signals of the pump inverter, such as lifting, tilting, and side shifting, are input when the key is turned on. The corresponding switch can be replaced or adjusted. It can also be directly determined which signal input has a problem through monitoring, and directly check it.	Neutral and throttle output ≤25%	1. The inverter does not output; 2. The fault indicator indicates 4-7 fault codes.
6	undervoltage	Condition: power supply voltage ≤ configured undervoltage value ±2V; Method: Measure the battery voltage with a multimeter to see if it is too low, and compare it with the multimeter voltage through monitoring. If it is consistent, check whether the undervoltage parameter configuration is correct.	Power supply voltage > (configured undervoltage value +2V) ±2V	1. Limit the maximum current output by the inverter proportionally; 2. The fault indicator lights 2-3 fault codes.
7	Severe undervoltage	Condition: Power supply voltage ≤ severe undervoltage value 2V (Note: severe undervoltage value = configured voltage value+battery voltage and power reduction range) Method: Measure the battery voltage with a multimeter to see if it is too low, and compare it with the multimeter voltage through monitoring. If it is consistent, check whether the undervoltage parameter configuration is correct.	Power supply voltage > (severe undervoltage value+2V)+ 2V	1. The inverter does not output; 2. The fault indicator indicates 1-7 fault codes.

8	Overtension	Condition: Power supply voltage ≥ configured overvoltage value 2V Method: Measure the battery voltage with a multimeter to see if it is too low, and compare it with the multimeter voltage through monitoring. If it is consistent, check whether the overvoltage parameter configuration is correct.	Power supply voltage < (configured overvoltage value+2v)+ 2V	1. Limit the maximum current output by the inverter proportionally; 2. The fault indicator lights 2-4 fault codes.
9	Severe overvoltage	Condition: Power supply voltage ≥ severe overvoltage value 2V (Note: severe overvoltage value = configured overvoltage value +10V) Method: Measure the battery voltage with a multimeter to see if it is too low, and compare it with the multimeter voltage through monitoring. If it is consistent, check whether the overvoltage parameter configuration is correct.	1. the power supply voltage < severe overvoltage. ±2V; 2. Restart the key	1. The inverter does not output; 2. The fault indicator indicates 1-8 fault codes.
10	Motor overtemperature	Condition: motor temperature ≥ motor overtemperature value Method: Monitor whether the motor temperature reaches the motor overtemperature value. If so, stop and have a rest. If the monitored temperature is much different from the actual temperature, replace the motor temperature sensor or replace the motor.	Motor temperature < motor overtemperature value	1. Limit the maximum current of control output proportionally; 2. The fault indicator indicates 2-8 fault codes.
11	Motor temperature sensor fault	Condition: The motor temperature sensor is disconnected or the output is short-circuited to the ground. (Note: motor temperature detection should be enabled); Method: Check whether the wiring harness of the motor temperature sensor is well connected, and if so, replace the motor temperature sensor or the motor.	Connect the motor temperature sensor correctly.	1. Limit the output of the inverter to 50% of the maximum current; 2. Malfunction indicator light 2-9 malfunction light
12	The inverter temperature is extremely low.	Condition: inverter temperature ≤-40℃; Method: Monitor whether the temperature of the inverter reaches a serious low value. If so, the ambient temperature is too low, making it unsuitable for operation. If the monitored temperature is much different from the actual one, replace the inverter.	1. Temperature of inverter >-40℃; 2. Restart key	1. The inverter does not output; 2. The fault indicator indicates 1-5 fault codes.
13	Inverter temperature is too high.	Condition: inverter temperature ≥ 85℃; Method: Monitor whether the inverter temperature reaches the inverter overtemperature value. If so, stop and rest. If the monitored temperature is much different	Inverter temperature <85±℃	1. Limit the maximum current of control output proportionally; 2. The fault indicator indicates 2-2 fault codes.

		from the actual one, replace the inverter.		
14	The inverter temperature is too high.	Condition: inverter temperature ≥ 95℃; Method: Monitor to see if the temperature of the inverter reaches the serious over-temperature value of the inverter. If so, stop and have a rest. If the monitored temperature is much different from the actual one, replace the inverter.	1. Temperature of inverter < 95℃; 2. Restart key	1. he inverter does not output; 2. The fault indicator indicates 1-6 fault codes.
15	External +5V fault, Overload of external power supply	Condition: external +5V voltage < 4.5V or > 5.5V external power supply output current < configured minimum output current or > configured maximum output current; Method: Measure whether the external output 5V is normal by monitoring or multimeter (generally used in J26 pin of motor code wheel power supply). If it is in production, monitor the external output current value. If it is out of range, check whether the circuit is connected well. If it is connected well and less than the minimum current value, change the parameter minimum current value to see if it can be solved. If it is not solved, replace the motor. If the connection is good and larger than the maximum current, replace the motor.	External +5V voltage ≥4.5V and ≤ 5.5V, the output current of external power supply is ≥ configured minimum current value and ≤ configured maximum current value.	2-5, 6-9 fault codes are reported by the fault indicator.
16	Accelerator output is high.	Conditions: the accelerator is disconnected or the output voltage of the accelerator is ≥ 5.5V; Method: If the accelerator voltage is ⩾5.5V measured by monitoring or multimeter, use multimeter to check whether the inverter terminal and accelerator terminal are connected. Generally, this fault will be reported when the signal line is not connected.	Connect accelerator correctly.	1. The equivalent output of accelerator is 0; 2. The fault indicator indicates 4-1 fault code.
17	Brake output is high.	Condition: the brake is disconnected or its output is ≥5.5V (Note: this fault is only detected when the brake pedal is enabled); Method: If the brake voltage is ⩾5.5V measured by monitoring or multimeter, use a multimeter to check whether the inverter end and the brake end are connected. Generally, this fault will be reported when the signal line is not connected.	Connect the brakes correctly.	1. The equivalent output of throttle is full braking value; 2. The fault indicator indicates 4-3 fault codes.

18	Accelerator overcurrent	Condition: the current at the low end of accelerator or brake is too large (100 mA); Method: Disconnect the accelerator connector to see if the fault can be eliminated. If so, replace the accelerator, if not, replace the inverter (only the accelerator with 5V power supply will have this fault)	Connect accelerator or brake correctly.	1. The equivalent output of throttle is 0; 2. Equivalent brake output full brake value; 3. The fault indicator indicates 4-5 fault codes.
19	Write EEPROM lose effectiveness	Conditions: 1. Unable to write correct data to EEPROM; 2. The written data is not within the set range; Method: Replace the inverter.	1. Ensure the correct connection of hardware; 2. Write correctly. Data; 3. Restart the key	1. The inverter does not output; 2. The fault indicator indicates 4-6 fault codes.
20	EEPROM Data out of range	Conditions: 1. Unable to read correct data from EEPROM; 2. The read data is not within the set range; Method: Restore to factory settings.	1. Ensure the correct connection of hardware; 2. Restore the factory Setting;	1. The inverter runs according to the default configuration parameters; 2. The fault indicator indicates 4-8 fault codes.
21	Important parameter modification breakdown	The important parameters were modified after the contactor was closed.	Restart key	1. The inverter does not output; 2. The fault indicator indicates 4-9 faults.
22	Inverter overflowing	The phase current output by the inverter is > 1.1 times of the current limiting value.	Restart key	1. The inverter does not output; 2. The fault indicator indicates 1-2 faults.
23	Motor lock-up	Condition: motor current > 325A, accelerator input > 50%, speed < 50rpm, duration > 5s Method: Check whether the code disk harness is connected normally and the parameters are configured correctly. Generally, the code wheel parameters are wrong or the code wheel is damaged. If changing the code disk parameters can't solve the problem, replace the code disk sensor or the motor.	1. Confirm if the code wire harness is in good condition; 2. Modify the parameter exchange code disk or phase line; 3. Restart the key;	1.The inverter does not output; 2. The fault indicator indicates 7-3 faults.
24	Motor learning failure	Report this fault after motor learning is completed.	Restart the key after reading the learning parameters.	1. The inverter does not output; 2. The fault indicator indicates 2-6 faults.

25	Current sensor fault block	Condition: the neutral point voltage of the sensor is out of range; Method: Replace the inverter.	Replace inverter.	1. The inverter does not output; 2. The fault indicator indicates 1-3 faults.
26	DSP match Wrong parameter setting	Condition: Error in configuring parameters of DSP; Method: Replace the inverter.	Restart key	1. The inverter does not output; 2. The fault indicator indicates 1-1 fault.
27	Receive and transmit fault between MCU and DSP CAN	Condition: Communication between MCU and DSP fails; Method: Replace the inverter.	Restart key	1. The inverter does not output; 2. The fault indicator indicates 2-1 fault.