Pure Electric Terminal Tractor Introduction

Model:SM4253T0BEV

SANY Marine Heavy Industry Co., Ltd

1. Design milestones

First model Start from 2018, handover in Dec. 2018

2nd Generation start in 2019, first batch(5 units) handover in Sep. 2019

3rd Generation for unmanned ETT

- First contract from China Merchant-18 units (cab remain), plan handover in Q3 2021;
- R&D project set by 2H 2021, ETT without cab type, special design for fully automation terminal

4th Generation for Autonomous ETT

R&D design for fast exchange battery(take 5 mins) solution to keep the ETT 24/7 operation (project start at 2022) , target fully automation terminal.

Total handover over 160 units in China

2. SM4253T0BEV Main Dimension and Appearance

Length：6340mm（Anti-collision beam can be shortened, the total length can be changed to 6250mm）
Width：2550mm；
Height：3580mm；
Wheelbase：3720mm；
Front Truck：2048mm；
Rear Truck：1860mm；

Vehicle appearance

Truck Specs Overview

Item	Specs
Model	SM4253T0BEV
Drive Type	4×2
Weight（kg）	9250
Wheelbase（mm）	3720
Max traction Mass（kg）	70000
Max. Speed（km/h）	30(Limit Speed)
Acceleration Speed(0-30Km/h)	14.45s/59m (Empty) 21.5s/90.6m(Loaded)
Deceleration Speed	2s/8m(Empty) 3.13s/13.3m(Loaded)
Min. Turning Diameter（mm）	14000mm
Min Clearance（mm）	240±20mm
Front Load(Loaded/Unloaded)	8680KG/5310KG
Rear Axle Load(loaed/Unloaded)	22569KG/3940KG
Fifth wheel(Loaded/Unloaded)	22000KG/0KG
The Fifth Wheel Clearance	1315mm
Max. grade(%)	8%

Item		Specs
Steering /Braking System		Electrically Driven Integrated Gear Type with Mechanical Back-Up/Pneumatic Disc Brakes,
Chasis		Sany Double-Deck Girder（8+6mm Thickness）
Front Suspension Composition		Plate spring Shock absorber Lateral stabilizer
Rear Suspension Composition		High Intensity Plate spring
Battery System	Type	Lithium-ion battery- CALTI
	Voltage（V）	618.24 V
	Rated storage energy（kWh）	282KW/H
Charing	Type	Doubel Gun Fast Charing Soc 20%~95% 60mins
EM Motors	Rated/Peak Power（kW）	100/185KW
	Rated/Peak Torque（Nm）	750/1300Nm
	Max. Rotating Speed（rpm）	3500rpm
TM Motors	Rated/Peak Power（kW）	80/150Kw
	Rated/Peak Torque（Nm）	750/1700Nm
	Max. Rotating Speed（rpm）	3000rpm
Tyre		12R22.5-18PR

3. Market developing plan

2018-2020 **(Stage 1)**
With domestic market (China) growth, market demands by environment policy, SANY comes as advanced player to lead market;

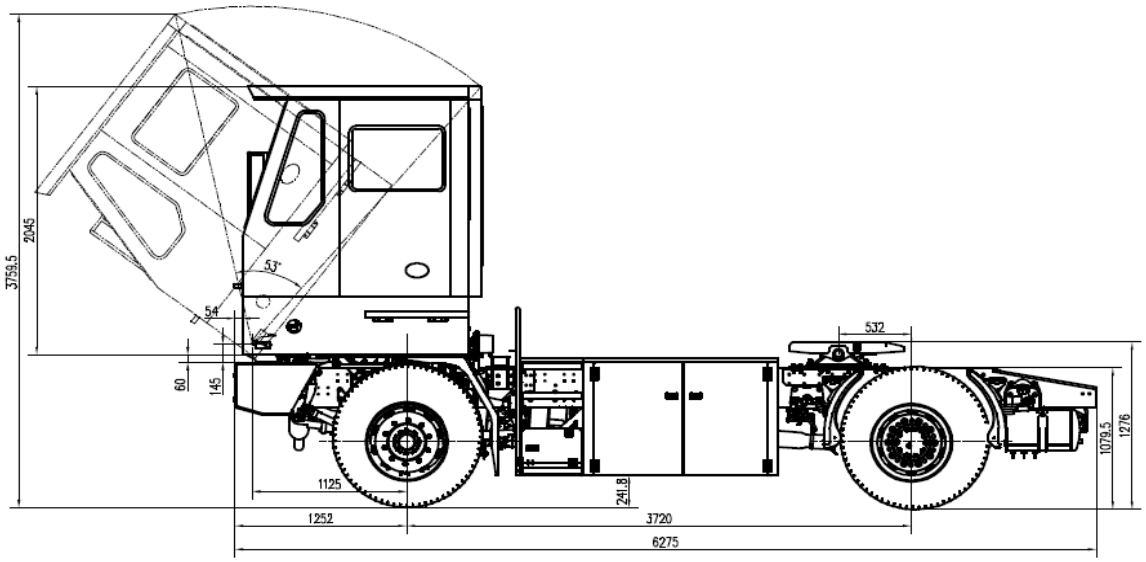
2020-2022 **(Stage II)**
During domestic market growth, SANY take much experience in this field, attempt to overseas market with partners; (South-east Asia & Africa & Latin America) as first target market); the battery technology develop influence on market select(warm area & similar entry standard with China);

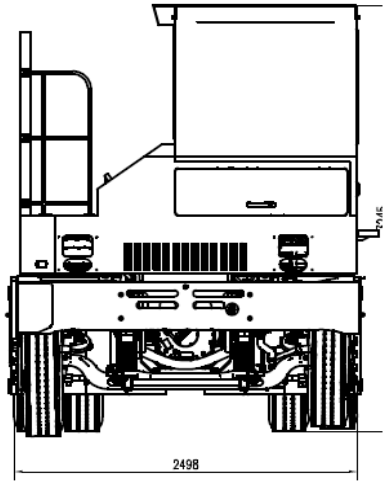
2022-2024 **(Stage III)**
With the battery technology developing & key components supplier products open to Europe & US market, CE & ANSI standards will be covered. SANY launches fully electric products to Globally market.

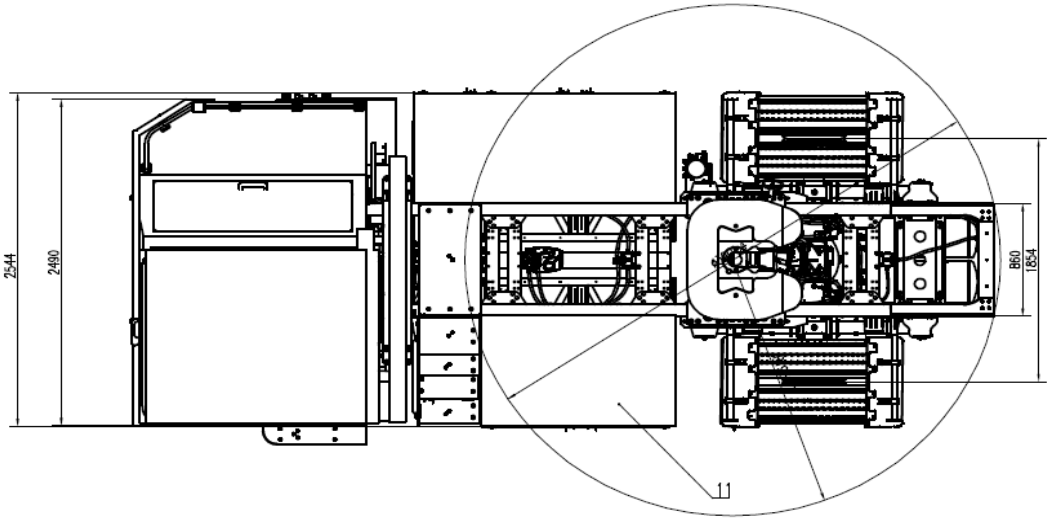
4. Following design standards:

NO.	Standard	Standard
1	GB/T16178-2011 场（厂）内机动车辆安全检验技术要求	GB/T16178-2011 Safety examinations and technical requirements for powered vehicles on the place used for a particular purpose
2	JT-T 886.1-2014 道路甩挂运输车辆技术要求 第1部分：半挂牵引车	JT-T 886.1-2014 Technical requirements for swap trailer transport of road vehicles. Part 1:Semi-trailer towing vehicle
3	GBT 18384.1-2015 电动汽车安全要求 第1部分：车载可充电储能系统（REESS）	GBT 18384.1-2015 Electrically propelled road vehicles——Safety specifications. Part 1: On -board rechargeable energy storage system(REESS)
4	GBT 18384.2-2015 电动汽车安全要求 第2部分：操作安全和故障防护	GBT 18384.2-2015 Electrically propelled road vehicles——Safety specifications. Part 2: Vehicle operational safety and protection against failures
5	GBT 18384.3-2015 电动汽车安全要求 第3部分：人员触电防护	GBT 18384.3-2015 Electrically propelled road vehicles——Safety specifications. Part 3: Protection of persons against of electric shock
6	GB/T18488.1-2015《电动汽车用电机及其控制器技术条件》	GB/T18488.1-2015 Technical conditions of motors and controller for eletrically propelled road vehicles
7	GB/T18488.2-2015《电动汽车用电机及其控制器试验方法》	GB/T18488.2-2015 Testing methods of motors and controller for eletrically propelled road vehicles
8	QC/T413-2002《汽车电气设备基本技术条件》	QC/T413-2002 Basic technical conditions of electric vehicles accessory
9	GB/T-17619-1998《机动车电子电器组件的电磁辐射抗扰性限值和测量方法》	GB/T-17619-1998 Limits and methods of testing for immunity of electrical/electronic sub-assemblies in vehicles to electromagnetic radiation
10	GB/T 18655-2010 车辆、船和内燃机 无线电骚扰特性 用于保护车载接收机的限值和测量方法	GB/T 18655-2010 Vehicles, boats and internal combustion engines——Radio disturbance characteristics——Limits and methods of measurement for the protection of on-board receivers
11	QC/T 897-2011 电动车用电池管理系统技术条件	QC/T 897-2011 Technical specification of battery management system for electric vehicles
12	QC/T 417.3-2001 车辆电线束插接器	QC/T 417.3-2001 Connectors of electric wireharness for vehicle
13	GB/T 2423 电工电子产品环境试验	GB/T 2423 Environmental test for electrical product
14	GB/T 4208-2008 外壳防护等级(IP代码)	GB/T 4208-2008 Degrees of protection provided by enclosure(IP)
15	GB/T 2408-2008 塑料 燃烧性能的测定 水平法和垂直法	GB/T 2408-2008 Plastic——Determination of burning characteristics——Horizontal and vertical test
16	GB/T 19596-2017 电动汽车术语	GB/T 19596-2017 Terminology of electric vehicles
17	GB/T 18384.1~18384.3-2015 电动汽车安全要求	GB/T 18384.1~18384.3-2015 Safety requirements for electric vehicles
18	QC/T 743-2006 电动汽车用锂离子蓄电池	QC/T 743-2006 Lithium-ion battery for electric vehicle
19	GB/T 27930-2015 电动汽车非车载传导式充电机与电池管理系统之间的通信协议	GB/T 27930-2015 Communication protocols between off-board conductive charger and battery management system for electric vehicle
20	GB/T 18487.1-2001 电动车辆传导充电系统一般要求	GB/T 18487.1-2001 The general requirements of electric vehicle conductive charging system
21	GB/T 20234-2011 电动汽车传导充电用连接装置	GB/T 20234-2011 Connection set of conductive charging for electric vehicles
22	GB/T 17626.12-1998 振荡波抗扰度	GB/T 17626.12-1998 Oscillatory waves immunity test
23	GB/T31484-2015 电动汽车用动力蓄电池循环寿命要求及试验方法	GB/T31484-2015 Cycle life requirements and test methods for traction battery of electric vehicle
24	GB/T31485-2015 电动汽车用动力蓄电池安全要求及试验方法	GB/T31485-2015 Safety requirements and test methods for traction battery of electric vehicle
25	GB/T31486-2015 电动汽车用动力蓄电池电性能要求及试验方法	GB/T31486-2015 Electrical performance requirements and test methods for traction battery of electric vehicle
26	GB/T31467.2-2015 电动汽车用锂离子动力蓄电池包和系统 第2部分：高能量应用测试规程	GB/T31467.2-2015 Lithium-ion traction battery pack and system for electric vehicles——Part 2: Test specification for High energy applications
27	GB/T31467.3-2015 电动汽车用锂离子动力蓄电池包和系统 第3部分：安全性要求与测试方法	GB/T31467.3-2015 Lithium-ion traction battery pack and system for electric vehicles——Part 3: Safety requirements and test methods
28	GB/T 32960.1-2016 电动汽车远程服务与管理系统技术规范 第1部分：总则	GB/T 32960.1-2016 Technical specifications of remote service and management system for electric vehicles—Part 1: General principle
29	GB/T 32960.2-2016 电动汽车远程服务与管理系统技术规范 第2部分：车载终端	GB/T 32960.2-2016 Technical specifications of remote service and management system for electric vehicles—Part 2: On-board terminal
30	GB/T 32960.3-2016 电动汽车远程服务与管理系统技术规范 第3部分：车载通讯协议及数据格式	GB/T 32960.3-2016 Technical specifications of remote service and management system for electric vehicles—Part 3: Communication protocol and data format
31	GB/T 34658-2017 电动汽车非车载传导式充电机与电池管理系统之间的通讯协议一致性测试	GB/T 34658-2017 Conformance test for comunication protocols between off-road conductive charger and battery management system for electric vehicle
32	GB/T 18655-2010 车辆、船和内燃机无线电骚扰特性用于保护车载接收机的限值和测量方法是不注日期的引用文件，其最新版本（包括所有的修订单）适用于本产品。	GB/T 18655-2010 Vehicles, boats and internal combustion engines——Radio disturbance characteristics——Limits and methods of measurement for the protection of on-board receivers. It is an undated reference file and the latest version (including all revised versions) is applicable to this product.

5. Layout

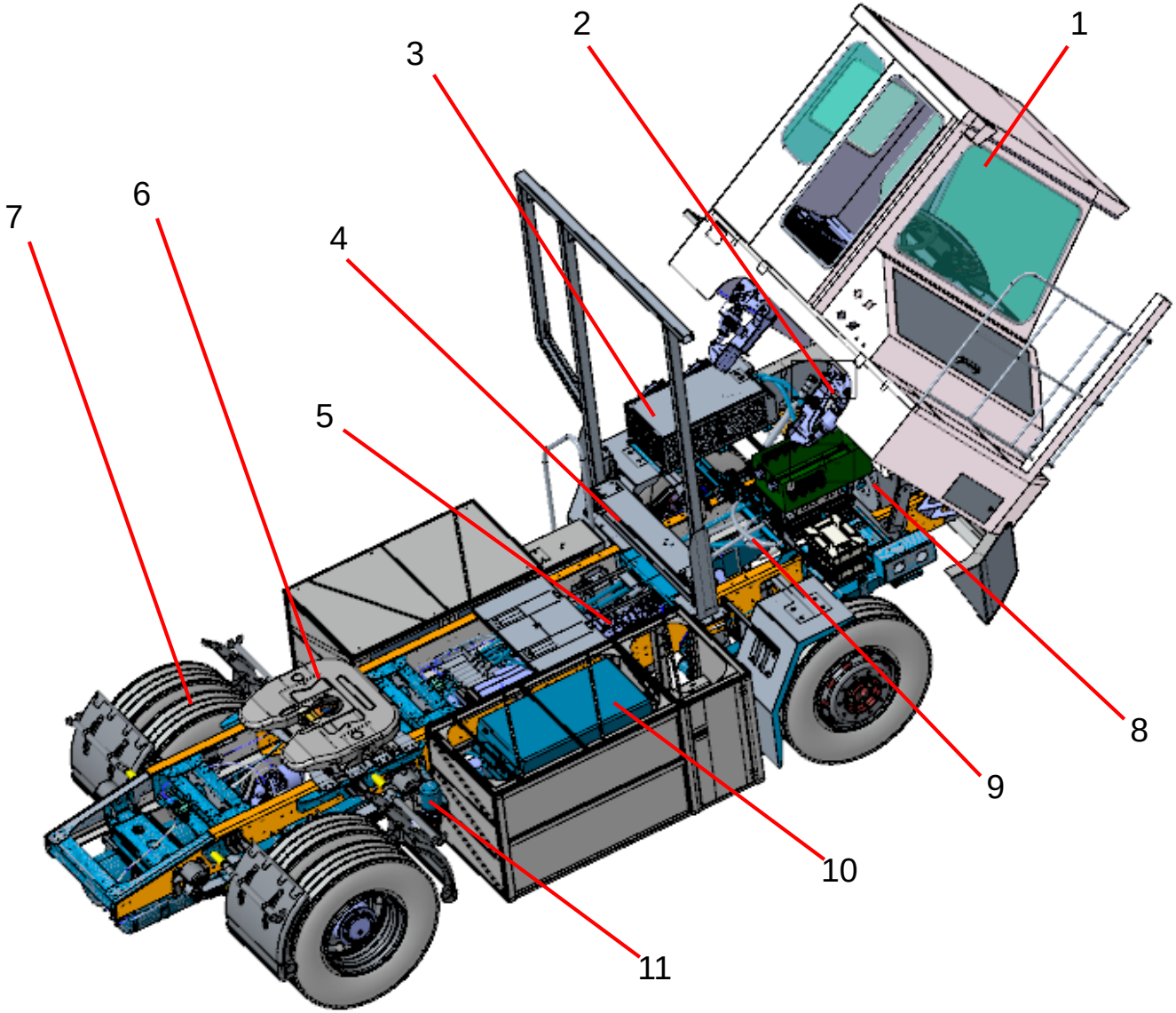






Overall Dimension:
Length : 6275 mm
Width : 2544mm ;
Height : 3580mm ;
Wheelbase : 3720mm ;
Front Truck : 2544mm ;
Rear Truck : 1854mm ;

Layout



1. Cabin & operation package
2. Electric steering system
3. Battery cooling system
4. Chassis accessory system
5. Electric drive system
6. Traction saddle device
7. Chassis main structure
8. AC system
9. Cooling system
10. Electric system
11. Electric braking system

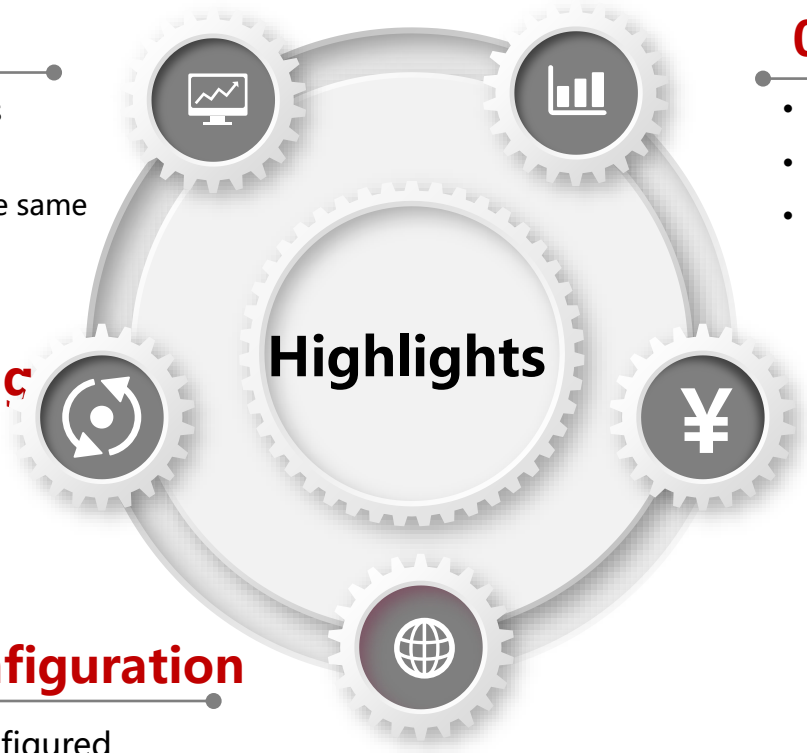
6. Highlights of Sany Pure Electric Port Tractors

01 large load

- Maximum traction mass 70,000kg
- Carry 2 containers at the same time

02 long endurance

- Range is 130KM
- Range time is 18 Hrs
- Energy saving 20% compared with similar products



03 Fast charging

- Charge to 95% in 60 minutes

04 Low cost

- simple structure and low maintenance cost, saving 8,000 RMB/ year.
- low consumption of electricity and operation cost, saving 150,000 RMB/ year, according to 120km/day and 7 days per week.

05 Flexible configuration

- Battery capacity is configured according to demand

7. Technology Characteristic

01 AMT Dual Motor system

- High efficiency 10- 30km/h
- Single motor working when lifting empty container ;
- double motor working when Lifting loaded container. Simple structure, and fast acceleration
- High efficiency of braking energy recycling

02 Double BMS Battery System

- Lithium Iron Phosphate battery has no gas release and expanding
- cycle life(4000times)
- Safe charging and balanced control

03 Heavy Chassis

- 4×2 Heavy Duty Chassis
- Double-Deck Girder（8+6mm thickness ）wheel side deceleration structure, higher efficiency

04 Data interconnection

- Access to Terminal management system, real time monitoring of tractor operation data, facilitate tractor management and improve working efficiency.

8. Principle of Equipment Power System

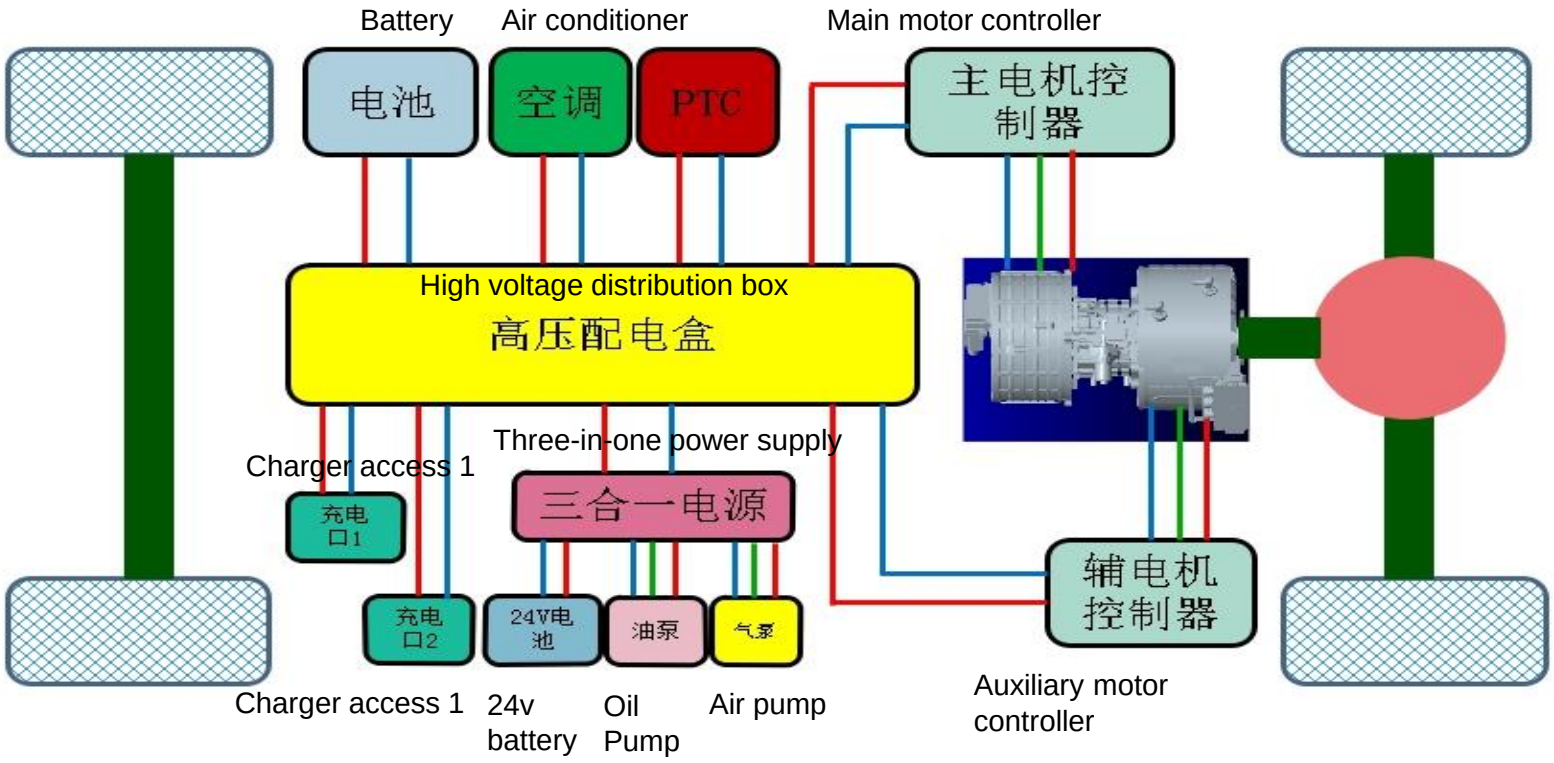
The power system of the pure electric terminal tractor consists of a drive system, power battery, power distribution system and auxiliary system.

The drive system consists of a double motor plus gear box assembly and a main motor controller and auxiliary motor controller;

The power battery adopts a double-loop lithium iron phosphate battery system;

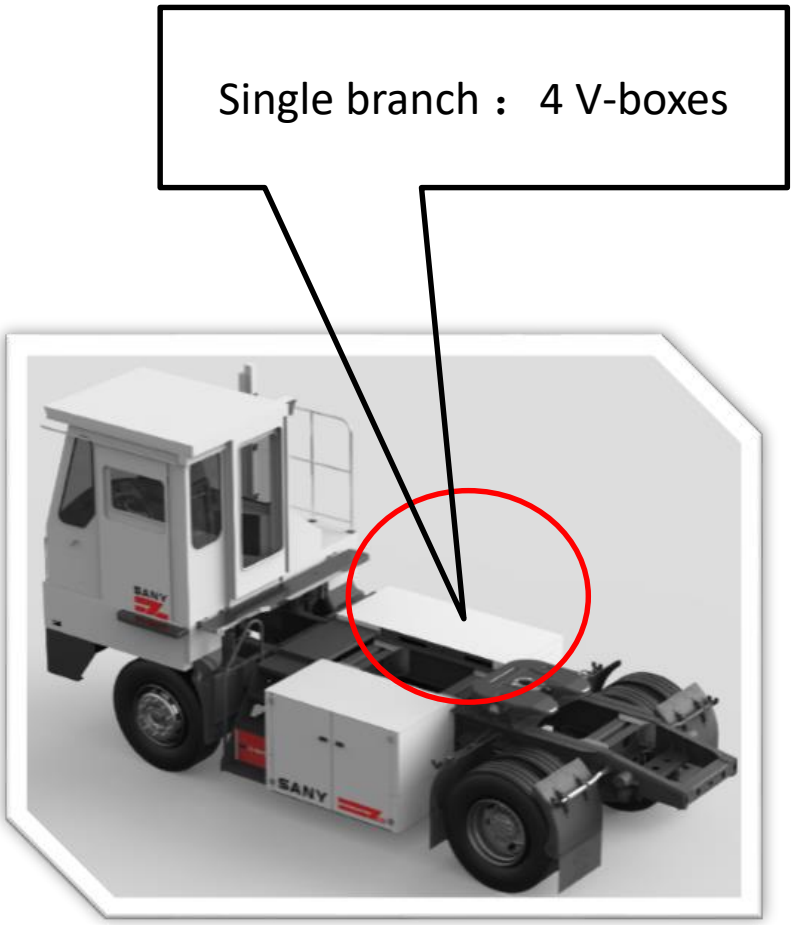
The power distribution system consists of MSD, main branch contractor, main branch fuse and insulation monitor;

the auxiliary system consists of electric pump, electric oil pump, air conditioner and PTC. The system works as follows:



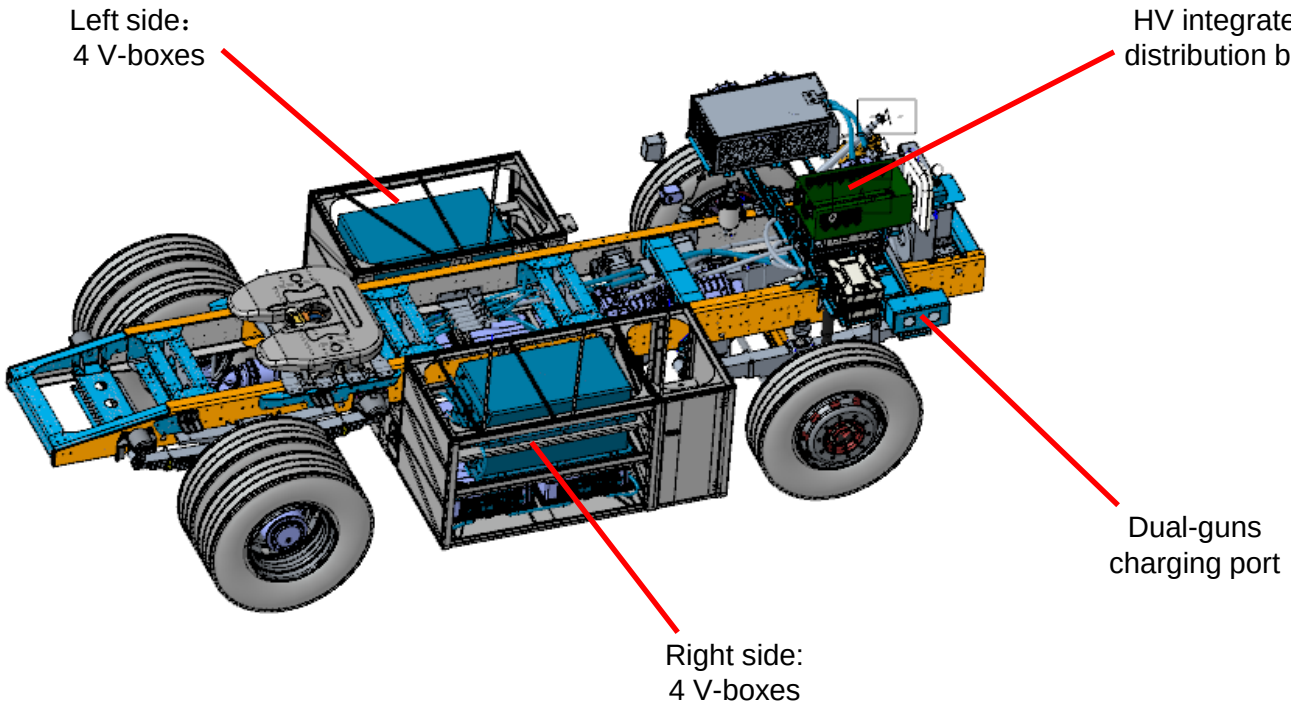
9. Battery system parameters and arrangement

Project name	Technical Parameters
Operation Temperature	System：-30℃~60℃ Battery charging：0～55℃ Battery discharge：-30～60℃
Rated capacity (Ah)	**456**
Standard Voltage (V)	**618.24**
Rated stored Energy (kWh)	**282Kw/h**
Operation voltage range (V)	480-700.8
Group energy density (Wh/kg)	≥ 155Wh/Kg
Total mass of system (kg)	1750kg
Charging rate	1C（Max.）
IP Protective Level	Battery box IP67、high voltage box IP67、harness connector IP67
Battery Life Cycle	**10 years or 2000cls to 70% remain**
Qty of battery	8



10. Battery system parameters and arrangement

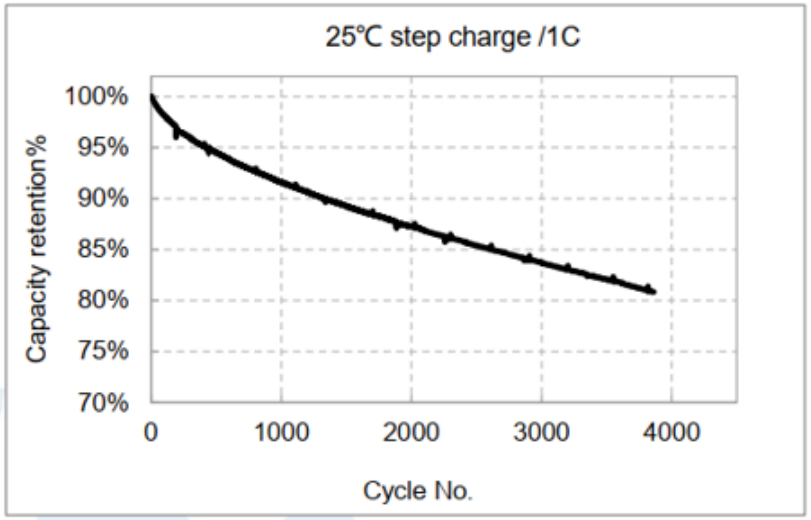
- The electric collection card battery system consists of 8 battery boxes, junction boxes, charging system and BMS. The external double branches are in parallel. The principle is shown in Fig. 15, and the arrangement on the vehicle is shown in below:
- Lithium iron phosphate battery, lithium battery with stable safety performance, maintenance-free, no memory, fast charging and discharging characteristics, especially in the safety aspect of the design in full consideration of fire prevention, explosion prevention.
- The battery box body is far away from the cab. When the battery fails suddenly, it can protect the safety of the driver and take quick response measures: disconnect the high-voltage maintenance switch;



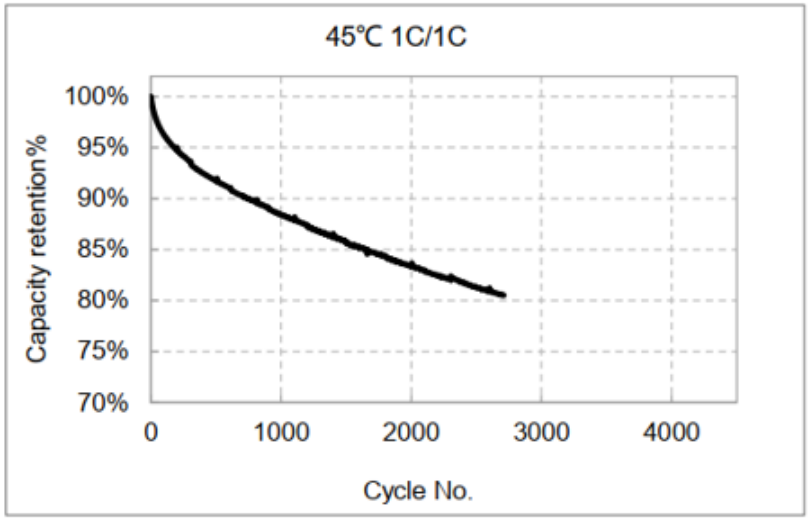
11. Battery attenuation curve

Test Condition: 25℃, 2.5V~3.65V(100%DOD), step charge /1C Cycle;
45℃, 2.5V~3.65V(100%DOD), 1C/1C Cycle

- **25℃ Cycle Life**



- **45℃ Cycle Life**

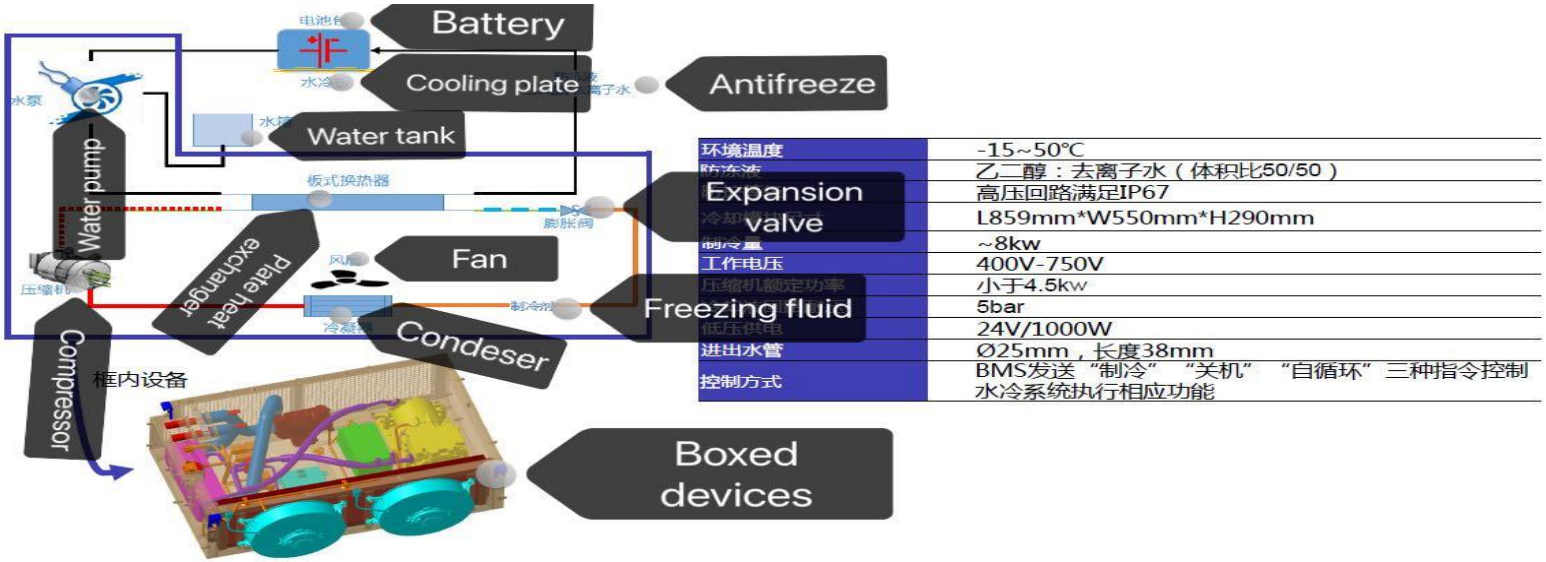


80.8% reversible capacity retention @ 25 ℃ 3900cycle

80.5% reversible capacity retention @ 45 ℃ 2750cycle

1. At least take 1 time maintenance fro battery per year, ignore battery damaged. (daily used condition)
2. Charging to 100% per 3 days (daily used condition)

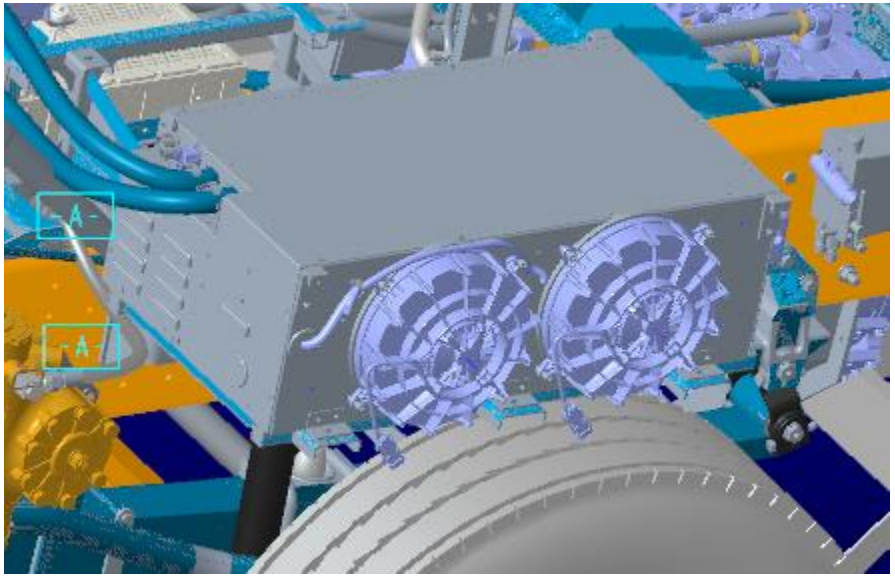
12. Cooling system



Ambient Temperature	- 15/ 50°C
Antifreezing Solution	Ethylene glycol; Deionized water (volume ratio 50/ 50)
IP Grade	High pressure loop meets IP67
Cooling Module Size	L859mm*W550mm*H290mm
Refrigerating Capacity	8kw
Working Voltage	400V- 750V
Compressor Rated Power	less than 4.5kw
Collant Circuit withstand voltage	5bar
Low- voltage power supply	24V/ 1000W
In and Out of the water pipe	Ø25mm, Length 38mm
Control Method	BMS send 'cooling';turn off' 'self- circulation' 3 orders control cooling system perform related function

13. Cooling system fast replace solution

Battery cooling system replace solution

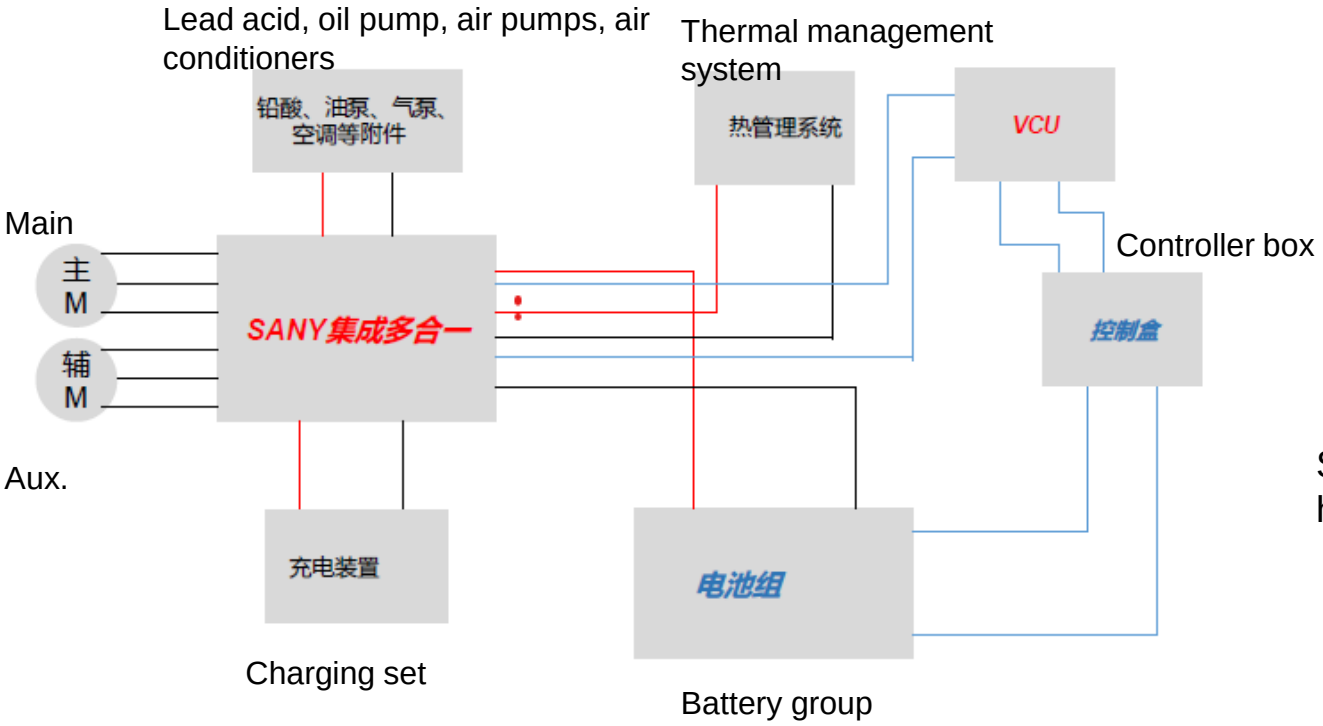


The battery cooling unit is installed on the lower left of the cab.

1) Turnover cab 53°;
2) Remove the cooling water pipe (note to use the container to hold the coolant);
3) Remove the high and low voltage wiring harness;
4) Use spanner to remove the battery cooling unit directly.
5) The installation sequence is opposite to the disassembly.

14. Advantages of Battery power

- Iron phosphate batteries with high safety, good charging rate and long cycle life
- Battery group scheme with double branches and high voltage platform reduces battery current, which is conducive to fast charging and discharging of battery to improve battery stability ，（reasonable use of mature protective electrical components, such as relays and fused).
- High voltage distribution box, modular design, reduce the Nos of components, low equip. Failure rate。
- Battery management system (with thernmal management system)，which has a wider application range and ensure battery life and charging safety.
- Installed the double gun charging access（single gun charging current ≤250A），meet the fast charging mode



Schematic diagram of high voltage principle

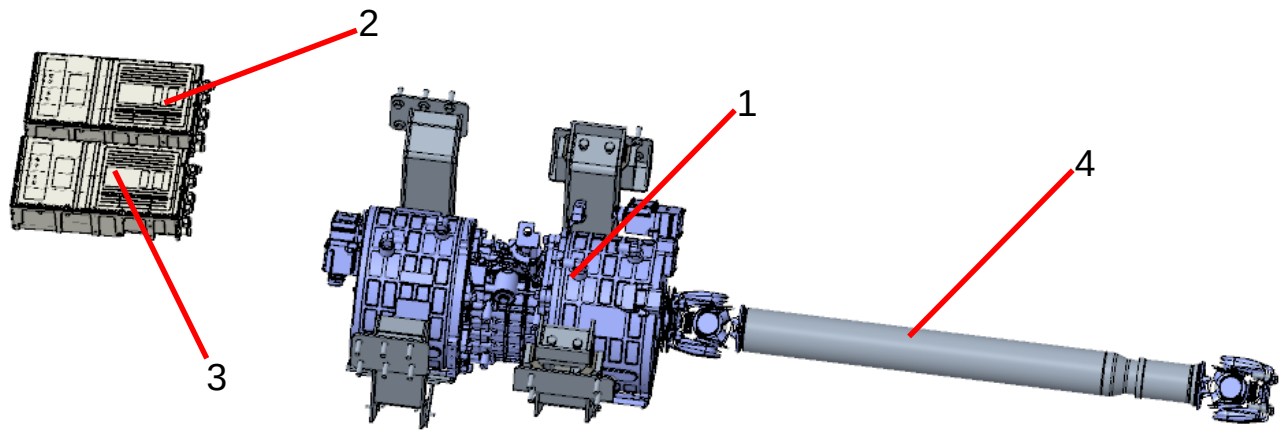
15. Drive system : AMT (double motor +2 shift gear box)

- The electric drive system is composed of double motor +2 gear box, main motor controller, auxiliary motor controller, transmission shaft and other parts.
- The electric collector adopts AMT technology, and its power transmission route is:

A. motor → drive shaft → drive axle → tire;

B. Energy transfer route: power battery → high voltage distribution box → motor controller → motor.

- Drive motor in addition to provide driving power but also as a generator function, play an auxiliary brake.
- This transmission mode is characterized by simple structure, stable power output, high reliability of the transmission system, simple maintenance and flexible and light control.

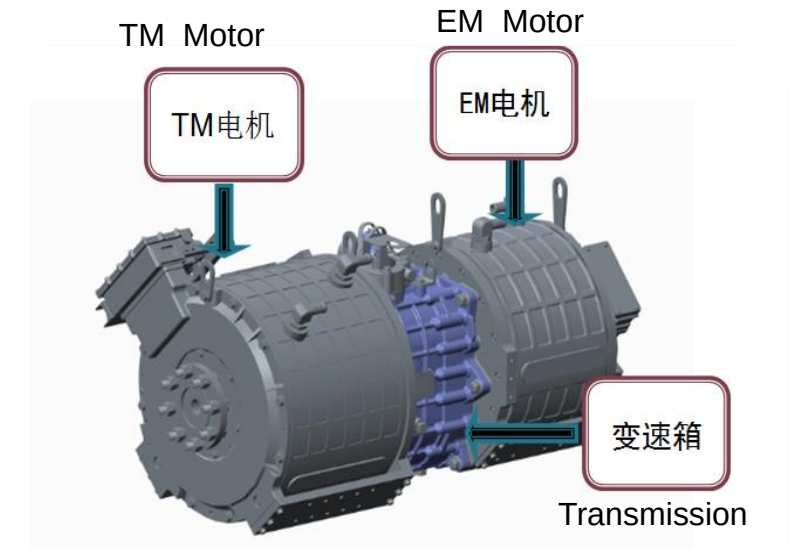


1. dual-2 level gear-box; 2. main motor controller; 3. auxiliary motor control;
4. transmission shaft

16. Drive system：AMT（double motor +2 shift gear box）

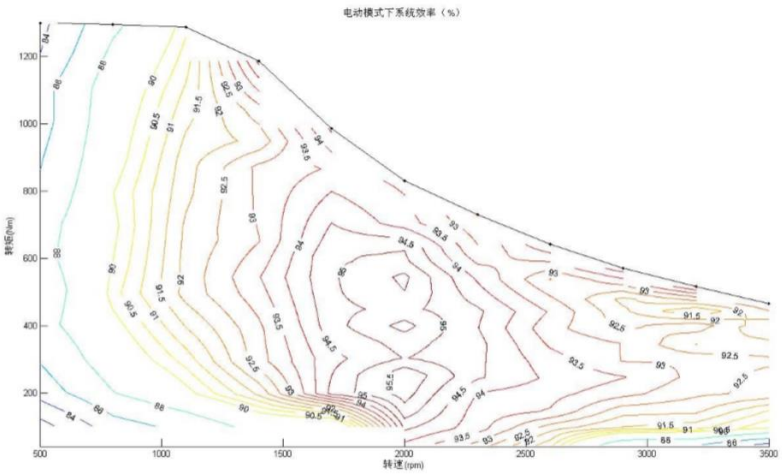
- High efficiency：use the high efficiency of motor（10km/h-30km/h），economical；
- Energy saving：double motor output with large torque and can adapt to terminal working condition（single motor working for empty container lifting; double motor working for loaded container lifting
- Fast acceleration：0~30km/h acceleration time is less than 25s。
- few maintenance parts：2 shift gear box of simple structure；transmission maintenance oil 1.8L and reduced failure rate；
- High braking energy recycling system：the auxiliary motor is used as the generator of braking energy（not through gearbox），and realizes the auxiliary braking braking function，so the retarder can be cancelled by pure electric power。

Motor parameters		
Motor	EM motor	TM motor
Rated /peak power	100/185kW	80/150kW
Rated /Peak Torque	750/1300Nm	750/1700Nm
Max. Speed	3500rpm	3000rpm

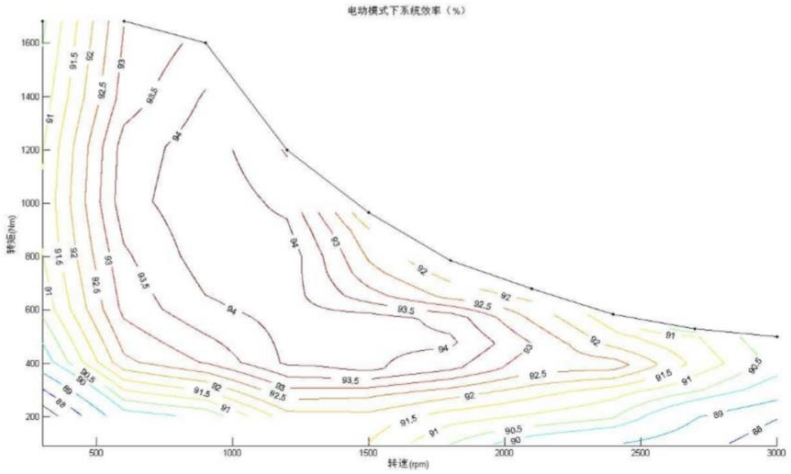


17. Drive system：AMT (double motor +2 shift gear box)

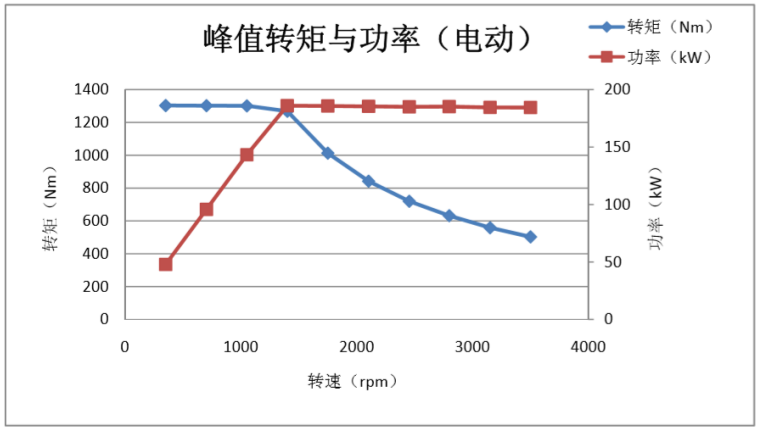
➢ Power curve & MAP



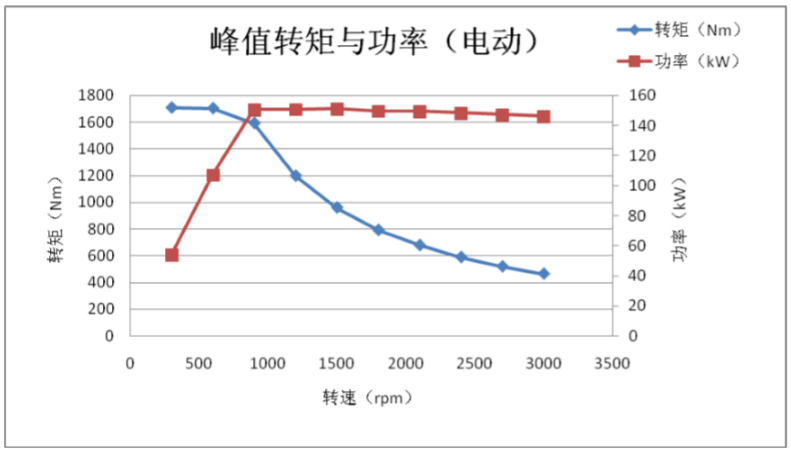
附图 2 电动模式下电机效率 map 图



附图 2 电动模式下电机系统效率 map 图



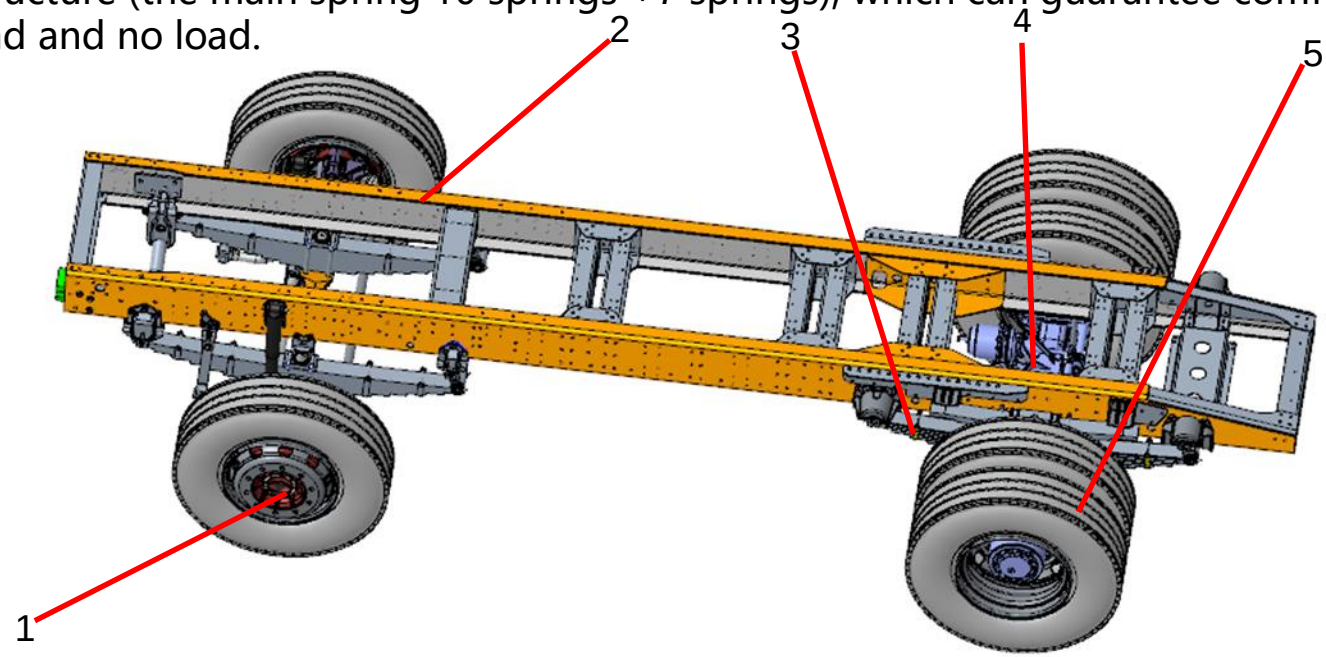
EM motor efficiency MAP & peak torque power curve



TM motor efficiency MAP & peak torque power curve

18. Structure-Chassis

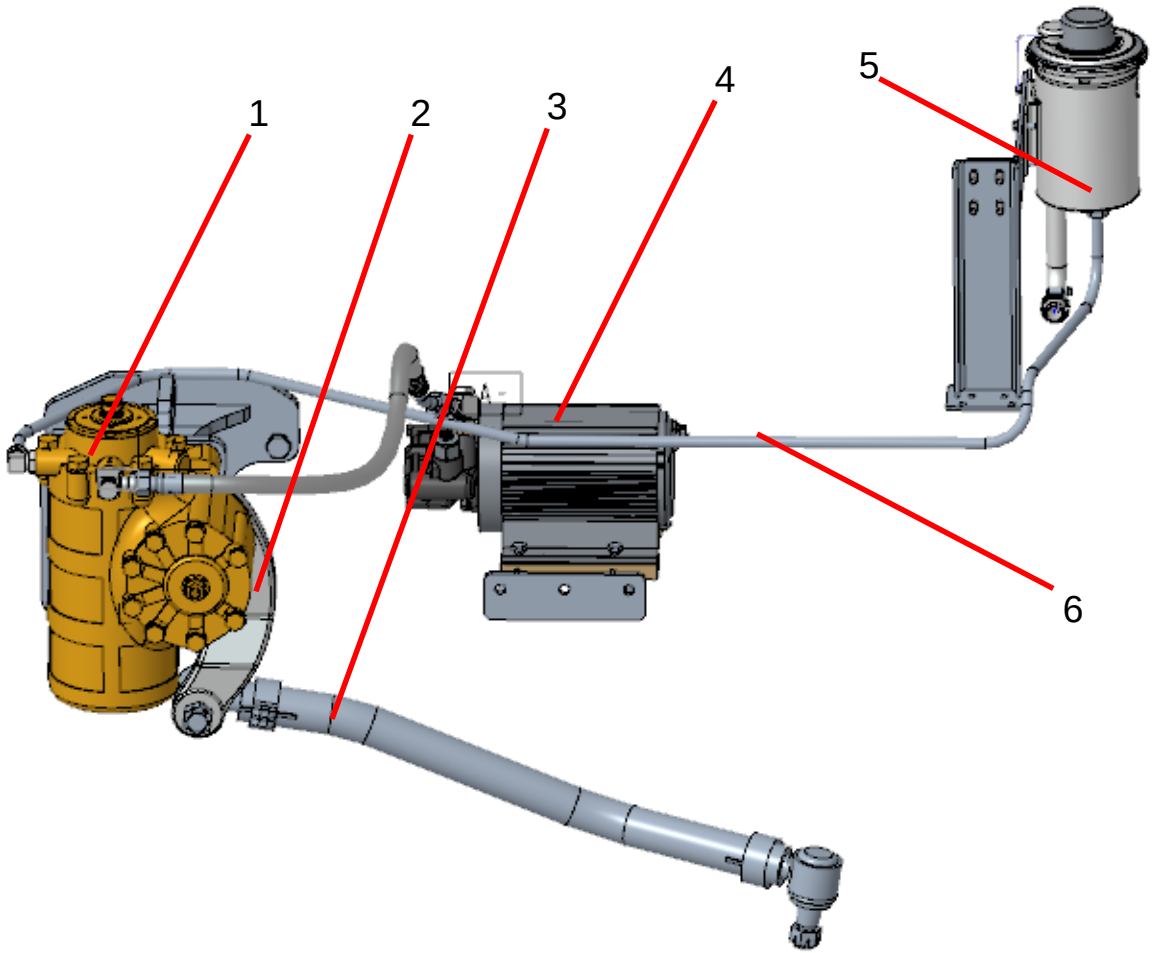
- The chassis powertrain is composed of front axle, frame, suspension, rear axle and tire rim.
- The front axle adopts the rated bearing capacity of 7t die section I-beam to steer the front axle, and the rear axle adopts the enhanced 16t wheel edge reduction axle with automatic adjusting arm.
- The frame assembly adopts high strength 610L steel, the thickness of double-layer girder is 14mm(8+6), the outer width of girder is 860mm, and the height of girder is 300mm. According to CAE analysis, it is loaded with 3 times safety factor analysis, and three beams are strengthened to 75t.
- The suspension is made of special steel plate spring, and the front suspension is made of 11 leaf springs + hydraulic shock absorber + transverse stability.The rear suspension adopts double leaf spring structure (the main spring 10 springs +7 springs), which can guarantee comfort under heavy load and no load.



1. Front axle; 2. Chassis; 3. hanger bracket; 4. Rear axle; 5. tyre & rim;

19. Steering system

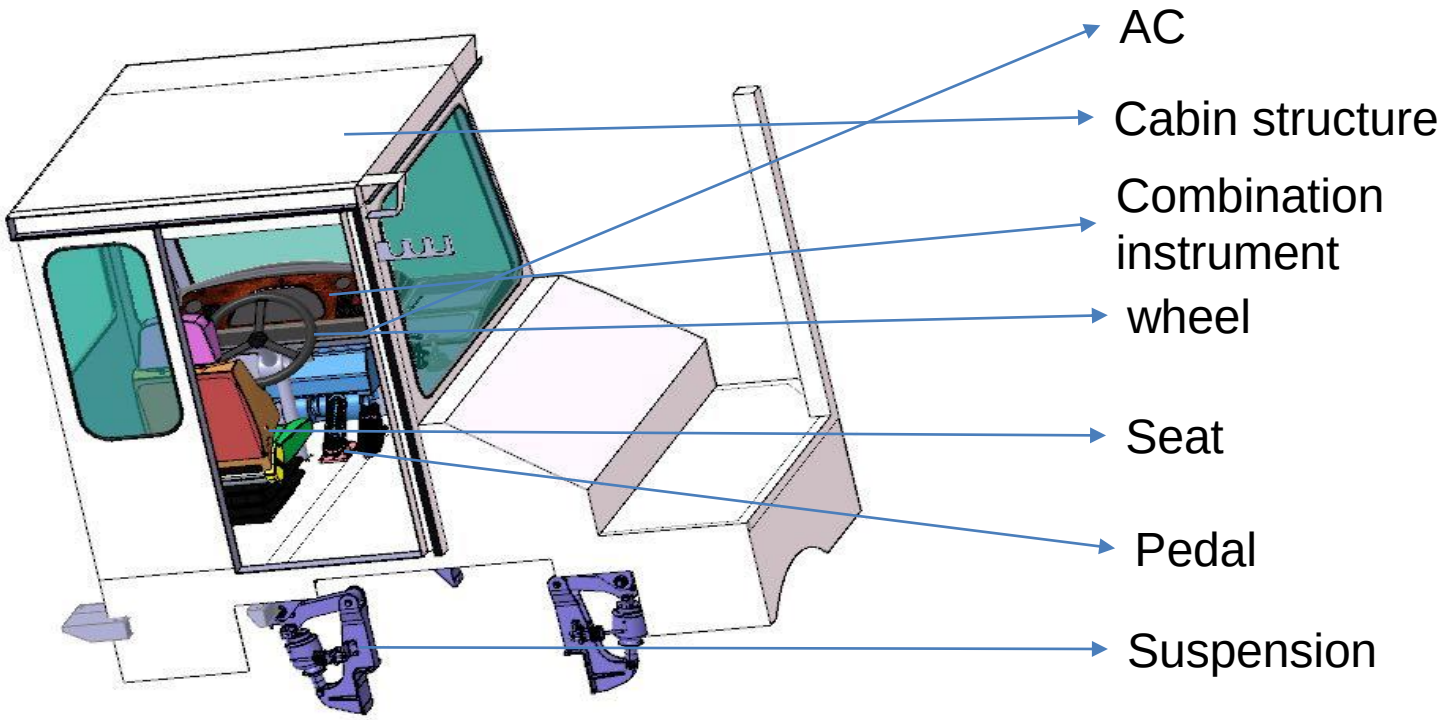
- The electric steering system is controlled by a left steering wheel (LHD) with an electric power booster.Consisting of steering wheel and steering string (placed in the cab assembly), steering gear, steering vertical arm, steering straight tie rod, electric steering pump assembly, steering oil can and steering line:



1. Diverter;
2. Drop arm;
3. Steering drag link;
4. Electric steering power pump;
5. Steering oil can;
6. steering line

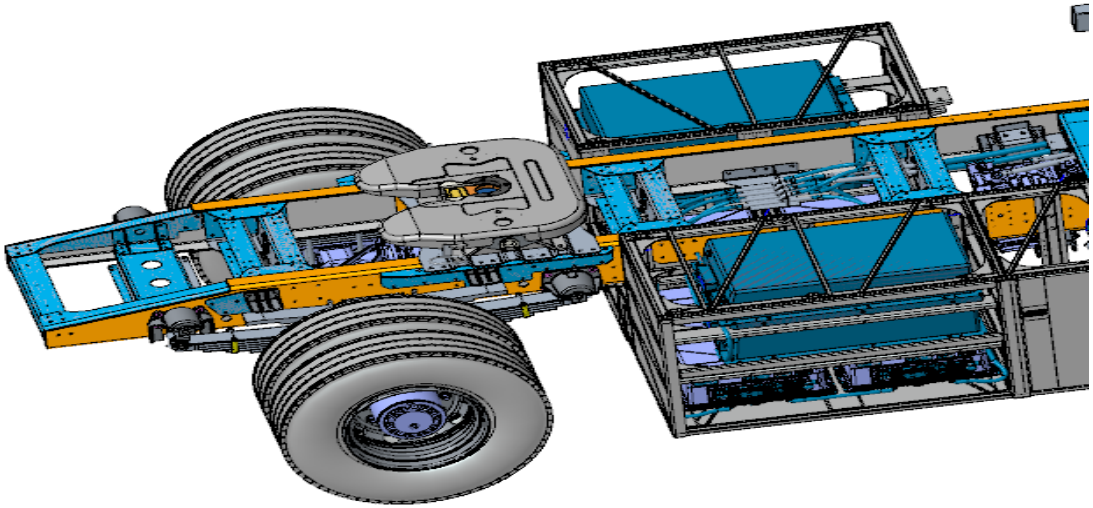
20. Structure-Cabin

- The cab adopts the truss structure, front and rear window glass, the view is more opened. The cab is equipped with the ergonomic air-suspension shock absorbing driving seat, and the operation handle and button that can change the position accordingly with the seat adjustment, which can maximize the efficient operation of the electric collection card. The indoor heating and cooling air conditioning can keep the temperature at 15℃~25℃, and has the functions of anti-fog, defrosting and air exchange. At the same time the configuration of the cab air bag suspension, can reduce the fatigue of the driver at work, to ensure a comfortable working environment.



21. Structure-saddle

- Traction saddles can be matched to the semi-trailer's 2-inch main pin (SAE standard) for a maximum static load of 28T, and can accommodate dock loading and unloading shocks, bumping back and forth and side to side swing.Guide grooves are installed on both sides of the rear end of the frame to facilitate the connection of the semi-trailer.

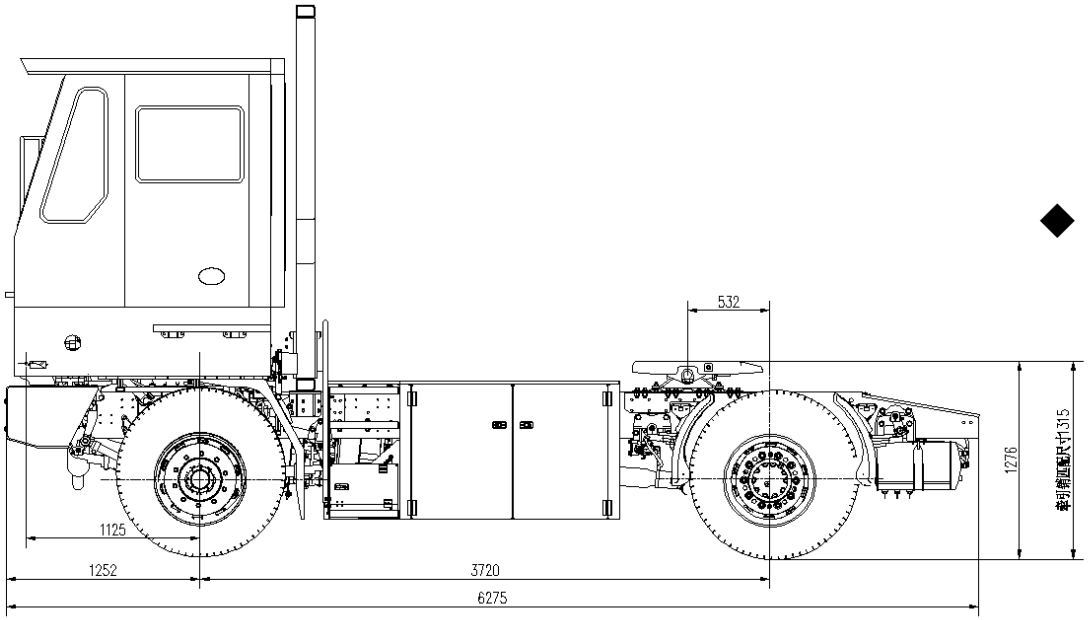


The fixed saddle advantage:

- Fixed design more stable and easy to maintenance
- Better suspension with structure design (plate spring better than rigid structure, driver seated more comfortable)

Disadvantages: the trailer front leg could be adjust by manual operation

22. Tractor-trailer connection layout



- Docking height of terminal tractor and trailer 1315mm±10mm。

Terminal tractor and trailer docking pipe is arranged on the right side of the cab(rear-side)

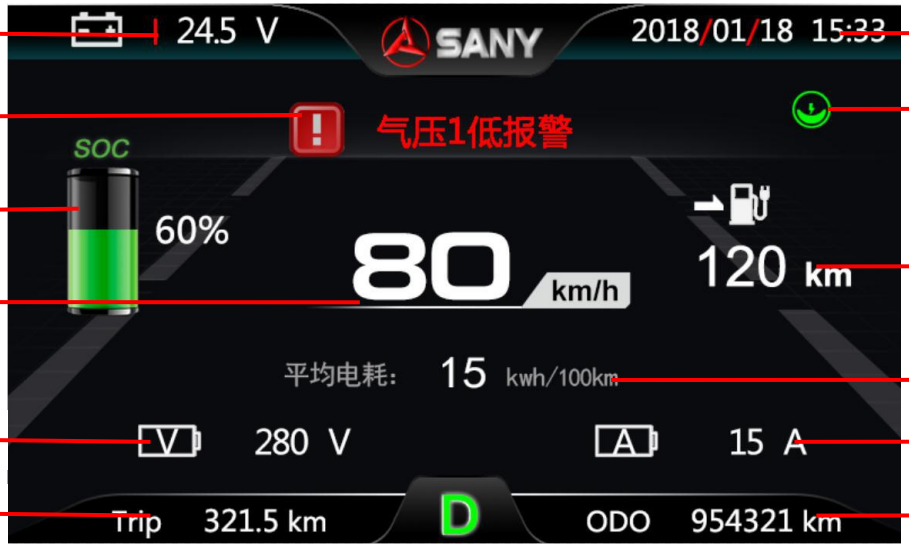
23. Charging station specification

System Specification	Dimention	1500*1050*1800mm
	Cable length	4m (customized)
	installation type	Hanging installation
	Working temperature	- 20℃- 50℃
	Ralative humidity	5%RH- 95%RH
	Altitude	=<2000m
	Input voltage	AC380V±15%
	charge type	Twin- gun charge/one gun for one
	Total power	15- 300KW
	output voltage	250- 750V
	output current range	0- 500A
	number of Charging guns	2(Expandable charging terminal)
	electronic lock	open to charge/close to charge, with 12v impulse type with feedback
	BMS auxiliary power supply	12Vdc or 24Vdc (control by display)
Performance	efficiency	>95
	power factor	=>0.99
	starting mode	swiping card/app/VIN automatic recognition/scheduling recognition
	Level of protection	=>IP54

24. Display & battery management system

Ⅰ、SANY pure electric terminal tractor humanized design (display language could be adjust by English & France version)

- 7-inch Full LED instrument with simple interface and rich functions can effectively improve comfort and reduce driving fatigue.
- Manual shift mechanism(D-P-R), simple operation, reduce driving fatigue.
- Cab airbag suspension device to improve driving comfort
- Air ride seats to reduce driver fatigue
- Offset cab, better visibility, meet the requirements of terminal tractor characteristics



低压蓄电池电压
Low voltage battery

故障报警信息
Fault alarm info

动力电池剩余电量
Residual of battery power

数字车速
digital speed

动力电池电压
Batter power voltage

小计里程
Mileages of trip

时间日期
Time / date

能量回馈显示
Energy recycling display

续驶里程
Mileages of Fuel range

平均电耗
Average consumption

动力电池电流
Battery power current

累计里程
Miles

25. Safety function

Safety function of SANY Pure Electric Tractor

- The protection level of high-voltage components of the whole equip. IP67
- Installed the shift error prevention function (shift can be started after stepping on the brake), which is safe and reliable
- Safety functions such as complete machine high voltage emergency detection function, power-on and power-off safety function and temperature control.
- The vehicle is equipped with turn signals, width lights, brake lights, adjustable anti-glare headlights, fog lights, back-up lights, saddle searchlights, back-up buzzers, and 24V warning lights. These lamps are reasonably installed and not easy to be damaged.
- Electrical horn for traction equipment.
- All lamps are easy to install, and lampshade wiring harness is waterproof, including headlights.
- The electric cable of the whole machine is made of flame retardant material with sufficient capacity.

Lights arrangement appearance

1.foglight; 2. Headlamp; 3. Height lamp; 4. Beacon; 5. Left turn indicator; 6. Front brake lamp; 7. Front reversing light; 8. Right turn indicator; 9. Working light; 10. Rear reversing light; 11. Rear brake lamp; 12. Rear reversing light;

27. Major Components brands

Components	Brands	Model
Battery	CATL	228Ah618.24V2P192S-282KWh
Front Axle	SANHUAN	9t-Fist type I-shaped rigid special,
Rear Axle(drive)	Hande	16t-HDS16T331500025; Stamping enhanced central and wheel edge two - stage deceleration
AMT dual-motor & controller	LVKON	TED5080;Dual motor system, maximum output power: 335KW, maximum output torque: 3000N.m, maximum speed: 3000RPM, maximum efficiency up to 95%
Motor control system	LVKON	Dual motor controller: main controller: maximum capacity 200KVA, efficiency 98%;Auxiliary controller: maximum capacity: 400KVA, efficiency 98%
Power charge station	TLED/HICONICS	300KW
Truck control system integration	SANY	
Air Condition	Design by SANY	2KW
Steering pump	DEFU	
Tyre	China Chaoyang	12.00R20-18PR
HV distribution box	CATL	
Saddle (5th wheel)	JOST	50#, statics load 28000kg

28. Warranty guarantee & Service solution

Warranty

- Battery: 8 years (attenuation to 70%)
- Machine: 2 years
- Battery Cooling system: 3 years

Service offer:

- One site engineer arrived before machine arrived; Site daily care in first three month;
- Training course one week;
- Set service office near site;
- Set consignment stock, signed consignment contract; (recommend parts list attached)

29. Reference list

Electric Terminal Tractor reference				
No.	Customer name	Model	Qty	Year of signed
1	Shenzhen Muyue Technolgy company	SEV2503	1	Dec. 2018
2	Wuhan Container port terminal	SEV2503	2	Mar. 2019
3	Jiangyin Ronghui machinery Co., Ltd	SEV2503	2	Mar. 2019
4	Xiamen Port Authority	SM4251T0BEV	5	Sep. 2019
5	Guangzhou Nansha terminal	SEV2503	2	Dec. 2019
6	Xiamen Port Authority	SM4252T0BEV	35	Aug. 2020
7	Guangzhou container terminal	SM4252T0BEV	10	Nov. 2020
8	Guangzhou Nansha phase III terminal	SM4252T0BEV	20	Nov. 2020
9	China Merchants Ports(shenzhen Mawan terminal)	SEV2503 (unmanned type)under production	18	Feb. 2021
10	Guangzhou container terminal	SM4252T0BEV	10	June. 2021
11	Jiangsu Taicang Port	SM4253T0BEV	10	July. 2021
12	Hainan Yanpu Port	SM4255T0RBEV	36	July.2021
			151	

30. Reference case

- Qingdao Terminal (Test) :

1) site: the site is relatively large, average transportation distance is 3km, the smoothness of brick and stone road is slightly poor.

2) Usage：Tractor driving speed ≤30km/h，daily mileage is 120~150km，working time is within 22hrs ；70% tractor utilization rate ；

3) load situation：total mass is 80ts accounting for 20%, total mass 55 T accounting for 38%。

- **SANY Pure Electric Terminal Tractor Operation Data**

Models	Total Mileage km	Charging electricity consumes kwh	Electricity consumes per KM kwh
6×4	10791	16186.5	1.5

31. Reference case

Pure Electric Terminal Tractor Operation of WUHU Port

1) Site: inland river terminal, 1.8~2.8km per cycle; the road was bumpy with a slope of 7%.

2) Tractor usage: driving speed ≤30km/h (20km/h uphill), 8 hrs day operation, 12hrs at night working, 5 cycles per hour, the driver working situation: 13 drivers on day time; 16 drivers on night time.

3) Carrying situation: tractor transport 40-foot empty container, 20 food empty container (2 pcs). 20 food loaded container (1 pc); the max. traction mass if 50t.

Operations :
1) the charging pile(station) 60kW,
2) Power consumption: : 1.96kWh/km (air conditioner for heating in winter.)

SANY

Reference case

Pure Electric Terminal Tractor Oper ation of WuHan Port

1) Site: inland river terminal, 1.8~2.8km per cycle; the road was bumpy with a slope of 7%.

2) Tractor usage: driving speed ≤ 40km/h (20km/h uphill), requires climbing on both side to cross the bridge.

3) Carrying situation: tractor transport 40-foot empty container, 20′ loaded container (2 pc); the max. traction mass if 70t.

Operations :
1) the charging pile(station) 120kW, charging for more than 2 hrs.

2) Working rate of pure electric terminal tractor is 80%, total operating mileage exceeds 20000km.

3) Power consumption: ：2.1 kWh/km (air conditioner for heating in winter.) other time: 1.67kWh/km

SANY

Reference case

Pure Electric Terminal Tractor Operation of Guangzhou Port

Guangzhou Port operation data（Heavy container ratio 78.8%）

Energy type	Consumption per standard container	Energy bill price（RMB）	cost of energy per standard container（RMB/ TEU）	Annual operation volume （10000 TED）	Annual energy cost (10,000 RMB)	Annual Energy consumption	Annual energy consumption （stand. Tons of coal）	Description of unit price
Electric power	2.0kWh	0.7	1.4	3.6	5.04	72000 kWh	8.85	Electricity price is calculated by 0.7 RMB/kWh, loss is calculated by 7%.
diesel	0.9L	6.5	5.85	3.6	21.06	27.23t	39.48	Diesel price 6.5 Yuan /L

Note: 1)The data is the operation data from April to Aug 2019, the charging compartment time is 29.7h; 2) 1 kg diesel is equal to 1.45kg coal, 1kwh equal 0.1229 kg standard coal.

Compared with the diesel tractor, electric tractor has 76.1% lower cost per standard container and 77.6% lower annual energy consumption.

Reference case

Port operation date：

Energy type	Consumption per standard container	Energy bill price（RMB）	cost of energy per standard container（RMB/ TEU）	Annual operation volume （10000 TED）	Annual energy cost (10,000 RMB)	Annual Energy consumption	Annual energy consumption（stand. Tons of coal）	Description of unit price
Electric power	1.38KWH	0.5	0.74	2.5	1.85	3.4500 kWh	4.24	Electricity price is 0.5元/KWH， consumption is calculated by 7%
diesel	0.7L	5.08	3.56	2.5	8.9	14.83T	21.50	Diesel price 5.08RMB /L

Note: 1)The data is the operation data from Jan 2020, the charging compartment time is 19.7h; 2) 1 kg diesel is equal to 1.45kg coal, 1kwh equal 0.1229 kg standard coal.

Compared with the diesel tractor, electric tractor has 79.2% lower cost per standard container and 90.3% lower annual energy consumption.

Economic benefits (Taking a port in South china as an example)

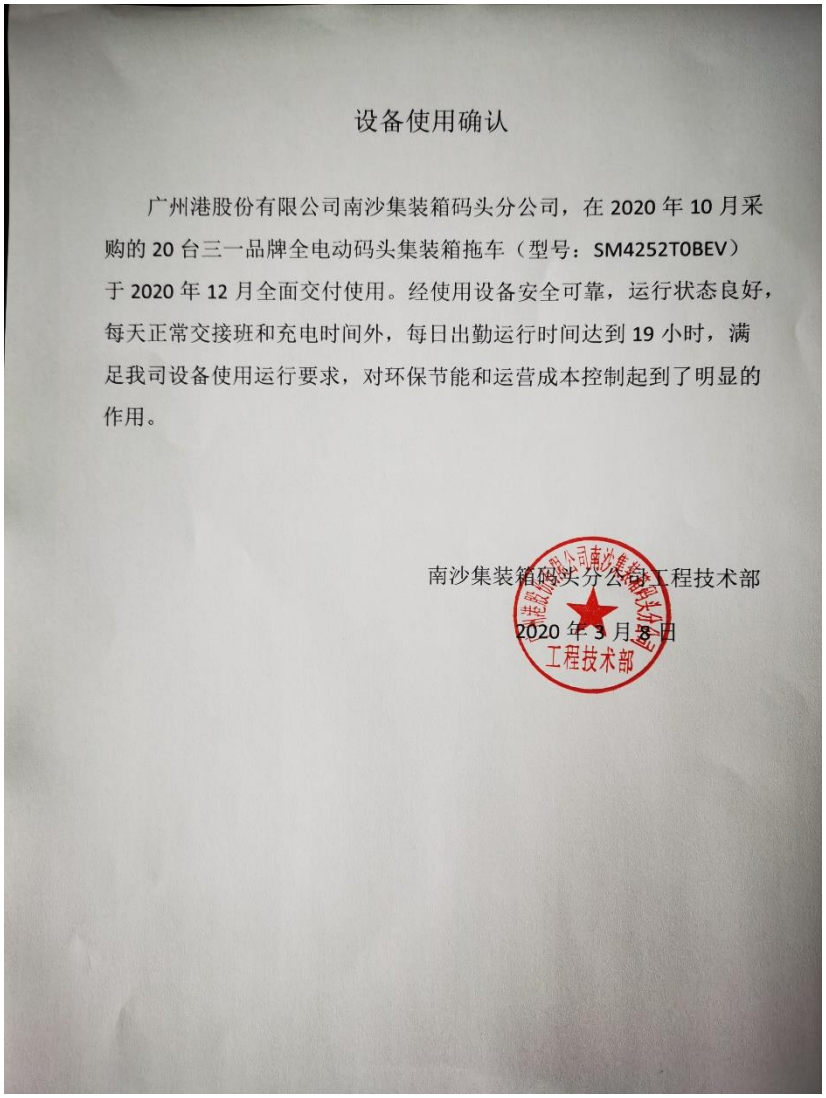
◆ Comparison between electric tractor and diesel tractor

- Working volume：3200TEU per month,22h per day、120km per day。
- Fuel Consumption：2880L/ month (consumption :0.9L/TEU×3200TEU/month)
- Electric tractor energy consumption：2.15kWh/TEU（Terminal Operation data）。
- Cost：Excluding the cost of engine overhaul, the electric tractor save nearly 150,000RMB per year in maintenance, diesel and etc.
- Carbon emission: reduce emission by 92.5 tons per year.

Cost item	Fuel (10,000 RMB)	Pure electric tractor (10,000 RMB)	Notes
Tractor maintenance cost (10,000 RMB)	0.96	0.12	Fuel tractor：800RMB/Month×12month =9600 RMB Electric Tractor ：gearbox 1200 rmb/ year
Fuel / electric cost (10,000 RMB/ Year)	22.46	8.26	Fuel tractor：6.5 RMB /L×2880L/ month ×12month =224,600 RMB ；Diesel 6.5RMB/ L Electric Tractor ：2.15kWh/TEU×1RMB /kWh×3200TEU×12month =82,600RMB
Total Cost of use (10,000 RMB/ year)	**23.42**	**8.38**	Cost saving：23.42-8.38=150,400 RMB
Carbon Emission (kg/year)	**92499**	**0**	CO2 emission per liter of diesel ：3.1863kg*0.84=2.6765kg

Customer Certificate

Customer ETT certificate from NanSha terminal (20 units)



设备使用确认

广州港股份有限公司南沙集装箱码头分公司，在 2020 年 10 月采购的 20 台三一品牌全电动码头集装箱拖车（型号：SM4252T0BEV）于 2020 年 12 月全面交付使用。经使用设备安全可靠，运行状态良好，每天正常交接班和充电时间外，每日出勤运行时间达到 19 小时，满足我司设备使用运行要求，对环保节能和运营成本控制起到了明显的作用。

南沙集装箱码头分公司工程技术部

2020 年 3 月 8 日

工程技术部

Certificate

Guangzhou Port Co., Ltd. NANSHA Container Terminal, as we purchased 20 units SANY brand pure electric terminal tractor in October 2020 and delivered and handover in December in the same year（Model：SM4252T0BEV）. The tractors felt safe and reliable, the performance condition really high efficiency. In addition to the driver-shift and charging time, the daily attendance and running time reaches 19 hours. It can meet the operation requirements of our terminal's equipment and has played a significant role in environmental protection, energy-saving, and operating cost control.

Engineering Technology Department of

NANSHA Container Terminal Branch

March 8, 2020

SANY

Quality Changes the World