

23 Jul, 2024

RoboSense | 02522.HK

Growth momentum will be brought by dual drivers

STOCK RATING

BUY

TARGET PRICE

HK\$ 23.30

RoboSense (02498.HK) is a LiDAR and perception solutions provider in China, it specializes in the provision of LiDAR for ADAS, robotics and others (incl. robotaxi, cleaning, logistics, industrial, public services and inspection etc.) and the formulation of perception solutions that endow automobiles and robots with perception capabilities. The Group has launched R, M and E Platforms, products in the i) R Platform are traditional, mechanical LiDAR products serving robotics and other applications, ii) M Platform serve as the main LiDAR to be installed on vehicles, iii) E Platform are designed specifically for short-range detection and are installed in addition to the main LiDARs for blind spot detection.

Broadening product coverage: Launched in Apr 2024, the maximum detection range of MX can reach 200 meters, with a field of view angle of 120°×25°. MX has an unparalleled 25mm slim appearance, and the power consumption is below 10W. The production cost of MX is also lower because fewer transmitters and receivers are adopted, giving it advantages when compared to similar products. RoboSense (02498.HK) also introduced new product lines covering over 300m detection ranges, including M3 which was launched at CES 2024 in Jan 2024 and F Platform which will be released in 2025. The former adopts a 940nm wavelength, bringing advantages like being smaller in size, lower power consumption and more cost-effectiveness. The latter is a product with ultralong detection ranges that has exceptional detection capabilities for small objects, and it is more suitable in countries requiring longer detection ranges.

Growth momentum will be brought by dual drivers: RoboSense (02498.HK) has developed both mechanical LiDAR and solid-state LiDAR. M platform is the primary income source, and the mass production of the E Platform and F Platform will be carried out in 2025 and 2026 respectively, it is expected that these two platforms will also be the drivers in the future. Besides, RoboSense (02498.HK) defines itself as a robotics company, its LiDAR products are suitable for robotics applications, including R Platform, a mechanical LiDAR platform, and E Platform, a solid-state LiDAR platform. The Group currently fulfils most of the needs with Helios and Blackpearl products, especially cleaning and unmanned forklift robots. The E Platform will be delivered in 2024 Q4, primarily serving the demand for robots for home services. Some pre-IPO investors like Alibaba and Xiaomi also participate in the robotics area, and the former is currently a customer of the Group, giving growth opportunities to the Group.

Valuation: By using DCF valuation methodology and PS valuation methodology to derive the fair value, we initiate our first coverage on RoboSense (02498.HK) with a "BUY" rating and a HKD 23.30/share target price.

INITIATION REPORT

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RoboSense (02498.HK)

Stock Rating (Previous Rating) **BUY (-)**
Target Price (Previous TP) **HK\$ 23.30 (-)**

 Current Price **HK\$ 15.52**

 52-Week Range **HK\$ 14.3 – 137.5**

 Market cap. (HKD, bn) **HK\$ 7.0**

RMB, mn	23(A)	24(E)	25(E)	26(E)
Revenue	1,120.1	2,463.0	3,961.9	5,303.9
Gross Profit	93.6	406.3	735.3	1,171.5
Gross Margin	8.4%	16.5%	18.6%	22.1%
Profit Attr.	(4,336.6)	(409.2)	(194.2)	112.4

Performance	1 mth	3 mth	6 mth	1 year
Absolute	-74.9%	-59.7%	-63.5%	-
Relative to HSI	-72.7%	-66.5%	-81.4%	-

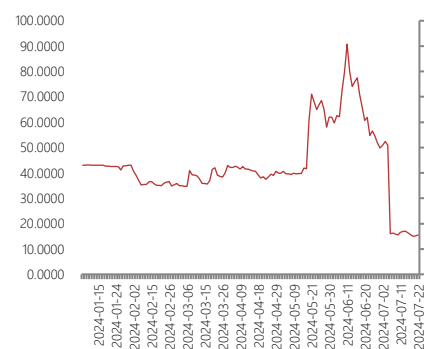


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Business Overview

RoboSense (02498.HK) is a LiDAR and perception solutions provider in China, it specializes in the provision of LiDAR for ADAS, robotics and others (incl. robotaxi, cleaning, logistics, industrial, public services and inspection etc.) and the formulation of perception solutions that endow automobiles and robots with perception capabilities. As at the end of May 2024, RoboSense (02498.HK) earned design wins for mass production of LiDAR products for 71 vehicle models with 22 automotive OEMs and Tier 1 suppliers, and it had achieved SOP(Start of Production) for 25 vehicle models with 12 customers. Primary customers include Geely Auto, GAC Aion, Great Wall Motor, XPeng and Lucid etc.

The Group launched R, M and E Platforms in 2016, 2019 and 2022 respectively, and it is in the process of designing and developing the F Platform. Products in the i) R Platform are traditional, mechanical LiDAR products serving robotics and other applications, ii) M Platform serve as the main LiDAR to be installed on vehicles, iii) E Platform are designed specifically for short-range detection and are installed in addition to the main LiDARs for blind spot detection, supplementing the M Platform products to provide vehicles with zero blind zones, iv) F Platform support ultra-long detection ranges and are expected to be used for commercial vehicles, railway transportation and other scenarios that require longer detection ranges.

LiDAR Platform

■ R Platform

R Platform is a result of early research and development efforts, it embeds with 1D scanning architecture and includes a comprehensive line-up of mechanical LiDAR products comprising 16, 32, 80 or 128 channels. R Platform products have been used in various robotics applications such as delivery robots and inspection robots.

■ M Platform

M Platform is the flagship platform for automotive-grade solid-state LiDAR, designed for ADAS applications. It uses a fast-steering MEMS scanning chip that enables high-performance scanning. Besides, the MEMS mirror embedded is comparatively larger, and each transceiver within the M Platform adopts a modular design that allows each transceiver to be independently produced and installed.

■ E Platform

E Platform is a solid-state LiDAR product platform, based on Flash technology, it is developed to address the market demand for blind spots and short-range detection. This platform combines the core components of receiving and processing, simplifying the circuit design and production process. The transmission system adopts VCSEL technology, and the driver IC is highly integrated, making it small, lightweight and durable; the receiving system uses an advanced 3D stacking process to integrate the SPAD array and high-performance SoC into one chip, simplifying the system and reducing cost. E platform can be adopted in the ADAS and robotics applications, including the provision of blind spot coverage for ADAS and the fulfilment of the perception requirements for logistics delivery and household robots, as well as in industrial robotics applications like AGVs (Automated Guided Vehicles), AMRs (Autonomous Mobile Robots), firefighting and inspection robots.

■ F Platform

F Platform LiDAR products support scenarios that require ultralong detection ranges, it is expected to deliver high resolution at an ultra-long range of over 300m. The Group expects to launch the F Platform in 2025.

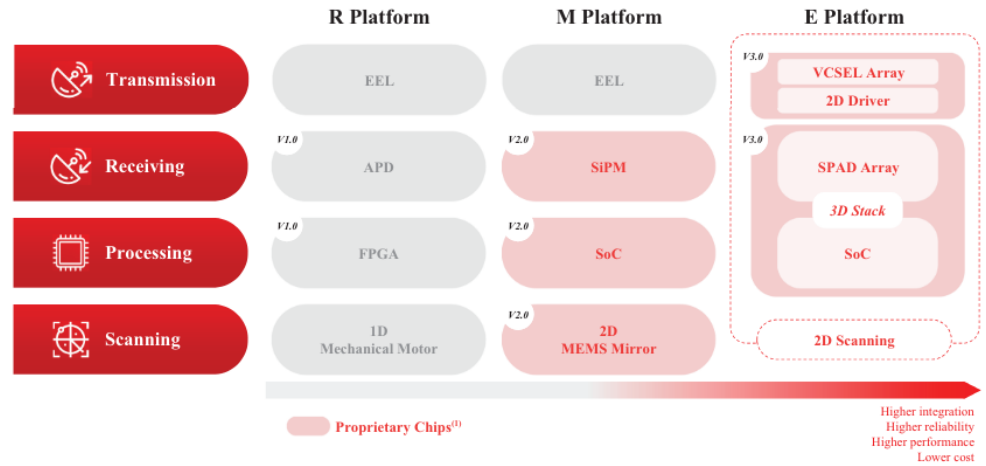
Exhibit: Technical specifications of the LiDAR Platforms of RoboSense (02498.HK)

	RS-LIDAR	Ruby Series	Helios Series	Bpearl	M1	M1 Plus	M2	E1
Applications		Robotics and others			ADAS			ADAS & Robotics
Launch Date	2016	2019	2020	2019	2019	2022	2022	2022
Laser wavelength(nm)	905	905	905	905	905	905	905	905
Range(m)	16-beam:150 32-beam:200	240	150	100	200	200	220	75
Blind spot(m)	≤0.4	≤0.4	≤0.2	≤0.1	≤0.5	≤0.5	≤1	≤0.1
Horizontal FoV	360°	360°	360°	360°	120°	120°	120°	120°
Vertical FoV	16-beam:30° 32-beam:40°	40°	26° - 70°	90°	25°	25°	25°	90°
Dimension(mm)	16-beam: 109x80.7 32-beam: 114x108.73	125x128	100x100	100x111	108x110x45	111x110x45	111x110x45	63x125x70
Weight(g)	16-beam:~870 32-beam:~1,130	~1,850	~1,000	~920	~730	~730	~730	~500

Source: Company data, West Bull Securities

The development of LiDAR-on-chip technology of the Group can be divided into 3 stages. The Group initially started to use APD and FPGA chips procured on R Platform products, then it further developed LiDAR-on-chip technology on the M Platform products that are equipped with MEMS scanning chips, along with custom-developed SiPM and self-developed SoC. Currently, the Group integrates SPAD array/SoC into a single chip for the E Platform products.

Exhibit: Roadmap of the deployment of LiDAR-on-chip technology on the LiDAR platforms

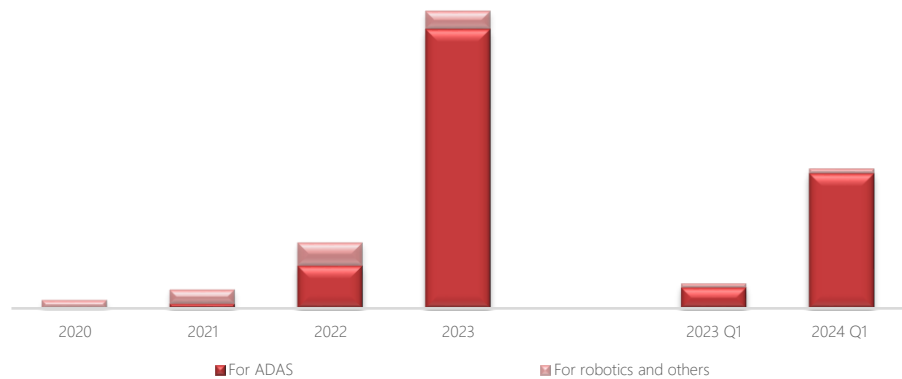


Source: Company data

Sales of LiDAR Products

Breaking down the sales volume by applications, the sales of LiDAR products applied to ADAS were 240k and 116k in 2023 and 2024 Q1 respectively, representing YoY 5.5x and YoY 5.4x growth. The sales of LiDAR products applied to robotics and other applications were 16k and 4.2k in 2023 and 2024 Q1 respectively, representing YoY -20.0% and YoY 20.0% growth.

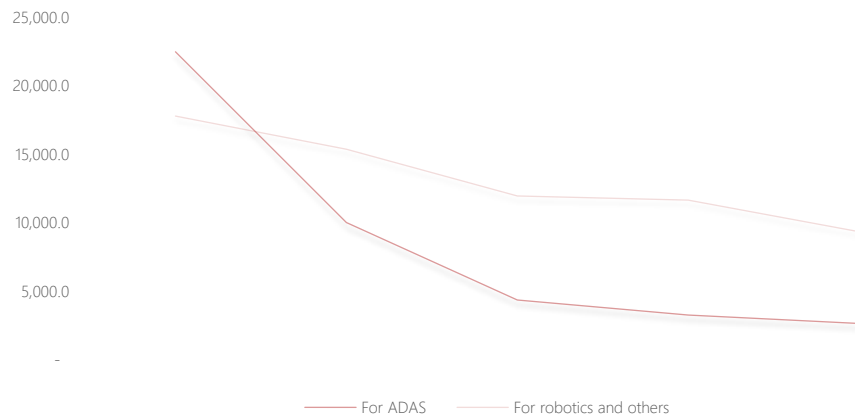
Exhibit: Breakdown of sales volume by applications



Source: Company data, West Bull Securities

RoboSense (02498.HK) commenced the mass production of LiDAR products for ADAS in 2021. The ASP in 2022 dropped significantly due to a lower proportion of prototypes. Besides, the economies of scale and the change in product mix further dragged the ASP to a lower level. In 2024 Q1, the ASP of LiDAR products for ADAS and robotics & others were RMB 2,632 and RMB 9,344 respectively.

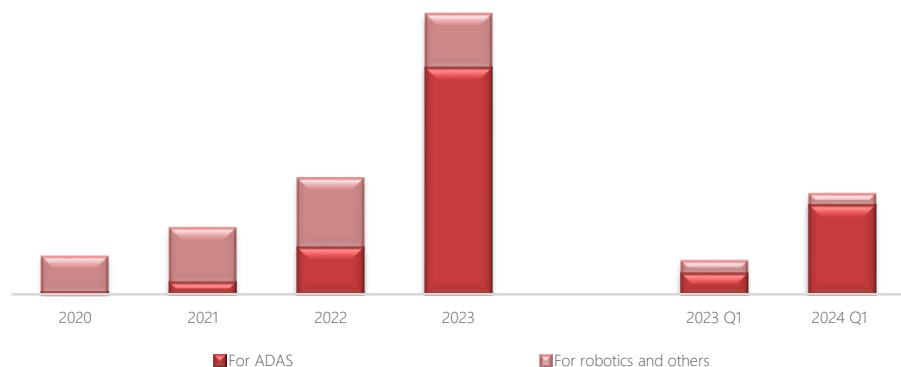
Exhibit: ASP of LiDAR products for ADAS and robotics & others



Source: Company data, West Bull Securities

Thanks to the climbing sales, the revenue generated from the LiDAR products for ADAS boomed YoY 3.8x and 3.3x to RMB 777.1mn and RMB 305.9mn in 2023 and 2024 Q1 respectively. The revenue generated from the LiDAR products for robotics & others also reached RMB 186.5mn and RMB 39.2mn in 2023 and 2024 Q1 respectively, implying YoY -22.0% and YoY 8.9% growth.

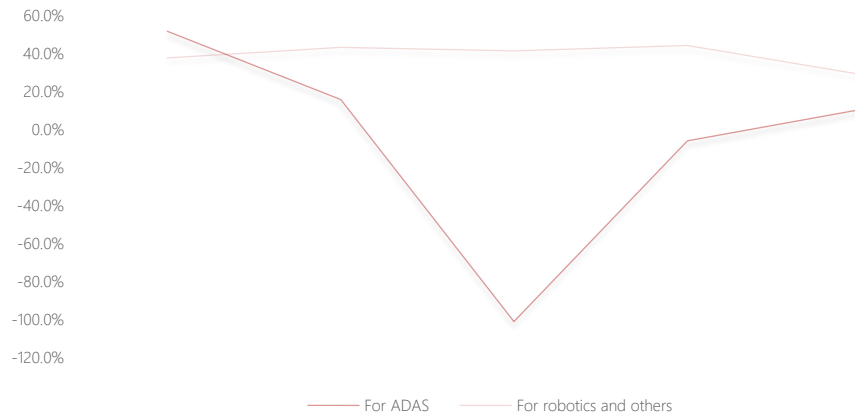
Exhibit: Breakdown of revenue by applications



Source: Company data, West Bull Securities

Resulted from i) the lower proportion of prototypes, ii) the higher procurement cost of semiconductors, iii) the increased inventory costs and provision expenses, iv) the expenses used for capacity expansion, and v) the lower ASP, the gross margin of the LiDAR products for ADAS was negative in 2022. However, the gross margin rebounded in 2023 2H and became positive in 2024 Q1 due to the economies of scale and the absorption of high-cost inventories.

Exhibit: Breakdown of gross margin by applications



Source: Company data, West Bull Securities

Production Capacity

RoboSense (02498.HK) operates two in-house manufacturing centers in Shenzhen, of which i) Honghualing factory occupies approximately 13,000 m² of space and produces solid-state LiDARs, with a monthly designed capacity of approximately 46,800 units, ii) Shiyan factory mainly produces R Platform LiDARs with a monthly designed production capacity of approximately 2,500 units. Besides, the factory owned by the associate, Luxsense, occupies about 27,000 m² of space. A new head office with 100,000 m² of space will also operate in 2024 Q3, the first batch of MX is expected to be produced in this factory.

Exhibit: Shiyan factory



Source: Company data

Exhibit: Honghualing factory

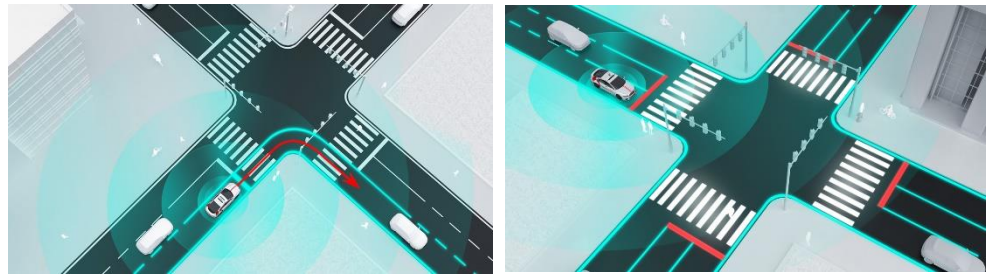


Source: Company data

AI Perception Software

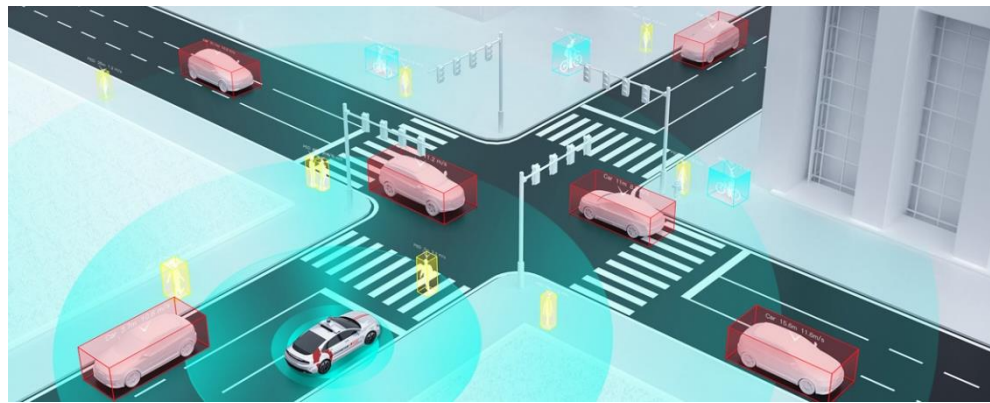
RoboSense (02498.HK) launched the LiDAR-based AI perception software HyperVision 1.0 in 2017, it can detect, track, and distinguish objects in real-world environments and directly display the position and distance information through radar transceiver signals. HyperVision 1.0 supports the detection and categorization of various objects in common traffic application scenarios, including free space detection, object detection, and moving object tracking. After the launch of HyperVision 2.0, HyperVision 1.0 is used to serve robotics applications and consumer demands.

Exhibit: Free space detection function of HyperVision 1.0



Source: Company data

Exhibit: Object detection function of HyperVision 1.0



Source: Company data

RoboSense (02498.HK) launched HyperVision 2.0 in 2020, core capabilities include i) identifying all static elements of the driving environment within the field of view, such as lane lines and road edges, ii) identifying all traffic participant information within the field of view, including pedestrians, cyclists and vehicles, iii) providing a real-time constructed 4D semantic occupancy field, iv) providing real-time understanding and behaviour prediction, predictive results and risk assessments based on 4D information and intentions of each traffic participant within the driving scenario. HyperVision 2.0 can be applied to pure vision, pure LiDAR and vision + LiDAR. It currently focuses on applications in the autonomous driving industry, and it is expected to expand to the robotics industry.

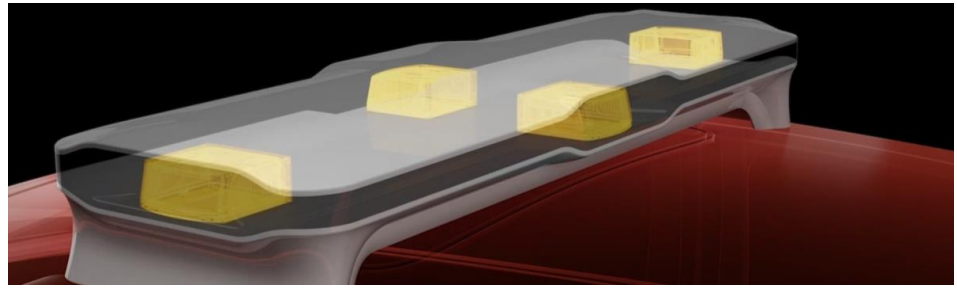
Solutions

The solutions provided by RoboSense (02498.HK) integrate LiDAR hardware and perception software. Complemented by expert training and support services, the solutions can meet customers' unique requirements.

■ P6 Solution

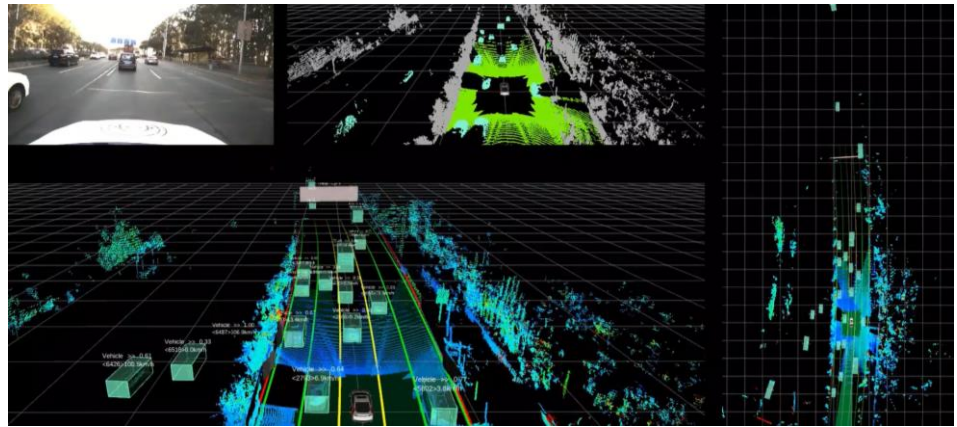
P6 Solution is a robotaxi solution for robotics applications and early testing stages of ADAS applications. 2 - 8 M series automotive-grade solid-state LiDARs are integrated, creating a 360° horizontal smart perception range up to 200 meters.

Exhibit: P6 Solution that integrates 4 M series solid-state LiDARs



Source: Company data

Exhibit: Illustration of P6 Solution



Source: Company data

Exhibit: Applications of P6 Solution – RoboTaxi and RoboTruck

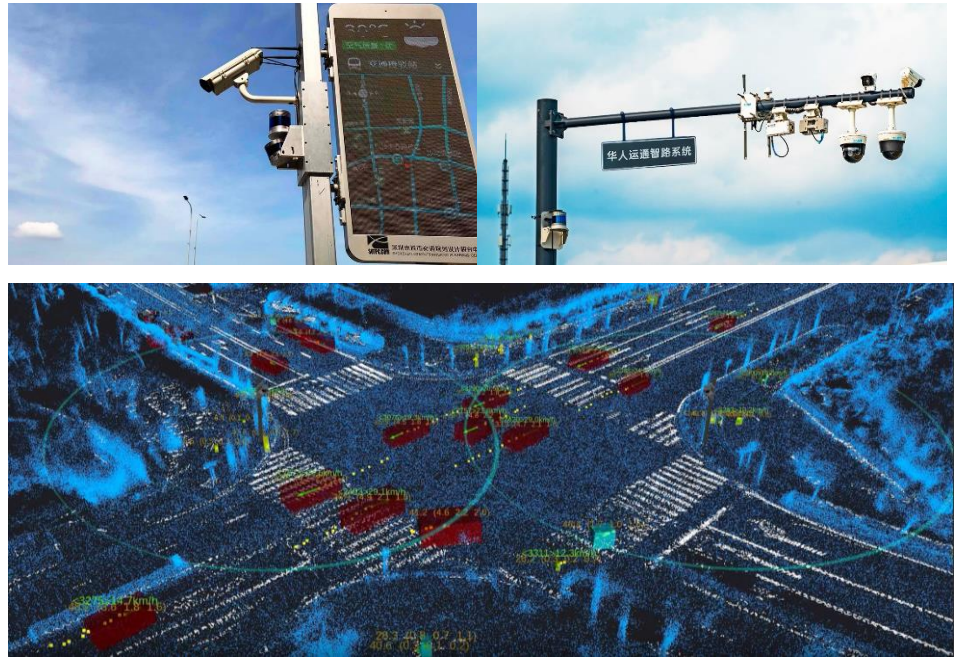


Source: Company data

■ V2X Solution

V2X Solution is a vehicle-to-road LiDAR solution for smart infrastructure applications including scenarios such as urban roads, highways, parking lots, logistics parks, terminals and mining areas. It achieves accurate space-time synchronization by fusing LiDAR point clouds from multiple base stations to form a complete composition of location information at a specific time in a specific area. V2X Solution can be divided into Vertical Mounting Scheme and Horizontal Mounting Scheme, the former comprises the hardware like Helios 16, Helios 32, Ruby Plus, Bpearl and the software HyperVision 1.0, the latter comprises the hardware like M1 & M1 Plus and the software HyperVision 1.0.

Exhibit: Illustration of V2X Solution

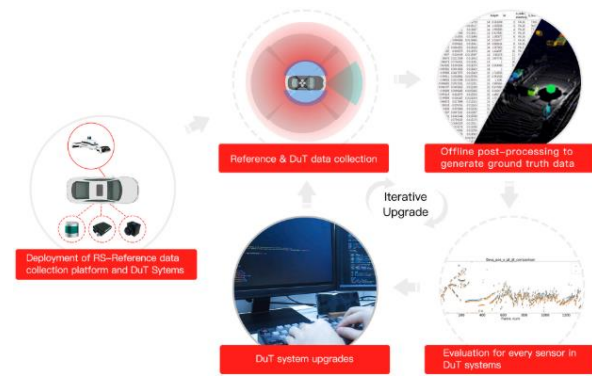


Source: Company data

■ Reference Solution

Reference Solution contains full-stack evaluation tools that include information collection, sensor calibration, visualization and manual verification. This solution helps customers build simulation scenes and evaluate roadside perception systems.

Exhibit: Validation workflow of Reference Solution



Source: Company data

Major customers

RoboSense (02498.HK) primarily serves automotive OEMS, Tier 1 suppliers and customers in a wide range of robotics and other non-automotive industries. As at the end of May 2024, the Group served over 270 automotive OEMS & Tier 1 suppliers and over 2400 non-automotive customers.

The customers of the Group in the automotive industry include SAIC, BYD, XPeng, Geely Auto, GAC, Great Wall Motor, Lotus and Lucid. Regarding the non-automotive area, Alibaba, Xingshen Technology, Neolix, ControlWorls and Brain Corp etc. are the major customers of the Group.

As at the end of May 2024, the Group had achieved SOP(Start of Production) for 25 vehicle models with 12 customers, and it obtained design wins for mass production for 71 vehicle models.

Exhibit: Design win conversion process

- The Group is notified by the automotive OEM customer via email after obtaining a design win, the email specifies the vehicle model, anticipated production volume and other relevant information.
- The Group signs a series of contracts with the automotive OEM customer, including purchase agreement, confidentiality agreement, quality guarantee agreement and other supplementary agreements. Such contracts usually outline agreed-upon terms such as price, expected order volume on a monthly and annual basis, payment terms and settlement methods.
- The average time from obtaining a design win to SOP is approximately 12 months. After SOP, the Group plans the mass production and delivery schedule according to the orders received, the lead time required varies among customers depending on the complexities of the customers' requirements. Customers generally place purchase orders or provide production forecasts one to three months before delivery.

Source: Company data, West Bull Securities

Company Background

Dr. Qiu Chunxin, Dr. Zhu Xiaorui and Mr. Liu Letian co-founded Shenzhen Suteng in Aug 2014, aiming to develop LiDAR technology for automobiles and robots.

Exhibit: Major milestones

2014	Shenzhen Suteng was incorporated
2016	Completed the development of mechanical LiDAR products
2016	Launched RS-LiDAR-16, the first LiDAR product for robotics and others
2017	Launched perception software, RS-LiDAR-Perception
2019	Launched M1, the first LiDAR product for ADAS
2019	Launched Ruby Series
2021	Started the mass production and delivery of M1
2022	Released E1, the automotive-grade solid-state blind spot LiDAR
2024	Listed on the HKEx
2024	Released M3 and MX

Source: Company data, West Bull Securities

Exhibit: Pre-IPO investments

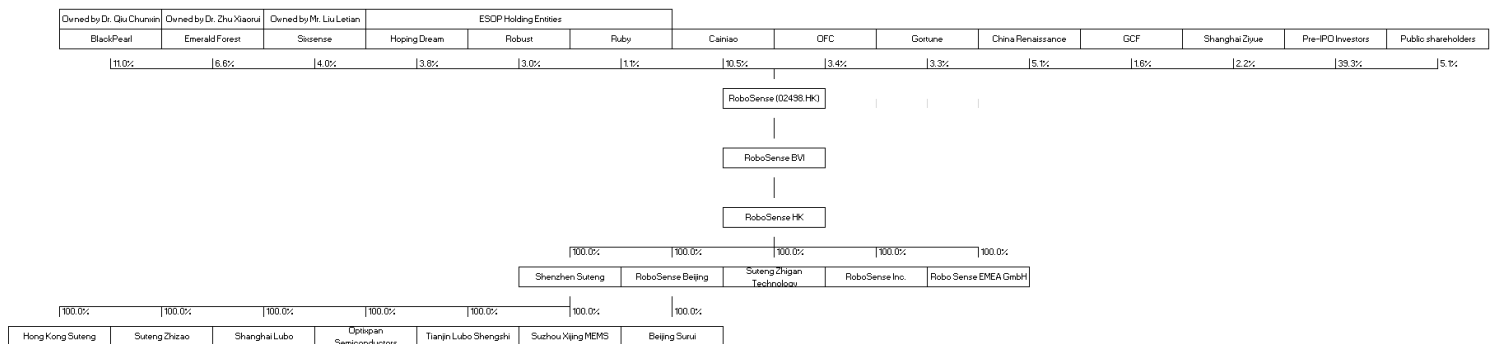
	Date of Investment agreements	Post-money valuation
Series Angel	2014	RMB 10mn
Series Seed	2015	RMB 100mn
Series A	2016	RMB 180mn
Series A+	2016	RMB 400mn
Series B	2017	RMB 571mn
Transfers of equity interest	2018	-
Series C	2018	RMB 1,217mn
Transfers of equity interest	2019	-
Series D	2020	RMB 3,500mn
Series D+	2021	RMB 3,670mn
Series E	2021	RMB 6,540mn
Series F	2021/2022	RMB 10,525mn
Series G-1	2023	RMB 14,400mn
Series G-2	2023	RMB 16,491mn

Source: Company data, West Bull Securities

The Company performed a series of financing activities before IPO, those Pre-IPO investors are subject to 6-month lock-up periods. Pre-IPO investors include BAIC, Alibaba, China Mobile, China Renaissance, China Structural Reform Fund, Fortune Athena and Fortune Miner, Fosun, Zhejiang Geely Holding Group, Gortune, Haitong, Kinzon, Luxshare, OFC, Puhe, Shangqi Management, Smart Han, Sino-Rock, Xiaomi, Yunfeng and Yutong Bus etc.

RoboSense (02498.HK) was listed on the HKEx main board in Jan 2024, introducing Nanshan SEI Investment to be the cornerstone investor. The Group was listed at HKD 43.0 and the valuation was HKD 19.4bn.

Exhibit: Holding structure after IPO



Source: Company data, West Bull Securities

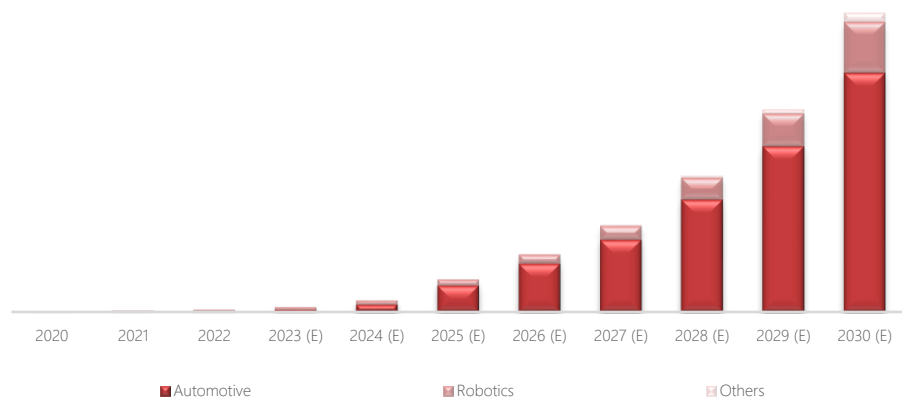
Industry Overview

LiDAR solutions market

LiDAR is a type of sensor that uses laser beams to calculate an object's variable distances from the targeted surface. LiDAR solutions can collect, interpret and analyze information, facilitating efficient and safe automation in various settings, and they are adopted in automotive and non-automotive industries, such as robotics, smart cities and V2X.

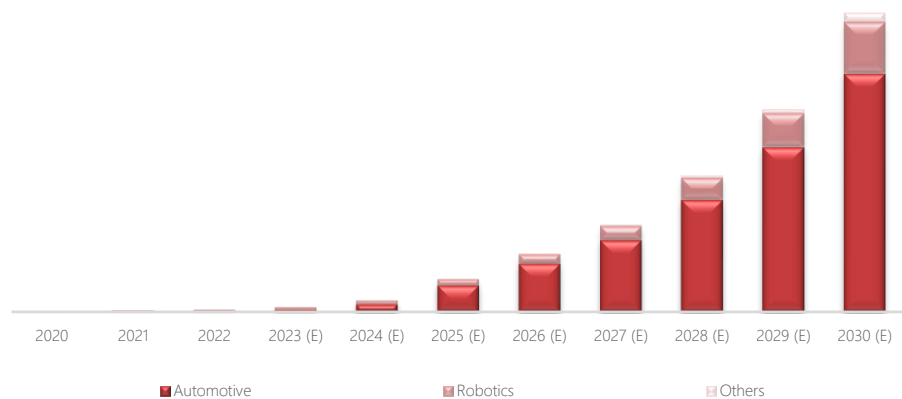
According to the CIC Report, the global LiDAR solutions market size was RMB 12.0bn in 2022 and is expected to grow at a CAGR of 78.8% to RMB 1,253.7bn in 2030. The automotive industry, especially ADAS application, is expected to be the main driver in the LiDAR solutions market, constituting 79.8% of the global market by 2030.

Exhibit: Breakdown of the global LiDAR solution market size by applications (RMB, bn)



Source: CIC, Company data, West Bull Securities

Exhibit: Breakdown of the global LiDAR solution market size by types (RMB, bn)



























Source: CIC, Company data, West Bull Securities

Automotive LiDAR solutions market

The major sensors for autonomous driving perception include LiDARs, cameras, ultrasonic radars and millimeter-wave radars. Cameras are the most widely used sensors in the automotive perception market due to lower costs. In contrast, the market share of LiDARs is smaller because of the early stage of development.

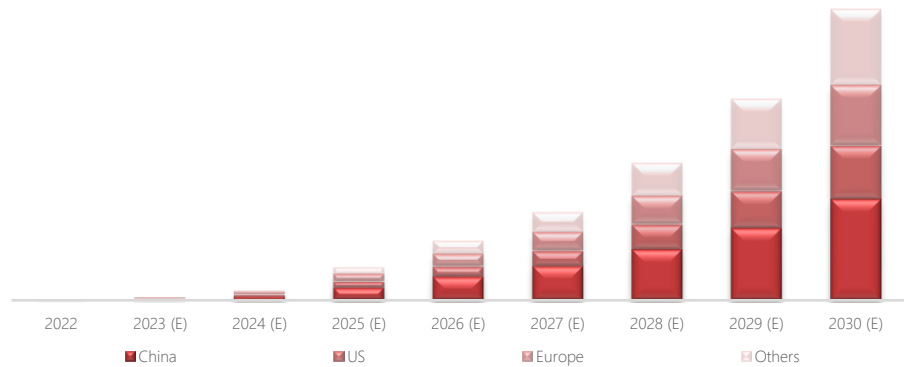
Exhibit: Comparison between LiDARs, millimeter-wave radars, ultrasound radars, and cameras

	Level of technology	Price, 2022	Global market size, 2022	Market share**	Adoption rate, 2022	Precision	Resolution	Adaptability	Key players	Automotive application examples	Future trends
	Primarily applied in L2-L5	\$500 ~ \$20,000	\$0.5 billion*	~2%					See "Competitive Landscape – Automotive Market"		As autonomous driving technology advances, the adoption rate of LiDARs and the number of LiDARs per vehicle are expected to increase rapidly.
	Primarily applied in L2-L5	\$50 ~ \$150	~\$3.5 billion	~15%					Mainly Tier 1 suppliers		The development of autonomous driving technology will lead to a gradual increase in the adoption rate of millimeter-wave radars.
	Extensively applied in L1-L5	\$10 ~ \$15	~\$3.5 billion	~15%					Mainly Tier 1 suppliers and some Tier 2 suppliers		The adoption rate of ultrasonic radars is expected to steadily increase with the development of autonomous driving technology.
	Extensively applied in L1-L5	\$25 ~ \$100	~\$15.4 billion	~68%					Mainly Tier 1 suppliers		As autonomous driving advances, the adoption rate of cameras is expected to steadily increase, and the number of cameras per vehicle is expected to increase obviously.

Source: CIC, Company data

According to the CIC Report, the market size for LiDAR solutions in the automotive market was RMB 3.4bn in 2022 and is expected to grow at a CAGR of 103.2% to RMB 1,000.3bn by 2030. China is expected to be the most active and prominent market in the global automotive LiDAR solutions market, accounting for about 34.6% of the global market in 2030, with a CAGR of 104.2% from 2022 to 2030.

Exhibit: Breakdown of the automotive LiDAR solutions market by regions (RMB, bn)



Source: CIC, Company data, West Bull Securities

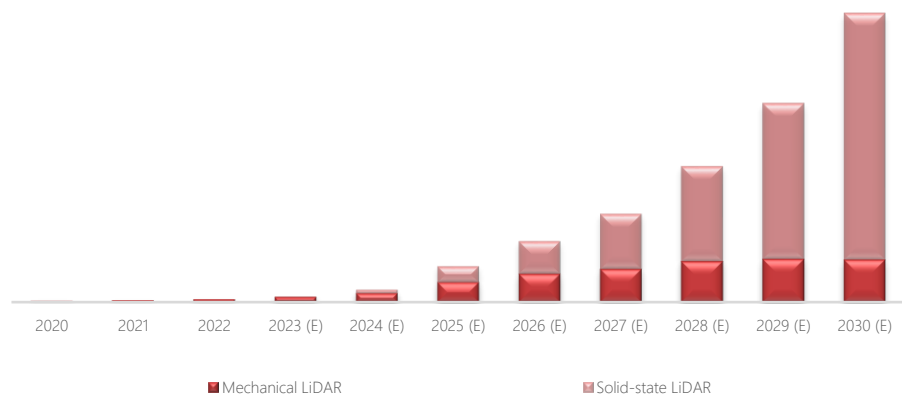
LiDAR hardware can be divided into solid-state LiDAR and mechanical LiDAR. Mechanical LiDARs are complex in structure, bulky, and costly, while solid-state LiDARs are smaller in size and more economical. Solid-state LiDARs are expected to replace mechanical LiDARs in many application scenarios and become the mainstream LiDAR in the future, accounting for 85.3% market share in 2030, according to the CIC Report.

Exhibit: Comparison between solid-state LiDAR and mechanical LiDAR

Type	Description	Development status	Pros	Cons	Application scenarios	
Solid-State LiDAR	MEMS (2D scanning)	MEMS-based mirrors reflect the laser to different angles to complete the scan	<ul style="list-style-type: none"> In mass production 	<ul style="list-style-type: none"> Low cost Small dimensions 	<ul style="list-style-type: none"> Medium FOV 	<ul style="list-style-type: none"> Automobiles Robotics Smart cities & V2X
	Flash (No scanning)	Flashing light is produced to detect the whole surrounding area at a single point in time and analyzes the information with image sensors	<ul style="list-style-type: none"> Near mass production 	<ul style="list-style-type: none"> Small dimensions Low cost 	<ul style="list-style-type: none"> Short detection range 	<ul style="list-style-type: none"> Automobiles Robotics
	OPA (No scanning)	Arrays of closely spaced optical antennas radiate coherent light in a broad angular range	<ul style="list-style-type: none"> In development 	<ul style="list-style-type: none"> Wide FOV Small dimensions Low cost 	<ul style="list-style-type: none"> Immature technology 	<ul style="list-style-type: none"> Automobiles
Mechanical LiDAR	Mechanical rotating LiDAR (1D scanning)	The laser generators are arranged vertically and perform scanning through 360-degree physical rotation to fully cover the surrounding environment	<ul style="list-style-type: none"> In mass production 	<ul style="list-style-type: none"> 360° FOV Detailed mapping of environment 	<ul style="list-style-type: none"> Large dimensions High cost 	<ul style="list-style-type: none"> Robotics Smart cities & V2X
	Rotating mirror LiDAR (1D scanning)	The transmitter emits laser light to irradiate the mirror surface, and the mirror surface continuously rotates to complete the scanning work	<ul style="list-style-type: none"> In mass production 	<ul style="list-style-type: none"> Detailed mapping of environment 	<ul style="list-style-type: none"> Large dimensions High cost Medium FOV 	<ul style="list-style-type: none"> Automobiles Robotics Smart cities & V2X
	Dispersive prisms LiDAR (2D scanning)	Dispersive prisms rotate around the same axis to generate flower-like scanning patterns	<ul style="list-style-type: none"> In mass production 	<ul style="list-style-type: none"> Detailed mapping of environment 	<ul style="list-style-type: none"> Large dimensions High cost Narrow FOV 	<ul style="list-style-type: none"> Automobiles Robotics Smart cities & V2X

Source: Company data

Exhibit: Breakdown of the LiDAR hardware market by types (RMB, bn)







Source: CIC, Company data, West Bull Securities

Robotics LiDAR Solutions Market

With the ability to operate semi-autonomously or autonomously, robotics plays a vital role in assisting or even replacing humans in addressing hazardous, labour-intensive, and complex tasks. Robotics, thus, have been widely used in delivery services, commercial cleaning, security, industrial applications, and other scenarios. According to the International Federation of Robotics and the CIC Report, global robot shipments increased from 18.9mn units in 2020 to 21.4mn units in 2022, and are expected to further increase to 40.6mn units in 2030.

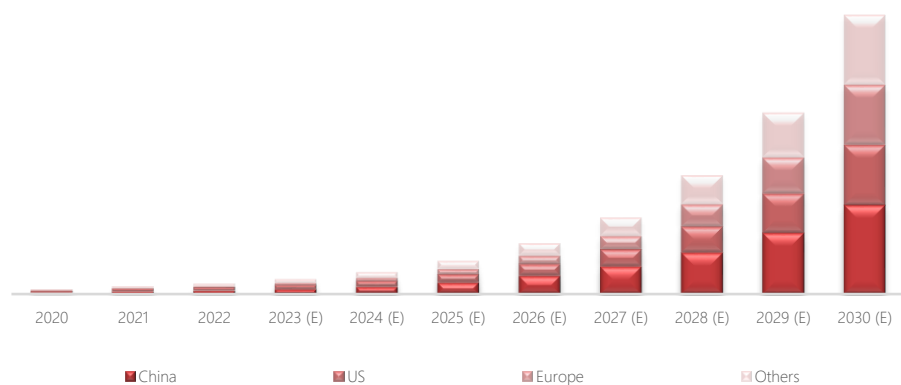
Robotics are mostly adopted in closed and semi-open environments. The 360° mechanical LiDARs equipped provide the robots with environmental recognition capabilities for positioning and navigation as well as abilities to identify and avoid obstacles and realize intelligent mobility. The major sensors for robotics perception include LiDARs, cameras, ultrasonic radars and millimeter-wave radars, different sensors have their respective functions and advantages for application scenarios.

Exhibit: Comparison between LiDARs, Millimeter-wave Radars, Ultrasound Radars and Cameras

	Price, 2022	Global Market size, 2022	Precision	Resolution	Adaptability	Key players	Robotics application examples**	Future trends
 LiDARs	\$20 ~ \$20,000	\$1.2 billion*	●	●	●	See “– Competitive Landscape – Robotics Market”	LiDARs can be installed on the top as well as the front and rear of a robot	As robotics technology advances, the adoption rate of LiDARs and the number of LiDARs per robot for highly intelligent robots are expected to increase rapidly.
 Millimeter-wave radars	\$20 ~ \$150	N.A ⁽¹⁾	●	●	●	Tier 1 suppliers and industrial sensor manufacturers	Millimeter-wave radars can be installed on the front and rear of a robot	The adoption rate of millimeter-wave radars is expected to increase due to the need of object detection, and environmental perception in diverse robotics applications.
 Ultrasound radars	\$3 ~ \$15	N.A ⁽¹⁾	●	●	●	Tier 1 suppliers and industrial sensor manufacturers	Ultrasonic radars can be installed on the front, rear, and left and right sides of a robot	As robotics technology advances, the adoption of ultrasound radars is anticipated to grow continuously.
 Cameras	\$20 ~ \$150	N.A ⁽¹⁾	●	●	●	Tier 1 suppliers and industrial sensor manufacturers	Camera can be installed on the front, rear, and left and right sides of a robot	Cameras are expected to remain the high adoption rate and the integration of multiple cameras per robot are expected to increase.

Source: CIC, Company data

Exhibit: Breakdown of the robotics LiDAR solutions market by regions (RMB, bn)



Source: CIC, Company data, West Bull Securities

Investment Thesis

Broadening products coverage

- Mechanical and solid-state LiDARs provided cover the ADAS and robotics applications
RoboSense (02498.HK) has launched R, M and E Platforms in 2016, 2019 and 2022 respectively. Products in the R Platform are mechanical LiDAR products comprising 16, 32, 80 or 128 channels, they have been used in various robotics applications. Products in the M Platform serve as the main LiDAR to be installed on vehicles. This platform uses a fast-steering MEMS scanning chip, and the MEMS mirror embedded is comparatively larger. E Platform is a solid-state LiDAR product platform, based on Flash technology, it is developed to address the market demand for short-range detection. E platform can be adopted in the ADAS and robotics applications, including logistics delivery and household robots, as well as in industrial robotics applications like AGVs, AMRs, firefighting and inspection robots.
- Products iteration
Launched in Apr 2024, MX is equipped with an in-house SOC M-Core and 2D MEMS chip. Similar to other M series products, the maximum detection range of MX can reach 200 meters, with a field of view angle of 120°×25°. However, MX has an unparalleled 25mm slim appearance, which is much thinner than other M series products with 45mm thickness. Besides, the power consumption is below 10W, less than M1 and M1 Plus. The production cost of MX is also lower because fewer transmitters and receivers are adopted, giving it advantages when compared to similar products.

Exhibit: MX and M1 Plus



Source: Company data

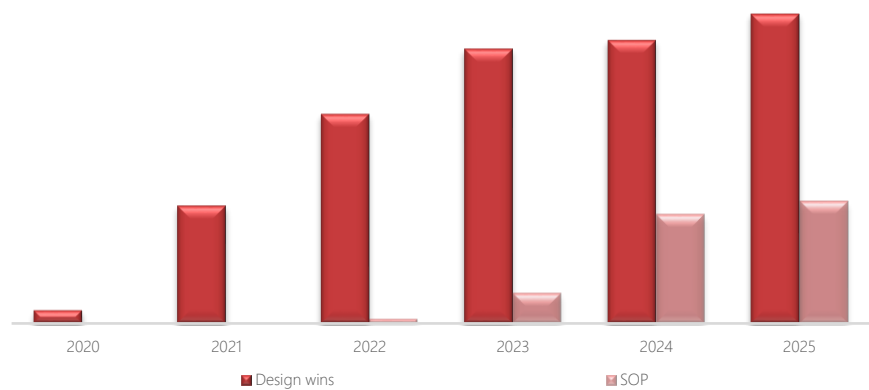
- Products with ultralong detection ranges help explore new markets
RoboSense (02498.HK) introduced new product lines covering over 300m detection ranges, including M3 which was launched at CES 2024 in Jan 2024 and F Platform which will be released in 2025. The former adopts a 940nm wavelength, bringing advantages like being smaller in size, lower power consumption and more cost-effectiveness. The latter is a product with ultralong detection ranges that has exceptional detection capabilities for small objects, and it is more suitable in countries requiring longer detection ranges.

Growth momentum will be brought by dual drivers

■ LiDAR for ADAS – the core growing momentum

RoboSense (02498.HK) has developed both mechanical LiDAR and solid-state LiDAR. M platform is the primary income source, and the mass production of the E Platform and F Platform will be carried out in 2025 and 2026 respectively, it is expected that these two platforms will also be the drivers in the future. The revenue generated from the sales of LiDAR for ADAS boomed YoY 3.3x in 2024 Q1, accounting for 84.7% of total revenue. The sales volume soared YoY 5.4x to 116k in the same period, ranking top 1 in the market. As at the end of May 2025, the Group earned design wins for mass production of LiDAR products for 71 vehicle models, bringing foreseeable growth to the Group.

Exhibit: Number of vehicle models obtaining SOP and design wins



Source: Frost & Sullivan, Company data, West Bull Securities

The Group is developing new LiDAR products for ADAS, including M3, launched in early 2024, with 940nm wavelength and MX, launched in Apr 2024, with mid-detection ranges. The former, supporting L3 – L4, is small in size with lower power consumption and production costs, and the latter has obtained 3 design wins for mass production and the mass production will be carried out in 2025 1H.

According to the CIC Report, the market size for LiDAR solutions in the automotive market was RMB 3.4bn in 2022, and is expected to grow at a CAGR of 103.2% to RMB 1,000.3bn by 2030. Benefit from smaller-in-size and lower costs, CIC further expects that the penetration rate of sold-state LiDAR will continue to increase, and the market size of sold-state LiDAR will boom at a CAGR of 128.8% from RMB 1.0bn in 2022 to RMB 750.7bn in 2030.

- Robotics applications may be the next growth momentum

RoboSense (02498.HK) defines itself as a robotics company, its LiDAR products are suitable for robotics applications (e.g. robotaxi, cleaning, logistics, industrial, public services and inspection etc.), including R Platform, a mechanical LiDAR platform, and E Platform, a solid-state LiDAR platform.

According to CIC, to enhance the robustness and accuracy of a robot's perception, robots need to be equipped with more sensors to perceive their surrounding environment comprehensively. Therefore, highly intelligent robots equipped with multiple LiDARs have become a trend. Benefit from an increase in the number of robots, the growth of adoption rates of LiDARs among robots, and the rising number of LiDARs installed per robot, the robotics LiDAR solutions market is expected to grow at a CAGR of 50.6% from RMB 8.2bn in 2022 to RMB 216.2bn by 2030.

The Group recorded a YoY 22.0% decrease in the revenue generated from the sales of LiDAR for robotics to RMB 186.5mn in 2023, it was attributed to the suspension of production of the lower margin product, RS-LiDAR-16. The gross margin in 2023, thus, surged 2.9p.p. to 44.3%. The Group currently fulfils most of the needs with Helios and Blackpearl products, especially cleaning and unmanned forklift robots. The E Platform will be delivered in 2024 Q4, primarily serving the demand for robots for home services. As some pre-IPO investors like Alibaba and Xiaomi also participate in the robotics area, and the former is currently a customer of the Group, giving growth opportunities to the Group.

Amelioration of profit margin

- Achievement of positive gross margin in the business of the sales of LiDAR products for ADAS
RoboSense (02498.HK) achieved 42.7%/-7.4%/8.4%/12.3% gross margin in 2021/2022/2023/2024 Q1 respectively. The negative gross margin in 2022 was a result of the sales of LiDAR products for ADAS which accounted for over 70% of total revenue. Resulted from i) the lower proportion of prototypes, ii) the higher procurement cost of semiconductors, iii) the increased inventory costs and provision expenses, iv) the expenses used for capacity expansion, and v) the lower ASP, the gross margin of the LiDAR products for ADAS was negative in 2022. However, the gross margin of the LiDAR products for ADAS rebounded from -101.1%/-5.9% in 2022/2023 respectively to 10.6% in 2024 Q1, bringing the overall gross margin to a low-teen level.

- Increasing economies of scale

RoboSense (02498.HK) achieved 240k and 116k sales volume of LiDAR products for ADAS in 2023 and 2024 Q1 respectively, implying YoY 5.5x and YoY 5.4x growth. As at the end of May 2024, the Group obtained design wins for mass production of 71 vehicle models. The average time from obtaining a design win for mass production to SOP is approximately 12 months, implying that the delivery of LiDAR for ADAS will grow significantly in the coming future, bringing economies of scale to the Group in terms of procurement and production costs.

- Fast product iteration results in an improvement in gross margin

RoboSense (02498.HK) focuses on developing chip-driven LiDAR platforms based on proprietary LiDAR-on-chip technology that enables fast and efficient product iterations, and the mass production of M1/M1 Plus/M2 were realized in 2021/2022/2023 respectively. All of these products can achieve performance improvements without significant changes to their physical dimensions or connectors, allowing the customers to easily implement upgrades with minimal additional effort. Moreover, the Group typically enters into contractual agreements on future pricing with certain design-win customers upon SOP, which stipulate annual price reductions ranging from 1% to 5%, a fast and efficient product iteration is positive for an improvement in gross margin.

Expansion of production capacity meets the booming demand

RoboSense (02498.HK) operates two in-house manufacturing centers in Shenzhen, of which i) Honghualing factory occupies approximately 13,000 m² of space and produces solid-state LiDARs, with a monthly designed capacity of approximately 46,800 units, ii) Shiyan factory mainly produces R Platform LiDARs with a monthly designed production capacity of approximately 2,500 units. Besides, the factory owned by the associate, Luxsense, occupies about 27,000 m² of space, and the annual designed capacity is about 280,000 units of modules. A new head office with 100,000 m² of space will also operate in 2024 Q3. The production capacity is expected to grow to over 1mn units in total, meeting the potential demand in the future.

Forecast and Valuation

Forecast

■ Total revenue

Benefit from i) an increment in design wins for mass production, the shipment of RoboSense (02498.HK) is expected to increase, ii) the mass production of MX series, iii) capacity expansion, we expect that the shipment will climb to approximately 800k and 2mn in FY 2024 and FY 2025 respectively, and it is expected that the E Platform and F Platform will further fuel the shipment. However, the ASP will be dragged by the annual adjustment for existing products and the MX series whose price is much lower than the M series. We, thus, expect that the Group may realize YoY 33.9% - YoY 119.9% growth in the top-line of the coming three years.

■ Gross profit

RoboSense (02498.HK) recorded a positive gross margin in the LiDAR products for ADAS in 2024 Q1, we believe that the gross margin will climb further due to the economies of scale. The gross margin of the primary contributor, the M series, may improve to around 15%, and the gross margin of the MX series is expected to be a bit higher than the M series. Besides, the gross margin of the LiDAR products for robotics slumped in 2024 Q1 because of the increase in the shipment of products with a lower gross margin like the Helios series and Bpeal series. We believe that the Ruby series and the E Platform can bring the Group a better gross margin, resulting in an improvement in the long term. Therefore, we forecast that the gross margin of the Group will gradually improve to about 16.5% - 22.1%.

■ Net profit

Thanks to an improvement in gross margin and the economies of scale, the net loss is expected to be improved and the operating expenses as a percentage of revenue will be lower. However, the Group will continue to invest in R&D for product iteration, the R&D expenses are expected to remain at a high level and the Group may continue to incur a loss in the bottom-line. Besides, we further expect that the Group will realize a profit after the shipment of E Platform and F Platform.

Valuation

By using DCF valuation methodology and PS valuation methodology to derive the fair value, we initiate our first coverage on RoboSense (02498.HK) with a “BUY” rating and a HKD 23.30/share target price.

■ DCF valuation

We expect that RoboSense (02498.HK) will invest approximately RMB 100mn to RMB 200mn annually to expand the production capacity to cater for the booming demand of LiDAR products, including the MX series, bringing the Group a negative free cash flow. Besides, although we expect a net loss will be incurred in the coming two years, we expect that the improvement in the net margin will ameliorate the operating cash flow of the Group, leading to a positive free cash flow to the Group in FY 2025. Derived from the DCF model with the assumptions below, we assign a fair value of HKD 24.30/share to RoboSense (02498.HK).

Exhibit: Assumption of valuation

Discounted Cash Flow	-60.8mn	LT Debt-to-Equity Ratio	-
Terminal Value	12,732.8mn	BETA	1.0
Discounted Terminal Value	10,107.7mn	LT Risk-free Rate	4.0%
		Risk Premium	4.0%
		LT Equity Cost	8.0%
		LT Debt Cost	-
		LT Debt Cost (After Tax)	-
		WACC	8.0%
		LT Growth Rate	3.0%

Source: West Bull Securities

■ PS valuation

We adopt PS valuation methodology as a reference due to the net loss assumptions, we especially compare RoboSense (02498.HK) to the peers operating in similar regions. We believe that the valuation of RoboSense (02498.HK) is a bit higher than the peers due to the growth potential. The market share of the Group is booming in terms of shipment, and it ranked top 1 in 2024 Q1. Based on the growth potential and the leading market position, we assign a fair value of HKD 22.40/share to RoboSense (02498.HK).

Peers comparison

		Mkt. Cap.	P/E	Fw. P/E	P/B	P/S	Revenue	GM	ROE
		(HKD, mn)	(x)	(x)	(x)	(x)	(HKD, mn)	(%)	(%)
300552.CH	Vanjee	7,816.3	-	-	3.3	7.6	1,004.9	33.6	(15.5)
AEVA.US	Aeva	1,357.6	-	-	0.9	43.4	33.8	(136.5)	(59.8)
CPTN.US	Cepton	322.0	-	-	-	3.0	102.2	27.2	-
HSAI.US	Hesai	4,522.8	-	-	1.1	2.2	2,075.1	35.2	(14.2)
INVZ.US	Innoviz	1,083.8	-	-	1.1	5.0	163.4	(55.6)	(81.4)
LAZR.US	Luminar	5,810.6	-	-	-	8.8	546.3	(104.2)	-
LIDR.US	AEye	79.2	-	-	0.5	10.8	11.5	(946.4)	(145.2)
OUST.US	Outster	4,957.8	-	-	3.8	6.2	652.0	10.0	(90.1)
	<i>Average</i>	<i>3,243.8</i>	<i>-</i>	<i>-</i>	<i>1.8</i>	<i>10.9</i>	<i>573.7</i>	<i>(142.1)</i>	<i>(67.7)</i>
02498.HK	RoboSense	6,949.0	-	-	-	-	1,238.4	8.4	-

Source: Bloomberg, West Bull Securities

Risk factors

- Unable to maintain a strong market share and leading position
- Keen competition results in a decrease in the demand for LiDAR products
- Slow product iteration leads to a lower gross margin
- Sales of E Platform products are weaker than the M Platform products
- Unable to launch F Platform as expected
- Demand for robotics LiDAR products is weaker than expected
- An increase in R&D expenses is faster than the top-line growth

Financial Statement

PnL					Balance Sheet				
(RMB, mn)	2023 (A)	2024 (E)	2025 (E)	2026 (E)	(RMB, mn)	2023 (A)	2024 (E)	2025 (E)	2026 (E)
Revenue	1,120.1	2,463.0	3,961.9	5,303.9	PPE	268.1	324.3	374.6	451.9
YoY growth	111.2%	119.9%	60.9%	33.9%	Others	176.7	178.1	176.7	175.8
COGS	(1,026.5)	(2,056.7)	(3,226.6)	(4,132.4)	Non-current assets	444.8	502.4	551.4	627.7
Gross profit	93.6	406.3	735.3	1,171.5	Inventories	199.2	379.5	532.7	687.1
Other income	35.1	17.1	12.8	12.9	Trade receivables	678.3	946.0	1,202.8	1,498.8
Operating expenses	(1,069.4)	(904.4)	(1,033.5)	(1,166.7)	Cash & cash equivalents	1,826.4	2,386.0	2,477.9	2,714.4
Operating profit	(940.6)	(481.0)	(285.4)	17.7	Others	122.8	176.4	236.1	302.8
Finance expenses	78.1	68.3	88.8	91.3	Current assets	2,826.7	3,888.0	4,449.4	5,203.1
JV & Ass.	4.5	5.5	4.8	6.4	Total assets	3,271.5	4,390.4	5,000.8	5,830.8
Profit before tax	(858.0)	(407.2)	(191.7)	115.4	LT borrowings	-	-	-	-
Tax	(1.9)	(2.0)	(2.5)	(3.0)	Others	1,493.8	94.8	94.8	94.8
Net profit	(859.9)	(409.2)	(194.2)	112.4	Non-current liabilities	1,493.8	94.8	94.8	94.8
					Trade payables	490.2	581.7	775.5	884.3
					ST borrowings	1.0	-	-	-
					Others	10,356.3	349.4	466.5	530.8
					Current liabilities	10,847.5	931.1	1,242.0	1,415.2
					Total liabilities	12,341.3	1,025.9	1,336.8	1,510.0
					Non-controlling interests	15.8	21.8	28.3	35.3
					Controlling interests	(9,085.7)	3,342.6	3,635.7	4,285.5
					Total equities	(9,069.8)	3,364.5	3,664.0	4,320.8

Cash Flow					Financial Ratio				
(RMB, mn)	2023 (A)	2024 (E)	2025 (E)	2026 (E)		2023 (A)	2024 (E)	2025 (E)	2026 (E)
Profit before tax	(4,329.1)	(407.2)	(191.7)	115.4	Gross margin	8.4%	16.5%	18.6%	22.1%
Finance expenses, net	(78.8)	(68.3)	(88.8)	(91.3)	Operating margin	-84.0%	-19.5%	-7.2%	0.3%
D&A	149.4	104.4	122.3	135.3	Net profit margin	-386.6%	-16.6%	-4.9%	2.1%
Others	3,910.9	491.9	569.0	618.6	Return on Equity	61.4%	14.3%	-5.5%	2.8%
Change in working capital	(168.9)	(355.2)	(145.7)	(329.5)	Return on Asset	-129.3%	-10.7%	-4.1%	2.1%
CFO	(516.5)	(234.4)	265.1	448.5	Current ratio	26.1%	417.6%	358.3%	367.7%
					Quick ratio	24.2%	376.2%	314.2%	317.4%
CAPEX	(146.0)	(146.5)	(156.5)	(195.2)	Cash ratio	16.8%	256.3%	199.5%	191.8%
Others	411.6	-	-	-	Debt-to-Equity ratio	0.0%	0.0%	0.0%	0.0%
CFI	265.6	(146.5)	(156.5)	(195.2)	Net Debt-to-Equity ratio	20.1%	-70.9%	-67.6%	-62.8%
					Inventory turnover Days	86.8	51.4	51.6	53.9
Shares issuance	-	968.2	-	-	Receivable turnover days	144.2	120.4	99.0	93.0
Net borrowings	2.0	(1.0)	-	-	Payable turnover days	126.9	95.1	76.8	73.3
Interest paid	-	-	-	-					
Dividend paid	-	-	-	-					
Others	(36.6)	(26.6)	(16.8)	(16.8)					
CFF	(34.6)	940.6	(16.8)	(16.8)					
FCFE	(660.4)	(381.9)	108.6	253.3					
FCFF	(660.3)	(375.7)	116.6	263.3					

Source: Company data, West Bull Securities

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