

# ATS100 (With GPS) Intelligent Turn Assist System User Manual



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Autel Intelligent Automobile Co., Ltd.

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## **IMPORTANT**

Before operating or maintaining this unit, please read this manual carefully, paying extra attention to the safety warnings and precautions.

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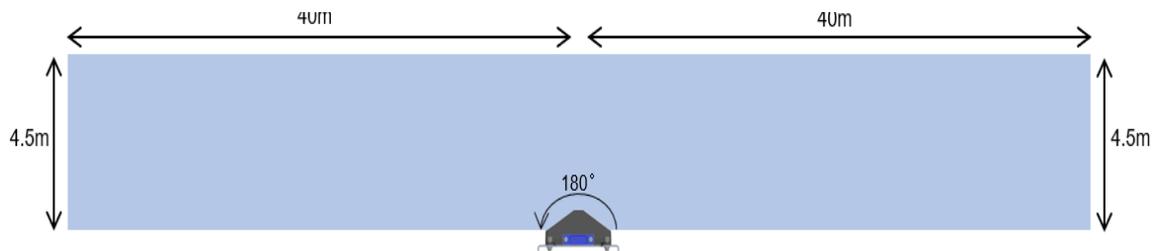
## Table of Contents

1.	ATS100 Turn Assist System Introduction.....	1
1.1	ASR100 Radar Introduction.....	2
1.2	Warning Display .....	3
1.3	GPS&IMU Module.....	6
1.4	System Connections & Wire Harness Description .....	7
2.	User Guide.....	10
2.1	Radar Installation .....	10
2.2	Radar Wiring.....	13
2.3	Input Signal Access .....	14
2.4	Power Access .....	15
2.5	GPS&IMU Module Installation .....	15
2.6	Display Screen Installation.....	16

# 1. ATS100 Turn Assist System Introduction

ATS100 is a turn assist system with accurate target detection and warnings for vehicle blind spots. The system components are as follows: a millimeter-wave radar with operation frequency 76-77GHz and max RF output power 12dbm, a spirit level, a mounting bracket (optional), a warning screen, a GPS&IMU module and the cable. The millimeter-wave radar can accurately measure the target distance, speed, angle, and other information through the difference in echoes between the transmitting and receiving electromagnetic waves. It is an all-weather and all-day operational turn assist system with working temperature from -40°C-85°C. The warning screen warns the driver of a dangerous target in the blind spot and reminds the driver to make timely adjustments to the driving trajectory, to avoid accidents.

The ATS100 turn assist system covers 180° on one side, ensuring no blind spots, with target detection range up to 80 x 4.5 m. With a compact structure, it comes with collision pre-determination and graded alarm function, can integrate with external CAN (Controller Area Network) and CAN FD (Flexible Data) interfaces, and supports 12 V or 24 V supply voltage.



**Figure 1-1 ASR100 radar coverage**

## **Warning targets of ATS100 turn assist system include:**

- Dynamic vulnerable road users, moving at speeds greater than 3 km/h, including pedestrians, bicycles, electric bicycles, etc.
- Dynamic cars, moving at speeds greater than 10 km/h.

Note: The safe use distance of the system needs to be greater than 4cm.

## 1.1 ASR100 Radar Introduction

The ASR100 77 GHz Millimeter-Wave Radar is a compact, rugged radar sensor designed and manufactured by Autel Intelligence Vehicle® in China for side blind zone warnings for heavy trucks/buses, etc. The ASR100 meets automotive grade standard for professional commercial vehicles and has an IP69K rating, in line with the commercial vehicle use environment.

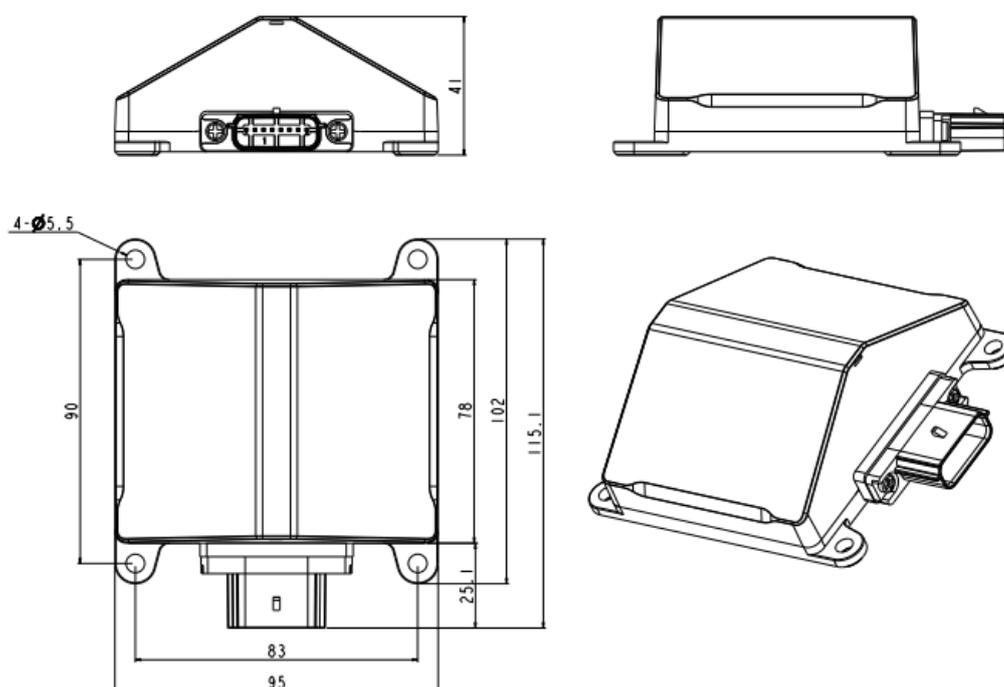


Figure 1-2 ASR100 dimensions

### Performance Parameter:

Working Frequency	76-77GHz	
Maximum Detection Range	±80m (Vehicle) ±40m (pedestrian/bicycle)	
Working Mode	Low Speed	High Speed
Minimum Detection Range	0.25m	0.9m
Distance Resolution	0.31m	0.96m
Distance Accuracy	±0.16m	±0.5m
Velocity Range	±60km/h	±150km/h

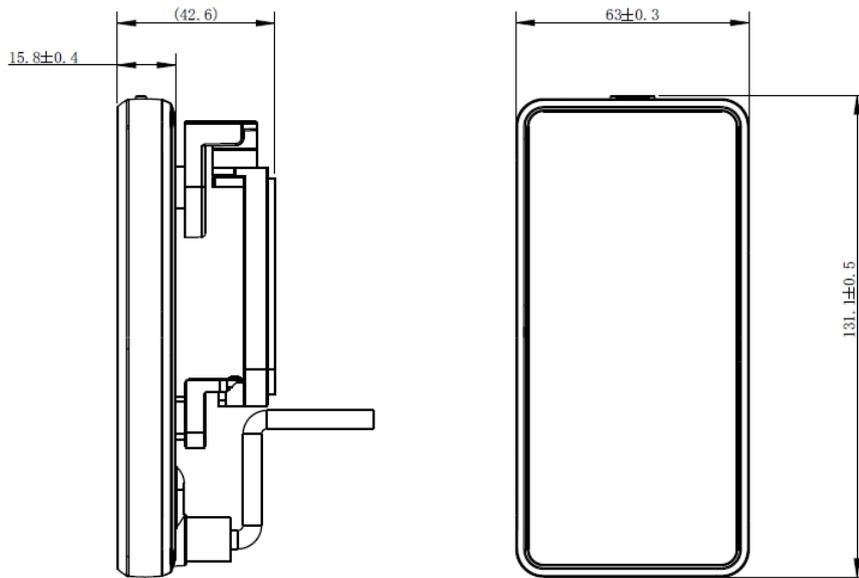
Velocity Accuracy	±0.43km/h
Velocity Resolution	0.86km/h
Horizontal Angle	180 °
Angle Accuracy	±0.8 °

### General Parameter :

Size	115mmX95mmX41mm
Weight	230g
Power Consumption	6.5W
Communication Interface	CAN2.0 , CAN_FD
Working Voltage	8V - 32V; Passenger Vehicle 12V, Commercial Vehicle 24V
Working Temperature	-40 °C ~ 85 °C
Storage Temperature	-40 °C ~ 105 °C
Installation angle redundancy	-5 °~5 °
Protection Rating	IP69K
Operation Cycle	60ms

## 1.2 Warning Display

The ATS100 turn assist system employs a precision sensing system to predict future collision probability with the target and provides users with dynamic sensing and display-based intelligent warnings, to remind drivers to take preventative measures in time to reduce the possibility of accidents. The warning display screen supports adaptive brightness control, enabling the screen's brightness to adjust based on the brightness of the surrounding environment, thereby reducing eye-fatigue for drivers during the night.



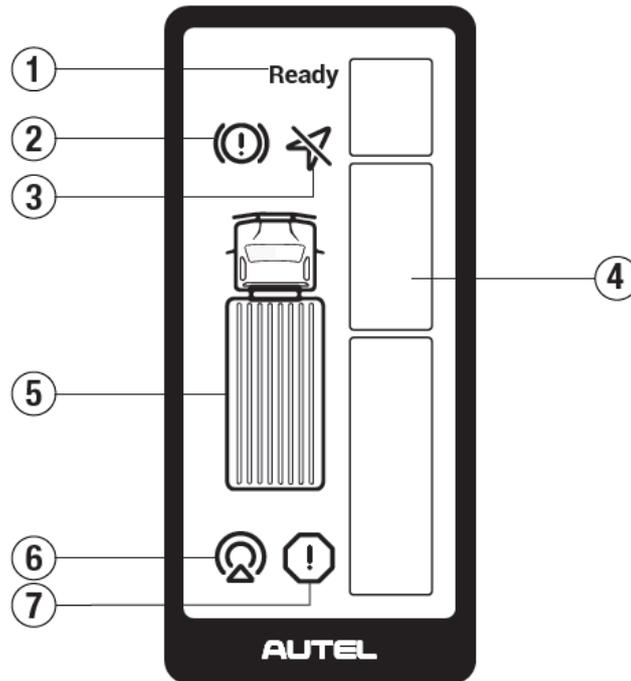
**Figure 1-3 Display size**

The warning function is divided into three levels as follows: (Note: Prerequisites for enabling the warning function: the speed of the vehicle is  $< 30\text{km/h}$ )

- **Level 1 warning:** The steering wheel angle is less than  $30^\circ$ , and the target enters the warning range, then a section of warning light LEDs, displayed in Figure 1-4, light up.
- **Level 2 warning:** The vehicle is turning to the right, the steering wheel angle is greater than  $30^\circ$  or turn on the turn signal (when the turn signal is connected), and it is expected that the vehicle and the target will collide within a certain amount of time, then a section of warning light LEDs start flashing.
- **Level 3 warning:** The vehicle is turning to the right, the steering wheel angle is greater than  $30^\circ$  or turn on the turn signal (when the turn signal is connected), and the vehicle and the target collision is imminent within a short amount of time, then the warning light will start flashing and a warning sound is generated.

The driver can get the approximate location of the target based on the section of warning light LEDs that are on or are flashing.

The detailed description of each warning light on the display is as follows:



**Figure 1-4 Description of warning light**

- ① Warning module power and status indicator: lights up when the status of the warning module is normal.
- ② Brake indicator: This light flashes when actively braking. (Currently this function is not available).
- ③ GPS fault indicator: on when GPS sensor has no signal (temporary), flashing when GPS sensor has faulty signal.
- ④ Warning light: provides early warning of dangerous targets. The warning area is divided into three different priorities: Zone top (2-5 m in front of the front of the vehicle), Zone central (2 m in front of the front of the vehicle- 7 m behind the front of the vehicle), and Zone bottom (7-30 m behind the front of the vehicle), If there are multiple targets in Zone top, central or bottom at the same time, give priority to Zone central, then Zone bottom, and then Zone top.
- ⑤ Vehicle model: for reference; is in a steady on state after power on.
- ⑥ Radar status indicator: steady on state indicates a temporary radar failure, usually caused by factors such as radar being blocked, bad weather conditions; flashing indicates a permanent radar failure, requiring professional repair.
- ⑦ System fault indicator: The indicator light is on when there is a fault in the entire system.

## Troubleshooting

**Table 1-1 Fault Description and Troubleshooting**

Status Icon	Fault Description	Repair Instructions
Warning module power and status indicator	does not light up after power on	Hardware failure and needs to be replaced
Radar status indicator	The fault light is always on	possible reason: 1. Obstructed by objects, such as snow, mud, etc. 2. Extreme weather, heavy rain and snow, etc. 3. The installation angle is greater than 5 °
Radar status indicator	Fault light flashes	Hardware failure and needs to be replaced
System fault indicator	Fault light flashes	Hardware failure and needs to be replaced
GPS fault indicator	Fault light flashes	Restart after power off, if the fault still exists, you need to replace the hardware

### 1.3 GPS&IMU Module

This module integrates high-precision gyroscope, accelerometer, GPS module, adopts high-performance microprocessor and advanced dynamic solution and Kalman dynamic filter algorithm, which can quickly solve the current real-time motion attitude of the module. Using advanced digital filtering technology can effectively reduce measurement noise and improve measurement accuracy. The module integrates an attitude solver and cooperates with the dynamic Kalman filter algorithm to accurately output the current attitude of the module in a dynamic environment. The attitude measurement accuracy is 0.05 degrees static and 0.1 degrees dynamic, with extremely high stability and performance even better than some professional inclinometer.

## 1.4 System Connections & Wire Harness Description

Connect each port of the radar, display, GPS&IMU module wiring harness as shown below.

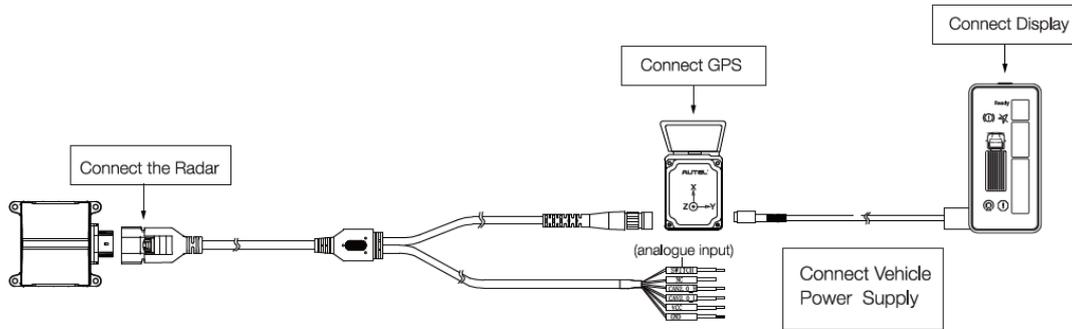


Figure 1-5 System connections diagram

### Radar Harness Description

In the figure below, the P1 connector is connected to the radar; it has 8 pins and the pin order is shown as below. The pin number in the figure corresponds to the pin definition in Table 1-2. The P2 connector is connected to the GPS&IMU module; it has 8 pins, and the pin number of P2 in the figure corresponds to the pin definition in Table 1-3. The P3 connector is connected to the vehicle and power supply, it has 6 pins, and the pin number of P3 in the figure corresponds to the pin definition in Table 1-4. The end of each cable has a printed label. Please check it carefully during installation. Do not turn the power on if the connectors are improperly connected.

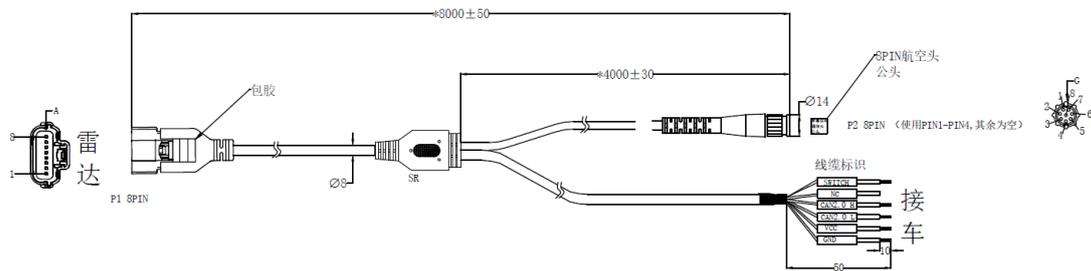


Figure 1-6 Radar wiring harness diagram

Radar interface P1 definition table:

Table 1-2 Definition of Radar Interface P1

No.	Definition	Range	Cable color
-----	------------	-------	-------------

1	VCC	8~32V DC	Red
2	NC	empty	Orange
3	SWITCH	Input: 12/24V DC Output: 0V DC	Blue
4	GND	0 V DC	Black
5	CAN2.0_H	-58~58 V DC	Green
6	CAN2.0_L	-58~58 V DC	Yellow
7	CAN_FD_H	-58~58 V DC	White
8	CAN_FD_L	-58~58 V DC	Purple

**GPS interface P2 definition table:**

**Table 1-3 Definition of GPS Interface P2**

No.	Definition	Range	Cable color
1	CAN_FD_H	-58~58 V DC	White
2	CAN_FD_L	-58~58 V DC	Purple
3	VCC_SCREEN	8~32 V DC	Red
4	GND_SCREEN	0 V DC	Black

**Vehicle power interface P3 definition table:**

**Table 1-4 Definition of vehicle power interface P3**

No.	Definition	Range	Cable color
1	VCC	8~32V DC	Red
2	NC	empty	Orange
3	SWITCH	Input: 12/24V DC Output: 0V DC	Blue
4	GND	0 V DC	Black
5	CAN2.0_H	-58~58 V DC	Green
6	CAN2.0_L	-58~58 V DC	Yellow

**Display Harness Description**

In the figure below, the left P4 connector of the display harness is connected to the GPS module; it has 8 pins and the pin order is shown as below. The pin number in the figure corresponds to the pin definition in Table 1-5.

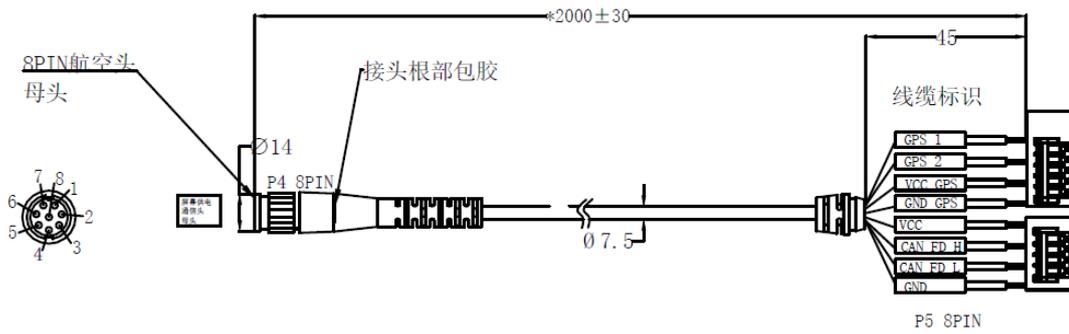


Figure 1-7 Display wiring harness diagram

GPS interface P4 definition table:

Table 1-5 Definition of GPS interface P4

No.	Definition	Range	Cable color
1	CAN_FD_H	-58~58 V DC	White
2	CAN_FD_L	-58~58 V DC	Purple
3	VCC	8~32 V DC	Red
4	GND	0 V DC	Black
5	GPS_1 Rx	0~5V DC	Blue
6	GPS_2 Tx	0~5V DC	Orange
7	VCC_GPS	5V DC	Green
8	GND_GPS	0V DC	Yellow

## 2. User Guide

### 2.1 Radar Installation

#### Notes on Installation

- The radar should be installed on a component with little vibration. Strong vibration will negatively affect its detection function.
- The radar should be installed on the most protruding plane on the side of the truck to prevent it from being blocked by other parts and its detection performance from being compromised.

**Installation position:** The radar should be installed on the right side of the truck. For right rudder country please install on the left side of the truck. We recommend you install it on the side guard plate, side guard rail of the truck.



**Figure 2-1 Radar installation position diagram**

#### Installation range:

When the radar is used, the reference coordinate origin is the center of the rear axle of the vehicle. The default installation position parameters of the radar are shown in Table 2-1 which only suitable for vehicles with a wheelbase of about 3.5-5m.

**Table 2-1 Radar default installation parameters**

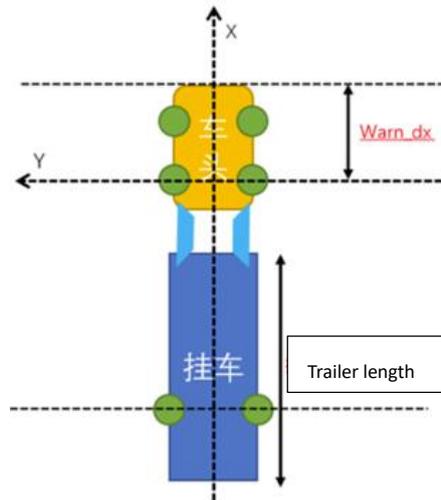
Installation Location	Right Side	Left Side
Lateral distance X (m)	2.85	2.85
Longitudinal distance Y (m)	-1.25	1.25
Installation angle (°)	90	-90
Warn_dx (m)	6.15	6.15

Lateral distance X: the longitudinal distance of the radar installation position relative to the center of the rear axle of the vehicle;

Longitudinal distance Y: The lateral distance of the radar installation position relative to the center of the rear axle of the vehicle;

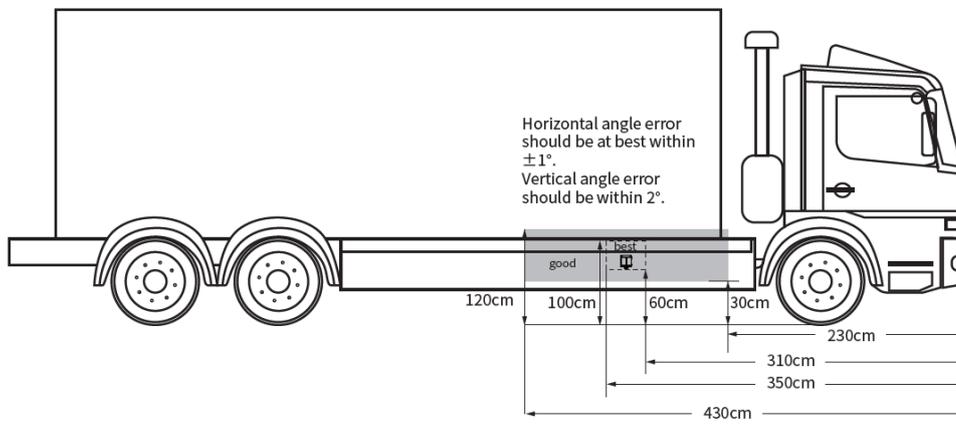
Installation angle: the rotation angle of the radar installation position relative to the center of the rear axle of the vehicle;

Warn\_dx: the distance from the center of the rear axle to the front edge of the vehicle.



**Figure 2-2 Radar installation location calibration parameters diagram**

Recommended sensor location is shown in Figure 2-2 below. The radar can be installed at a distance of 230-430cm back from the front edge of the vehicle and a height of 30-120cm from the ground.



**Figure 2-3 Recommended installation location diagram**

If your vehicle's wheelbase is not within 3.5-5 meters, using the above default radar installation position parameters will cause excessive errors. At this time, the user needs to measure the distance between the actual installation position of the radar and the center of the rear axle of the vehicle to calibrate the installation position of the radar. For the calibration of the radar installation position, please use our customer's host computer AutelRadarCfgTools. The operation steps are shown in Figure 2-4 below:

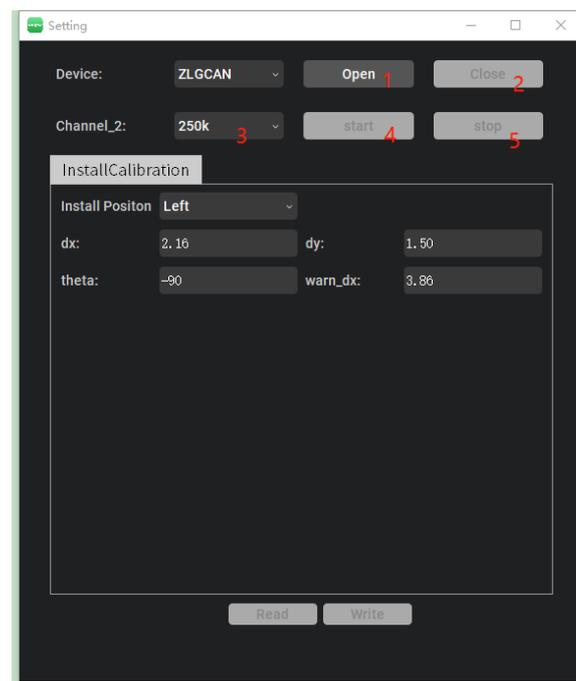
- (1) Click the Open button to open the CAN device;
- (2) Click the Close button to close the CAN device;
- (3) Select the baud rate of channel 2, the current default value is 250K
- (4) Click the Start button to open channel 2;
- (5) Click the Stop button to close channel 2;
- (6) Select whether the Install Position is facing the left or right side of the front of the vehicle;
- (7) Enter dx, dy, theta and warn\_dx values.

dx: the longitudinal distance of the radar installation position relative to the center of the rear axle of the vehicle. Unit: meter;

dy: The lateral distance of the radar installation position relative to the center of the rear axle of the vehicle, generally 1.25 m.

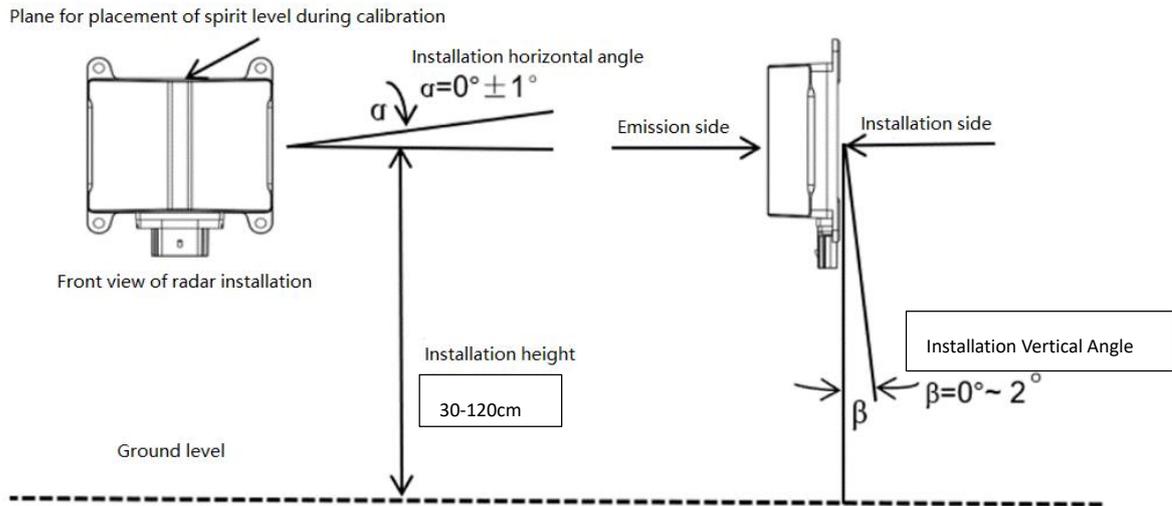
Installation angle: the left side is  $-90^\circ$ , right side is  $90^\circ$

Warn\_dx: the distance from the center of the rear axle to the front edge of the vehicle. Unit: meter.



**Figure 2-4 AutelRadarCfgTools Interface Icon**

**Installation deviations:** To ensure detection accuracy, the radar installation horizontal angle error should be at best within  $\pm 1^\circ$ . Installation vertical angle error should be at best within  $2^\circ$ .

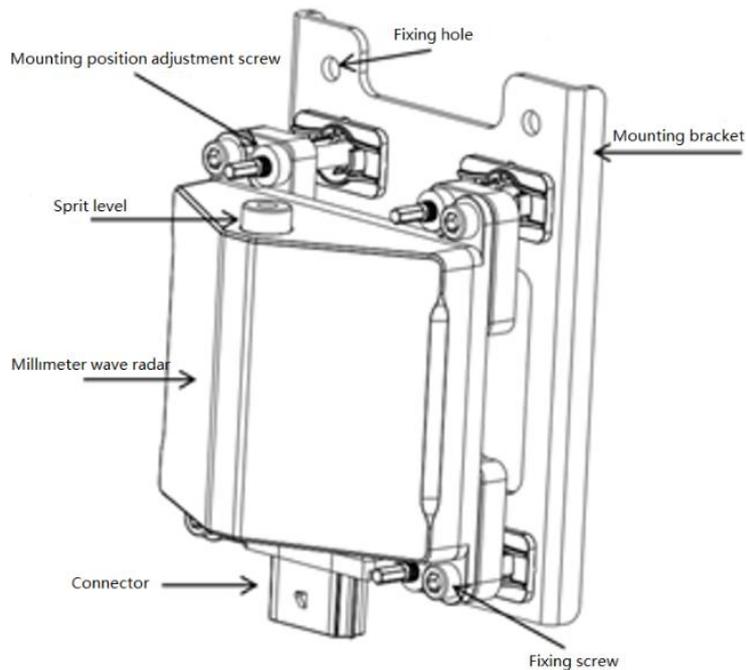


**Figure 2-5 Radar installation deviations diagram**

**Example of Installation**

In order to control installation deviations, an optional auxiliary mounting bracket can be used to adjust the direction and angle during installation.

1. With the front of the radar (the side with the plastic casing) facing the detection area, fix the radar to the mounting bracket using the screws.
2. Place the spirit level in the middle of the upper plane of the radar and adjust the mounting position adjustment screw until the bubble overlaps the ring in the middle.
3. Secure the mounting position adjustment screw, and then connect the cable.



**Figure 2-6 Radar installation and calibration diagram**

**2.2 Radar Wiring**

After the radar cable is connected to the radar, it should be routed into the cab together with the chassis cable, as shown in the image below.



The entry for the chassis cable into the cab is at the bottom of the cab. Therefore, you need to lift the cab during wiring, as shown in the image below.



In front of the front passenger seat (where the main fuse and the main ECU are located), connect the power supply, the display screen and the other parts of this product, as shown in the image below.



### 2.3 Input Signal Access

The Autel ATS100 requires the 5 interior signals below for its normal operation. The radar automatically reads these CAN J1939 signals by default, The baud rate is 250KB:

1. Vehicle speed
2. Steering wheel angle
3. Yaw rate
4. Longitudinal acceleration
5. Lateral acceleration

Identifier	Tmin	Tmax	Message Type	Byte Oder
0xCFE6CEE	50ms	50ms	cyclic	Intel

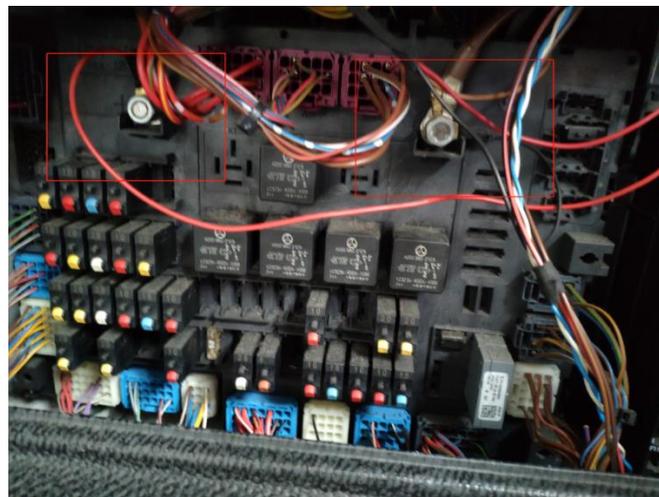
Signal	Byte	Bit	Length	Resolution	Offset	Minimum	Maximum	Unit
Vehicle Speed	6	48	16	0.00390625	0	0	250.996	km/h

Identifier	Tmin	Tmax	Message Type	Byte Oder
0xCF0090B	20ms	20ms	cyclic	Intel

Signal	Byte	Bit	Length	Resolution	Offset	Minimum	Maximum	Unit
Steering Wheel Angle	0	0	16	0.055952	-1797.6	-1797.6	1797.6	deg
YawRate	3	24	16	0.00699088	-224.6	-224.6	224.6	deg/s
Lateral acceleration	5	40	16	0.000488273	-15.687	-15.687	15.687	m/(s*s)
Longitudinal acceleration	7	56	8	0.1	-12.5	-12.5	12.5	m/(s*s)

## 2.4 Power Access

The radar has to be powered via KL15 or Clamp 15 (24V). We recommend you find KL15 on the main fuse board and connect the radar to it.



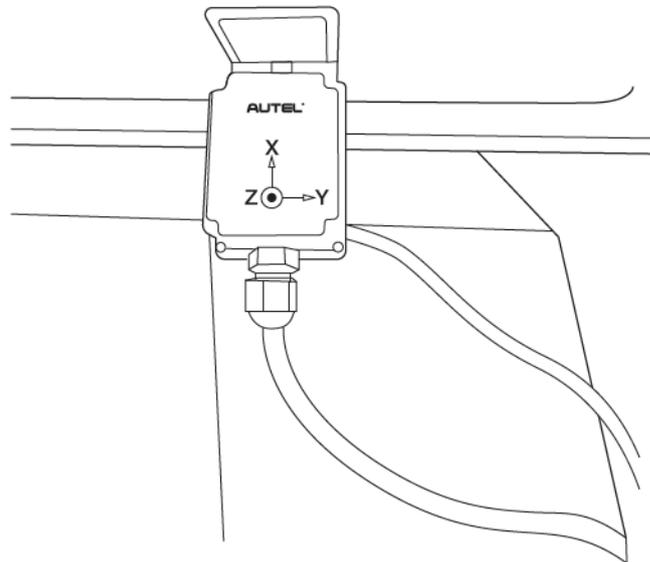
## 2.5 GPS&IMU module Installation

The GPS/IMU Module can be placed anywhere inside the driver cabin, the preferred position is behind the windshield glass and somewhere in the middle of cockpit.

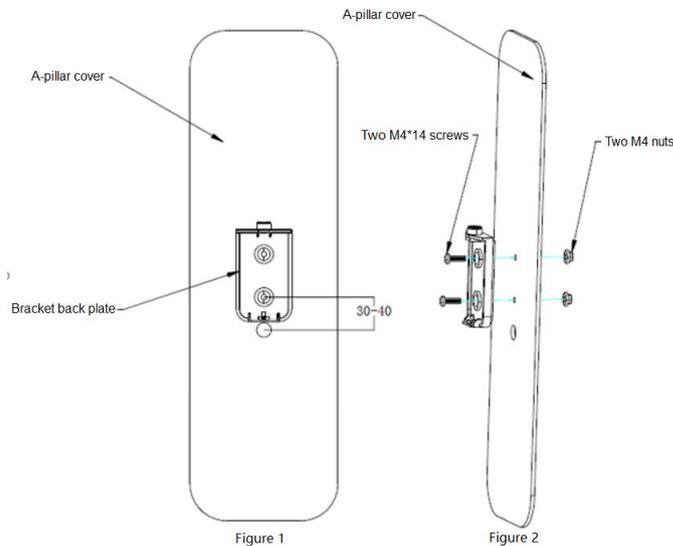
- a. Place the GPS&IMU module horizontally, and note that the X-axis direction is consistent with the vehicle's forward direction.

- b. The module can be fixed using screws or double-sided tape.
- c. Connect the two wire harnesses at the end of the GPS&IMU module to the radar and display respectively.

Note: GPS&IMU module installation angle tolerance <math><30^\circ</math>



## 2.6 Display Screen Installation

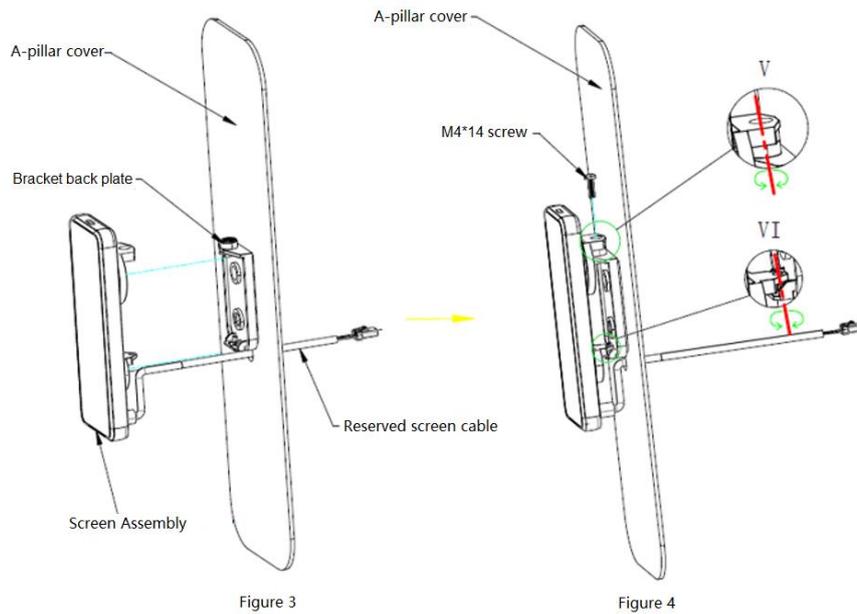


- a. Remove the A-pillar cover and drill holes: Referring to Figure 1, take the mounting holes on the bracket back plate as reference points, and drill two 4.5 mm mounting holes and one 12 mm hole to route the cable through (30-40 mm below the mounting holes).

- b. Referring to Figure 2, use two M4\*14 screws to fix the bracket back plate to the A-pillar cover.

Note: 3M adhesive on the bracket back plate allows the bracket to be stuck on the A-

pillar cover.



c. Referring to Figure 3, route the cable on the screen assembly through the cable hole on the A-pillar cover.

d. Referring to Figure 4, place the screen assembly on the corresponding position on the bracket back plate, as shown in view V and view VI. You can rotate the screen around the axis to adjust its angle, and then fix the screen assembly with M4\*14 screws.

e. Install the cover back to the A-pillar.