

# NOVA77GB-A 77GHz Millimeter-Wave Radar

## User Manual

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## 1 overview

When a vehicle equipped with the Nova MRR Lane Change Assistance system makes a lane change, the system can issue corresponding warnings to avoid accidents. The system complements the rearview mirror's field of view both inside and outside the car, and is not intended to completely replace the mirror. When the driver wants to change the lane, the millimeter-wave radar of the system will sense the driving environment and issue a warning to the driver if the lane change is not recommended.

## 2 Mechanical and interface definitions

### 2.1 Product picture



Figure 1 Product picture

## 2.2 Definition of Hardware interfaces

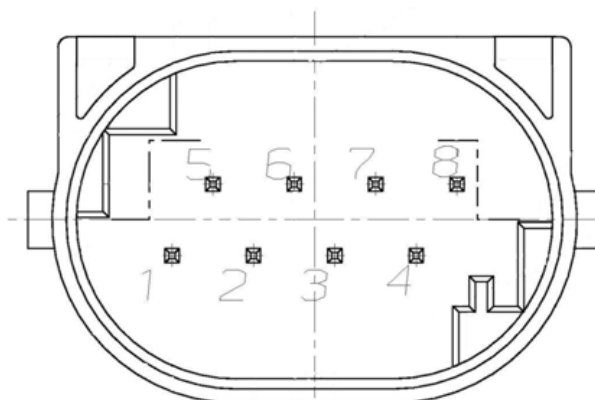


Figure 2 Hardware interfaces

Table 1 connector pin definition

PIN No.	functional description	maximum current	Signal types	Description
1	KL31	NC	power	Sensor ground: connected to KL31
2	CAN1_H	NC	signal	
3	CAN1_L	NC	signal	
4	KL15	NC	power	
5	CAN2_H	NC	signal	
6	CAN2_L	NC	signal	
7	LED_POWER_OUT	NC	power	LED_POWER_OUT
8	KL30	NC	power	Supply voltage for sensor connected to KL30(/KL15)

### 3 Installation Instructions

#### 3.1 Installation Instructions

##### 3.1.1 Installation height

The NOVA corner radar is recommended to be installed inside the rear bumper. The specific location requirements are as follows (see Figure 3 below):

- ① Installation height range for best performance: 0.3m—0.8m;
- ② Installation width range for best performance: within 0.35m from the side of the vehicle body.

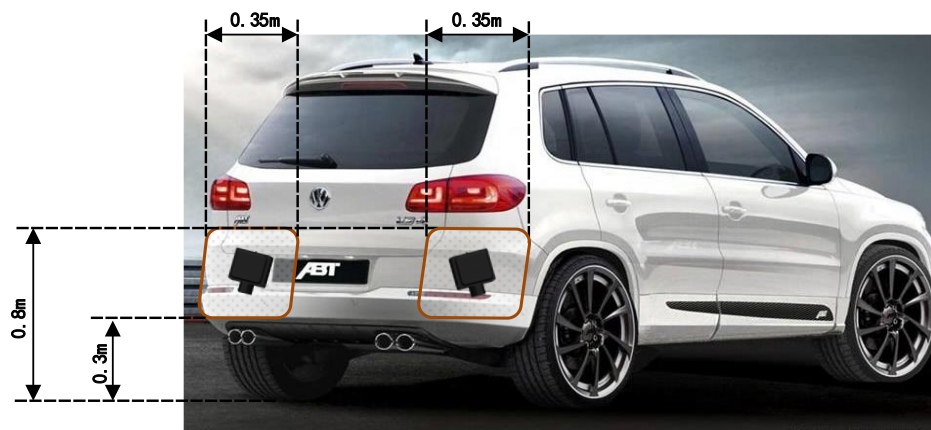


Figure 3 Radar installation height diagram

##### 3.1.2 Installation angle

NOVA angle radar should be installed at both ends of the vehicle side rear. Figure 4 shows a schematic diagram of the three-dimensional angle of the radar. The  $\alpha$  direction is the installation azimuth angle, and the installation angle is  $\pm 40^\circ$ ; the  $\beta$  direction is the installation pitch angle, and the installation angle is  $+8^\circ$ .

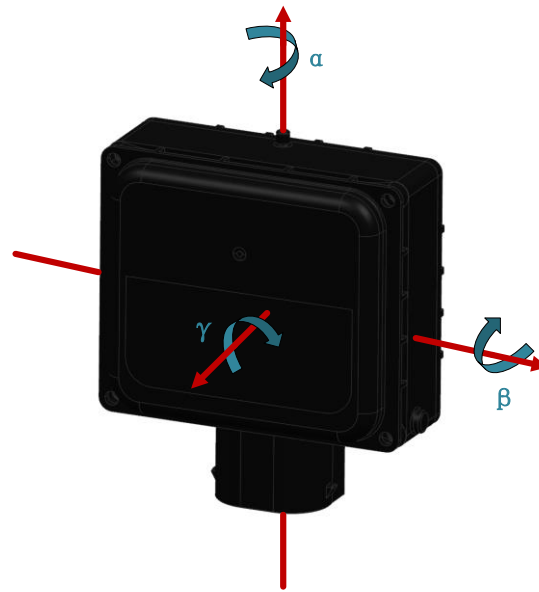


Figure 4 Schematic diagram of radar calibration angle

Figure 5 below is a schematic diagram of the two-dimensional installation angle. In the figure, the  $+x$  direction is the driving direction of the vehicle, the azimuth angle between the radar installation and the  $+y$  direction is  $40^\circ$ , and the pitch angle between the radar installation and the  $-z$  direction is  $8^\circ$ .

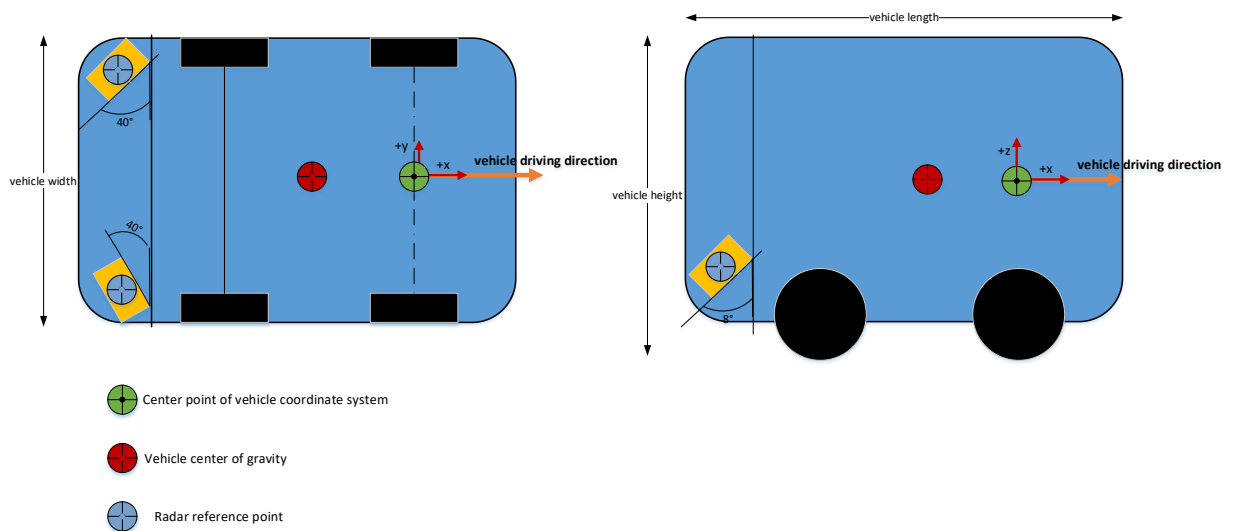


Figure 5 Schematic diagram of two-dimensional installation angle of radar

### 3.1.3 Installation error

The installation error of NOVA angle radar must meet the requirements of the following table to ensure the accuracy of radar detection angle and make the radar work normally. When calibrating the radar

installation angle, the vehicle must stay on a horizontal plane to avoid tilting the body.

Table 2 Angle installation error

Angle installation error	Horizontal angle error: $\pm 2^\circ$
	Vertical angle error: $\pm 1^\circ$

## 3.2 Bumper or Obstruction Restrictions

### 3.2.1 Basic requirements

Ideal situation: The radar beam covers the direction without any metal parts or painted bumpers.

General situation: The corner radar is usually installed in the bumper at the rear of the vehicle, so special attention should be paid to the material selection, shape design, paint and relative position of the bumper or cover. At the same time, water droplets, water film and snow accumulation on the surface of the occluder may cause additional signal attenuation and further lead to limited performance and functionality.

### 3.2.2 Bumper Material Requirements

There should be no obstructions (including bumpers) in front of the radar. If the obstructions or bumpers are unavoidable, the materials of the obstructions must have a small dielectric constant and dielectric loss. These materials include Polypropylene, Polyamide, Polycarbonate, ABS (Acrylnitril-Butadien-Styrol), PC-PBT (Polycarbonate Type), etc. These materials should reduce the use of metal and carbon fiber, and the surface of the material should not contain metal or metal material coatings.

The following table shows the material parameters of commonly used bumpers or coverings.



Table 3 Relationship between optimal thickness, loss and dielectric constant of materials

Material	Dielectric constant	Best thickness 1 (mm)	Best thickness 2 (mm)	Best thickness 3 (mm)	Loss (dB); 77GHz, optimal thickness 2
Polypropylene	2.35	1.28	2.55	3.83	0.10
Polyamide	2.75	1.18	2.36	3.54	0.30
Polycarbonate	2.8	1.16	2.33	3.49	0.17
ABS	3.12	1.10	2.21	3.31	0.30

### 3.2.3 Bumper Thickness Requirements

In order to ensure that the radar achieves high conductivity, the thickness of the bumper needs to be selected carefully. Among the above mentioned materials, the thickness of the bumper should be an integer multiple of half the wavelength of the 77GHz millimeter-wave radar. Such as ABS material bumper thick the degree should be  $n \times 1.2\text{mm}$  (in the 77GHz range,  $n=1, 2, \dots$ ). Attenuation increases with bumper thickness increase and increase.

In order to prevent the radar beam from being distorted, the bumper should be kept as flat as possible, and the thickness should be uniform, any slight bend can have a big impact on the radar beam.

### 3.2.4 Bumper shape requirements

The surface of the bumper or shield must be smooth (roughness should be less than one-tenth of a wavelength, about 400 microns), uniform in thickness, and its radius of curvature should be as large as possible (small curvature) to reduce distortion and attenuation of the radar beam . Figure 8 shows the influence of the shape of the bumper on the radar performance, from left to right are bumper digging (completely unobstructed), parallel, small curvature, thickness gradient, and sharp edge.



Figure 6 Bumper Shape Requirements

#### 4 Certified Product & Warnings

Please take attention that changes or modification not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference, and
- (2) This device must accept any interference received, including interference that may cause undesired operation.

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions:

- (1) this device may not cause interference, and
- (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radioexempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

- (1) l'appareil ne doit pas produire de brouillage, et
- (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

This equipment complies with FCC/IC RSS-102 radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

ce matériel est conforme aux limites de dose d'exposition aux rayonnements, FCC / CNR-102 énoncée dans un autre environnement. cette equipment devrait être installé et exploité avec distance minimale de 20 entre le radiateur et votre corps.

#### § 95.393 Instructions and warnings.

- (1) Instructions concerning all controls, adjustments and switches that may be operated or adjusted without resulting in a violation of FCC rules;
- (2) Warnings concerning any adjustment that could result in a violation of FCC rules or that is recommended to be performed only by or under the immediate supervision and responsibility of a person certified as technically qualified to perform transmitter maintenance and repair duties in the relevant radio service by an organization or committee representative of users of that service;
- (3) Warnings concerning the replacement of any transmitter component (crystal, semiconductor, etc.) that could result in a violation of FCC rules; and
- (4) For a transmitter that can only be operated with an FCC license, warnings concerning compliance with applicable licensing requirements and information concerning license application procedures.