TCR300 Traffic Flow Radar White Paper

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Table of Contents

White Paper on TCR300 Traffic Flow Radar

Abstract: TCR300 is a compact 80GHz high-performance traffic flow monitoring radar, which uses the frequency difference between the transmitted radio wave and the echo to accurately measure the speed, distance, angle and other information of the target. TCR300 adopts many advanced technologies such as DBF digital beam synthesis, MIMO virtual synthetic aperture, far and near dual-mode detection, etc. It has the characteristics of high precision, easy debugging, high stability, etc. The radar can detect 4~6 lanes and 128 targets at the same time, with a maximum detection distance of 280 meters, and can be widely used in application scenarios such as highway flow monitoring and intersection monitoring.

Keywords: TCR300; Traffic flow; 280 meters detection distance; 128 targets

1 Traffic Flow Radar Application Requirements

In recent years, with the promotion of social and economic development and national policies, China's urbanization process has developed rapidly. With the rapid growth of urbanization rate, there is a huge demand for urban transportation. China is not only one of the countries with the fastest construction speed of transportation infrastructure such as roads in the world, but also one of the countries with the fastest growth of transportation demand.

According to the data, the investment in highway construction in 2019 was 2,189.5 billion yuan, an increase of 2.6% over the previous year. Among them, the investment in expressway construction was 1,150.4 billion yuan, an increase of 15.4%; The investment in the construction of ordinary national and provincial highways was 492.4 billion yuan, down 10.3%; The investment in rural highway construction was 466.3 billion yuan, down 6.5%.

With the gradual maturity of artificial intelligence technology and the promotion of many policies, the intellectualization and intelligence of expressways

have become the main development direction of highway transportation. Through the construction of infrastructure, the construction of highway network will continue to increase, and the capacity of highway freight transportation will also continue to improve. With the further development of China's intelligent expressway construction, the market scale will gradually rise. The China Business Industry Research Institute predicts that the market scale of China's intelligent expressway will exceed 60 billion yuan in 2020.

Intelligent transportation products such as traffic flow monitoring, intelligent control system of intersection traffic lights, intelligent warning lights, intelligent parking navigation system and intelligent transportation guidance equipment began to emerge. Because of its powerful functions, such intelligent transportation products effectively improve the transportation efficiency and effectively solve the transportation problems in cities.

At present, there are many sensing technologies for traffic flow monitoring applications. They serve different markets, and each technology has unique advantages and disadvantages.

Inductive loop sensor. Through an insulated and conductive wire passing through a cut in the road, an electrical pulse passes through the wire, and the inductance change caused by the passage of the car indicates when the car passes or stops. This solution is common, but inductive loop sensors have the following disadvantages.

First of all, the detection is limited to vehicles where the main loop is installed, so it is difficult to predict the overall traffic situation. Secondly, coils are required to be installed at intersections in every area and lane. This system is expensive and complicated to implement.

The biggest disadvantage is that the road surface needs to be excavated to install or repair the system. Considering the cost of installing this system and the short service life (one to two years), the overall cost of the induction loop system is very high.

Cameras and vision-based sensors. Image data are captured from CMOS image sensors using a video image processor, a camera and a vision-based sensor, and then these images are analyzed to determine traffic behavior.

Vision sensors can not only measure traffic behavior at intersections and expressways, but also transmit real-time video to customers. However, changes in environmental conditions (day and night alternation, light and bad weather) directly affect the detection capability of this system.

Compared with the shortcomings of the above sensors, millimeter wave radar has many unique advantages, insensitivity to light or weather, wider application range and higher accuracy compared with vision-based technology, which make it perform better in traffic monitoring applications.

2 Overview of TCR300 Traffic Flow Radar

2.1 Product Features

TCR300 traffic flow radar detects the relative distance, relative speed and angle of the target by emitting dual-beam fan-shaped microwaves.

- Moving target
- Speed
- Distance
- Direction
- Angle

TCR300 traffic flow radar adopts highly integrated MMIC scheme, dual beam design, compact structure, extremely low power consumption (4W), maximum detection distance up to 280m, pitch angle can be calibrated according to installation height, and can be quickly deployed to various road application scenarios.

Fig. 1 Physical diagram of TCR300 traffic flow radar

2.2 Product Parameters

TCR300 traffic flow radar adopts FMCW modulation mode, which can accurately measure the speed, distance, angle and direction of the target. The parameters are as follows:

Table 1 Performance Parameter Table of TCR300 Traffic Flow Radar

Measurement Performance		**General Target (Non-Reflective Target)**
Modulation mode		FMCW
Ranging range	1. 2.	1.2~280m@0° for LRR 1.2 ~ 50m @ ± 45° for MRR
Range measurement resolution	Point target, non-tracking	1.2 m, two objects can be distinguished under the condition that the resolution is 1.5 to 2 times
Distance measurement accuracy	3.	± 0. 60m
Angle range		± 11° @ ± 6 dB
Angular accuracy		0.2° @ 0° 1° @ ± 45°
Speed range		0km/h... + 250km/h (+ means off target,-means near target)
Velocity resolution		±0.43km/h
Speed accuracy		±0.36km/h
Cycle period		80ms
Pitch beam	-6dB	13°
Azimuth beam	-6dB	90° for MRR 22° for LRR
Operating Conditions		
Radar transmitting frequency	Compliance with ETSI&FCC	80…81GHz
Transmission capacity	Average/Peak EIRP	29.8dBm
Power supply		12 VDC
Power Consumption		≤4W
Weight		650g
Operating temperature		-40℃…+70℃
Storage temperature		-40℃…+85℃

Level of protection		IP66
Interface Type		
Interface		RJ45/RS485
Shell		
Material	Enclosure front/rear lid	PBT front shell, die-cast aluminum bottom shell

TCR300 traffic flow radar adopts advanced planar microstrip array antenna with three transmissions and four collections. The receiving antenna contains 72 vertically polarized antenna elements and the transmitting antenna contains 326 vertically polarized antenna elements. Taylor algorithm is used to synthesize the antenna pattern with low sidelobe. The low sidelobe design of antenna makes radar not easily interfered by ground clutter and targets outside the main beam, and can significantly improve the signal-to-noise ratio of radar detection targets.

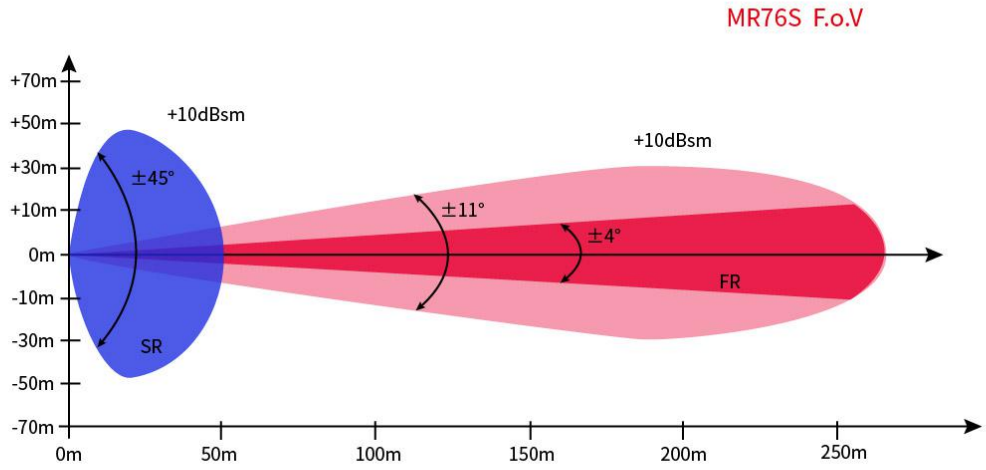

Fig. 2 FoV Diagram of TCR300 Traffic Flow Radar

The product outline is as follows:

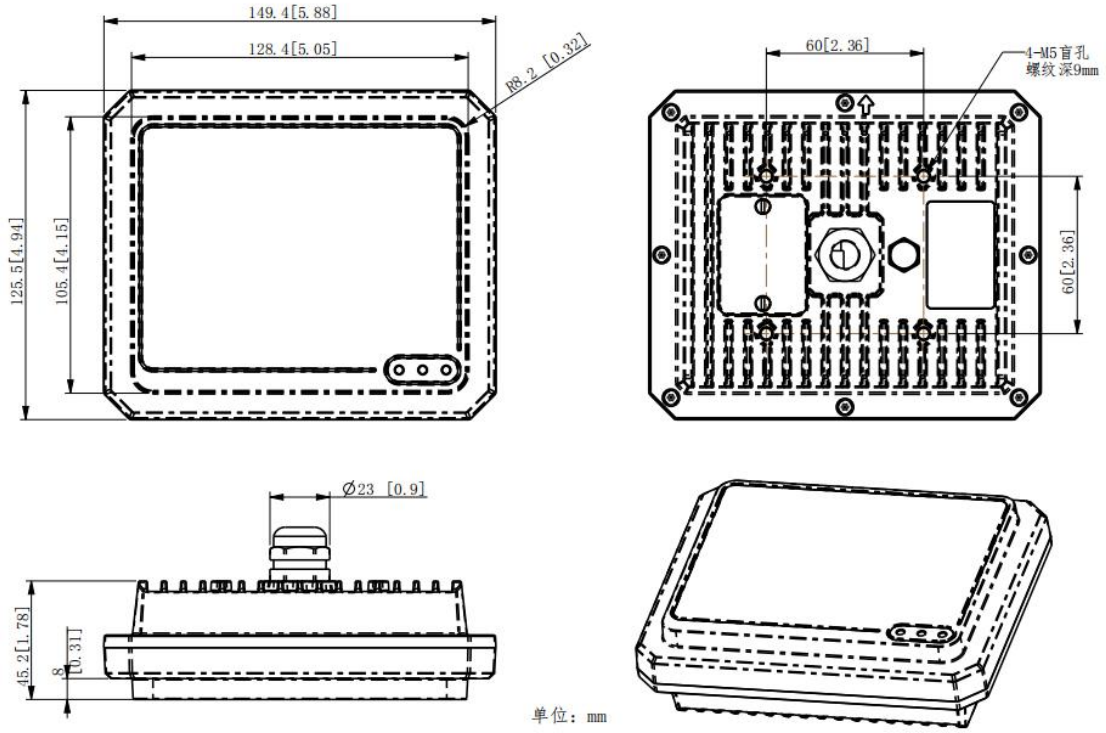

Fig. 3 TCR300 Traffic Flow Radar Dimension Diagram

2.3 Product Application Area

- Traffic flow statistics
- Whole process monitoring of bridges and tunnels
- Safety distance control snapshot
- Traffic cooperative safety early warning

3 Typical Application Cases

3.1 Traffic Flow Statistics

TCR300 traffic flow radar can simultaneously detect the distance, speed and angle information of 4~6 lanes and 128 target vehicles, and the maximum detection distance of radar can reach 280 meters.

Based on the advantages of millimeter wave radar, TCR300 is not affected by light and dust, and can realize all-day and all-weather real-time monitoring of road sections. TCR300 can effectively solve the problem of large vehicle target splitting, and does not produce false alarm and false alarm when the target is running at low speed. It can filter the false alarm caused by strong wind in the green belt of

highway and realize free flow traffic flow statistics and events.

The main application scenarios are:

1）Main roads and expressways, statistics of current section traffic flow, speed and other information.

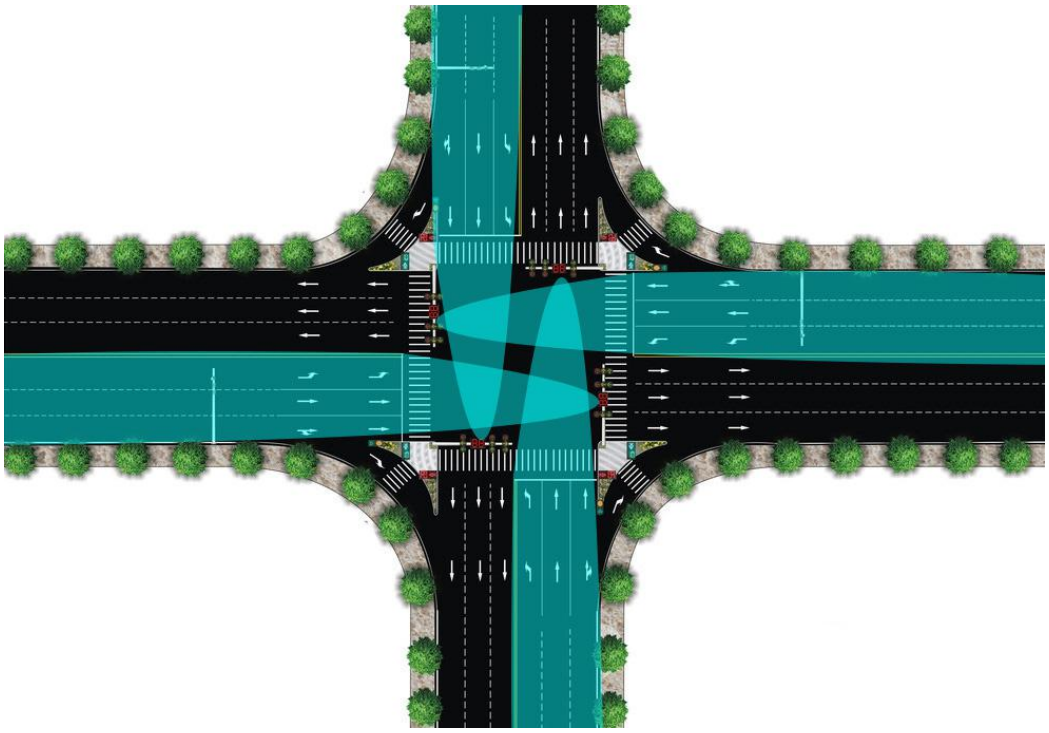

Fig. 4 Application diagram of TCR300 traffic flow radar

4 Concluding Remarks

TCR300 traffic flow radar is a traffic monitoring radar completely independently developed by Hunan Nanoradar Science and Technology Co., Ltd. The product adopts advanced MMIC and signal processing technology, has the characteristics of high precision, low power consumption, high stability, etc., and can be widely used in road flow and event monitoring systems and other fields. It can effectively improve road control ability and traffic efficiency, and reduce traffic accidents and incidents.