

# MR76S 80GHz millimetre wave radar White paper



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# Version history

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# MR76S 80GHz millimetre wave radar

## White paper

**Summary:** MR76S is the latest one compact type 80GHz frequency channel millimeter wave radar which researched and developed by Nanoradar. MR76S detect the reflection situation of millimeter wave through forward launch multiply beams fan-shaped millimeter wave, judge whether has obstacles at front and feedback the relative distance, speed and angle information between obstacles and radar, able to real time detect and trace the big, small vehicles, e-bike and other information on road. This product adopt DBF digit wave beam combine, MIMO invented hold diameter, far and near wave beam-forming and other multiply items advanced technology, realize 1.2-300m measure distance, support to detect 128 pieces objects, small and exquisite body, high sensitivity, stable performance, light weight and easy to integrate, product performance already been accepted by vast cooperate partners. This product able to be applied in the application scenes such as high speed flow monitor, crossing monitor, cross road income vehicle test, around boundary guard and others.

**Key words:** MR76S, 80GHz millimetre wave, 300m detect distance, 128 objects

## 1 Traffic flow statistic application requirements

### 1.1 Smart traffic faced opportunity and challenge

In the recent years, our country's urbanization process rapidly developed under pushed by social economy development and national policies. Accompany with quick increasing of urbanization rate, this bring huge requirements at city traffic transporting. Our country not only be one of the quickest traffic base facilities building speed in the world, but also be one country of the quickest increasing of traffic requirement.

Shown as the data, road building invested RMB2,189,500,000,000 in 2019, increased 2.6% compare to last one year. Among, highway building invested RMB 1,150,400,000,000, increased 15.4%; common national and province road building invested RMB 492,400,000,000, reduced 10.3%; village road building invested RMB 466,300,000,000, reduced 6.5%.

Along with gradually ripe artificial intelligence technology and pushed by multiply items policies, highway intelligentialize and smart come to be the main develop direction of current road transporting, road network building will continue increasing through foundation facilities building, road logistics capacity also will continue increasing. Market scale will gradually increase along with China highway

intelligentize building, China commerce industry research institute, our country highway intelligentize market scale will break through RMB60,000,000,000 in 2020.

Traffic flow monitor, crossing red-green lamp intelligent control system, intelligent alarm lamp, intelligent parking navigation system, intelligent traffic guide equipment and other intelligent traffic product start come forth. These types intelligent traffic products validly improved traffic travel efficiency because the strong functions, also validly solved the city transporting problems.

Currently there has multiply sensor technologies used in traffic flow monitor and application. They serviced for different market, each one technology all has special advantages and shortcomings.

Response circuit sensor. Pass the notch in road through insulate and conduct wire, one electric pulse pass through wire, the vehicle guide the vehicle when pass through or stop through caused inductance change. This is one more common solve schedule, but response circuit sensor has the below several shortcomings.

Firstly, the test only limit at the vehicles which at loop install position, so it's difficult that need calculate the whole traffic status. Second, required each one region and lane all need install coil at crossing, expensive and complex to carry out this system.

The maximum shortcoming is that need dig road to install or repair this system. Considered the cost that install this system and more shorter operating period (1 to 2 years), very high whole cost of response loop system.

Camera and sensor based on optic. Use video image processor, camera and sensor which based on optic to seize the image data from CMOS image sensor, then analyse these images to confirm the traffic actions.

The visual sensor not only able to measure the traffic actions at crossing and highway, but also able to transmit the real time video to customers. But change of environment conditions (day and night alternate, light and bad weather) directly

affect the system detect capacity. And, this optic challenge required to has the advanced signal process and algorithm, but also increased the complexity of system.

Compare to the above shortcomings of the sensor, the millimetre wave radar has many special advantages, include: insensitivity to light or weather, it has more wire applicable range compare to the technology which based on optic, and more higher precision, make it has more excellent performance in traffic monitor application.

## 1.2 The difference among millimetre radar and other methods

The millimetre wave radar able to improve transporting efficiency and safety through various methods.

Firstly, it working under whole weather condition. Radar insensitivity to changing environment condition, millimetre wave able to penetrate and sense bad weather condition, such as night, smoke, fog and rain. This capacity make millimetre wave radar come to be the best solve schemes, used to process outdoor detection in the uncontrolled and changed environment.

Second, detect the high speed objects in expanding range. Millimetre wave radar use quick frequency in 80GHz range to modulate continue wave (FMCW) radar, it has several advantages compare to traditional radar system. It able to make 80GHz radar system able to detect the vehicle objects which exceed 250km/h easily within 300m range through combine with the antenna design and radio frequency configuration.

Finally, high object measure precision. Integration processed quick FMCW radar able to multiply times measure range, radial speed and angle of multiply object reflex objects in the scene within 1s. The traffic monitor system which use millimetre wave solve scheme able to high speed resolution real time discriminate and trace several vehicles easily within far distance range.

80GHz millimetre wave radar still able to realize the functions such as flow statistic, vehicle model discriminate and congestion early alarm, etc, it has the

working characteristics such as whole weather, whole time, able to accurately detect and measure, able to act important role in traffic flow management system.

Table 1 Traffic flow measure technology contrast

Measure technology	Realize principle	Distance	Precision	Advantages	Shortcomings
<b>Visual camera</b>	Visual fix position	0.3~200m	±0.1m	High precision, more lower cost	High power consumption, complex algorithm, ad effect under fog and haze condition
<b>Ground sense coil</b>	Electromagnetism response	/	/	Low price, quick response speed, accurate measurement	Damage road, damaged easily and need large quantity layout
<b>80GHz millimetre wave radar</b>	FMCW	1.2~300m	±0.6m	High precision, whole weather	Difficult to discriminate object shape

## 2. Summary of MR76S 80GHz millimetre wave radar

### 2.1 Product characteristics

MR76S millimeter wave radar detect the reflection situation of microwave through forward launch double beams fan-shaped microwave, judge whether has obstacles at front and feedback the relative distance,

speed and angle information between obstacles and radar.

- Motion object
- Speed
- Distance
- Direction
- Angle

MR76S 80GHz millimeter wave radar adopt high integration degree MMIC scheme, super low power consumption (2.5W), more smaller size, double beams design, the farthest able to detect 300m, light quantization design, able to meet the distance measurement application of high requirements in performance and environment adaptability. Excellent performance of MR76S 80GHz millimeter wave radar highly accepted by vast cooperate partners.



Fig 2 Entity figure of MR76S 80GHz millimeter wave radar

MR76S 80GHz millimeter wave radar provided CAN communication joggle, convenient to users development and test. Board level communication CAN joggle default speed rate 500kbit/s, target refresh ratio 12.5Hz. Common outer joggle, able to quickly integrated with host computer or other MCU, save the configuration

operating time for users.

## 2.2 Product parameters

MR76S 80GHz millimeter wave radar adopt more higher complex FMCW modulate mode, able to accurately measure the distance with front obstacles in measure range. MR76S parameters shown as the below table:

Table 2 Performance parameters table of MR76S 80GHz millimeter wave radar

Measure performance		Common target (non reflex object)
Modulate method		FMCW
Distance measure range		1.2~300m@0° & 1.2-200m@±11° for LRR 1.2~50m@±45° for MRR
Distance measure resolution ratio	Point target, non tracing	1.2m (able to discriminate two objects under 1.5 to 2 times resolution condition)
Distance measure precision	Point target, non tracing	±0.6m
Position wave beam	-6dB(F.o.V)	90° for MRR 22° for LRR
Pitch wave beam	-6dB(F.o.V)	13°
Angle precision	Point target, non tracing	0.2°@±11° 1°@±45°
Speed range		-200km/h...+250km/h (+means far away target, - means close to target)
Speed resolution	Point target, non tracing	0.43km/h
Speed precision	Point target, non tracing	±0.36km/h
Circling period		About 80ms
Antenna passageway quantity		3TX/4RX=12 passageways
Operating conditions		
Radar launch frequency	Follow ETSI&FCC	76...80GHz
Transmit capacity	Average/peak value EIRP	29.8dBm
Power supply		12V DC
Power consumption	Under 12V/24V	2.5W
Operating temperature		-40°C...+80°C
Storage temperature		-40°C...+85°C
Protection grade		IP67
Joggle types		
Joggles	The max support 8 pieces ID	1xCAN- high speed 500kbit/s

Shell		
Size	Length*width*height (mm)	137*75*20
Weight	Without harness	124g
Materials	Shell front end/rear cover	PBT front shell+glass fiber, press casting aluminum bottom shell

MR76S 80GHz millimetre wave radar adopt advanced three launch and four retrieve integration plane micro band array antenna, the retrieve antenna include 72 pieces vertical polarization antenna unit, the launch antenna include 324 pieces vertical polarization antenna unit. Retrieve and launch antenna adopt Taylor algorithm to process low pair petal syn for antenna direction diagram. Antenna low pair petal design make radar not easy to be disturbed by ground mix wave and objects out of main wave beam, able to notably improve the signal-noise ratio of radar detected objects.

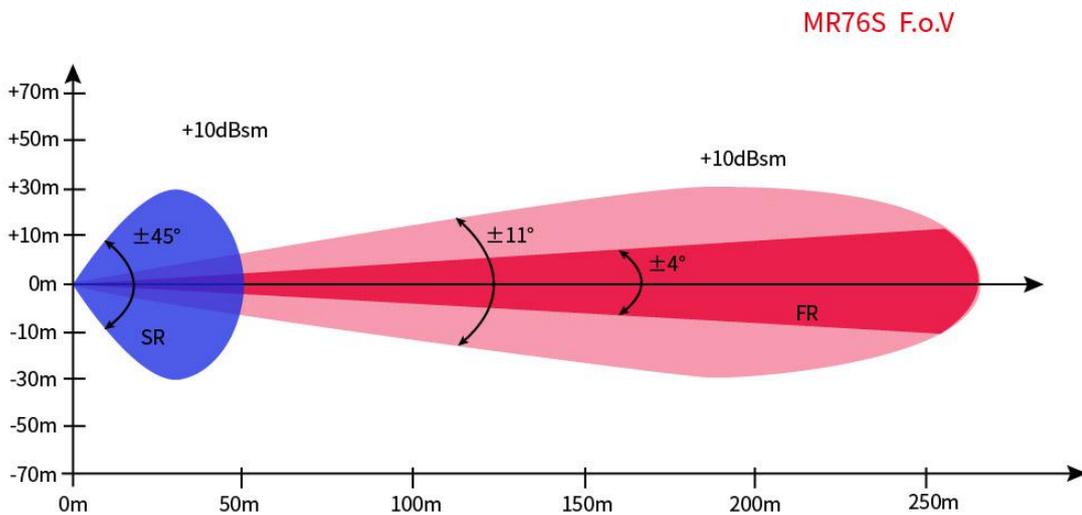


Fig 3 FoV figure of MR76S 80GHz millimetre wave radar

Product profile shown as the below picture:

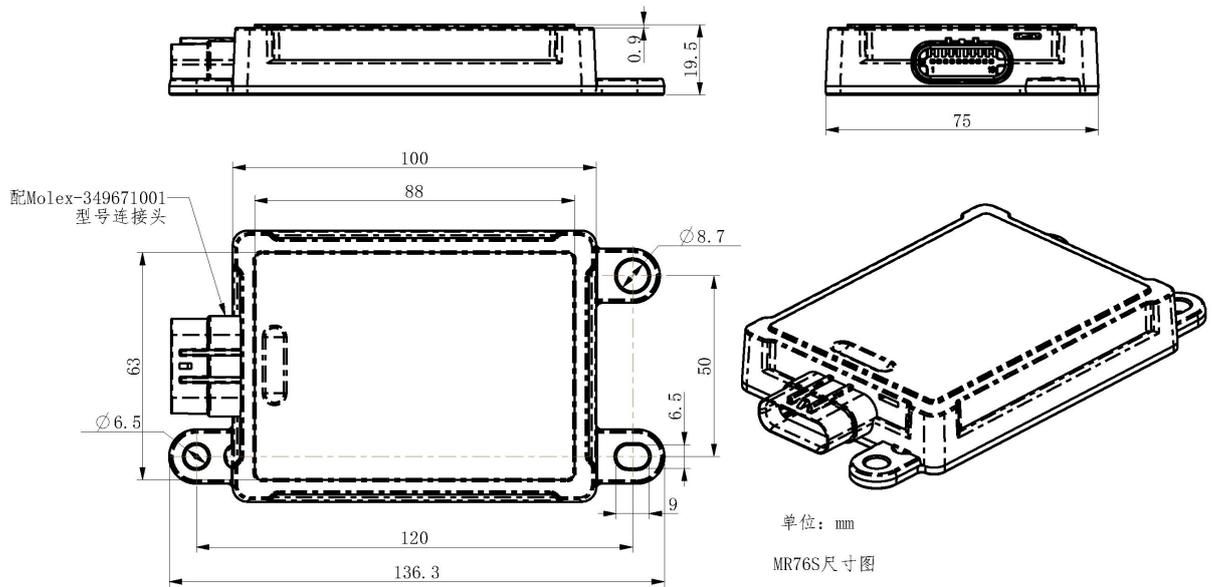


Fig 4 Size figure of MR76S 80GHz millimetre wave radar

## 2.3 Product application areas

- Traffic flow statistic
- Road safety alarm
- Around boundary safety guard
- Crossing income vehicle alarm
- Road side violate parking monitor
- Teach exhibition

# 3 Typical application cases

## 3.1 Traffic flow statistic

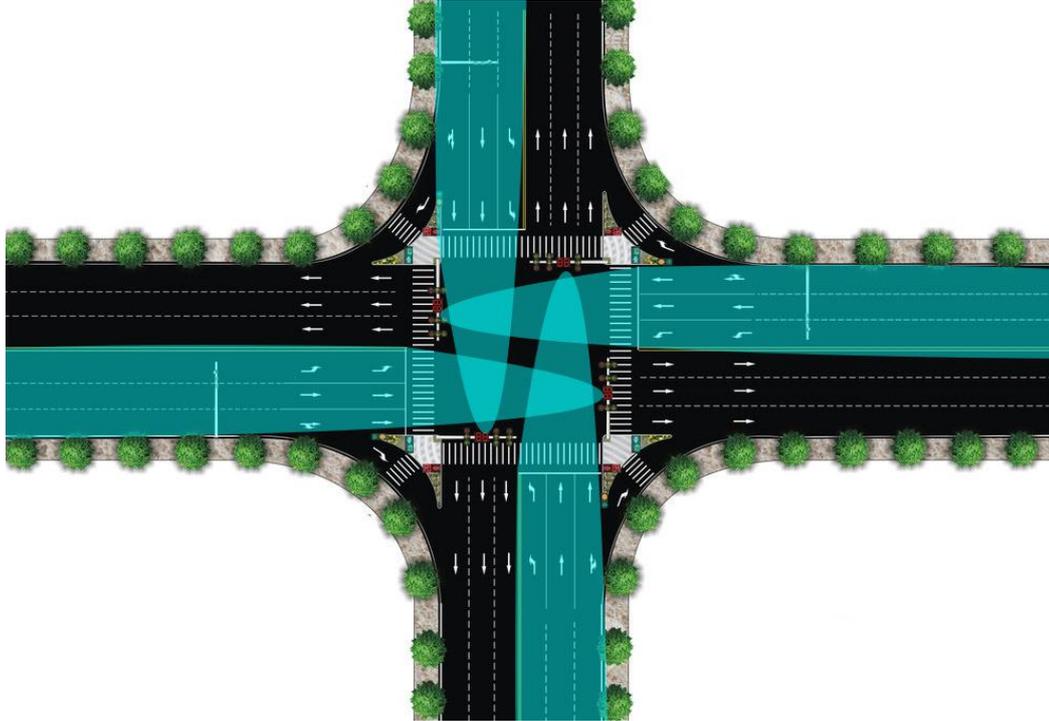
MR76S 80GHz millimetre wave radar able to detect 8 pieces lanes, distance, speed and angle information of 128 pieces target vehicles at the same time, the farthest detect distance of radar up to 300m.

MR76S not affected by light and dust based on advantages of millimetre wave radar, able to realize real time monitor whole time and whole weather on the road. MR76S validly solve the big vehicle target split problems, also not generate error report and omit report when target low speed driving, better algorithm filter at the void alarm of road green belt caused by big windy. It has most competitive cost advantage replace traditional traffic flow statistic scheme through merged camera. The customers able to self develop flow statistic and road congestion alarm function

based on the above product characteristics of MR76S, realize that free flow traffic flow statistic and congestion alarm system.

Main application scenes are:

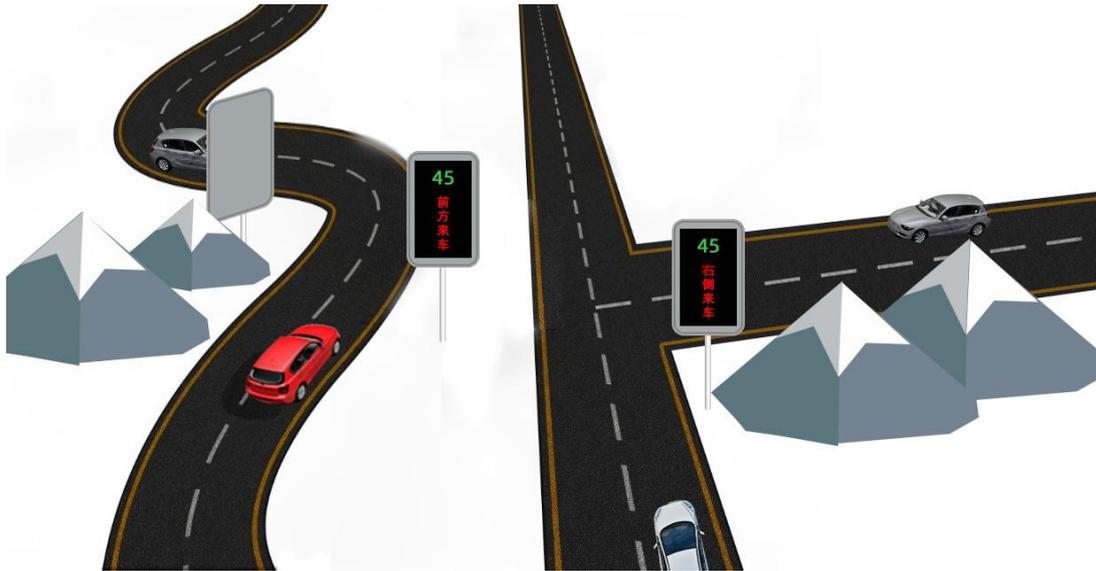
- 1) Main road and highway statistic the current section of the road vehicle flow, speed and other information.



### 3.2 Crossing income vehicle early warning

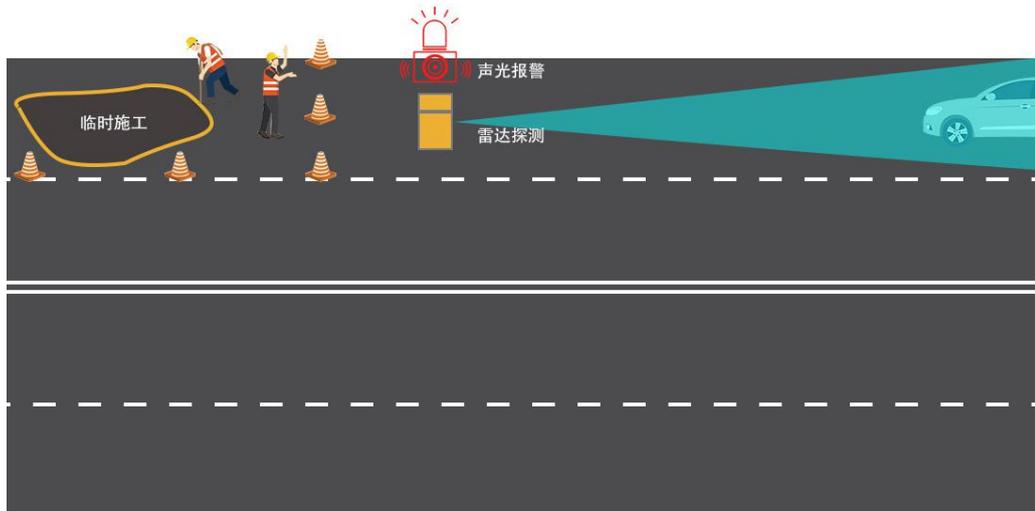
Crossing income vehicle warning system, able to intelligent detect vehicle models, alarm on other direction indicate screen at the 100-200m crossing in advance according to the alarm information which generated by the information such as vehicle distance and speed, etc, validly prevent the traffic accident happen. Crossing income vehicle alarm system merged MR76S traffic radar, sound-light alarm device, LED indicate screen, etc, able to fix or moveable layout according to road actual situation. Validly solve the key problems such as high building cost of traditional traffic lamps and command station, few alarm power sources. Realize crossing alarm management at 7\*24hours, various weather condition and income vehicles at various type road. At the same time, able to reduce the early period building and later period operating cost of traditional income vehicle alarm system

through solar power supply power method which profit from low power consumption solve scheme of MR76S.



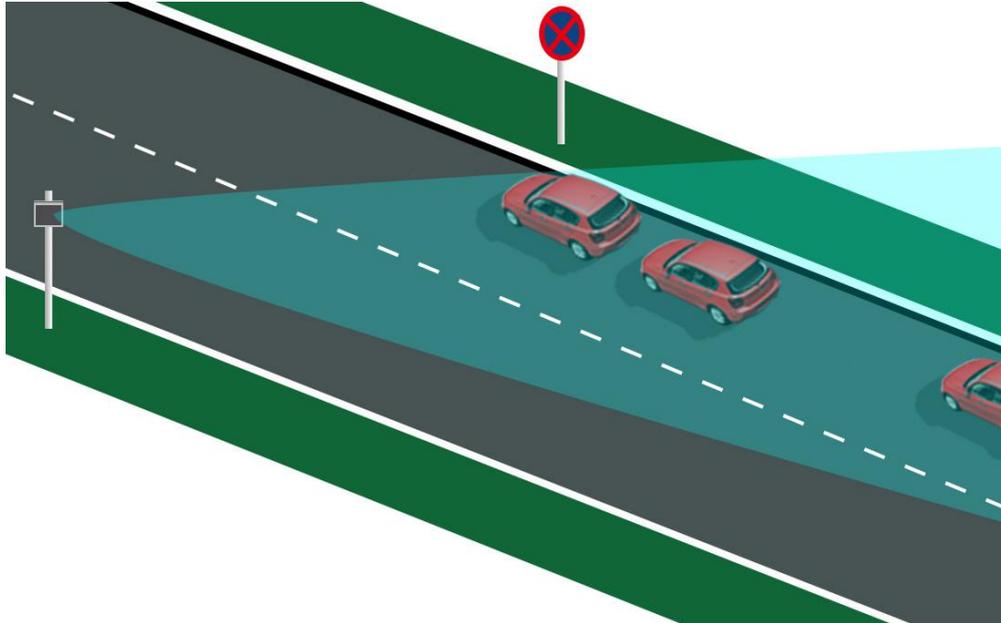
### 3.3 Road safety warning

MR76S able to realize that distance, speed and lane detection of vehicles within 1.2-300m range. Able to remind the past and come vehicles out of 300m, remind vehicles reduce speed, change lane or passing round, prevent it happen accident or congestion. Able to remind the pass and come vehicles process the corresponding application through build temporary road safety alarm equipment at temporary building road, accident happen road and temporary passing round section. MR76S small designed volume and low power consumption, able to guarantee the customers convenient to carry, move and long time working when whole set applying. The design based on protection grade IP67, working temperature  $-40^{\circ}\text{C}$  to  $80^{\circ}\text{C}$  and anti vibration, etc, able to suitable the working requirements under various weather condition, more better to meet customer requirements contrast to traditional equipment.



### 3.4 Road side violate parking monitor

MR76S able to discriminate the vehicle types, able to discriminate the target and motion status, process a period time tracing the objects from motion to static. Able to accurately fix position of vehicle position, violate parking and leave time through merge radar and shooting camera, radar link with camera to process license plate to shoot, realize that road side violate parking monitor. Few policemen but more vehicles, road side violate parking already seriously affect normal running of city traffic, how to utilize the existing police power to guarantee the smooth city road already been the pain point of city traffic management. Through that combine with apply MR76S and shooting camera and charge in each important traffic manage and control area, judge driving locus and parking time, these validly discriminate the temporary parking and long time violate parking, shooting the violate parking vehicles, manage and control the management section under the situation that nobody on duty, validly reduce violate parking appearance, guarantee city road smooth without block.



### 3.5 Boundary safety guard application

Safety guard radar system able to be divided into boundary safety guard radar and region safety guard radar according to the performance range and different position. These two types not only able to exist independently, but also able to assembly use, the operating method based on the detail application environment. The performance of boundary safety guard system are, build one closed “Guard wall” along with the boundary of protected area, safety guard system alarm immediately once happened illegally invade, remind the safety guard staffs process it in time.

MR76S 80GHz millimetre wave radar able to provide the early alarm function through find and discriminate the objects in illegally invade warn range, provide whole time and whole weather safety guard for the around environment of important facilities place (example: village, school, etc). Able to detect distance, speed and angle information of 64 pieces motion objects at the same time, the farthest detect distance of radar up to 150m, cross distance 150m.



Main application scenes are:

- 1) Building boundary area safety guard at park, village and school, etc.
- 2) Safety guard at other import area.

**Advantages of MR76S 80GHz millimetre wave radar:**

1. Accurate distance measurement;
2. Small volume and low power consumption;
3. Strong anti disturb capacity and easy to integrate.

## 4 Tag

MR76S 80GHz millimetre wave radar is the highest cost-performance products in current domestic traffic flow monitor area, it has the characteristics such as high precision, low power consumption and high stability, etc, this radar able to detect the distance, speed and angle information of 8 pieces lanes and 128 pieces target vehicles, the farthest detect distance of the radar up to 300m. The performance of this product already verified by vast customers, able to quickly replace the oversea traffic flow monitor radar.

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