

K-77-G3-12,K-77-G3-24
K77 Mid/Long Range Radar
Product Manual

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1. Overviewⁱ

1.1 Description

K77 is positioned as the next generation of medium and long-distance automotive millimeter wave radar for ADAS and autonomous driving. Using the FMCW technique, the radar can measure the range, velocity, azimuth and elevation of the target in the environment.

1.2 Feature

- Using the advanced 77GHz RFCMOS technology and hardware signal processing acceleration.
- Using the powerful algorithm and signal processing computing platform, which are highly customizable.
- Suitable for the current passenger car ADAS radar 4+1 solution.

1.3 Application

- Automatic Emergency Braking (AEB)
- Forward Collision Warning(FCW)
- Adaptive Cruise Control(ACC)

1.4 Appearance

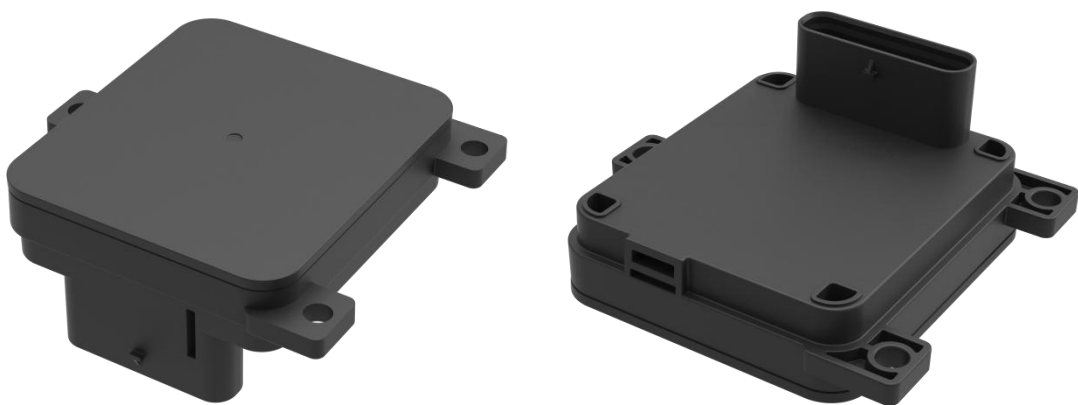


Figure 1. Product Appearance

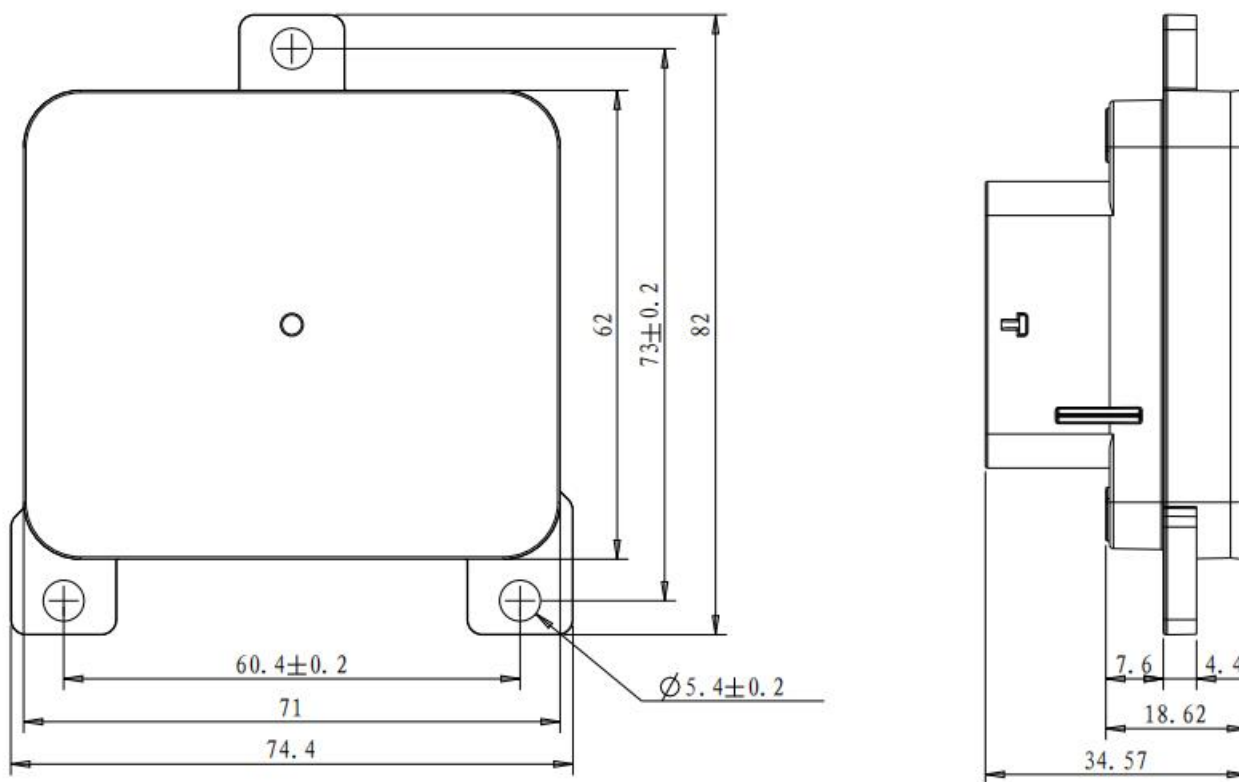


Figure 2. Dimensions of K77

2. Technical Specifications

Frequency Range	76-77 GHz
Power Consumption	< 4W
Operating Temperature	-40 ~ 85°C
Protection Rafting	IP69
Detection Range	0.5 ~ 240 m
Range Accuracy	±0.1m
Range Resolution	0.2m
Detection Velocity	-110m/s ~ 55m/s
Velocity Accuracy	±0.05 m/s
Velocity Resolution	0.1 m/s
Field of View (Azimuth)	-60°~60°

Azimuth Accuracy	$\pm 0.1^\circ$
Azimuth Resolution	3°
Field of View (Elevation)	$-15^\circ \sim 15^\circ$
Update Rate	Approx. 66 ms
Dimensions	62×71×18.62 (mm)

3. Detection distance

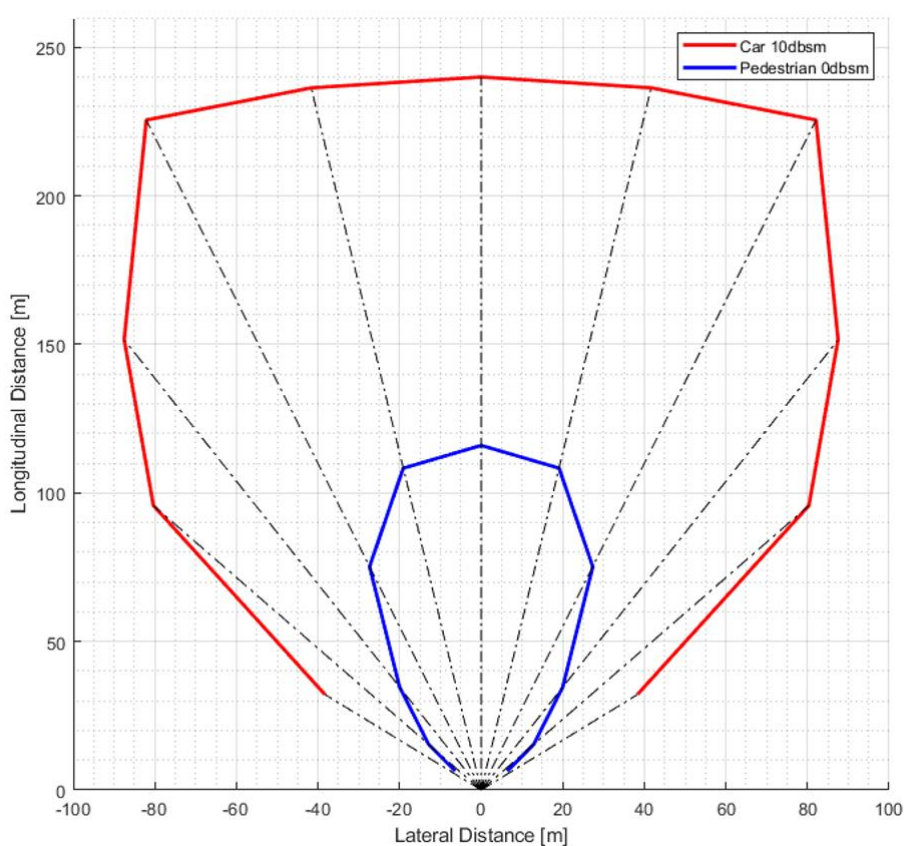


Figure 3. Radar Detection Ranges for Design Targets

4. Communication interface

- Support CAN with ISO-11898
- Support UDS diagnosis over CAN

5. Power Supply

K77 is powered by 12V DC power supply. The operation mode of section voltage is shown in the table below:

Table 1. Voltage Supply Operation Modes

UBATT(12V)	Operation Mode	Behavior
$<6.5V$	Safe	■ No communication on vehicle interface ■ Restricted fault monitoring ("undervoltage")
$6.5V \leq UBATT. < 9V$	Low-voltage	■ Normal communication on vehicle interface ■ Normal hardware monitoring ■ fault monitoring ("undervoltage")
$9V \leq UBATT. < 16V$	Normal	■ Normal communication on vehicle interface ■ Normal hardware monitoring ■ Full fault monitoring
$16V \leq UBATT. < 18V$	High-voltage	■ Normal communication on vehicle interface ■ Normal hardware monitoring ■ fault monitoring ("overvoltage")
$18V < UBATT.$	Safe	■ No communication on vehicle interface ■ Restricted fault monitoring ("overvoltage")
Monitor tolerance: $\pm 10\%$		

6. Hardware Interface

6.1 Interface Model

The radar interface and connector information are shown in the following table:

Supplier	Connector Type
TE	C-1-1719393-1-E-3D

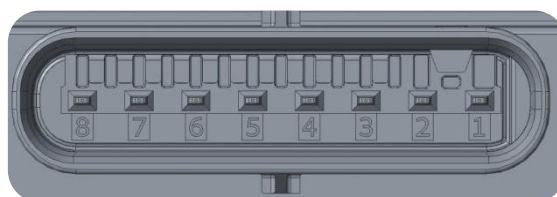


Figure 4. Radar Interface

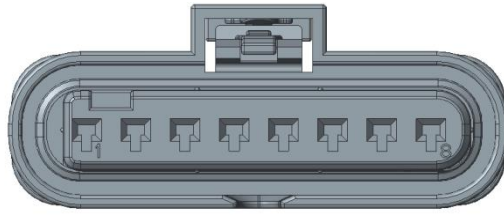


Figure 5. Cable Interface

6.2 Pin Definition

Pin Order	Pin Definition
1	Reserved
2	Reserved
3	CAN2 L(PRIVATE)
4	CAN2H(PRIVATE)
5	GND-IN
6	CAN1 L(VEHICLE)
7	CAN1 H(VEHICLE)
8	DC-IN

7. Mounting Specification

7.1 Installation Diagram

When the radar is applied to the forward ADAS application, the installation position is shown in the figure below, and the included angle between the radar normal and the body axis is 0 °.

7.2 Mounting Location Tolerances

- Limits of horizontal deviation based on vehicle axis

35cm from vehicle center (Recommended)

35-45cm from vehicle center (Allowed)

Above 45cm from vehicle center (Not recommend with performance limitations)

- Limits of horizontal deviation from road surface

From 30-80cm from road-surface level (Recommended)

From 30-90cm from road-surface level (Allowed)

Low than 30 or above 90cm from road-surface level (Not recommend with performance limitations)

Note: If the vehicle has wading requirements, the radar should be installed above the wading altitude line.

7.3 Angular Mounting Tolerances

Angle	Tolerance(°)
Yaw	$\pm 3^{\circ}$
Pitch	$\pm 2^{\circ}$
Roll	$\pm 2^{\circ}$

8. Radar Calibration

K77 radar supports EOL calibration, static service calibration, after-sales service calibration and self-calibration during radar operation.

8.1 EOL Alignment

After the vehicle is assembled from the production line, the offline calibration is performed, and the installation angle deviation of the radar is calibrated. If the installation angle deviation of the radar meets the requirements, the radar will record the angle deviation, which is used to calibrate the target measurement results. For offline calibration, calibration targets should be installed on the production line and the production line environment should be appropriately modified to ensure that the calibration process will not be interfered by other targets.

8.2 Service Alignment

If the radar needs to be replaced for various reasons, the vehicle can be calibrated on site through the 4S store. If the 4S shop does not have the conditions for four-wheel positioning and installation of calibration targets, it can be calibrated by driving on the actual road for a period of time under certain conditions.

8.3 Auto-alignment

During driving, due to road bumps and other conditions, the radar may have a certain installation deviation, and the radar can self-correct to ensure good performance.

9. Radar Input & Output

9.1 Input Signal

- Vehicle static parameter(Vehicle length, vehicle width, wheel base etc.)
- Vehicle dynamic parameter(Vehicle speed, steering angle, yaw rate, driving direction etc.)

9.2 Output Signal

K77 radar outputs object list (via private CAN) and diagnostic information (via public CAN) by default. If other signals need to be output, which are related to vehicle functions, they need to be agreed with the customer.

Two parts are included in each object: target_xx_Part1_Msg and Target_xx_Part2_Msg. Each frame can send up to 40 objects. The signals contained in each message are shown in the table below, with the byte order of Motorola.

Type	Signal	Description	StartBit	Len	Factor	Offset	Unit
Object Info	FRS_P1_xx_Obj_ID	0xff: invalid 0x00-0xFE: valid	0	8	1	0	NA
	FRS_P1_xx_Obj_XPOS_stdev	Estimated 3-sigma standard deviation value of longitudinal position of the object.	8	7	0.1	0	m
	FRS_P1_xx_Obj_updateFlag	Object history flag 0x0: new object in the cycle; 0x1: object existed in previous cycle	15	1	1	0	NA
	FRS_P1_xx_Obj_YPOS_stdev	Estimated 3-sigma standard deviation value of lateral position of the object.	16	7	0.1	0	m
	FRS_P1_xx_Obj_ValidFlag	0x0: Object invalid 0x1: Object valid	23	1	1	0	Na
	FRS_P1_xx_Obj_obstacleProb	Estimated probability of the object being an obstacle.	24	5	3.2258	0	%
	FRS_P1_xx_Obj_MotionPattern	Motion type of object. 0x00: Unknown 0x01: Stationary 0x02: Stopped 0x03: Moving 0x04: Crossing	29	3	1	0	NA

		0x05-07: reserved					
	FRS_P1_xx_Obj_XAccRel	Relative longitudinal acceleration of the object	33	7	0.15	-9.6	m/s ²
	FRS_P1_xx_Obj_XAccRel_stdev	Estimated 3-sigma standard deviation value of the relative longitudinal velocity of the object.	42	7	0.05	0	m/s ²
	FRS_P1_xx_Obj_AliveCounter	Alive counter shall be incremented every radar sensor measurement cycle.	48	4	1	0	NA
	FRS_P1_xx_Obj_exstProb	Estimated existence probability of the object.	52	6	1.5873	0	%
	FRS_P1_xx_Obj_checksum	Check sum	56	8	1	0	NA
	FRS_P2_xx_Obj_XVelRel	Relative longitudinal velocity of the object.	13	11	0.1	-102.4	m/s
	FRS_P2_xx_Obj_YPos	Position of target object in lateral direction	16	13	0.015625	-64	m
	FRS_P2_xx_Obj_Type	0x00: Unknown 0x01: 4 wheeler 0x02: 2 wheeler 0x03: Pedestrian	32	2	1	0	NA
	FRS_P2_xx_Obj_XPos	Position of target object in longitudinal direction	34	14	0.015625	0	m
	FRS_P2_xx_Obj_AliveCounter	Alive counter	48	4	1	0	NA
	FRS_P2_xx_Obj_MeasFlag	0x0: object measured in this cycle 0x1: object extrapolated in this cycle	52	1	1	0	NA
	FRS_P2_xx_Obj_YVelRel	Relative lateral velocity of the object	53	11	0.1	-102.4	m/s
	FRS_P2_xx_Obj_Checksum	Check sum	56	8	1	0	NA
Status Info	FRS_status_latency	Radar process latency in ms	2	6	2	0	ms
	FRS_status_timestamp	Sensor internal time stamp	18	16	1	0	s
	FRS_status_HostSpeed	Host vehicle over-ground speed	38	12	0.025	-20	m/s
	FRS_status_Blockage	Sensor blockage status indication.	40	1	1	0	NA

		0x0: FRS is NOT blocked 0x1: FRS is blocked					
	FRS_Fail	0x0 = FRS radar is NOT working 0x1 = FRS radar is working	41	1	1	0	NA
	FRS_MeasEnabled	This signal indicates if the radar sensor is performing measurement or not.	42	1	1	0	NA
	FRS_HostYaw	Host vehicle yaw rate in deg/s	43	11	0.1	-102.4	deg/s
	FRS_AliveCounter	Alive counter	48	4	1	0	NA
	FRS_status_MisAlign	This signal indicates radar sensor mis-alignment status. 0x00:unknown 0x01:calibrated 0x02:sensor mis-alignment detected 0x03:calibration in progress 0x04:uncalibratable 0x05-07: reserved	52	3	1	0	NA
	FRS_status_HWerr	Flag to indicate if HW is failed or not. 0x0:HW is NOT failed 0x1:HW is failed	55	1	1	0	NA
	FRS_Msg_checksum	Check sum	56	8	1	0	NA

10. (Optional) Radar GUI

An application GUI can be provided to better use of K77 radar, see the user guide for Automotive Radar for more detail.

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FCC Warning

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.

Any Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

This equipment complies with FCC 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.