Microwave Radar System User Manual V5.0

Model Number – **RDR-FSK-O1A**

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1 Overview

1.1 Features

- Advanced movement detection system
- High performance signal processing
- Flexible alarm algorithm
- Configurable alarm trigger condition
- Intelligent rainfall detection
- Output overload protection

1.2 Applications

Radar module for Predictive Stop Arm System.

1.3 Description

RDR-FSK-01A is a high-energy, high-sensitivity, low-noise, environment-adaptable microwave radar system developed by TechSols Inc. It provides timely and effective warnings of the proximity of dangerous vehicles approaching a school bus.

2 Alert Principle

2.1 Radar detection area definition

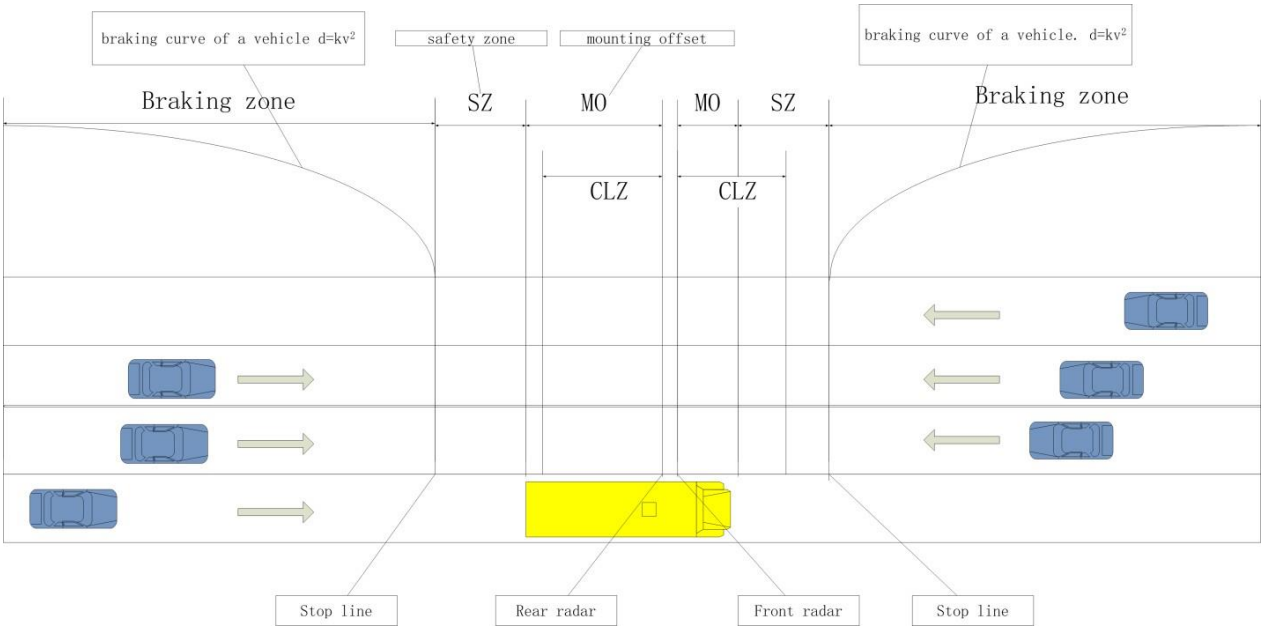


Fig.2: Radar detection area definition

The radar detection area is divided into four areas: Mounting Offset (MO), Safety Zone (SZ), Clearance Zone (CLZ), and Braking Zone.

Mounting Offset (MO): The distance is from the radar installation position to the front edge of the bus for the front radar, or the distance is from the radar installation position to the rear edge of the bus for rear radar.

Safety Zone(SZ): The distance is from stop line to the front edge of the bus, for front radar. The distance of stop line to the rear edge of the bus, for rear radar.

Clearance Zone (CLZ): CLZ is defined to avoid near-distance noise interfere. This setting is important to eliminate false alarms in hostile weather conditions, such as heavy rain.

Braking Zone: The area in front of the stop line.

2.2 Alert trigger conditions

2.2.1 The target(s) within braking zone

The braking curve of a car approximates a parabola.

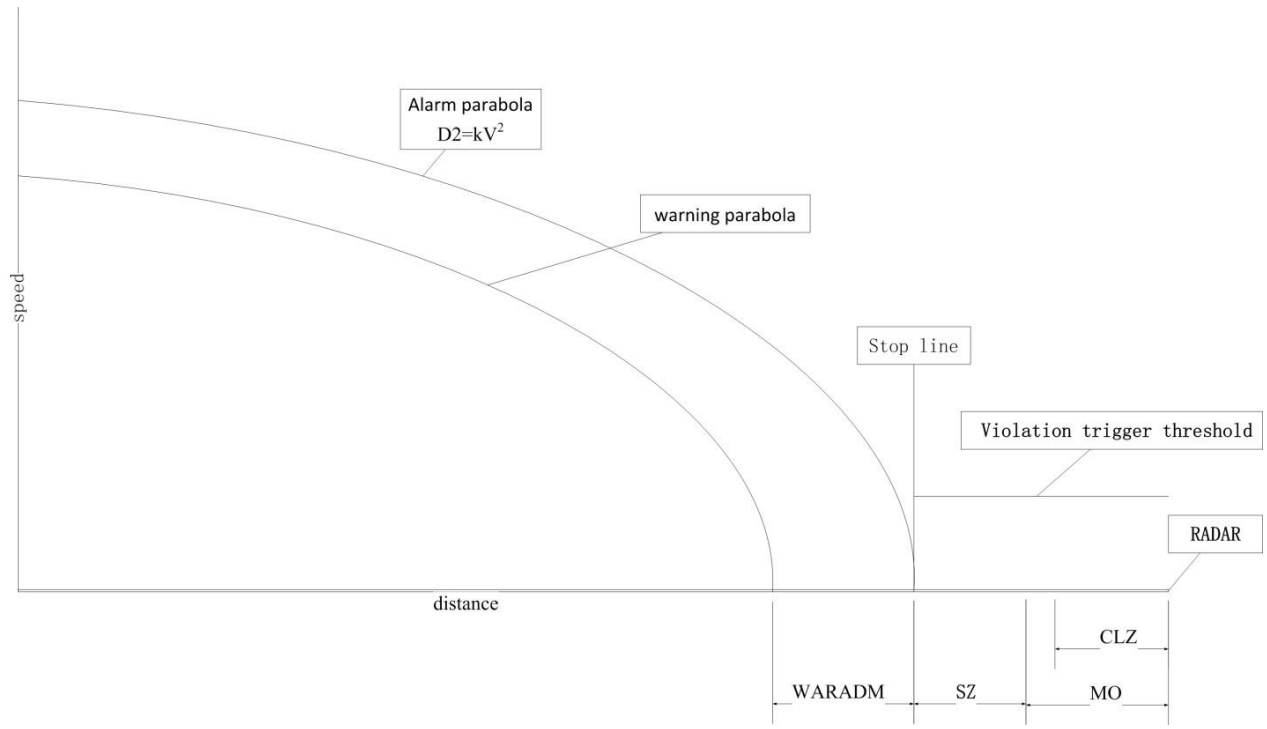


Fig.3: Alert trigger conditions

The radar measures the distance D1 and velocity V of the target. The built-in program calculates the required braking distance D2 for the target by the formula $D2=kV^2$. We define the parameter ALATPC asalarm parabola coefficient k(*ALATPC is not a real K. The built-in program converts ALATPC to K. Here, the user can approximate that ALATPC is equal to the braking distance that the target speed from 100km/h--0km/h*), the parameter WARADM as warning parabolic adjustment value.

a, If D2>D1, radar outputs alarm.

b, If D1>= D2>D1- WARADM, radar outputs warning.

2.2.2 The target(s) within the safety zone or mounting offset zone

Since the car is not allowed in this range, the violation and alarm will be triggered as soon as the target speed is found to be greater than 15km/h. This speed threshold is based on the exclusion of pedestrians and other situations in this area.

2.2.3 Heartbeat and Health check

If the radar is available, it sends a heartbeat ($READY) every 5 seconds.

The client also can send a health check message (@RADAR \r\n) to check the radar status when the timer expires. If the system status is normal, the system will reply $READY, otherwise the system will reply $RADARINOP.

2.3 Intelligent rainfall judgment

Radar can use algorithms to determine the intensity of rainfall and change its configuration parameters in real time. The algorithm allows the radar to work in extreme weather conditions and improve alert accuracy.

If there is no rain or light rain, CLZ will be modified to 6m and VIO will be modified to 15Km/h.

If there is moderate rain, CLZ will be modified to 10m and VIO will be modified to 15Km/h.

If there is heavy rain, CLZ will be modified to 10m and VIO will be modified to 35Km/h.

2.4 Alert Priority

Alarm priority is higher than Warning. Violation works independently, but Violation will trigger Alarm.

For example:

1. If the system detects Alarm, Warning, Violation at the same time, it will output Alarm and Violation.

2. If the system detects Alarm, Violation at the same time, it will output Alarm, Violation.

3. If the system detects Warning, Violation at the same time, it will output Alarm, Violation.

4.If the system detects Alarm, Warning at the same time, it will output Alarm.

5. If the system only detects Alarm, it will output Alarm.

6.If the system only detects Warning, it will output Warning.

7. If the system only detects Violation, it will output Alarm and Violation.

2.5 LOG output control

Radar output of large amounts of data is a burden for the radar and not useful to the customer. This radar allows customers to change LOG output rules.

The default LOGMODE = 0: the radar only outputs heartbeat.

If LOGMODE = 1, the radar outputs heartbeat and detected data.

If LOGMODE = 2, the radar outputs heartbeat and alarm.

If LOGMODE = 3, the radar outputs heartbeat and detected raw data and alarm.

3 Command System

3.1 Parameter Storage

All parameters are permanently stored into the processor-internal EEPROM.

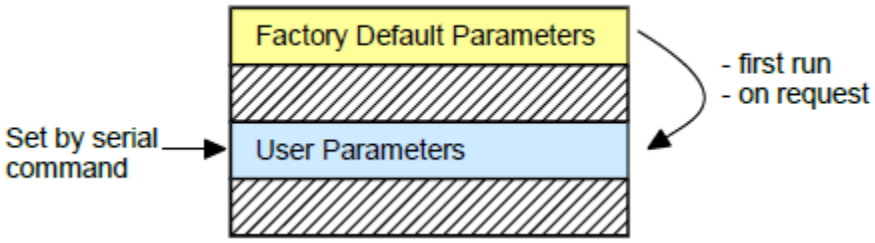


Fig.4: EEPROM parameter organization

3.2 Host Command Interface

This is a standardRS232interface:

Physical data: 19'200 Baud, 8 data bit, 1 stop bit, no parity, no handshake Protocol: Client-Server protocol. Radar acts as server.

3.3 Command Format

Command format description	Commands start character	Command	Command separator	Three digits	Command terminator
Example	@	SZ	=	006	\r\n

3.4 Command List

Command	Description	Input example	Output example

@ALATPC=XXX\r\n	Modify alarm parabola coefficient	@ALATPC=050\r\n	$ALATPC=050\r\n
@WARADM=XXX\r\n	Modify warning parabolic adjustment value	@WARADM=015\r\n	$WARADM=015m\r\n
@VIO=XXX\r\n	Modify Violation Speed threshold	@VIO=015\r\n	$VIO=015 Km/h\r\n
@SZ=XXX\r\n	Modify the safety zone range	@SZ=006\r\n	$SZ=006m\r\n
@MO=XXX\r\n	Modify the Mounting offset range	@MO=010\r\n	$MO=010m\r\n
@CLZ= XXX\r\n	Modify the Clearance Zone	@CLZ=010\r\n	$CLZ=010 Km/h\r\n
@VER\r\n	View radar firmware version	@VER\r\n	$TECHSOLS radar firmware version：v5.0\r\n
@CFG\r\n	View Configuration	@CFG\r\n	$ALATPC= 50 \r\n $WARADM= 15 m \r\n $VIO= 15 Km/h \r\n $SZ= 0 m \r\n $MO= 10 m \r\n $CLZ= 6 m \r\n $LOGMODE= 0 \r\n $Front Radar \r\n
@RCD\r\n	View radar configuration definition	@RCD\r\n	$Front radar\r\n
@LOG= XXX\r\n	Modify the LOGMODE	@LOG=001\r\n	@LOGMODE=1\r\n
@RSTFR\r\n	Restore the factory settings of front radar	@RSTFR\r\n	$Front radar restore succeed! \r\n
@RSTRR\r\n	Restore the factory settings of rear radar	@RSTRR\r\n	$Rear radar restore succeed! \r\n
@RADAR \r\n	Health check	@RADAR \r\n	If System operational Output: $READY\r\n Not Ready Output: $RADARINOP\r\n

3.5 Default Setting

3.5.1 Default settings, Front radar

Parameter	Default Setting
ALATPC	50
WARADM	15
VIO	15
SZ	0
MO	10
CLZ	10
LOGMODE	0

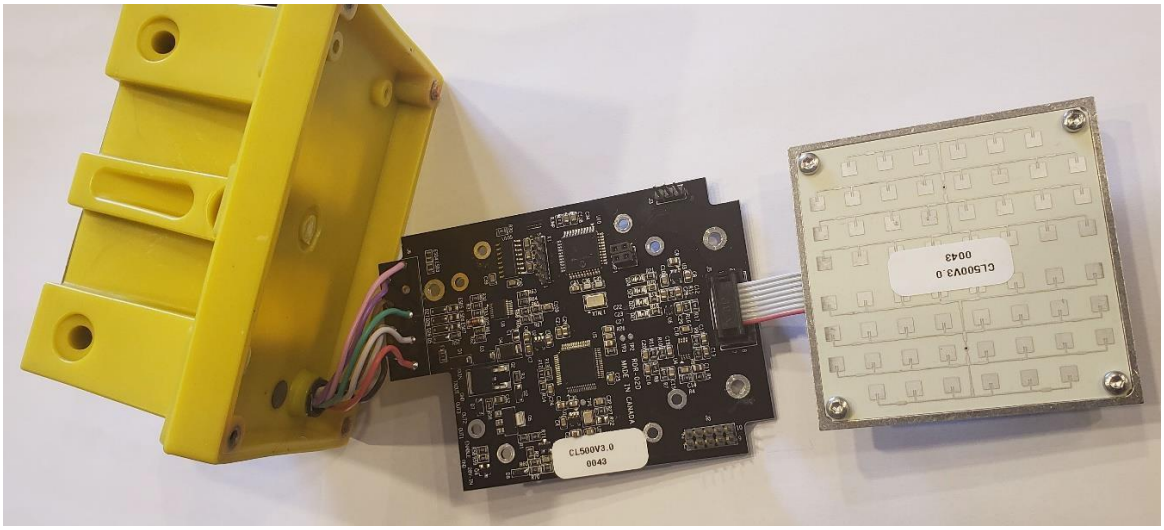
3.5.2 Default settings, Rear radar

Parameter	Default Setting
ALATPC	50
WARADM	15
VIO	15
SZ	0
MO	12
CLZ	10
LOGMODE	0

4 Technical Information

Frequency band	24000–24250 MHz
Frequency Min (MHz)	24025
Frequency Max (MHz)	24025
Field strength, dBµV/m @ 3 m	96.020 (Peak)
Measured BW (kHz) (99%)	440.7
Emission classification (F1D, G1D, D1D)	N0N
Transmitter spurious (dBµV/m @ 3 m)	51.12 at 48 GHz (Average)
Antenna information	Patch antenna up to 100% duty cycle

5, Photos



Internal photo: Housing PCB assembly, Transceiver

Bottom

Front

6 Disclosure

PART 15 COMPLIANCE INFORMATION
FCC 15.19(a)(3)
"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."

FCC 15.21

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

Statement:

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

(1) This device may not cause interference.

(2) This device must accept any interference, including interference that may cause undesired operation of the device.

L'émetteur/récepteur exempt de licence contenu dans le présentappareilestconforme aux CNR d'Innovation, Sciences et Développementéconomique Canada applicables aux appareils radio exempts de licence. L'exploitationestautorisée aux deux conditions suivantes :

1) L'appareil ne doit pas produire de brouillage;

2) L'appareildoit accepter tout brouillageradioélectriquesubi, mêmesi le brouillageest susceptible d'encompromettre le fonctionnement.

This device complies with Industry Canada's RSS-310. Operation is subject to the condition that this device must not cause harmful interference and must accept any interference, including interference that may cause undesired operation of the device.

Cetappareilestconforme au CNR-310 d'Industrie Canada. Son exploitation estautorisée à condition que l'appareil ne produise pas de brouillagepréjudiciable et qu'ilaccepte tout brouillage, mêmecelui susceptible d'encompromettre le fonctionnement.

Revision Control:

V1.0	Initial release	Feb.18, 2018
V2.0	Released for prototyping	Mar.26, 2018
V3.0	Revised default settings	May.14, 2018
V4.0	Added MO	Aug.12, 2018
V5.0	Added weather condition measures	Sep.03, 2018