User Manual

1 Brief introduction

The microwave sensor is used as human body detector for automatic control. The sensor adopts frequency modulated continuous wave (FMCW) technique, so has higher ranging accuracy and stronger adaptability compared with doppler sensor. The sensor can detect distance and motion state of ambient human body in real time, and send corresponding signal to master controller to control automatic opening/closing of cover & seat and auto-flushing.

Notice：

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

Operation Frequency Range:	**Brand**	Modulation:	Antenna type:
24.00~24.25 GHz	Kohler	FMCW	PCB Antenna

This Module complies with FCC&ISED radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 1.02cm between the radiator and your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.
Please notice that if the FCC identification number is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. For FCC, this exterior label should follow "Contains FCC ID: N82-KOHLER053". In accordance with FCC KDB guidance 784748 Labeling Guidelines.
The OEM integrator is responsible for ensuring that the end-user has no manual instruction to remove or install module.
The module is limited to installation in mobile application, a separate approval is required for all other operating configurations, including portable configurations with respect to §*2.1091* and difference antenna configurations.
If you desire to increase antenna gain and either change antenna type or use same antenna type certified, a Class II permissive change application is required to be filed by us, or you (host manufacturer) can take responsibility through the change in FCC ID (new application) procedure followed by a Class II permissive change application.

This modular transmitter is only FCC authorized for the specific rule parts listed on our grant, host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification.

Host manufacturer in any case shall ensure host product which is installed and operating with the module is in compliant with Part 15B requirements.

Please note that For a Class B or Class A digital device or peripheral, the instructions furnished the user manual of the end-user product shall include statement set out in *§15.105 Information to the user* or such similar statement and place it in a prominent location in the text of host product manual. Original texts as following:

For Class B

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.

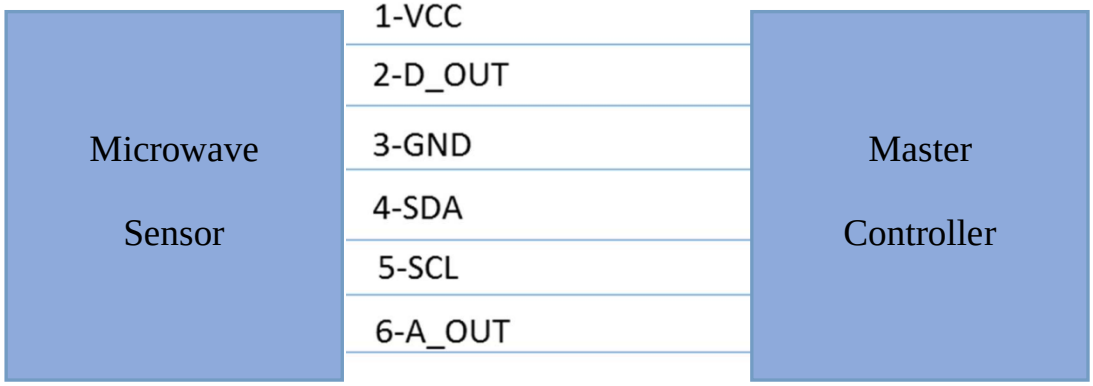
—Consult the dealer or an experienced radio/TV technician for help.

For Class A

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

2 Datasheet

2.1 Pin function definition



No.	Label	Color	Description	IN/OUT	Voltage

1	VCC	Red	Positive pole of power supply	IN	5V
2	D-OUT	Orange	Digital output	OUT	5V
3	GND	Black (Thick)	Negative pole of power supply	IN	GND
4	SDA	Brown	Data line of I2C communication	OUT/IN	3.3V
5	SCL	Yellow	Clock line of I2C communication	IN	3.3V
6	A-OUT	Black (Thin)	Analog output	OUT	3.3V

2.2 Electrical parameters

(EU power) 24.00GHz to 24.25GHz: 15.56 dBm

Parameters	Min.	Typ.	Max.	Unit	Comments
Transmitting frequency	24.00		24.25	GHz	FMCW
FM period	1.66	1.67	1.68	ms	Time of a scanning cycle
Working voltage	4.5	5	5.5	V	Long-time voltage
Limiting voltage	-12		12	V	Short-time voltage
Working current		80		mA	
Starting time	2	2.5	3	s	Time from powering-on to outputting stably
Detection angle		40		°	Horizontal direction
		90		°	Vertical derection
Detection range	0		250	cm	
Detection accuracy		10		cm	
Detection range of slight motion	0		70	cm	
Working temperature	-10		+65	℃	
Storage temperature	-40		+80	℃	

3 I2C communication protocol

Microwave sensor is always working as slave at any time.

3.1 Setting detection range

Master sends: 0x5C, 0x00, 0xXX

Comment:

0x5C--- Slave address, write operation

0x00--- Device address

0xXX--- Gear value

- <0x6C: near gear
- =0x6C: middle gear
- >0x6C: far gear

3.2 Querying preset gear value saved in sensor

Step1: Master sends 0x5C, 0x00

Comment:

0x5C--- Slave address, write operation

0x00--- Data address in device

Step2: Master sends 0x5D

Slave responds 0xXX

Comment:

0x5D--- Slave address, read operation

0xXX--- Depending on actual condition, e.g. 0x6C if middle gear

3.3 Querying distance values of series of gears saved in sensor

Step1: Master sends 0x5C, 0x0X

Comment:

0x5C--- Slave address, write operation

0x0X--- Device address for saving far/middle/near gears distance values (as per the list in 3.8)

Step2: Master sends 0x5D

Slave responds 0xXX

Comment:

0x5D--- Slave address, read operation

0xXX--- Depending on actual condition

3.4 Querying software version of sensor

Step1: Master sends 0x5C, 0x05

Comment:

0x5C--- Slave address, write operation

0x05--- Data address in device

Step2: Master sends 0x5D

Slave responds 0xXX， 0xXX

Comment:

0x5D--- Slave address, read operation

0xXX， 0xXX --- Depending on actual condition

3.5 Setting distance value of far gear triggering

Master sends 0x5C, 0x01,0xXX

Comment:

0x5C--- Slave address, write operation

0x01--- Device address for saving far gear distance value

0xXX--- Distance value of far gear triggering

3.6 Setting distance value of middle gear triggering

Master sends 0x5C, 0x02,0xXX

Comment:

0x5C--- Slave address, write operation

0x02--- Device address for saving middle gear distance value

0xXX--- Distance value of middle gear triggering

3.7 Setting distance value of near gear triggering

Master sends 0x5C, 0x03,0xXX

Comment:

0x5C--- Slave address, write operation

0x03--- Device address for saving near gear distance value

0xXX--- Distance value of near gear triggering

3.8 Comparison table of device addresses and data contents

Slave address	Device address	Data content	Comment
0101 110 W/R	0x00	Gear value (far, middle or near gear)	One of the three: <0x6C, =0x6C or >0x6C
0101 110 W/R	0x01	Distance value of far gear	In hexadecimal format
0101 110 W/R	0x02	Distance value of middle gear	Ditto
0101 110 W/R	0x03	Distance value of near gear	Ditto
0101 110 W/R	0x05	Software version	Requiring 2 bytes

4 Signal definition of digital output pin

Digital output pin remains low electric level. Once target object moves in the distance of the preset gear, the sensor output pulse signal with special frequency, which would keep till the object moves out of the distance range. The period of the pulse signal is 50 ± 1ms, and the duty ratio of high/low electric level is 50% with high electric level of 5V.

5 Certification information

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.

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.

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

Note: This product 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 product 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 product 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.

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.

The module is limited to OEM installation ONLY

The OEM integrator is responsible for ensuring that the end-user has no manual instruction to remove or install module.

When the FCC identification number or ISED certification number is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording such as the following: "Contains FCC ID: N82-KOHLER053, Contain IC: 4554A-KOHLER053" and the information should be also contained in the devices' user manual.

RF Exposure Information

This device has been tested and meets applicable limits for Radio Frequency (RF) exposure. This equipment must be installed and operated in accordance with provided instructions and the antenna(s) used for this transmitter must be installed to provide a separation distance of at least 1.7cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

EU Conformity Statement:

This product is marked with “CE” and comply therefore with the applicable harmonized European standards listed under the Radio Equipment Directive 2014/53/EU.