

# **K60168-M User Manual**

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## Main specifications

### Description

K60168-M is a hand gesture recognition SoC using 60GHz millimeter-wave radar and AI accelerator.

Radar gesture recognition system is mainly composed of the following parts:

Radar transceiver module: responsible for transmitting and receiving millimeter wave signals.

Data processing module: responsible for processing the signals received by the radar to extract gesture features.

Gesture recognition model: responsible for gesture recognition based on gesture features.

The SoC has 1 transmit antenna and 3 receive antennas which are integrated on top of a 6.1 x 3.9mm package. This SoC is also able to perform 1D, 2D, and 3D position tracking. As it stands, it can be used in smart phone, tablet, notebook, gaming console, TWS, etc. as human-interface device.

### Gesture control feature

- Application distance 1-30 cm
- Angle, FOV +/- 30° 3dB beamwidth.
- Gesture recognition
- Provide pre-trained gestures for evaluation
- Gesture recognition accuracy > 95%
- Personalized gestures
- Gesture tracking, support 3D finger tracking

### SoC/AiP

- Full Integration of millimeter-wave transceiver, baseband, radar DSP, AI accelerator, DC/DC, and PMU.
- Antenna in package design.
- Require external 8Mbits 3.3V flash, QSPI interface.
- Interface to host: I2C/UART/GPIO/SPI\*2.
- Support software toolchain for I2C and SPI
- MCU: ARM® Cortex™-M0 core.

- 40MHz clock rate.
- A 32-bit hardware multiplier.
- System interface supports little-endian data accesses.
- Build-in temperature sensor.
- Power consumption (mW).
- Gesture mode (1Tx, 3Rx): 36mW.
- Stop mode: 500uW.
- Deep power down <200uW.

### Transceiver

- Integrated frequency synthesizer, transmitter, receiver, baseband and ADC...
- Radar modulation – FMCW.
- Max modulation bandwidth 10GHz from 57~67GHz.
- Operational modulation bandwidth.
- (FCC Requirement) 7GHz from 57~64GHz.
- Build-in self-test and calibration.

### DSP

- Adaptive Interference Cancellation (AIC).
- Self-Interference Cancellation (SIC).
- Fast Fourier Transform (FFT) programmable engine.
- Build-in 3D tracking engine.

### AI accelerator for machine learning

- Gesture inference running on AI accelerator to minimize power consumption and latency.

### Power management

- DC/DC buck converter with integrated PMU for high power efficiency.
- Built-in LDO network for enhanced PSRR.

### BOM count

Few external components needed.

- IC body size: 6.1\*3.9\*1.3mm BGA 35.
- 40MHz XTAL (1.6\*1.2\*0.3 mm).
- 4.7uH\*1 (2\*1.6\*1mm) Inductor.
- 4.7uF\*1 (1.6\*0.8\*0.8mm) Capacitor.
- 0.1uF\*1 Capacitor.

### **Operation temperature**

- Temperature range: -40 ~ 85 °C

### **Applications**

- True Wireless Stereo (TWS).
- Gaming control.

- Smart appliance touchless control.
- AR/VR gesture control.
- Mobile phone gaming accessories.
- Wearable device.
- Personal IoT.
- Smart home device / appliance.

## FCC-B Radio Frequency Interface Statement

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.

### **CAUTION:**

Any changes or modifications not expressly approved by the grantee of this device could void the user's authority to operate the equipment.

## FCC Conditions

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- This device may not cause harmful interference
- This device must accept any interference received, including interference that may cause undesired operation.

FCC ID: 2A9BM-K60168-M

## RF Exposure warning

- The equipment complies with FCC RF exposure limits set forth for an uncontrolled environment.
- The equipment must not be co-located or operating in conjunction with any other antenna or transmitter.

This module is intended for OEM integrator. The OEM integrator is responsible for the compliance to all the rules that apply to the product into which this certified RF module is integrated. Additional testing and certification may be necessary when multiple modules are used.

### USERS MANUAL OF THE END PRODUCT

In the user's manual of the end product, the end user has to be informed to keep at least 20 cm separation with the antenna while this end product is installed and operated.

The end user has to be informed that the FCC radio-frequency exposure guidelines for an uncontrolled environment can be satisfied.

The end user has to also be informed that any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment.

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.

### LABEL OF THE END PRODUCT

The final end product must be labeled in a visible area with the following "Contains FCC ID: 2A9BM-K60168-M".

This radio transmitter FCC ID: 2A9BM-K60168-M has been approved by FCC to operate with the antenna types listed below with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

#### Antenna List

No.	Manufacturer	Part No.	Antenna Type	Peak Gain
1	C-Media	K60168-M	AiP	9.36 dBi