# Product Description

XGO-mini K210 Programmable Robot Dog

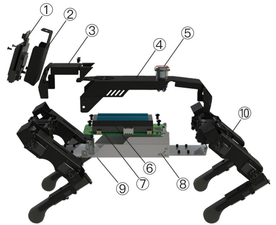
AI Education

XGO-mini is a desktop AI robot dog with 12 DOF powered by a Kendryte K210 chip for AI edge computing applications. It supports omnidirectional movement, 6D posture control, posture stability, and multiple motion gaits, internally equipped with 9-axis IMU, joint position sensors and current sensors to feedback postures, joint rotation and torque readings for internal algorithms and secondary development. The robot dog allows for Blocky and Python programming via a custom APP or PC for developing AI applications.

## Product Data

Model: XGO-mini K210
Dimensions: 250x150x180mm
Weight: 700g
Battery: 7.4V 2500mAh lithium battery
Material: Body-1.5mm aluminum
Legs-Upper: Aluminum
Lower: Silicone & Nylon

Processor: K210+STM32
Screen: 240*240 pixel full-color LCD
Camera: 0.3 mega pixels OV2640
Storage: 16G SD card
Charger rated input: 100-240V~50-60Hz
Charger rated output: 8.4V 1A




① AI module
② AI module bracket
③ Front cover
④ Back cover
⑤ Illuminated ON/OFF Switch
⑥ 18650 2S battery
⑦ Core drive board
⑧ Bottom cover
⑨ Charge jack
⑩ Metal Gear, High-Speed Magnetic Encoding Servos (1 of 12)

## AI Module Features

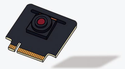
The AI module is the master control for AI related applications and has basic computer vision recognition and machine learning model inference, which can facilitate both entry and advanced-level AI applications.

Front view of the AI module

(1) Built-in Kendryte K210 chip, featured RISC-V processor architecture, audio-visual, standalone IP core and excellent programmability.
(2) Supports images, audio, video, machine learning models and other types of files stored on a Micro SD card;
(3) The integrated camera module jack is used for forward view imagines.

(1) The integrated camera module jack is provided for forward view images;
(2) 1.54" LCD full-color screen can display pictures in JPG, BMP and other image formats;
(3) External 2.5mm audio interface;
(4) Onboard power amplifier chip and speaker, support playback of audio files in WAV format.

Front view of the screen module



Front view of the camera module

The AI camera resolution is 0.3 mega pixels and can be plugged into the screen module or AI module, functioning as a front or rear camera.

## Key Technologies Employed

**IMU posture self-stabilization**
Based on the attitude data obtained from IMU and with closed loop control, the robot dog can remain stable regardless of surface movement.

**6 DOFs posture control**
With fixed foot tips, allows the entire body to remain under 6 DOF motion control.

**Move, Record and Playback**
You can even code by simply moving XGO-Mini's joints by hand while automatically recording the sequence for playback as a program.

**User communication and secondary programming interface**
The open-access underlying serial port protocol applies to secondary development and verification.

**Motion gait planning**
The robot dog comes with Low, Medium and High height postures which is linked to three different speeds with appropriate gait strategies and rules are applied.

**Kinematics and dynamics simulation interface**
In a ROS scenario, kinematics and dynamics simulations are conducted on Rviz and gazebo platforms.

**Omnidirectional motion**
With 12 active joints and through kinematics decoupling, the robot dog can perform omnidirectional motion combining Forward/Reverse, Right/Left with Rotational input for a smooth gait in any direction.

**Artificial Intelligence**
Machine vision, face recognition, speech recognition, model training and other AI functions.

## Technical Robotic Content

**Mechanics** — Motor and drive
12 micro-sized servos provide 6 DOF
single-leg 3 DOF motion analysis

**Motion** — Motion and drive
Derived forward and inverse kinematics, complete Cartesian space control and joint space control

**Sensing** — Gyroscope + Accelerometer + Magnetometer
Provides joint position, speed of the robot dog,
torque (via current) and other motion data.

**Control** — Control theory and control planning
PID control, trajectory planning control, space posture stability control

**Intelligence** — Robot dog intelligence
Machine vision, speech recognition, face recognition,
Face detection and color recognition and other AI functions

**Simulation** — Simulation practice
Kinematics and dynamics simulation

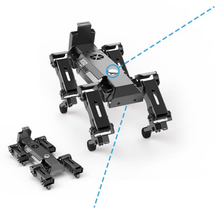
# Operation Instructions

XGO-mini K210 Programmable Robot Dog

AI Education

## ◆ START ◆

**IMPORTANT:** Please charge the XGO before using it the first time to increase battery life and DO NOT allow the Battery Charge level to fall below 20% to avoid Battery Degradation over time.



### How to Power Robot ON and OFF

**Powering ON:** First, place the robot dog in a prone position laying down as shown in the lower left picture to avoid joints from jamming during initial boot up. Then press the ON/OFF Switch once (the Power Indicator will illuminate, indicating that the Robot is now Powered ON.

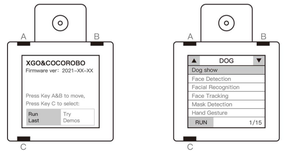
**Powering OFF:** Press the ON/OFF Switch once, the Power Indicator will start flashing and the dog will slowly lie down in the prone position. When the Robot is fully at rest the Power Indicator will no longer be illuminated, indicating that the Robot has fully Powered OFF.

**Charging the Robot:** The Robot's Charging Port is located under the Robot. Insert the Charger Plug into the Charging Port. The Charger's LED will glow Red while charging and turn Green when the batteries are fully charged.

**NOTE:** During charging, the Robot remains OFF regardless of Power Switch operation.

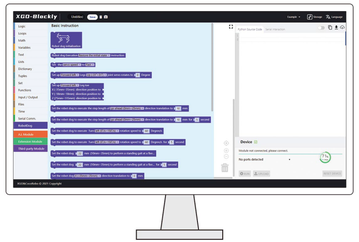
## ◆ Illustration ◆

After the Robot is Powered ON, press "A" or "B" to reach the Application Menu "Try Demos", then use "A" and "B" separately to scroll up and down to select the desired AI Application, then press "C" to confirm and execute the action selected. If it is desired to switch AI tasks, press "C" continuously or Power OFF the unit and reboot.




## ◆ PC Operation ◆

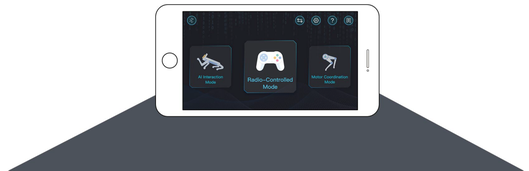
Visit www.xgorobot.com, download XGO Edu application, user can simply create programs by just selecting and dragging existing programming blocks with the desired functions.




## ◆ Operating by Phone App ◆

Search "XGO" in the Apple Store or Google Play, find the App associated with your product then download and install as you would normally do. Connect your Robot using your phone's Connections Tool, select Bluetooth and search for "XGOMINI" then initiate the App.

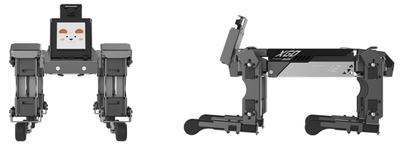
NOTE: in Performance Mode you should always use the Reset button (or wait until the Action selected completely stops before selecting another Action) otherwise, there may be a command conflict which "confuses" the robot and causes malfunctioning movements.




## ◆ Special Operation Notes ◆

CAUTION: This operation is irreversible and the factory settings will be overwritten. Read this manual thoroughly and carefully before you attempt calibration.

When the posture of the Robot dog no longer returns to the proper starting position (per pictures), e.g.: in the standing positon, one or more legs cannot touch the floor due to a servo joint being seriously offset, it is likely that the initial position of one or more servos is mechanically offset from the predefined program value. This may be simply due to a loosened screw or a slipped servo gear. If all of the screws are tight, you may need to recalibrate the Robot to establish the mechanical offsets to the original predefined values. To correct this situation, open the XGO APP, connect to the Robot via Bluetooth, click the option to run as developer and then return to the home screen. Click and go to the calibration screen, click "Enter calibration mode". At this point, the servo joints of the robot will not output torque, you can rotate all joints freely.



Place the robot dog in the posture as shown above, make sure the shoulder part of every leg is perpendicular to the body, with upper legs perpendicular to the table surface and lower legs perpendicular to the upper legs. This positioning directly affects the working posture of the robot.

After the robot is placed in original good starting position, click "Calibration completed" on the calibration screen, the robot will return to the standing posture. If the standing posture is still seriously offset, DO NOT USE the ROBOT, otherwise the robot may malfunction or become damaged. Please contact our after-sales support if you cannot calibrate the Robot to the original good starting position.

## ◆ Appendix ◆

### Precautions:

1. Unplug the unit if left unused. When charging, only use the specific charger that came with the Robot.
2. The Robot's skeleton and frame are made of metal, use caution when handling to avoid injury to hands and fingers.
3. DO NOT expose the Robot to water, moisture, humid conditions or long periods of direct sunlight. To prevent serious damage, avoid dropping the Robot from any height.
4. CAUTION: After prolonged periods of use, the Servos (in the leg joints and hips) may become warm. This is normal, but higher than normal operating temperatures through continuous and prolonged use may cause permanent harm to the Servos. It is strongly advised not to use the Robot for extended periods of time.

### Maintenance and Storage:

CAUTION: ALWAYS Power the Robot OFF before attempting ANY maintenance procedure.

1. Clean the exposed surfaces of the Robot while not exposing the control board to any moisture.
2. Check for loose screws and tighten any you may find.
3. When storing or transporting your Robot, use the special packaging box that your XGO came in, to avoid accidental damage. The Robot's four legs should be securely retained in the foam cutouts to avoid excessive movement during transport.

### Troubleshooting:

| Problem | Possible Cause | Solution |
|---|---|---|
| The ON/OFF Indicator does not light after the unit is Powered ON | Battery has little or no charge remaining (check the battery charge indicator in the App to verify) | Charge the battery with the supplied power adapter |
| The ON/OFF Indicator is lit but no actions are executed after the unit is Powered ON | There is a problem with the control system Robot is still in calibration mode | Contact our after-sales support for advice or repair service |
| The standing posture is seriously offset compared to the Robot's reference picture | The initial position is offset from the predefined values | Recalibrate the Servo Joints according to Special Operation Notes |
| One joint has no torque output (no movement is observed at this joint) | The Servo of the join is damaged | Contact our after-sales support for repair service |

Customer Service Email:hello@xgorobot.com