

WLKATA MIROBOT PROTOCOL INSTRUCTION SET

Version number 1.1

- WLKATA Mirobot Gcode is an important part of the Mirobot software.
- Based on the standard gCode protocol, we added some new instructions to implement some mirot-specific functionality.

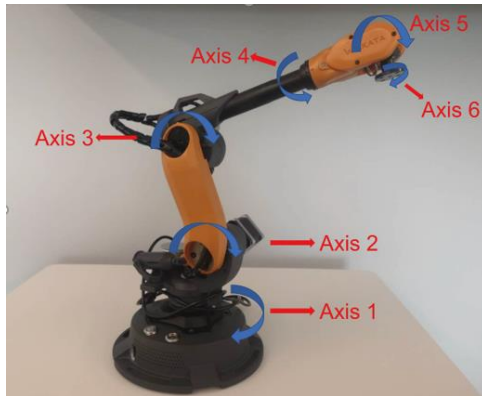


Fig. 1 The six axes of Mirobot

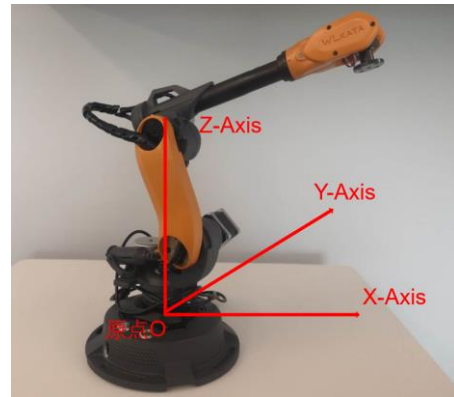


Fig. 2 Robot coordinate system and origin

I. instruction description

1. Mirobot uses a **USB serial port for communication**. Baud rate is 115200, data bit 8, stop bit 1.
2. Mirobot adopts instruction control **based on G code**.
3. The letters in the instruction are not case sensitive.
4. Mirobot can **output two sets of PWM signals** to control the end clamp or suction cup.

2. Instruction set

1.

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| Instruction format | ? |
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| Function description | Obtain the status and position information of the current manipulator |
|----------------------|---|

Parameter Description:

| Parameter | Must filled-in subjects | Parameter type | Describe |
|-----------|-------------------------|----------------|----------|
| Empty | No | Empty | Empty |

Return value:

<Idle,Angle(ABCDXYZ):{A},{B},{C},{D},{X},{Y},{Z},Cartesian coordinate(XYZ RxRyRz):{X},{Y},{Z},{Rx},{Ry},{Rz},Pump PWM:{PWM1},Value PWM:{PWM2}>

Return value Description:

Idle indicates that the manipulator is in idle state, and angle (ABCDXYZ) is followed by the angle values of each axis of the manipulator. The order is: the fourth axis {A}, the fifth axis {B}, the sixth axis {C}, the external slide rail {D} (if installed), the first axis {X}, the second axis {Y}, and the third axis {Z} (the positions of each axis are shown in Figure 1). Cartesian coordinate (XYZ RxRyRz) is followed by the position and orientation of the end of the manipulator (the coordinate system of the manipulator is shown in Figure 2), {X}, {Y}, {Z} represents the X-Y-Z coordinate value, {Rx}, {Ry}, {Rz} represents the orientation (RPY angle). {PWM1}, {PWM2} are two sets of PWM values output by the manipulator.

Example of return value:

```
[14:00:11.978]发→◇?
[14:00:11.986]收←◆◀Idle,Angle(ABCDXYZ):0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,Cartesian coordinate(XYZ RxRyRz):202.000,0.000,143.000,0.000,0.000,0.000,Pump PWM:0,Valve PWM:0,Motion_MODE:0>
ok
```

Meaning of return value: idle indicates that the manipulator is in idle state, angle (ABCDXYZ) is followed by the angle value of each axis of the manipulator, the fourth axis is 0°, the fifth axis is 0°, the sixth axis is 0°, the external slide rail (if installed) is 0°, the first axis is 0°, the second axis is 0°, and the third axis is 0°. Cartesian coordinate (XYZ RxRyRz) is connected to the position and orientation of the end of the manipulator, position (202, 0143), orientation (0, 0, 0),

The two output PWM values are both 0.,

Remarks: Empty

Modification record: Empty

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| 2. Instruction format | M50 |
| Function description | Release the shaft locking state after power on. Before using the mechanical arm, "homing" operation must be carried out. In order to prevent errors caused by direct movement of the mechanical arm without homing operation, we set each axis as the locked state after power on. Only after homing operation, the locked state can be released. The M50 command is used to unlock each axis directly. |

Parameter Description:

| Parameter | Must filled-in subjects | Parameter type | Describe |
|-----------|-------------------------|----------------|----------|
| Empty | Empty | Empty | Empty |

Return value: "M50: Unlock each axis."

Return value Description: empty

Example of an instruction:

Meaning of the directive:

Remarks: Empty

Modification record: Empty

| | |
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| 3. Instruction format | \$20=1 \$20=0 |
| Function description | Turn on or off the soft limit of each axis |

Parameter Description:

| Parameter | Must filled-in subjects | Parameter type | Describe |
|-----------|-------------------------|----------------|---|
| | | | Open soft limit: \$20 = 1 Close soft limit: \$20 = 0 Each axis has a range of motion angles that specifies the soft kickout range of motion for each axis. The value of the system parameter "\$20" can be set to turn the soft limit function on or off. |

Return value: empty

Return value Description: empty

Example of an instruction: \$20=0
 Meaning of the directive: Close soft limit

Remarks: Empty

Modification record: Empty

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|-----------------------|---|
| 4. Instruction format | \$21=1 \$21=0 |
| Function description | Turn on or off the angle hard limit function of axes 1 to 3 |

Parameter Description:

| Parameter | Must filled-in subjects | Parameter type | Describe |
|-----------|-------------------------|----------------|--|
| | | | Open hard limit: \$21 = 1 Close hard limit: \$21 = 0 Travel switches are installed on shafts 1 to 3 to detect the limit position of shaft movement and limit it. If the axis movement triggers the hardware kickout, the arm will stop moving. The |

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| | | | value of "\$21" system parameter is used to set the hardware limit function on or off. |
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Return value: empty

Return value Description: empty

Example of an instruction: \$21=0

Meaning of the directive: Close hard limit

Remarks: Empty

Modification record: Empty

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| 5. | Instruction format | M21 G90 X{1} Y{2} Z{3} A{4} B{5} C{6} F{7} |
| | Function description | Angle mode motion (controlling the rotation of each axis of the robot), absolute motion mode (the angle value of each axis is relative to the reset starting position, and the reset starting position angle is 0 °) |

Parameter Description:

| Parameter | Must filled-in subjects | Parameter type | Describe |
|-----------|-------------------------|----------------|-------------------------------|
| {1} | No | float | First axis angle position |
| {2} | No | float | Second axis angle position |
| {3} | No | float | Third axis angle position |
| {4} | No | float | Fourth axis angle position |
| {5} | No | float | Angle position of the Wu axis |
| {6} | No | float | Sixth axis angle position |
| {7} | No | integer | Speed (°/min) |

Return value: empty

Return value Description: empty

Example of an instruction: M21 G90 X10 Y15 C10 F2000

Meaning of the directive: Control the first axis of the robot to move to 10 °, the second axis to move to 15 °, the sixth axis to move to 10 °, and the speed is 2000 ° / min.

Remarks: Empty

Modification record: Empty

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| 6. Instruction format | M21 G91 X{1} Y{2} Z{3} A{4} B{5} C{6} F{7} |
| Function description | Angle mode motion (control the rotation of each axis of the robot), incremental motion mode (specified change of each axis angle motion) |

Parameter Description:

| Parameter | Must filled-in subjects | Parameter type | Describe |
|-----------|-------------------------|----------------|------------------------------------|
| {1} | No | float | Angle increment of the first axis |
| {2} | No | float | Angle increment of the second axis |
| {3} | No | float | Angle increment of the third axis |
| {4} | No | float | Angle increment of the fourth axis |
| {5} | No | float | Angle increment of the fifth axis |
| {6} | No | float | Angle increment of the sixth axis |
| {7} | No | integer | Speed (°/min) |

Return value: empty

Return value Description: empty

Example of an instruction: M21 G91 X10 Y-15 C-10 F2000

Meaning of the directive: The control robot moves 10 ° in the first axial positive direction, 15 ° in the second axial negative direction, 10 ° in the sixth axial negative direction, and the speed is 2000 ° / min.

Remarks: Empty

Modification record: Empty

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|-----------------------|--|
| 7. Instruction format | M20 G90 G0 X{1} Y{2} Z{3} A{4} B{5} C{6} F{7} |
| Function description | Cartesian fast motion mode (to control the end of the manipulator to move quickly to the specified position and orientation in |

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| | Cartesian space), absolute motion mode (to specify the end position and orientation) |
|--|--|

Parameter Description:

| Parameter | Must filled-in subjects | Parameter type | Describe |
|-----------|-------------------------|----------------|--------------------------------|
| {1} | No | float | X coordinates |
| {2} | No | float | Y coordinates |
| {3} | No | float | Z coordinates |
| {4} | No | float | Orientation angle: roll angle |
| {5} | No | float | Orientation angle: Pitch angle |
| {6} | No | float | Orientation angle: Yaw angle |
| {7} | No | integer | Speed (mm/min) |

Return value: empty

Return value Description: empty

Example of an instruction: M20 G90 G0 X150 Y-30 Z55 A0 B0 C0 F2000

Meaning of the directive: Control the robot to move quickly to (150, - 30,55) position, (0, 0, 0) RPY angle orientation, and the speed is 2000mm / min

Remarks: Empty

Modification record: Empty

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| 8. | Instruction format | M20 G90 G1 X{1} Y{2} Z{3} A{4} B{5} C{6} F{7} |
| | Function description | Cartesian linear interpolation motion mode (controlling the end of the manipulator to move straight to the specified position and orientation in Cartesian space), absolute motion mode (specifying the end position and orientation) |

Parameter Description:

| Parameter | Must filled-in subjects | Parameter type | Describe |
|-----------|-------------------------|----------------|----------|
|-----------|-------------------------|----------------|----------|

| | | | |
|-----|----|---------|--------------------------------|
| {1} | No | float | X coordinates |
| {2} | No | float | Y coordinates |
| {3} | No | float | Z coordinates |
| {4} | No | float | Orientation angle: roll angle |
| {5} | No | float | Orientation angle: Pitch angle |
| {6} | No | float | Orientation angle: Yaw angle |
| {7} | No | integer | Speed (mm/min) |

Return value: empty

Return value Description: empty

Example of an instruction: M20 G90 G1 X150 Y-30 Z55 A0 B0 C0 F2000

Meaning of the directive: Control the robot to move to (150, - 30,55) position in a straight line, and at (0, 0, 0) RPY angle, the speed is 2000mm / min

Remarks: Empty

Modification record: Empty

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|----|----------------------|--|
| 9. | Instruction format | M20 G91 G0 X{1} Y{2} Z{3} A{4} B{5} C{6} F{7} |
| | Function description | Cartesian fast motion mode (controlling the end of the manipulator to move rapidly to the specified position and orientation in Cartesian space), relative motion mode (specifying the increment of the end position and orientation) |

Parameter Description:

| Parameter | Must filled-in subjects | Parameter type | Describe |
|-----------|-------------------------|----------------|---|
| {1} | No | float | Increment value of X coordinate |
| {2} | No | float | Increment value of Y coordinate |
| {3} | No | float | Increment value of Z coordinate |
| {4} | No | float | Increment of orientation angle: Roll angle |
| {5} | No | float | Increment of orientation angle: Pitch angle |
| {6} | No | float | Increment of orientation angle: Yaw angle |
| {7} | No | integer | Speed (mm/min) |

Return value: empty

Return value Description: empty

Example of an instruction: M20 G91 G0 X10 Y-30 A0 B0 C0 F2000

Meaning of the directive: Control the robot to move rapidly, the increment of X coordinate is 10, the increment of Y coordinate is - 30, and the speed is 2000mm / min

Remarks: Empty

Modification record: Empty

| | | |
|-----|----------------------|--|
| 10. | Instruction format | M20 G91 G1 X{1} Y{2} Z{3} A{4} B{5} C{6} F{7} |
| | Function description | Cartesian linear interpolation motion mode (controlling the end of the manipulator to move straight to the specified position and orientation in Cartesian space), relative motion mode (specifying the increment of the end position and orientation) |

Parameter Description:

| Parameter | Must filled-in subjects | Parameter type | Describe |
|-----------|-------------------------|----------------|---|
| {1} | No | float | Increment value of X coordinate |
| {2} | No | float | Increment value of Y coordinate |
| {3} | No | float | Increment value of Z coordinate |
| {4} | No | float | Increment of orientation angle: Roll angle |
| {5} | No | float | Increment of orientation angle: Pitch angle |
| {6} | No | float | Increment of orientation angle: Yaw angle |
| {7} | No | integer | Speed (mm/min) |

Return value: empty

Return value Description: empty

Example of an instruction: M20 G91 G0 X10 Y-30 A0 B0 C0 F2000

Meaning of the directive: The linear motion of the robot is controlled. The increment of X coordinate is 10, the increment of Y coordinate is - 30, and the speed is 2000 mm / min

Remarks: Empty

Modification record: Empty

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|-----|----------------------|---|
| 11. | Instruction format | \$H |
| | Function description | Robot performs reset(homing) motion(Simultaneous reset movement of each axis) |

Parameter Description:

| Parameter | Must filled-in subjects | Parameter type | Describe |
|-----------|-------------------------|----------------|----------|
| Empty | No | Empty | Empty |

Return value: empty

Return value Description: empty

Example of return value: Empty

Meaning of return value: Empty

Remarks: The "\$HH" and "\$H" instructions are both arm homing instructions. "\$HH" is the single axis moving homing in sequence. "\$H" refers to the simultaneous movement of each axis

Modification record: In v1.0, this instruction means that each axis is reset in sequence, and in v1.1, this instruction is modified to reset each axis at the same time.

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|-----|----------------------|---|
| 12. | Instruction format | \$HH |
| | Function description | Robot performs reset (homing)motion(Each axis resets in sequence) |

Parameter Description:

| Parameter | Must filled-in subjects | Parameter type | Describe |
|-----------|-------------------------|----------------|----------|
| | | | |

| | | | |
|-------|----|-------|-------|
| Empty | No | Empty | Empty |
|-------|----|-------|-------|

Return value: empty

Return value Description: empty

Example of return value: Empty
Meaning of return value: Empty

Remarks: The "\$HH" and "\$H" instructions are both arm homing instructions. "\$HH" is the single axis moving homing in sequence. "\$H" refers to the simultaneous movement of each axis

Modification record: Empty

| | | |
|-----|----------------------|--|
| 13. | Instruction format | M3S{1} |
| | Function description | Turn the air pump on or off (specify the PWM output value of the air pump control) |

Parameter Description:

| Parameter | Must filled-in subjects | Parameter type | Describe |
|-----------|-------------------------|----------------|--|
| {1} | Yes | integer | Open air pump: m3s1000 Close air pump: m3s0 |

Return value: empty

Return value Description: empty

Example of an instruction: M3S1000
Meaning of the directive: Open air pump

Remarks: Empty

Modification record: Empty

| | | |
|-----|----------------------|---|
| 14. | Instruction format | M4E{1} |
| | Function description | Open or close gripper (specify PWM output value of gripper control) |

Parameter Description:

| Parameter | Must filled-in subjects | Parameter type | Describe |
|-----------|-------------------------|----------------|--|
| {1} | Yes | integer | Open grip: m4e65 Closed grip: m4e40 |

Return value: empty

Return value Description: empty

Example of an instruction: M4E65
Meaning of the directive: Open grip

Remarks: Empty

Modification record: Empty