Light Duty iGrinder®
M530X User's Manual

✍ Be careful of the dust and the grinding wheel burst.

✍ Read the user's manual before performing any installation or operation.

Sunrise Instruments

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Content

Safety Caution

- Be careful of the dust and the grinding wheel burst.
- iGrinder controller is powered by high-voltage AC power, be careful.
- The grinding tool rotates in high speed, keep away from it and do not touch it.
- Read the user’s manual before performing any installation or operation.
- Be careful of others.

1. Introduction

The intelligent grinder (iGrinder®) is patented by Sunrise Instruments (SRI).
iGrinder consists of a floating device, sensors and a controller. M530X is a Light–Duty axially floating grinder. There are a force sensor, a displacement sensor and a tilt sensor in M530X.The grinding force and floating displacement are monitored by force sensor and displacement sensor. Orientation relate to horizontal plane is measured by the tilt sensor, so grinding force changing due to the robot orientation can be compensated in realtime. iGrinder controller(M8412A) monitors all the sensors and control a servo-controlled pneumatic valve(M5151B) to make the system works with constant grinding force.
Compared with traditional force control technology, iGrinder offers a number of benefits:

Independent force control system, very easy to use

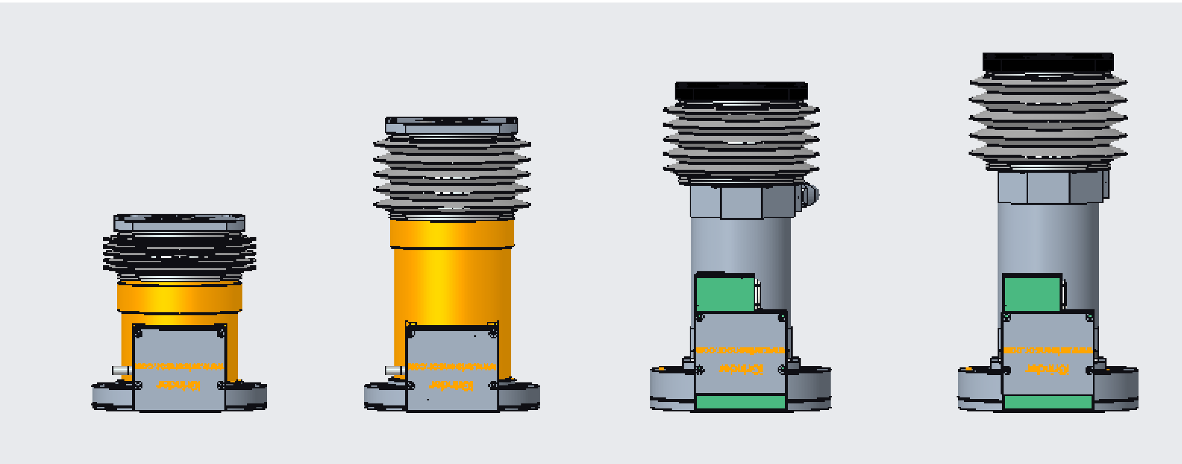
- iGrinder makes it very easy that robot grind (or polish or buff) parts with a constant contact force between the tool and the work piece. Before grinding, users just need set a desired force，iGrinder maintains this force automatically.
- No complicated robot software needed. When robot moving along the teach-path, iGrinder change its position to follow the object surface and apply a constant force on the work piece.

Different tools, different applications

- iGrinder works well with different tools in many applications, such as pneumatic grinder, motor, belt sander, draw bench, angle grinder and rotary burrs.

Other highlights

- Axially floating with constant grinding force
- Response time 5ms
- Integrated force sensor, displacement sensor and tilt sensor, grinding force is not affected by robot orientation.
- Ethernet, EtherCAT, RS232 and I/O communications
- IP65



• **Selection guide**

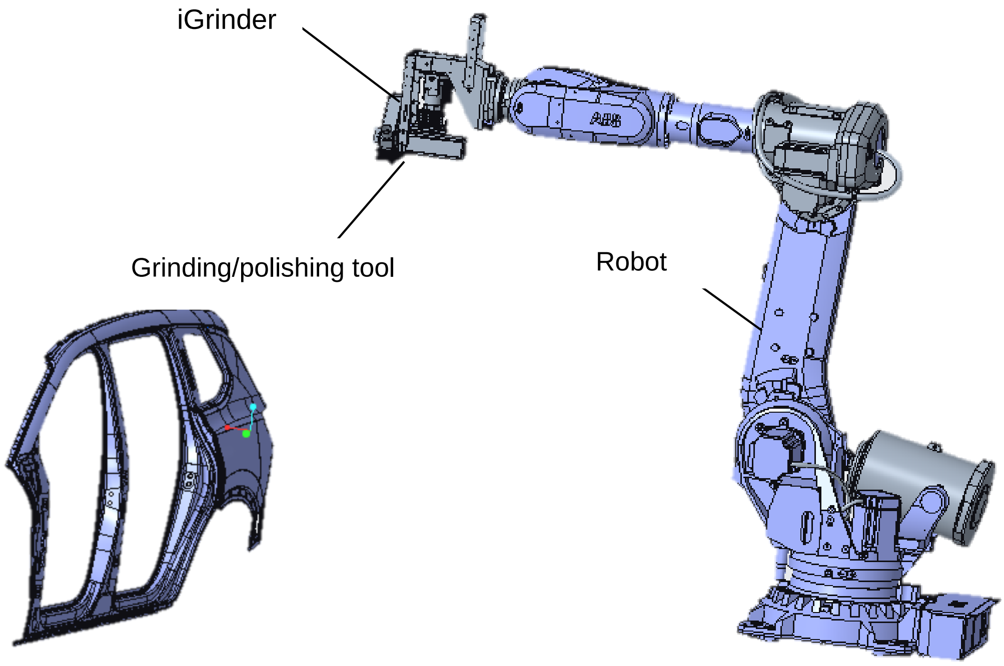
Model#	Force Range	Stork Range	Force Accuracy	Disp-sensor Accuracy	Payload	Weight
M5307A	0 ～ 100N	0 ～ 12mm	+/-1N	0.01mm	7kg	2.5kg
M5307B	0 ～ 150N	0 ～ 25mm	+/-2N	0.01mm	10kg	3.2kg
M5308B	0 ～ 150N	0 ～ 25mm	+/-2N	0.01mm	14kg	4.8kg
M5308C	0 ～ 200N	0 ～ 35mm	+/-2N	0.01mm	16kg	5.2kg

2. System construction

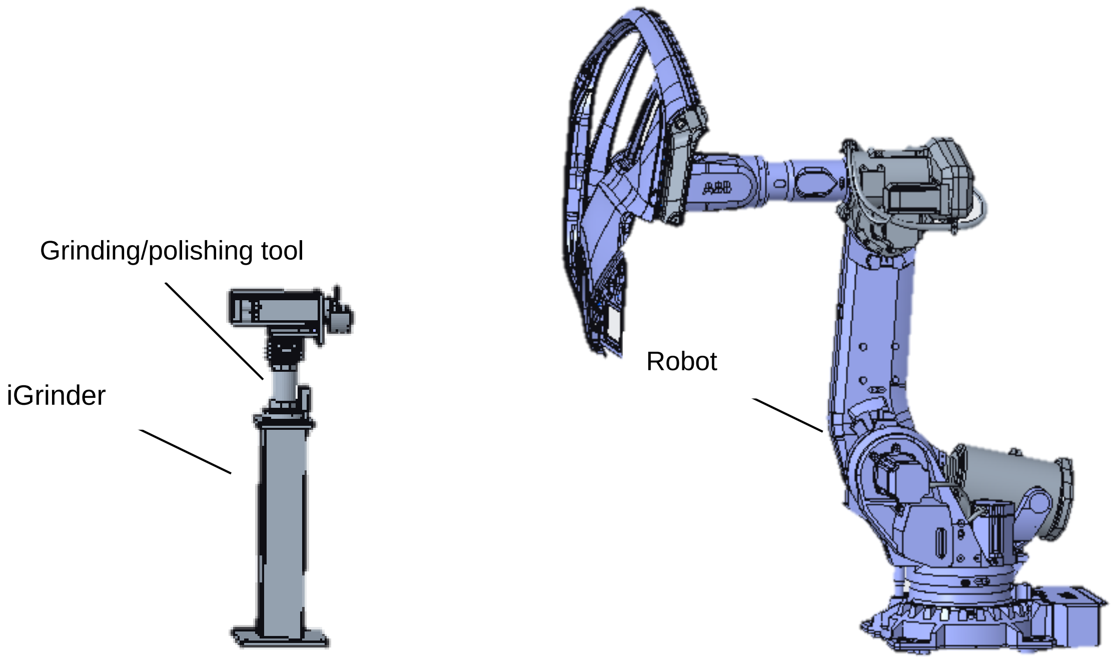
2.1 Robot grinding system construction

Robot grinding system consists of a robot, iGrinder, polishing tool and other components.
There are two installation methods:

1. Fix workpiece: the workpiece is fixed on the ground. The iGrinder is attached to the robot.
2. Fix iGrinder: the iGrinder is fixed on the ground. The robot grips the workpiece.



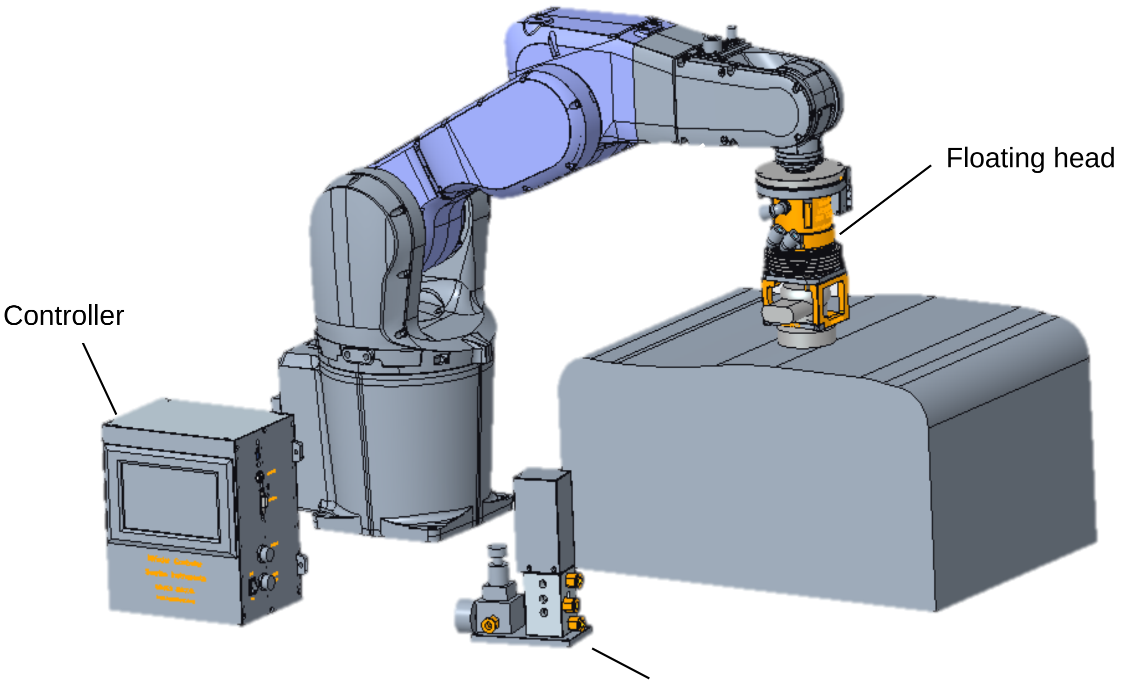
1. Fix workpiece



2. Fix iGrinder

2.2 IGrinder system construction

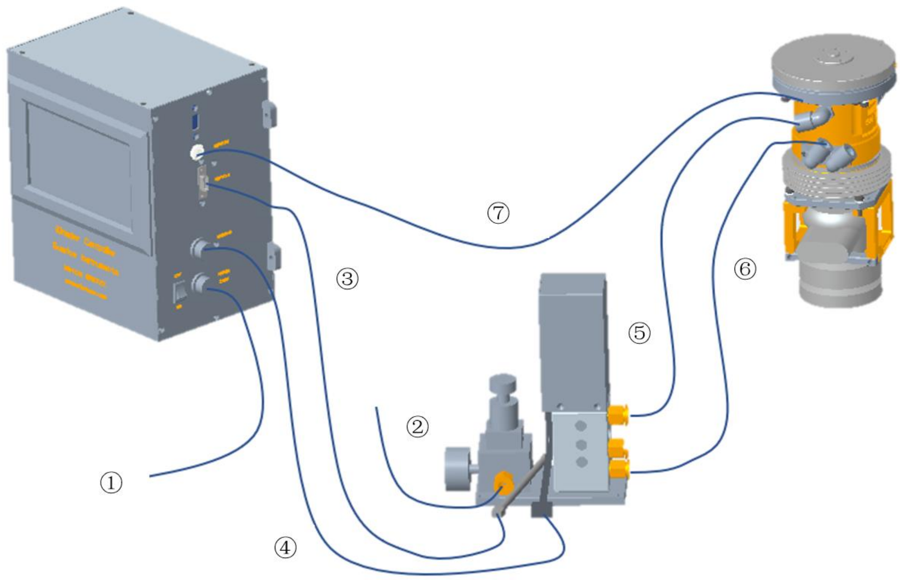
IGrinder consists of a floating head, a servo-controlled pneumatic valve and a controller.



2.3 Wiring diagram

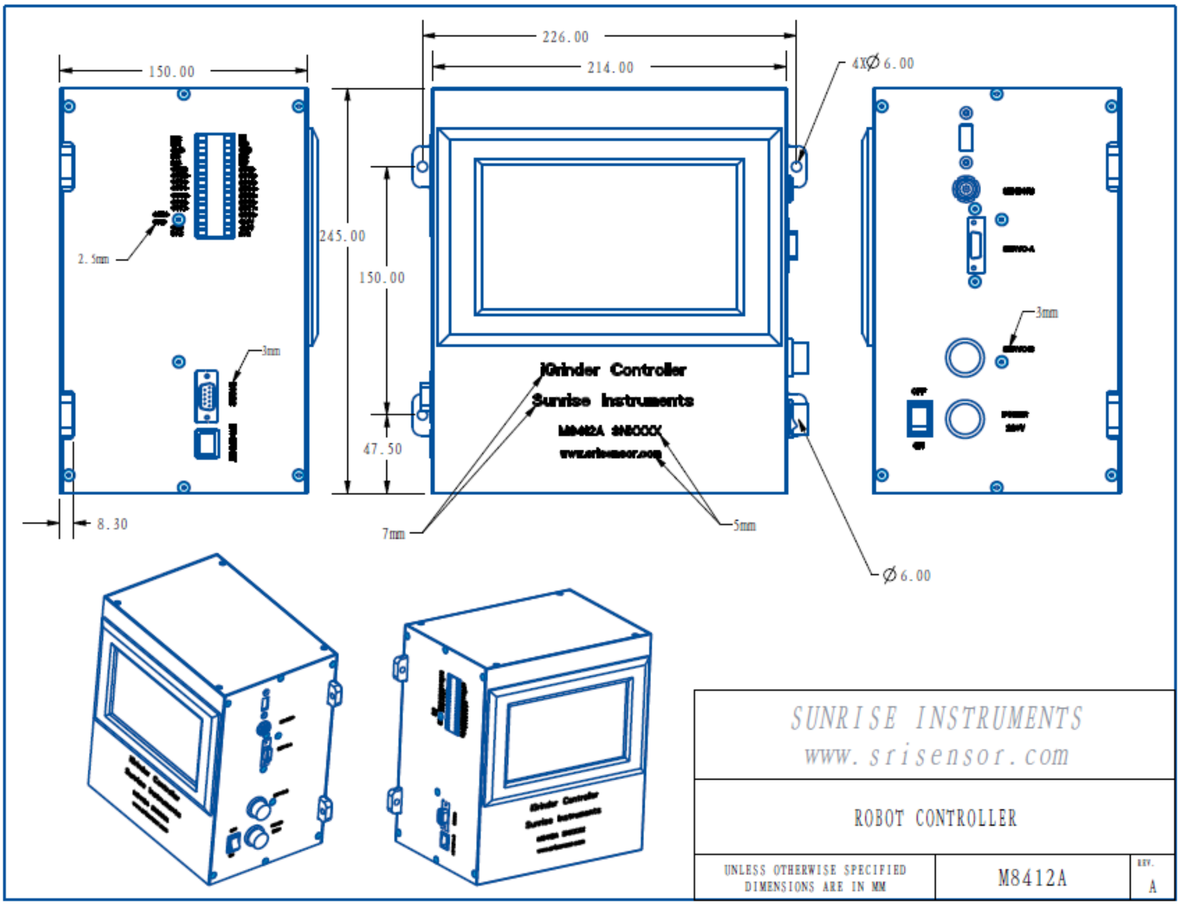
Controller M8412A is connected as shown below:

① Single-phase 220V AC power supply
② Air source: oil-free and water-free, 0.3-0.4Mpa
③ Servo cable A
④ Servo cable B
⑤ Tube A: outer diameter 10mm, inner diameter 6mm
⑥ Tube B: outer diameter 10mm, inner diameter 6mm
⑦ Sensor cable

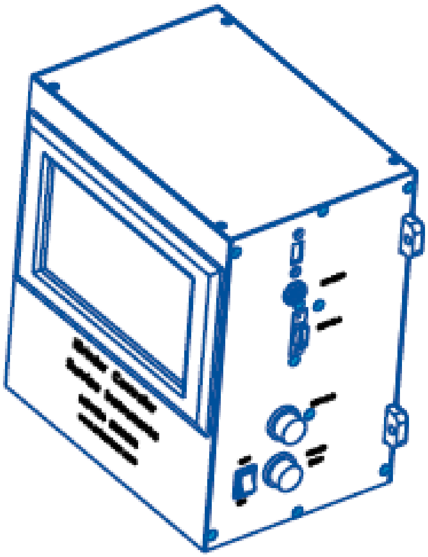


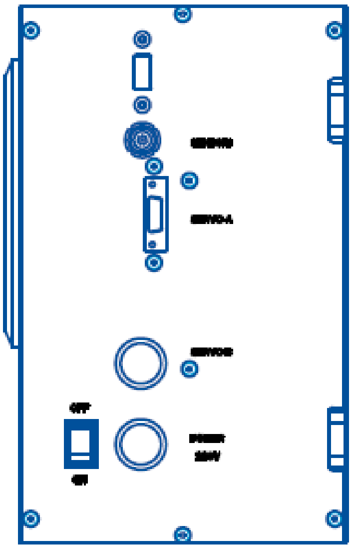
3. iGrinder Controller

iGrinder controller(M8412A) monitors all the sensors(including force sensor, displacement sensor and tilt sensor) ,and control a servo-controlled pneumatic valve(M530X) to make the system works with constant grinding force. M8412A supports Ethernet, RS232 and I/O communications. Users can get realtime data from M8412A by communication commands.

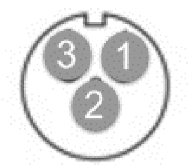


3.1 Connector pin definition



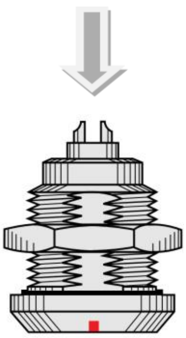


Power connector definition：



Pin #	Definition
1	AC220V - L
2	AC220V - N
3	AC220V - GROUND

Sensor1 connector definition：



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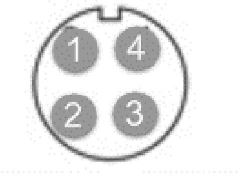
Pin #	Definition
1	FZ+
2	FZ-
3	Disp+
4	Disp-
5	485A
6	485B
7	+24V
8	GND

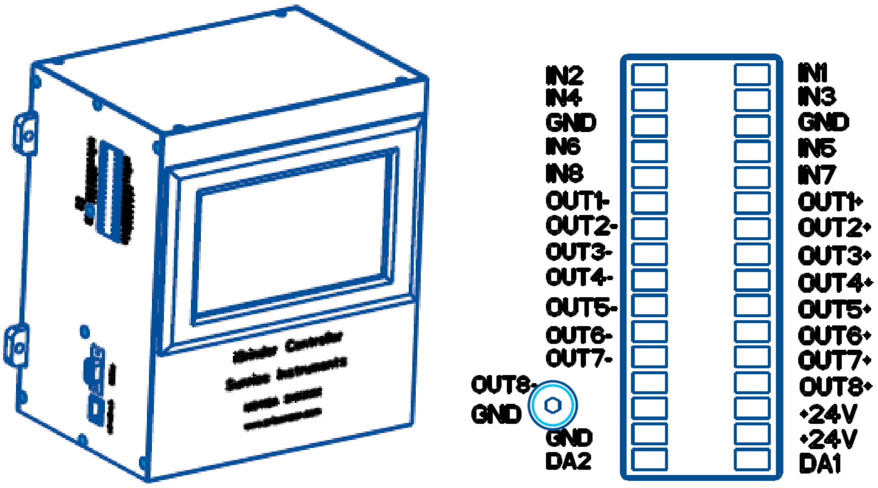
SERVO-B connector definition：



Pin #	Definition
1	W
2	V
3	U
4	GROUND

SERVO-A connector is prefabricated and unchangeable.

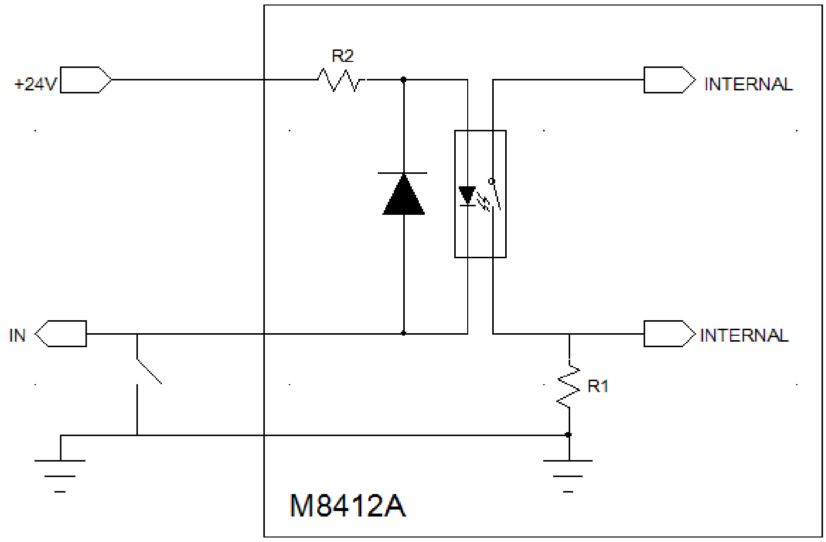
3.2 I/O definitions



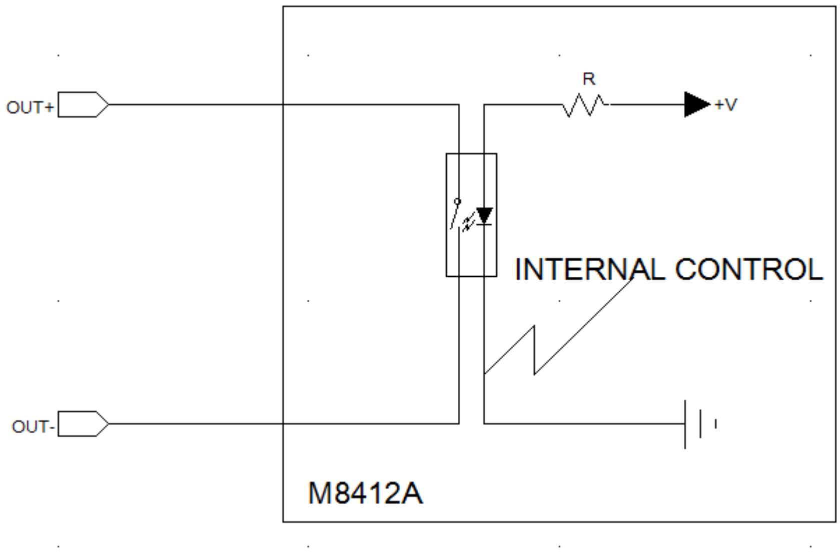
I/O Definitions

I/O	Definitions	Note
IN1	To set grinding force	
IN2	To set grinding force	
IN3	To trigger ending-grinding force	
IN4	To trigger to get displacement sensor data and compare with a reference.	For path change
IN5	To reset the displacement sensor	
IN6 ~ IN8	N/A	For future use
OUT1	To notice the result of comparing displacement sensor data with a reference.	For path change
OUT2	To indicate if the actual grinding force is beyond the set range respect to the set grinding force.	
OUT3	To indicate if displacement sensor data is below the threshold level.	
OUT4	To indicate if displacement sensor data is above the threshold level.	
OUT5	To indicate if iGrinder is in grinding status.	
OUT6～OUT8	N/A	For future use

Input I/O：

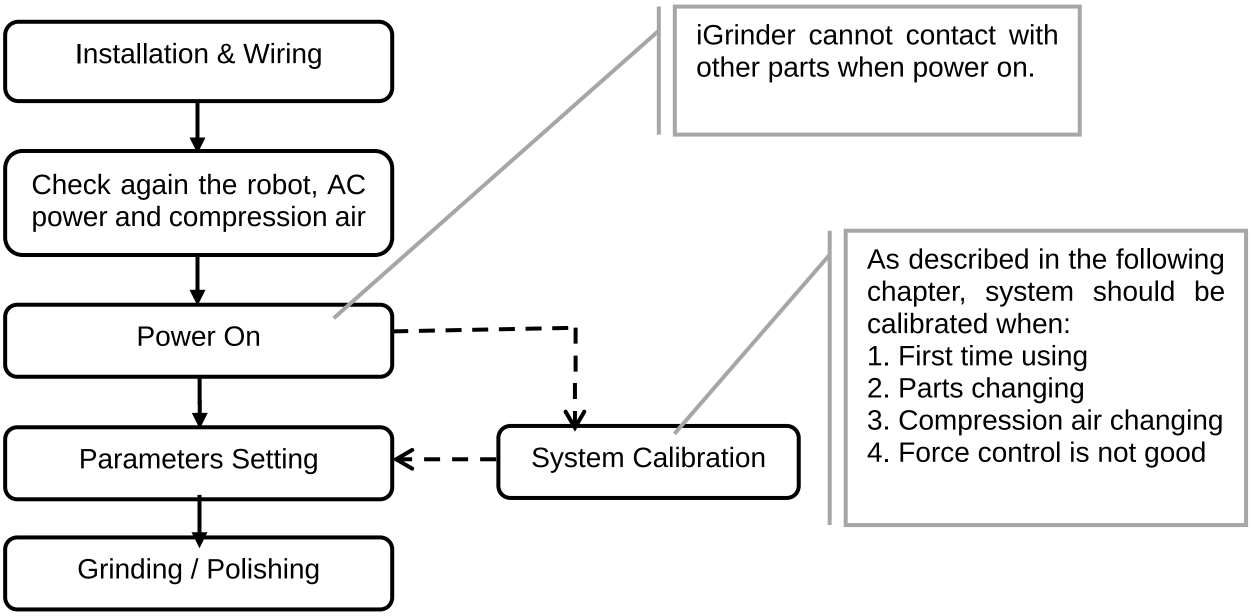


Output I/O：



4. Operation

4.1 Standard operation steps



4.2 Controller parameter setting

4.2.1 Operation interface

The touch screen operation interface is divided into two modules: RealTime and Configuration.

RealTime module only displays real-time data, and you cannot enter any parameters from here.

Configuration module is used to set parameters. To enter this module, password 9999 is needed.

4.2.2 Sensor sensitivity parameter

Click “Config” to enter configuration module, click   to find the sensor sensitivity configuration interface.

✍ Original parameters were set at the factory. Sensitivity should be reconfigured if changing a different sensor.

4.2.3 Control Mode Setting

Click “Config” to enter configuration module, click to find the Control Mode configuration interface.

✍ Original parameters were set at the factory.

4.2.4 System Control Parameters

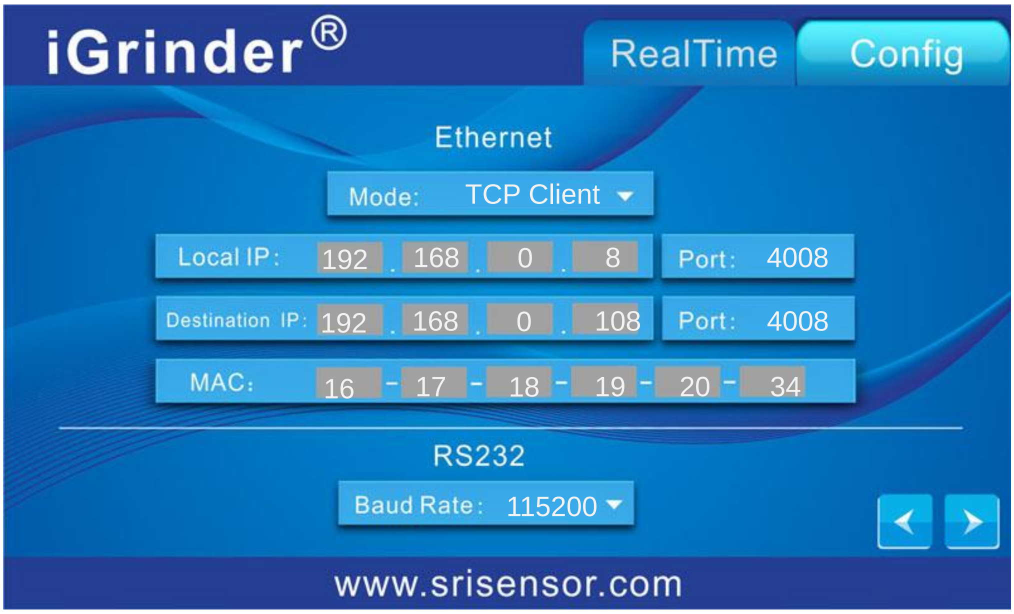
Click “Config” to enter configuration module, click to find the System Control configuration interface.

✍ Original configuration was set at the factory.

4.2.5 Communication Setting

Click “Config” to enter configuration module, click to find the Communication configuration interface.

✍ After setting communication parameters, the controller must be restarted, otherwise the setting is invalid.



4.2.6 Grinding Parameters Configuration

The grinding force can be set in the following two ways:
1. By Ethernet, RS232, etc.
2. By I/O.

There are two IOs (IN1 and IN2) to set the grinding force. Firstly, the truth table should be configured on the M8412A's screen. Finally, different grinding force can be set by I/O.

The default statue of input I/O is 0 (zero), so when there is no external IO connected, the grinding force is the first group (I/O "00").

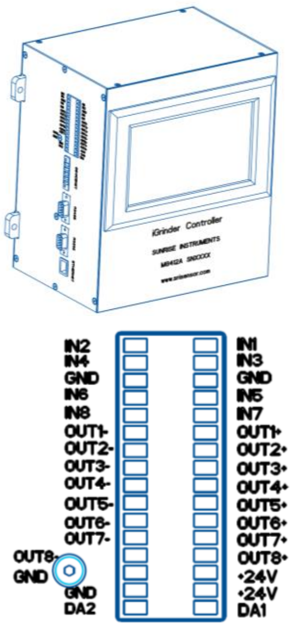
Click "Config" to enter configuration module, click < > to find the grinding force setting interface.

Four kinds of force can be switched through I / O, which is controlled by IN1 and IN2. IN2 is in high bit and IN1 is in low bit. Connecting IN1 or IN2 to GND is 1, otherwise is 0

Truth Table

IN2	IN1	Grinding force
0	0	Grinding force #1
0	1	Grinding force #2
1	0	Grinding force #3
1	1	Grinding force #4

IN1 and IN2 default to 00. Therefore, when there is no external IO, the controller outputs the grinding power of the first group ("00") by default.



4.2.7 Contact Force and Exit Force Setting

Click “Config” to enter configuration module, click to find the Contact Force and Exit Force setting interface.

Contact Force: The grinding force in the contact phase, from no contact to totally contact.

The time should be 0ms to Xms, and the Ratio to GrindingF should be Y to 100.

To trigger the Contact force: iGrinder controller triggers it automatically.

Exit Force： The grinding force in the exit phase, from totally contact to no contact.

The time should be 0ms to Xms, and the Ratio to GrindingF should be 100 to Y.

To trigger the Exit force: By connect IN3 of iGrinder controller to GND.

4.2.8 System warning

Click "Config" to enter configuration module, click to find the System Warning setting.

Path change:
Path change is not a standard function. Original parameters were set at the factory, please do not change them.

System Warning:

RFDR: Grinding force warning, unit is N. When difference between actual grinding force and setting force is bigger than RFDR, iGrinder controller will change a I/O's status(see I/O definition).
DWCL: I/O status will change when displacement sensor value is less than DWCL(see I/O definition).
DWCH: I/O status will change when displacement sensor value is above DWCH(see I/O definition).

4.3 System Calibration

During the calibration process, the system will get a group of optimal control parameters, based on the actual conditions such as air source and the weight of the polishing tool.

Calibration process must be performed when:

1). First time using
2). Parts changing
3). Compression air changing
4). Force control is not good

4.3.1 Calibration Parameters Setting

Click "Config" to enter configuration module, click to find the Calibration Parameters Setting interface.

– **Tool number:** Different grinding / polishing tools can be used with iGrinder. Different tools have different calibration parameters. Tool No is used to identify calibration parameters of different tools.

– **Number of calibration steps**: set to 1.

– **Tool Weight (Calculated)**: Read only. After the calibration process is performed, Tool Weight (Calculated) will be updated.

– **Tool Weight (Set)**: By default, Tool Weight(Set) must be set to OFF.
In some special applications, manual input of fixture weight is required. In this case, SRI will notify the user separately.

– **GCPN:** The number of points stored in the calibration curve. The more points, the longer time calibration process will take.

– **GFRAG:** Desired force range. Different application has different desired force range.
-5 to 100 is recommended.

– **GARAG:** Desired angle range. Different application has different desired force range.
0 to 90 is recommended.

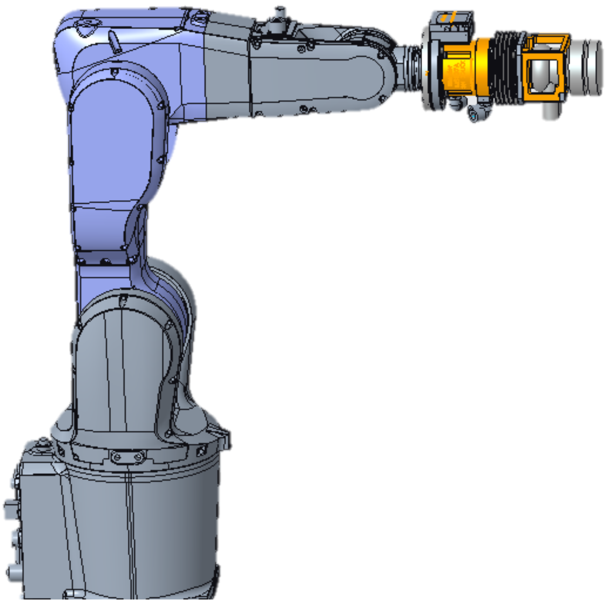
The sensor sensitivity configuration (4.2.2) and control mode (4.2.3) will also affect the calibration results. So, it's recommended to confirmed them too.

4.3.2 Calibration

Click “Config” to enter configuration module, click   to find the Calibration Parameter setting interface.

Three Steps:
1.Zero Offset at Horizontal
2.Zero Offset at Vertical
3.Calibration

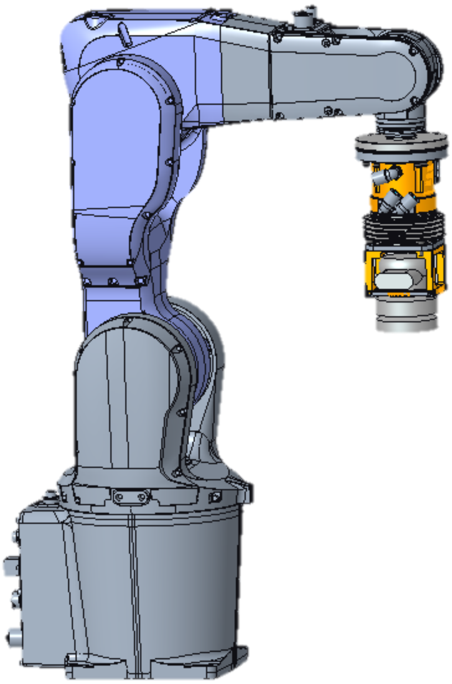
Step 1: Zero Offset at Horizontal
Make sure floating head M530X is at horizontal and not contacting with other parts.



Enter the system calibration page, click the [Zero Offset at Horizontal] button, and click [Yes] on the following page.

Step 2: Zero Offset at Vertical

Make sure floating head M530X is at vertical and not contacting with other parts.

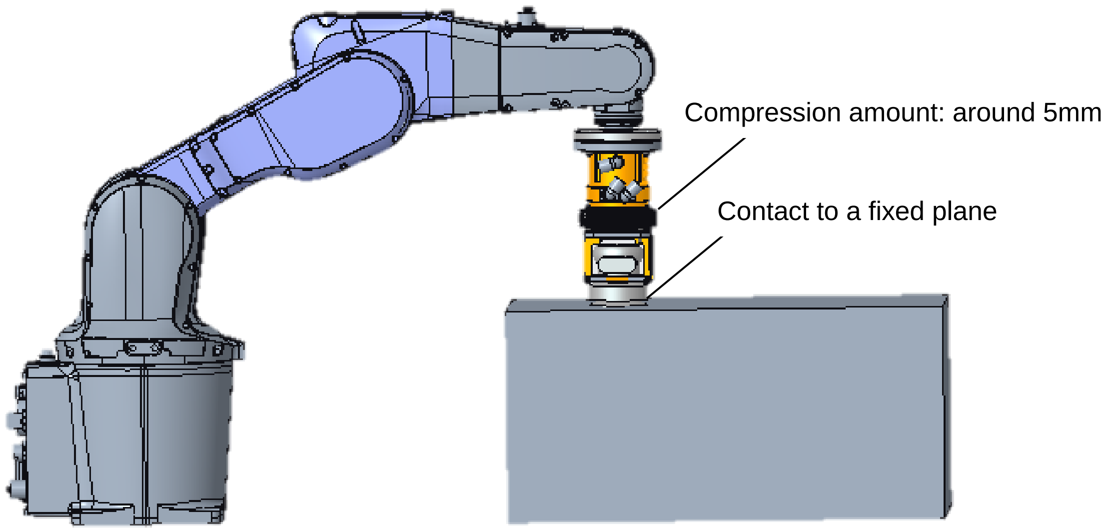


Click the [Zero Offset at Vertical] button, and click [Yes] on the following page to perform the zero offset compensation operation.

After this step, the system automatically calculates the weight of the fixture and displays it in [Tool Weight (Calculated)].

Step 3: Calibration

Make the floating head is vertically downward, contact it to a fixed plane with a compression amount around 5mm.



Click the [Calibration] button, and click [Yes] on the following page to execute the calibration process.

When the calibration is in processing, the calibration progress will be displayed on the controller. After the calibration is completed, it will automatically return to the calibration page.

4.3.3 Confirmation of Calibration Results

After the calibration is completed, set several different grinding forces, check the difference between the grinding force and the actual grinding force in the RealTime page. The difference is generally within +/- 3N.

5. Maintenance

Recommend one factory maintenance every year.

Daily maintenance:

#	Items
1	Overall appearance inspection
2	Dust cover inspection
3	Follow force control accuracy

6. Q&A

#	Q	A
1	What are the applications of iGrinder?	It can be used in grinding, polishing, wire drawing, cutting, deburring, and force-controlled assembly.
2	Does iGrinder have special requirements for robots?	No. Force control and floating are independently controlled by the iGrinder controller, and the robot only needs to follow the teaching trajectory.
3	What tools can iGrinder front-end connect for grinding and polishing applications?	Power tools such as pneumatic grinders (such as 3M), electric spindles, and motors. Can also be fitted with unpowered tools. Note that the lighter the front-end tool is, the better.
4	What are the ways to set iGrinder force?	1. By M8412A touch screen interface. 2. By I / O 3. By Communication via Ethernet or RS232
5	What are the general operating steps of iGrinder?	Please refer to Section 4.1