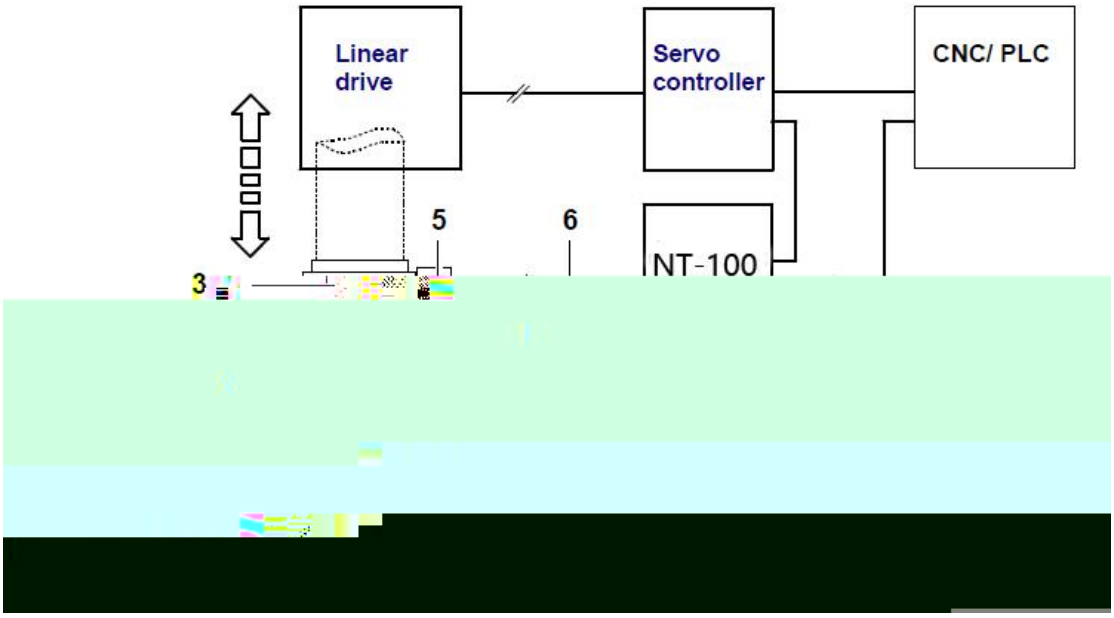
Chapter 1. Product introduction

1.1 Brief Introduction

NT-100 Capacitive Height Controller (hereinafter referred to as NT-100). In the process of laser cutting, the distance between the nozzle and the surface of the workpiece is not constant because of the uneven workpiece and cutting high pressure gas injection, which will have a negative effect on the cutting performance, or even crashing nozzle.

the distance between the nozzle and the workpiece surface, send the signal through preamplifier to the adjustment box for processing, and send output signal to the servo controller to control the Z axis.

The NT-100 height adjusting box can be used as a controller to output the control voltage or as a distance measurement system to output the distance signal. This depends on the selected mode, sensor control mode or distance measurement system mode.



1-1 System Wiring Diagram

Workpiece	Electrode cable
Sensor	Preamplifier
Cutting head	Sensor cable

1.2 Function Specification

- Capacitance sampling rate: 1,000 times per second.
- Static measurement accuracy: 0.001mm.
- Height measurement range: 0 ~ 25mm.

- The signal will not decay with strong capacity of resisting when the length of signal transmission cable is up to 100m.
- Support network communications and U disk online upgrade.
- Support the jitter suppression function; can effectively suppress the jitter caused by blowing air and dross, etc.
- Adapt to any cutting head and nozzle; capacitance parameter adaptive.
- Support panel collision alarm, nozzle electrode lost detection alarm, sensor wire breakage alarm.
- Support one point, two point and sixteen point capacitance calibration, support displaying the calibrated curve.
- Support real-time capacitance calibration, can effectively solve the influence of temperature and other factors on capacitance sensor.
- The 16 bit DA output, the output voltage (±10 V) signal in the sensor control mode, or the linear height signal of the signal output voltage (0-10 V) in the distance measurement mode, have an update cycle of 1000 times per second.
- The 14 bit AD input detects the external analog voltage signal (0V-10V) and adjusts the stationary distance in real time.
- Support oscilloscope function, can detect the capacitance and height changes in real time.
- Support oscilloscope function, can detect AD changes in real time.
- Support EtherCAT bus communication.

Chapter 2. Wiring Instruction

2.1 System Composition

The capacitive control system is composed of NT-100 controller, preamplifier, laser cutting head, cable and so on as shown below.

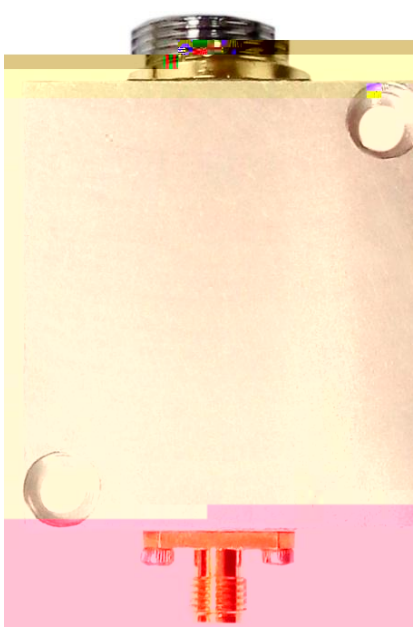
2.2 Installation Dimension

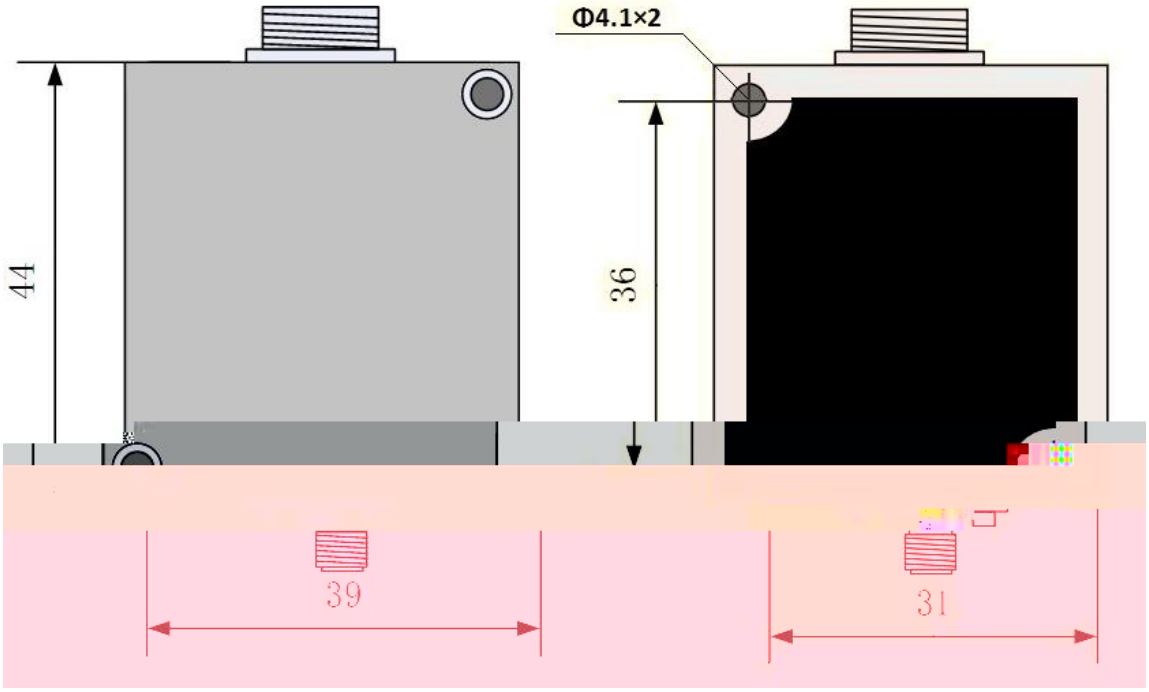
2.2.1 Master Controller

The Master Controller boundary dimension as shown in the below figure.

2.2.2 Preamplifier

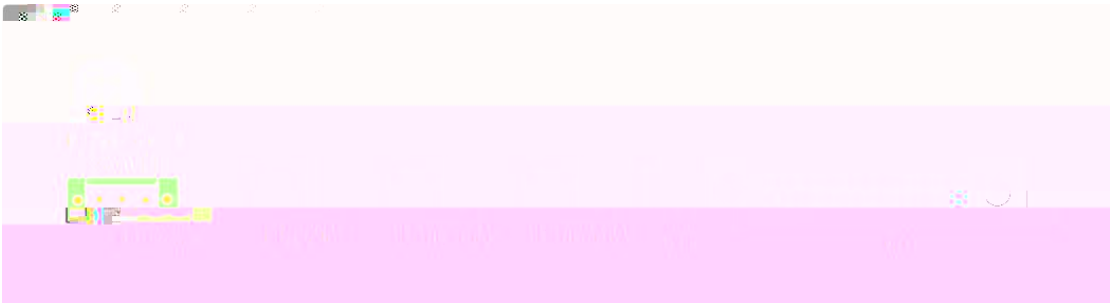
The appearance and dimensions of the preamplifier are shown in the figure below.



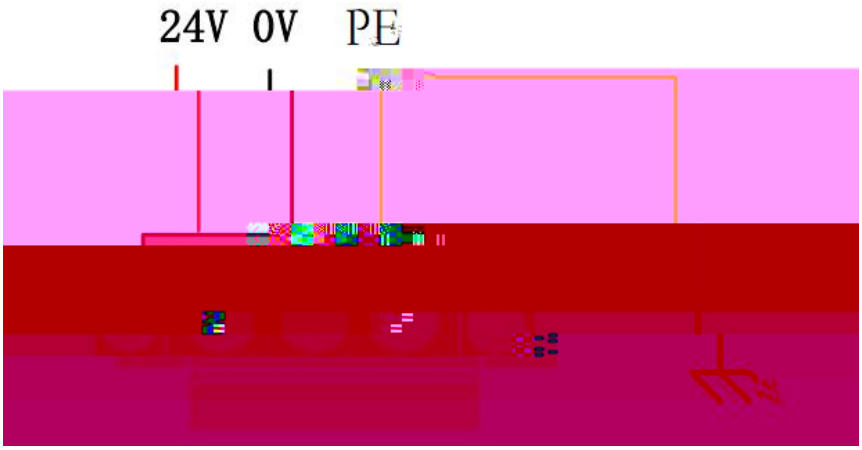


2.3 Interface Specification

2.3.1 Interface Layout

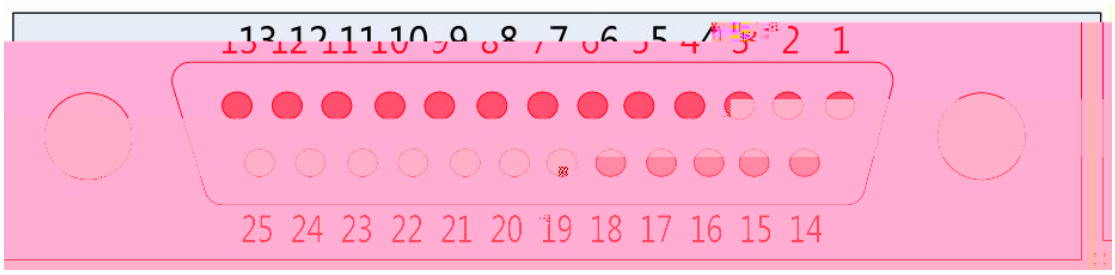


2.3.2 Power Supply Interface



The housing of the machine is the negative pole of the measured capacitance. In order to ensure the stable operation of the measuring circuit, The "PE pin" of the power supply interface must be reliably connected to the machine housing (that is, with the machine housing well on), and the preamplifier housing must also be well connected to the machine housing. The specific index is that the DC impedance is always less than 10 ohms, otherwise the actual follow effect may not be good.

2.3.3 Input / Output Interface



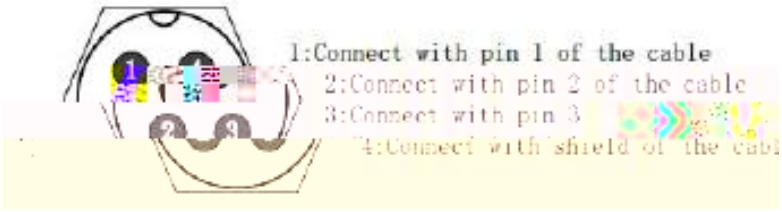
Pin	Signal Definition	Pin	Signal Definition
1			
2			
3			
4			
5			
6			
7			
8			

	Interface	Definition	I/O	Signal	Voltage	Note
Digital Quantity	IN1	A3	I	CAL.REQUEST/ SET RANGE/ SET RANGE		Reference point calibration; Two point calibration, 100%MBEW; 1 point calibration, 100%MBEW; Calibration start signal
	IN2	A4	I	SELECT CHAR.BIT0		Two point calibration 10%MBEW; Selective calibration characteristic curve
	IN3	A5		SELECT CHAR.BIT1		
	IN4	A6		SELECT CHAR.BIT2		
	IN5	A7		STROBE		Calibration signal (Teach mode)
	IN6	A8	I	Zn1-4 BIT0		Common operation mode; Selection interval (Zn1-4)
	IN7	A9		Zn1-4 BIT1		
	IN8	B1	I	CHECK		Real-time calibration signal
	OUT1	A10	O	FAR		Indicator sensor is outside the range of measurement
	OUT2	A11	O	COLLISION (+NOZZLE LOST)		Meaning depends on A14 & A15 as table below
	OUT3	A12	O	CABLE CUT		Indication sensor break
	OUT4	A13	O	READY		Height adjusting box is ready
	OUT5	A14	O	BODY TOUCH		Sensor and workpiece short circuit
	OUT6	A15	O	POS.REACHED/ NOZZLE LOST		Reaching the setting point or calibration complete; Nozzle electrode lost

	DA+	A19	A	OUT	0-10V	Linear distance

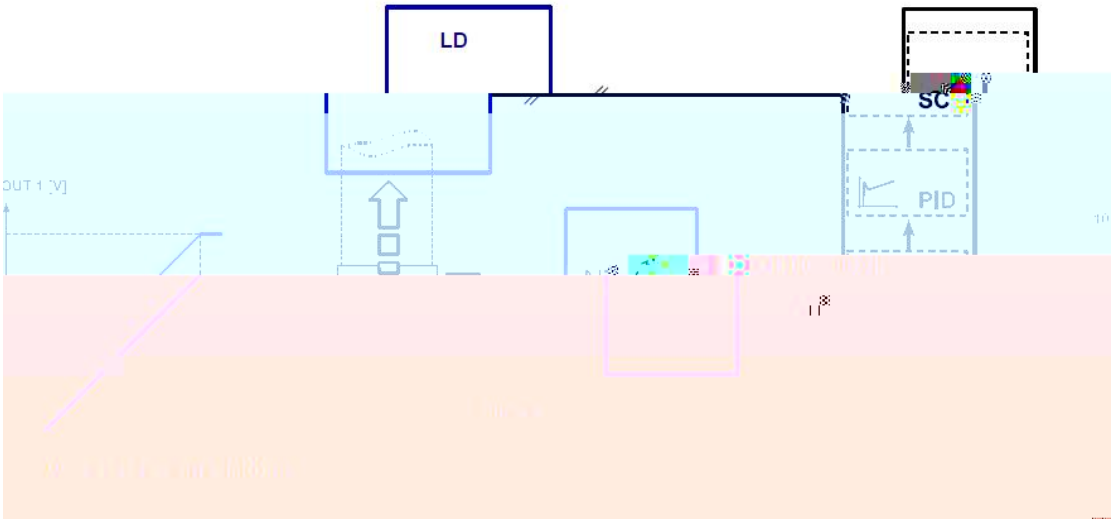
	A11	A14	A15	
TIP TOUCH	High			Sensor and workpiece short circuit
BODY TOUCH	High	High		Sensor body and workpiece short circuit
NOZZLE LOST	High		High	Nozzle electrode lost

2.3.5 Sensor Interface

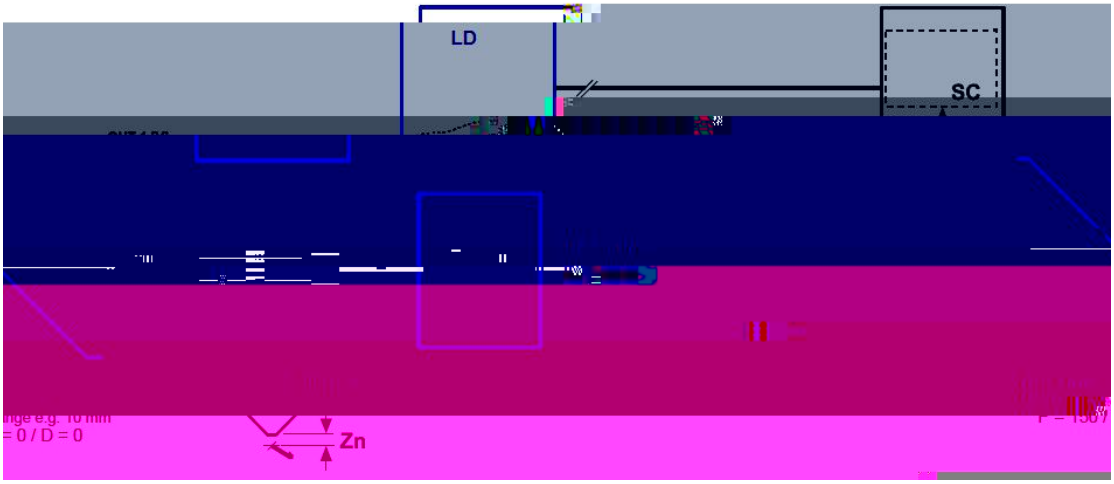


4-core sensor signal transmission cable can be made by 3-core shielded cable and 2 pcs of 4-core aviation plugs.Core 1, 2, 3 should be connected to corresponding core, core 4 should be connected to shielded.

2.3.4 Application Case



Control box as distance measuring system; Measuring range: 10mm; Output voltage: OUT = 0-10V

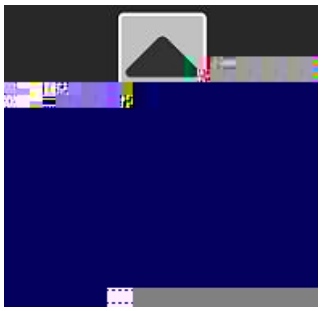


Control box as controller; Measuring range: 10mm; Zn=5mm; Proportional control, P=150 I=0 D=0.

Range from -5mm to 5mm, corresponding output voltage -10V to 10V

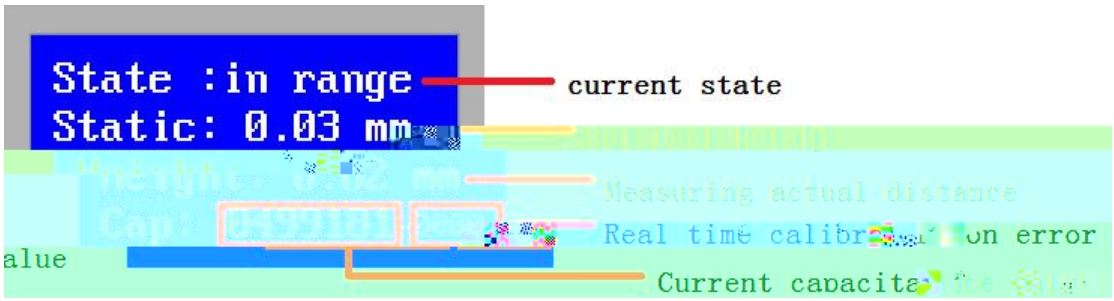
Chapter 3. Operating Instruction

3.1 Button Instruction

3.2 Main Interface

After electrified initialization, system enter “Main Interface” automatically. As shown below:



The display features on the main interface include:

State

Displaying the state of the current control box. There are several states:

A. **Nozzle collision:** Sensor and workpiece short circuit

B. **In range:** Measuring distance of sensor is within effective measuring range.

C. **Beyond measuring range:** Measuring distance of sensor exceeds effective measuring range.

Displaying static distance of system. Static distance is acquired by control box measuring input signal of (A16 - A17). This data is only valid in sensor control mode.

In capacitive measuring range, displaying distance between cutting head and plate surface.

The principle of system sampling is to measure the capacitance between the cutting head and the plate to get the distance. The closer the cutting head e

When the calibration is finished, there are two indexes, the first is to show the range of capacitance after calibration, the second is the state of this calibration: “excellent”, “good” or “bad”.

The floating head calibration process consists of the following steps:

(1).Operate the floating head move down slowly to detect touching plate.

(2).After touching plate, move the floating head up, operate according to the distance of calibrated point indicated on the screen. Press “ENTER” button to enter the next operation, or press “ESC” to end the calibration.

The meaning of the calibration results is as follows:

Stability: reflecting the static characteristics of the capacitance. If this calibrated index is not ideal, it may due to plate vibration or strong external disturbance. Meanwhile it reflects dynamic characteristics of capacitance change in calibration process. The ideal condition for this index is "excellent" or "good".

Effective value: Conversion value of capacitance from 0.5mm to the plate to infinity. It reflects measuring range of nozzle sensor. The larger the measuring range, the better the tracking accuracy and stability. Press “ENTER” to save calibration value.

Display height - capacitance graph. The normal graph should be smooth, as shown below:

3.4 Test Interface

In the main interface, Press “F2” Button to enter “Test Interface”. As shown below:

The meaning of each parameter is shown in the following table:

3.5.2 Senior Parameter

Press “Up” or “Down” to select the target menu item and press “ENTER” to enter the “Senior Parameter Interface”. As shown below:

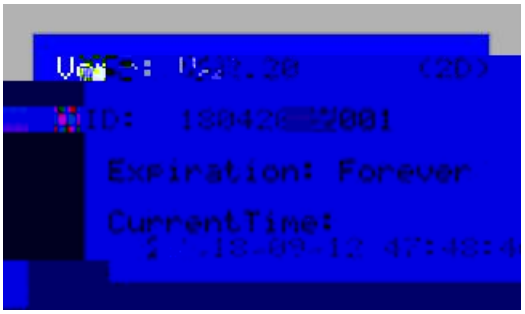
The meaning of each parameter is shown in the following table:

3.5.3 Restoration Parameter

3.5.4 Network Parameter

Press “Up” or “Down” to select the target menu item and press “ENTER” to enter the “Network Parameter Interface”. As shown below:

When connecting to a network, it is recommended that the PC and NT-100 be connected by the network cable.



Note:

When the NTĎ !

3.6.4 System Setting

Press “Up” or “Down” to select the target menu item and press “ENTER” to enter the “System Setting Interface”. As shown below:

The user can view in this interface:

Chapter 4. Alarm Instruction

4.1 Warning Instructions and Possible Causes

Alarm	Instruction	Possible Cause
		➢ ➢ ➢ ➢ ➢ ➢

➢

➢

➢

➢
➢

➢

➢

Chapter 5. Debugging Specification

5.1 Manual Reference Point (sixteen point) Calibration

1 Change or confirm measurement range limits (Maximum 25mm).

2 In the main interface, press "F1" to enter "Calibration" interface, then enter "sixteen point Calibration" menu.

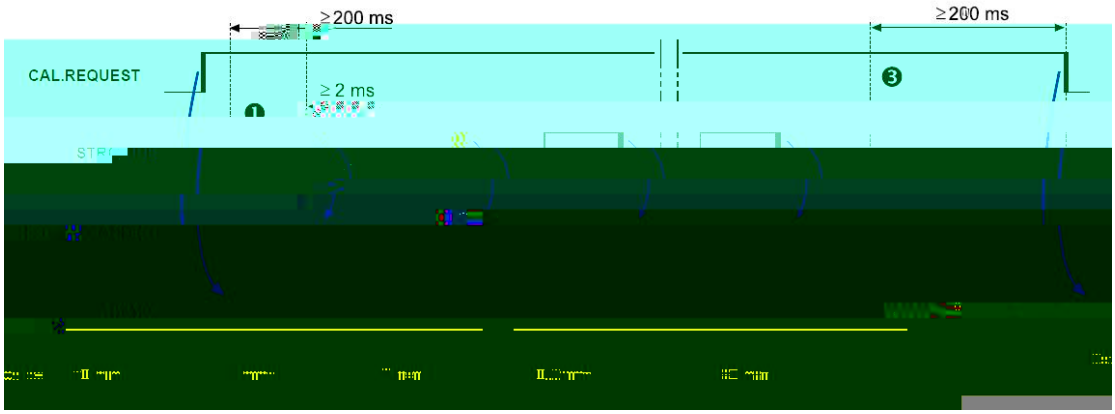
3 Start calibration, move the cutting head to the first point, and press "Enter" to confirm.

4 Move in turn and confirm the remaining fifteen points.

5 Confirm or cancel to exit; calibration ends.

5.2 Automatic Reference Point (sixteen point) Calibration

Automatic calibration control sequence diagram is as below



1 Change or confirm measurement range limits (Maximum 25mm).

2 Set CAL.REQUEST signal (PIN A3 High).

3 Move the sensor to the workpiece until the COLLISION signal is set (PIN A11, High), that is , touching the workpiece and finding the zero point needed for calibration.

4 Move to the first reference point (measurement range limit).

5 Set STROBE signal (PIN A7, High); confirm that the reference point has been reached.

6 Before POS.REACHED signal is read, STROBE must be maintained above 200ms. POS.REACHED (PIN A15, High) signal confirmed measuring value is received by CNC/PLC.

7 Handle the remaining fifteen reference points separately.

For example

Reference Point	Measuring Range 10mm	Measuring Range 15mm	Measuring Range 20mm	Measuring Range 25mm
Reference point 1	10.00mm	15.00mm	20.00mm	25.00mm
Reference point 2	8.00mm	12.00mm	16.00mm	20.00mm
Reference point 3	7.00mm	10.50mm	14.00mm	17.50mm
Reference point 4	6.00mm	9.00mm	12.00mm	15.00mm
Reference point 5	5.00mm	7.50mm	10.00mm	12.50mm
Reference point 6	4.00mm	6.00mm	8.00mm	10.00mm
Reference point 7	3.00mm	4.50mm	6.00mm	7.50mm
Reference point 8	2.50mm	3.75mm	5.00mm	6.25mm
Reference point 9	2.00mm	3.00mm	4.00mm	5.00mm
Reference point 10	1.80mm	2.70mm	3.60mm	4.50mm
Reference point 11	1.50mm	2.25mm	3.00mm	3.75mm
Reference point 12	1.20mm	1.80mm	2.40mm	3.00mm
Reference point 13	1.00mm	1.50mm	2.00mm	2.50mm
Reference point 14	0.70mm	1.05mm	1.40mm	1.75mm
Reference point 15	0.50mm	0.75mm	1.00mm	1.25mm
Reference point 16	0.20mm	0.30mm	0.40mm	0.50mm
Nozzle Lost	>30.00mm	>30.00mm	>30.00mm	>30.00mm

Nozzle lost detection function “NOZZLE LOST”

The following steps are mandatory, otherwise the entire calibration process will not be valid.

1 Set CAL.REQUEST signal (PIN A3 High .

2 Move the sensor away from the workpiece, the distance should be longer than 30mm.

3 Maintain the entire position at least 200ms to calibrate the NOZZLE LOST.

4 Reset CAL.REQUEST signal (PIN A3 Low).

If an error occurs during the calibration of the reference point, COLLISION (PIN A11, High) signal will be set.

If calibration fails, repeat the above steps.

5.3 Adjusting System and Controlling Parameters to Optimize PID

Para ter

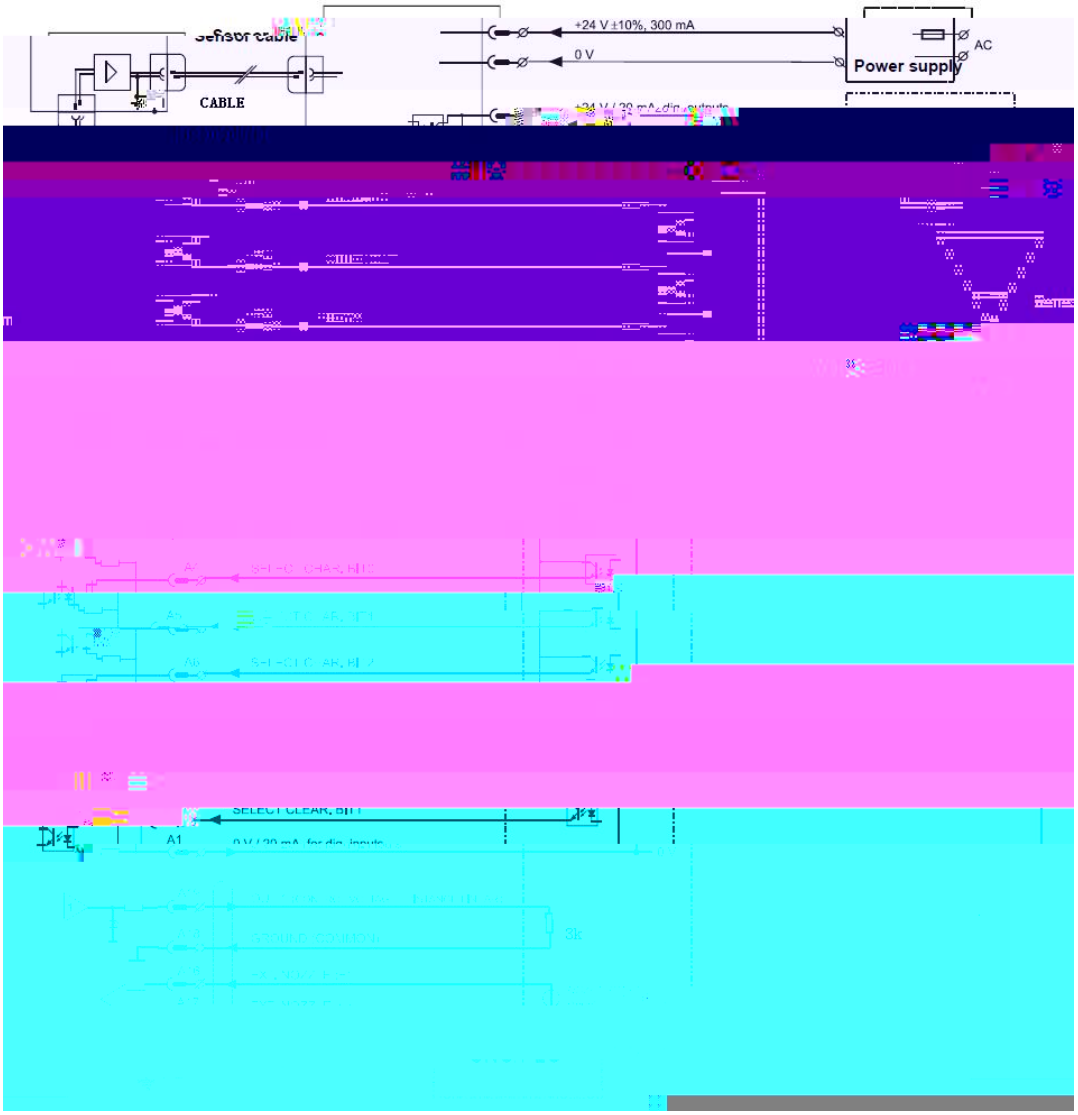
1 S tatic dista to (1mm).

2 S he fau PID parame P=20 I=0 D=0.

3 Swi tem to automa .

4 Monitor A19 signal on oscilloscope.

5 Increase P until oscillations (*P-Param*). When changing P, repeat the second to fifth steps.

6 Set P to 75% of

For example