Contents

1 Brief Introduction

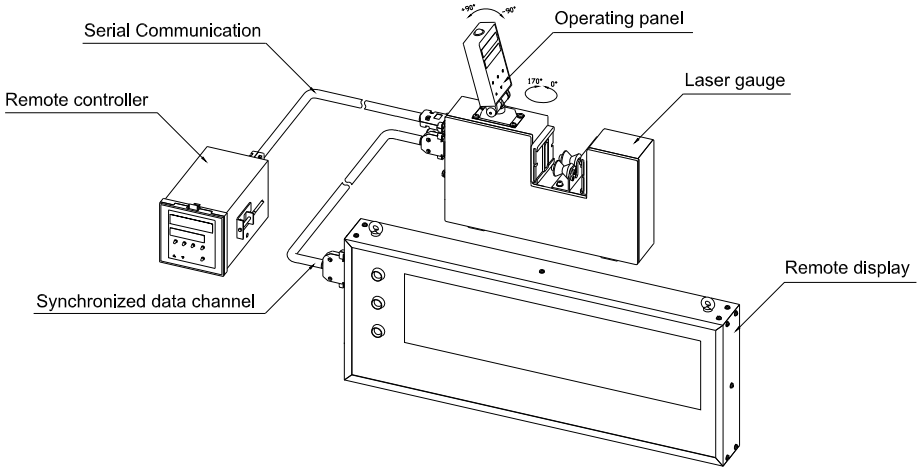
Opmac series of laser diameter gauge are specially designed for wires and cables, which not only measure and display diameter and deviation online, but also automatically control diameter of wire and print parameters according to user's demand. Opmac series instruments have two categories: the A series measure object in single dimension, and the B series measure object in two vertical dimension (X axis and Y axis). The two categories have same communication interfaces and operation functions.

1.1 Characteristics

- Suitable for online measurement of any round wires and other objects.
- Non-contact measurement，high-speed inspection, high precision and stable performance.
- Adopt Fθ optics，Fewer measurement error.
- Inside PID regulation module.
- All-dimensional revolving operating panel.
- Remote displays of various sizes are optional.
- Standard RS232/485 communication interfaces, supporting CAN and Modbus with extra protocol adapter.
- Wires quality management software can record the real time curve of changing external diameters.
- Reliable operation in the most foul environments.

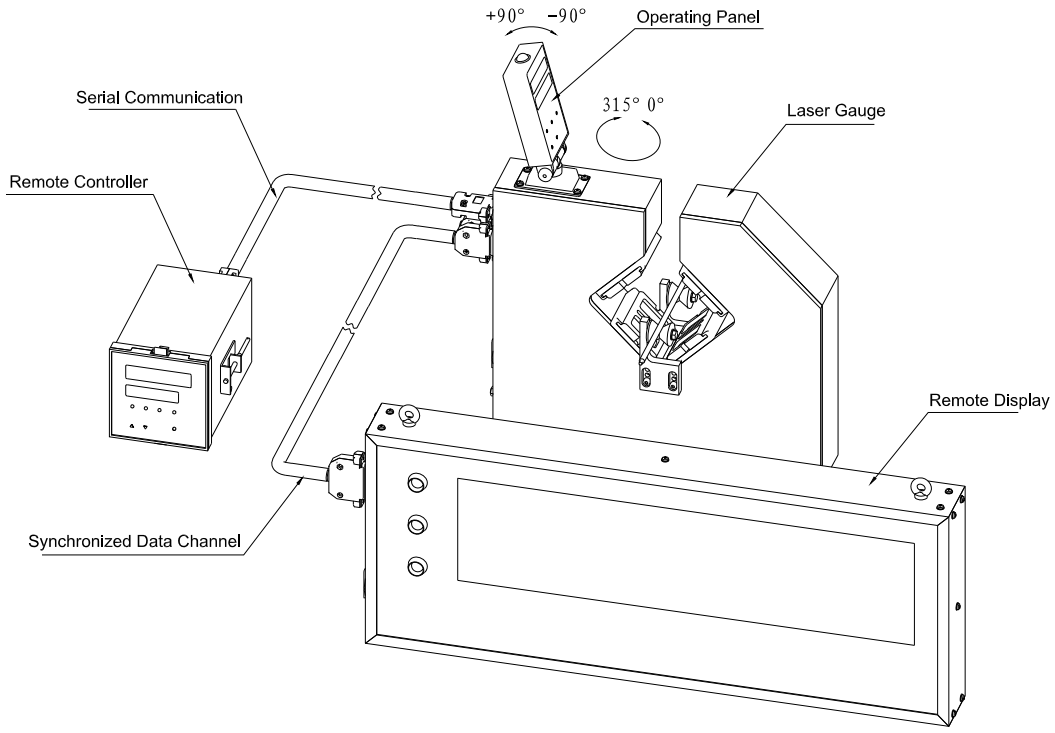
1.2 Composition

One basic Opmac instrument is composed of laser gauge, operating panel and remote controller and is able to be connected with different sizes of remote display as indicated in the Figure 1-1.



(a) single dimension

Figure 1-1



(b) two dimension

Figure 1

A high-precision laser scanning system and embedded digital processing electronics are inlayed in the measurement instrument. The signal of diameter processed by scanning system is converted to digital signal firstly and then comes out real diameter and related data through a series of operation. The communication interface of the measurement instrument contains one serial I/O and three synchronized data channels. It could transfers measured data to peripheral device (e.g. remote controller, PC and PLC, etc.) through the serial I/O and to remotely controls and displays through data channels.

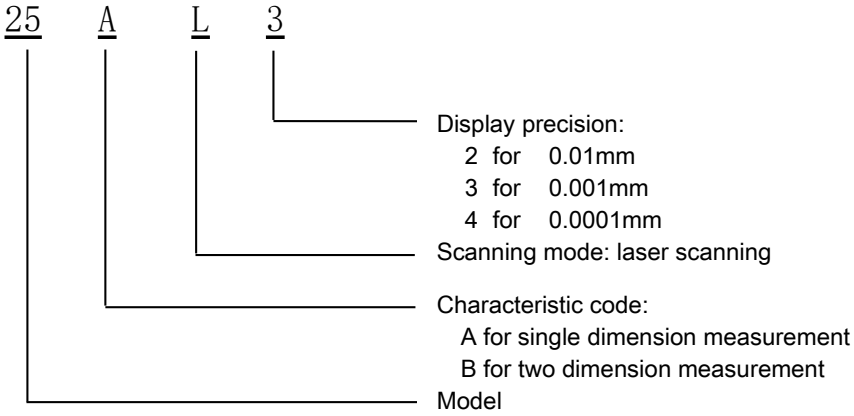
Operation panel is installed on top of the measurement instrument, which displays data and parameters and adjusts optic angle easily.

Remote controller is mainly used for automatic control, which obtains measured data from the measurement instrument. PID signal comes out through the comparison between measured diameter with pre-set diameter and controls traction speed thereby controls wire diameter. In addition, remote controller has a full-function operation panel and standard Serial I/O which communicates with PC and PLC and supports diameter monitor software.

Opmac series instruments are also applied for on-line measurement of optical fiber, glass tube, plastic tube and other spherical wire.

2 Specifications

2.1 Specification



2.2 Technical specification

Model	Measuring range		Accuracy	
25AL3/25BL3	0.1～25mm		±1μm±0.008%×X_Z	
40AL3/40BL3	1～40mm		±1.5μm±0.008%×X_Z	
50AL3/50BL3	1～50mm		±1.5μm±0.008%×X_Z	
70AL2/70BL2	1～70mm		±10μm±0.008%×X_Z	
90AL2	single axis	1～40mm	single axis	±10μm±0.008%×X_Z
	edge measurement	40～100mm	edge measurement	±10μm±0.008%×X_Z
100AL3(2)	single axis	1～45mm	single axis	±3(10)μm±0.008%×X_Z
	edge measurement	45～120mm	edge measurement	±6(10)μm±0.008%×X_Z
5AL3	0.03～5mm		±1μm±0.008%×X_Z	
5AL4	0.03～5mm		±0.4μm±0.008%×X_Z	

Table 1

X_Z：Standard diameter of the measured objective

2.3 Working condition & Environment

Power srequirements： 176V ~ 264V AC 50Hz

Operating condition: 5 ~ 45℃ ≤85%RH

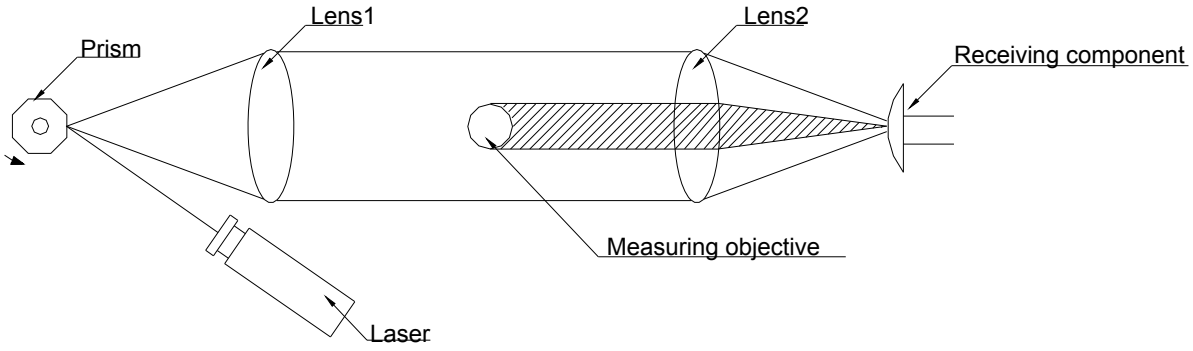
Consumed Power：≤12W

3 Laser Gauge

3.1 Measuring principle

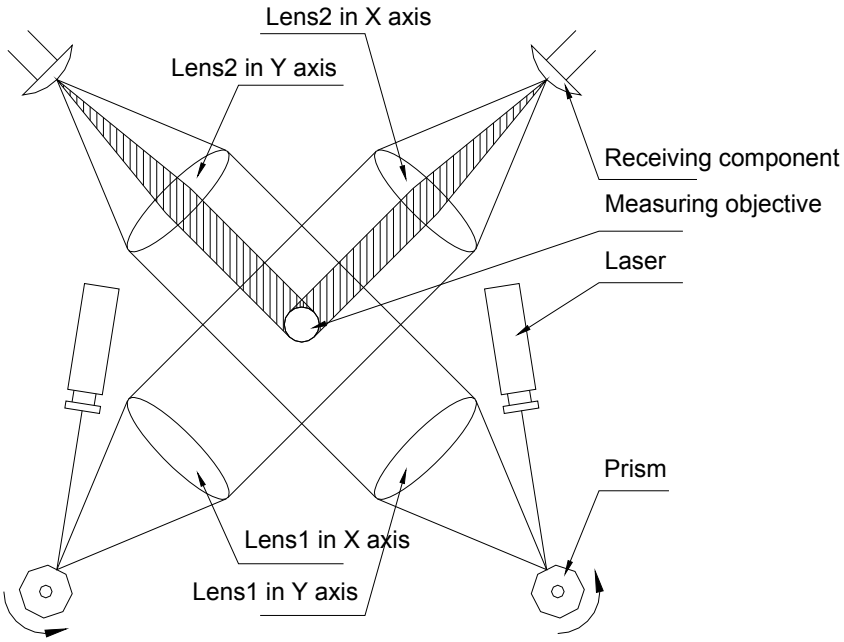
The laser beam irradiates to the rotating prism and after reflection and through lens 1, it becomes parallel beam. The parallel beam converges to the receiving component through lens 2 [See Figure 3-1(a,b)]. When placing EUT on focal plane (FP) of lens 1, part of lights are shadowed, thus becomes electrical signal on receiving component and then comes out diameter and a serial of related signals after processing by measurement instrument. The signal processing is indicated in Figure 3-2.

The 90AL and 100AL laser gauge is different from other one-axis gauge, for it has two parallel axes, which not only can be used to measure 2 small objects respectively, but also can be used to measure one large object [See Figure 3-1(c-f)].



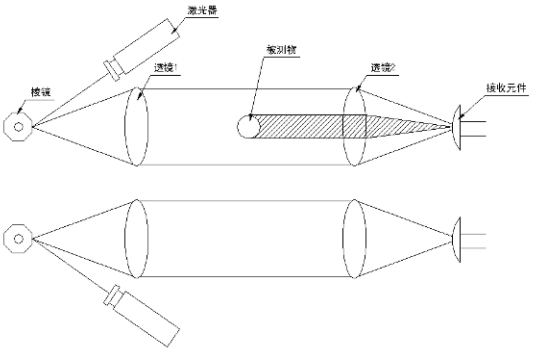
(a) single dimension

Figure 3-1

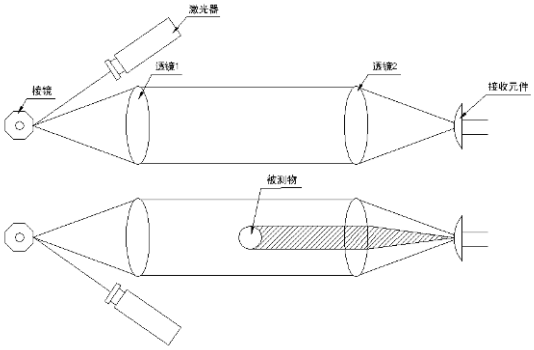


(b) two dimension

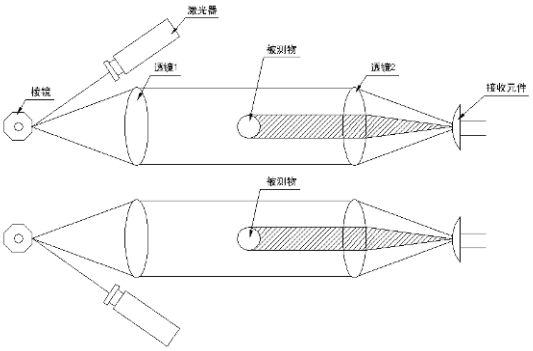
Figure 3-1



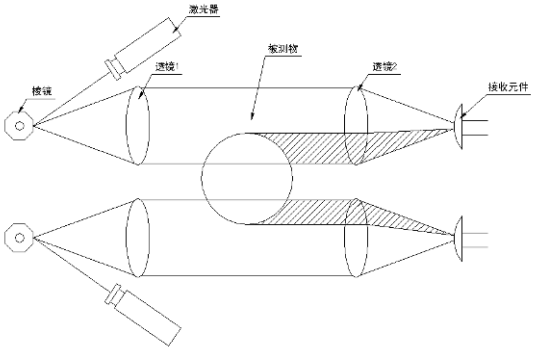
(c) single dimension of biaxial using upper axis
Figure 3-1



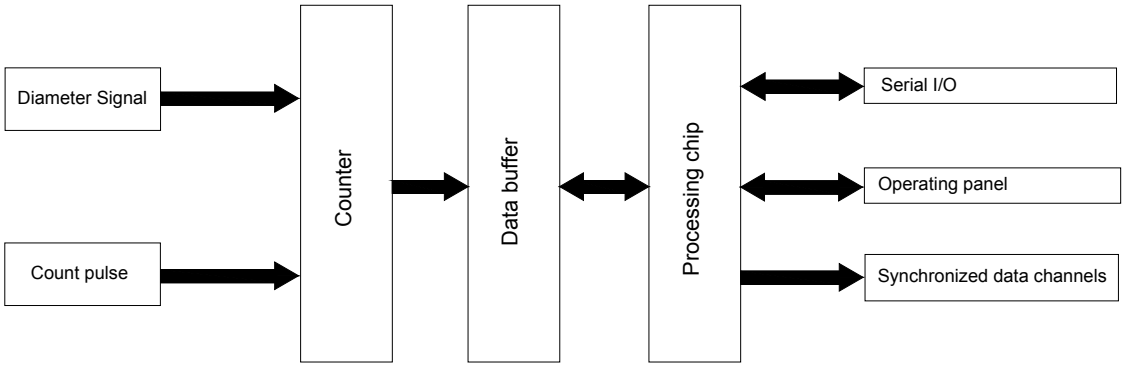
(e) single dimension of biaxial using lower axis
Figure 3-1



(d) single dimension of biaxial parallel measurement
Figure 3-1

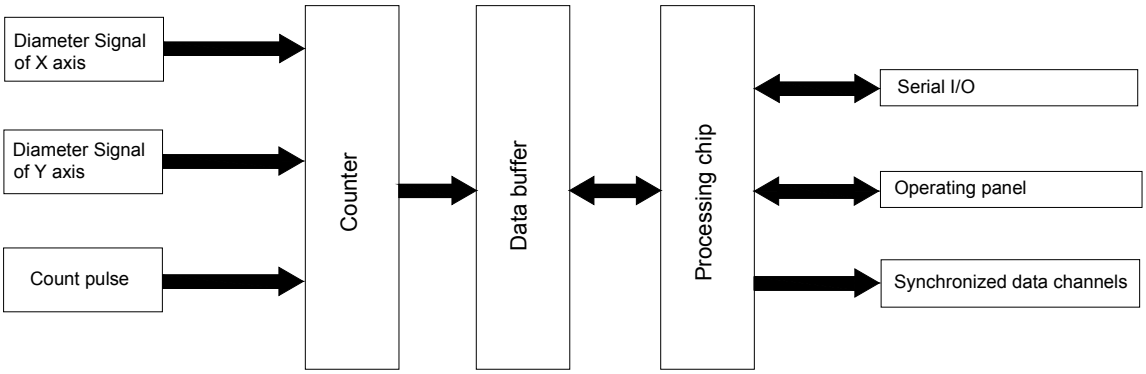


(f) single dimension of biaxial edge measurement
Figure 3-1



(a) single axis

Figure 3-2



(b) biaxial

Figure 3-2

3.2 Layout and function

The functional layout of Laser diameter measurement instrument is indicated in Figure 3-3. Take the Opmac 25AL and 25BL for examples.

3.3 Application

Laser gauge equals to a high-precision diameter sensor which not only measures online in real time but also boosts strong data communication function.

3.3.1 For some occasion requiring only diameter measure, the laser gauge with the operating panel is competent for diameter measurement, display and over-deviation alarm. [See Figure 3-4(a)]

3.3.2 For some occasion not only requiring diameter measure but also automatic control, the solution includes remote controller and laser gauge, which communicating with the former via serial I/O. [See Figure 3-4(b)]

1. **Laser gauge**
2. **Guide roller holder**
3. **Guide roller**
4. **Synchronized data channel 1**
5. **Serial I/O**
6. **Synchronized data channel 2**
7. **Synchronized data channel 3**
8. **Power switch**
9. **Grounding bolt**
10. **Power socket**

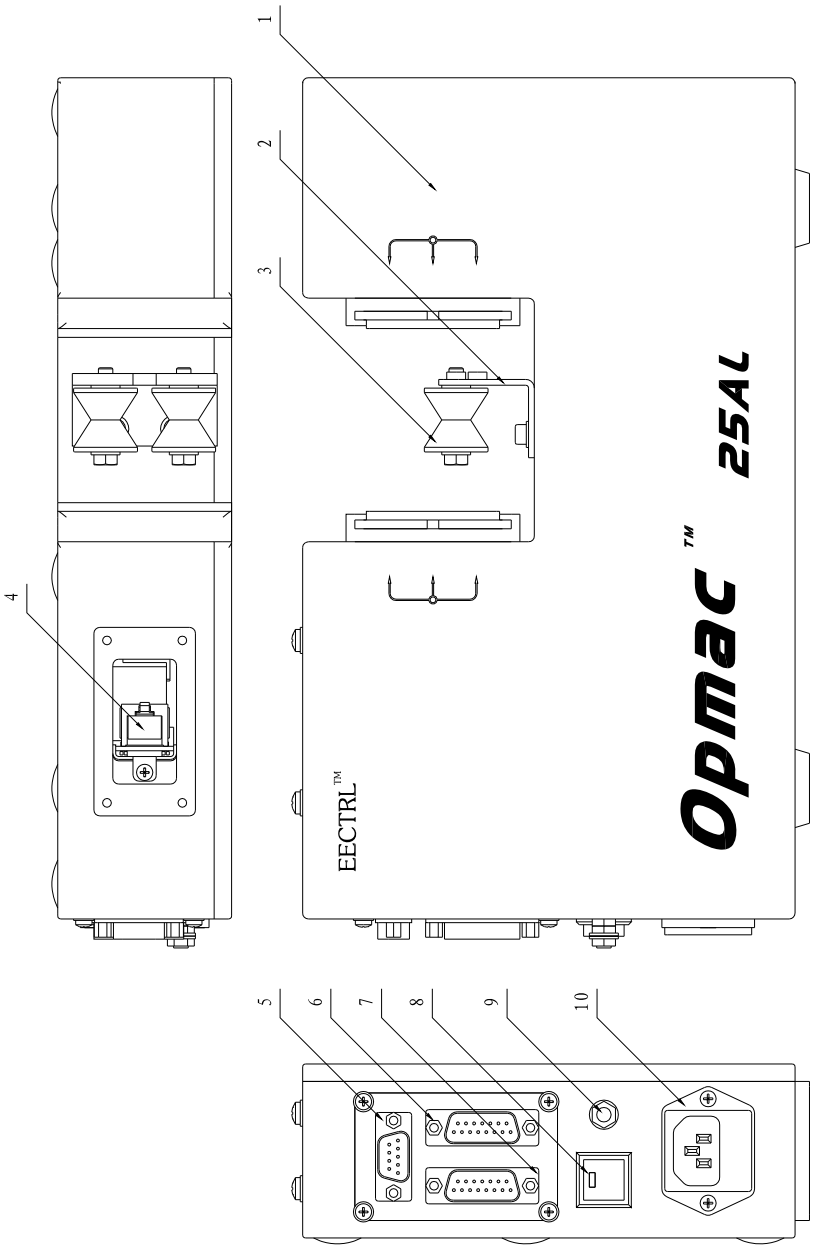
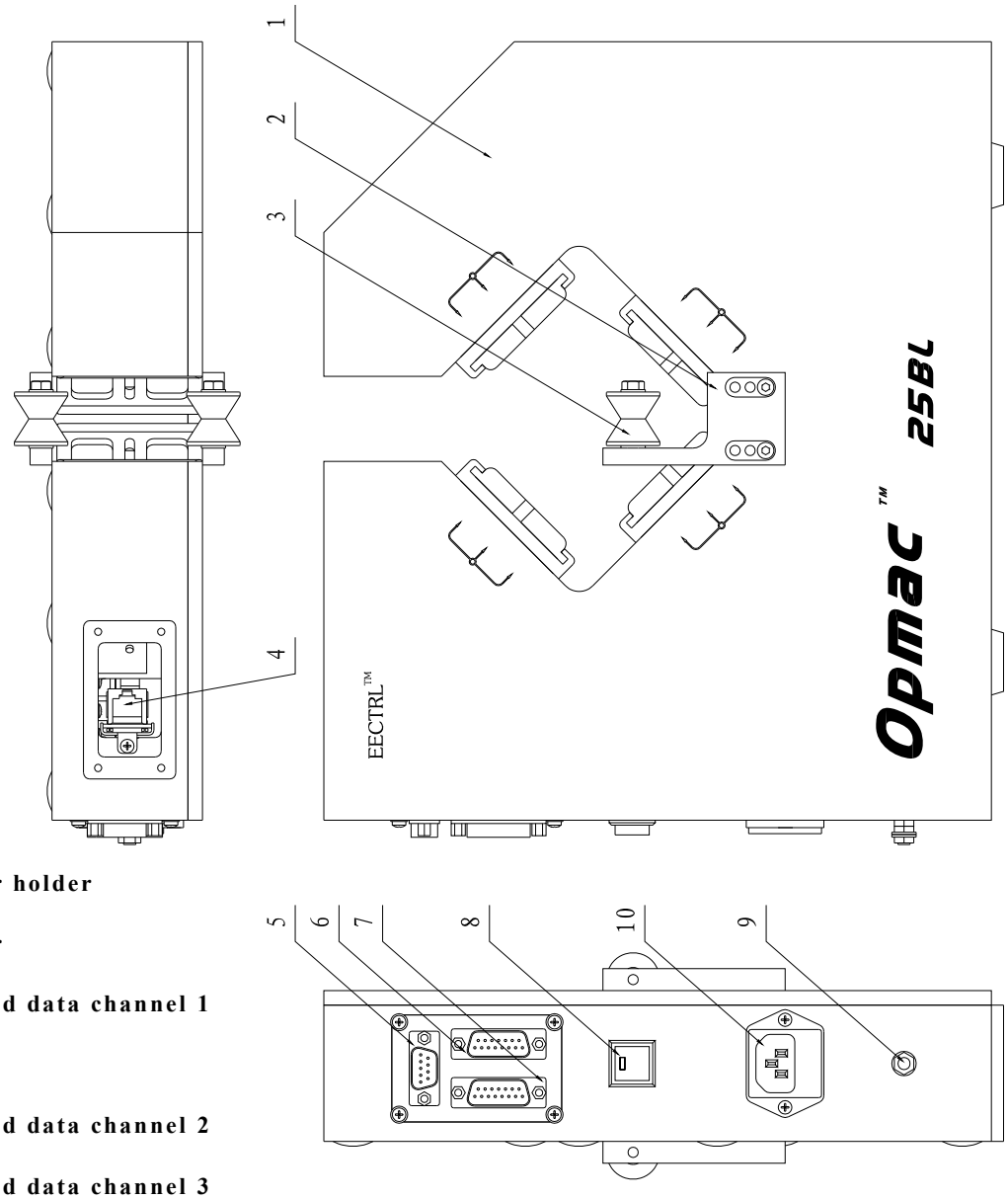


Figure 3-3(a)



1. **Laser gauge**
2. **Guide roller holder**
3. **Guide roller**
4. **Synchronized data channel 1**
5. **Serial I/O**
6. **Synchronized data channel 2**
7. **Synchronized data channel 3**
8. **Power switch**
9. **Grounding bolt**
10. **Power socket**

Figure 3-3(b)

3.3.3 For some occasion requiring management of several laser gauges simultaneously, the measured data from different instruments can be sent to a PC via serial I/O and processed there. [See Figure 3-4(c)]

3.3.4 Synchronized data channel is applied to be connected with remote displayer to display data in long distance with transmission speed up to 1MB/s and distance of 300 m. The connecting method is indicated by Figure 3-5.

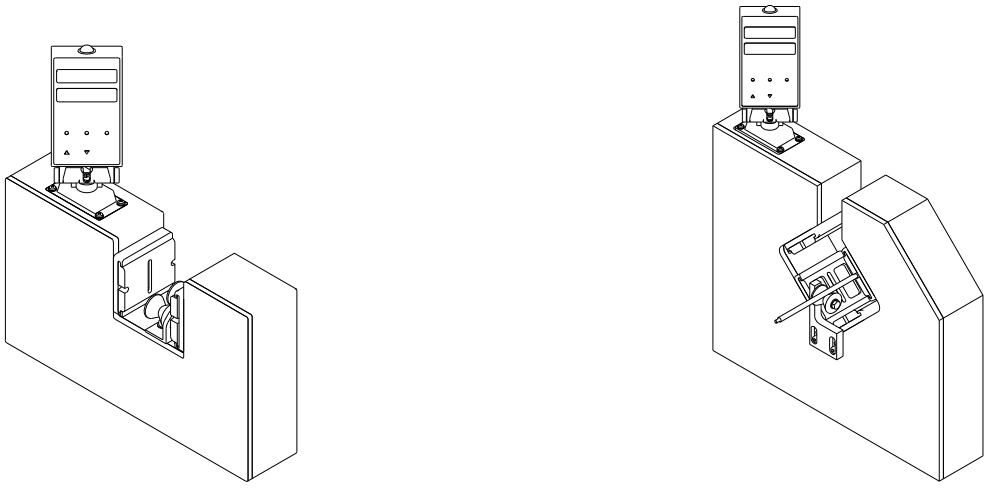


Figure 3-4(a)

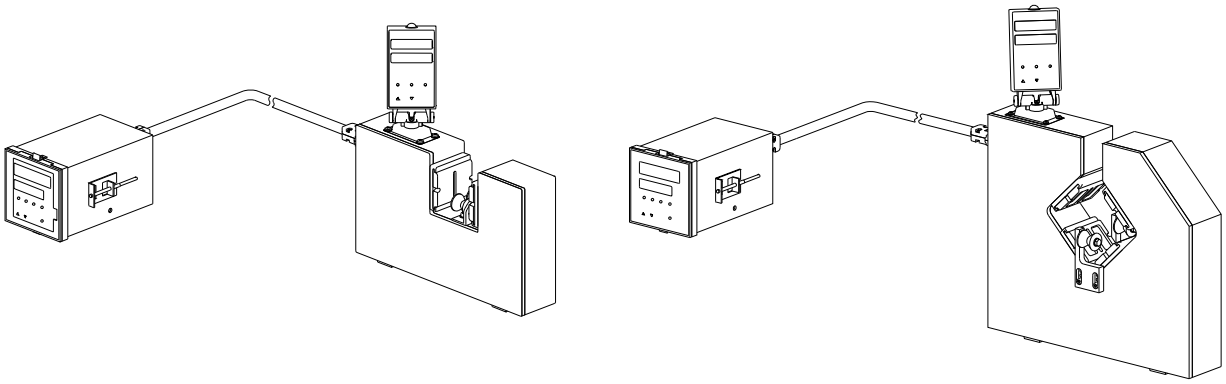


Figure 3-4(b) connected with remote controller

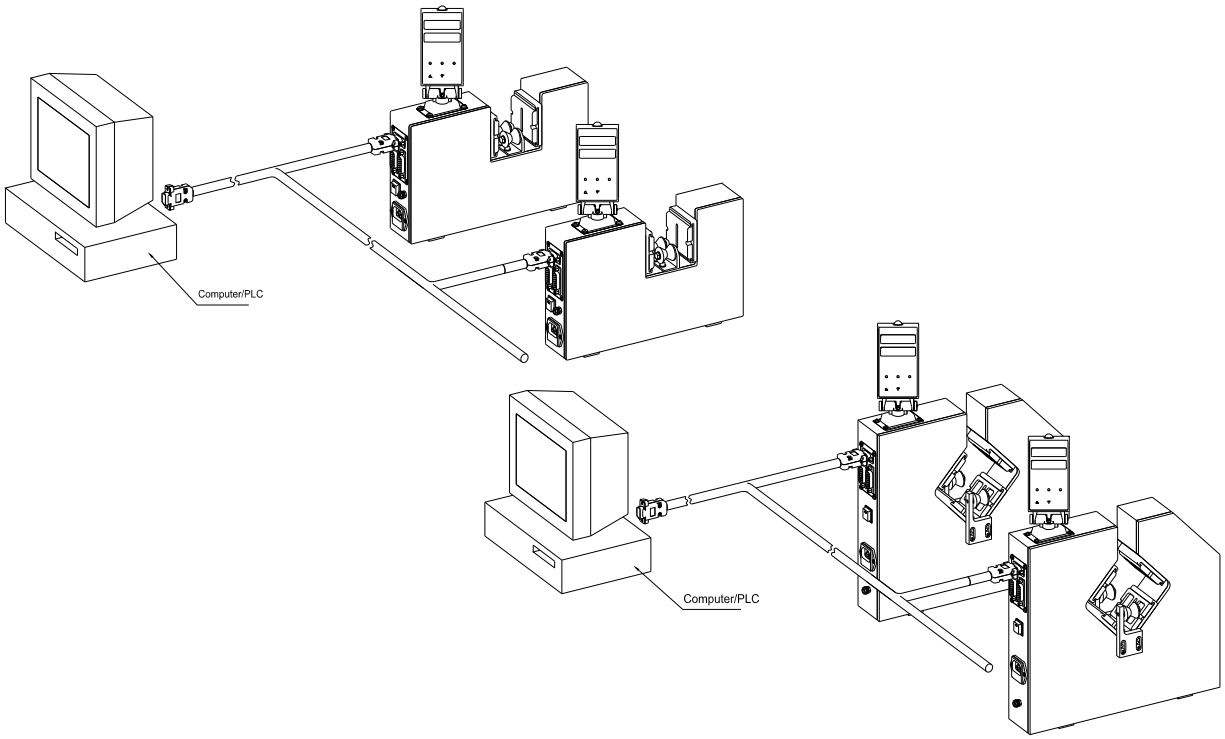


Figure 3-4(c) manage several gauges simultaneously

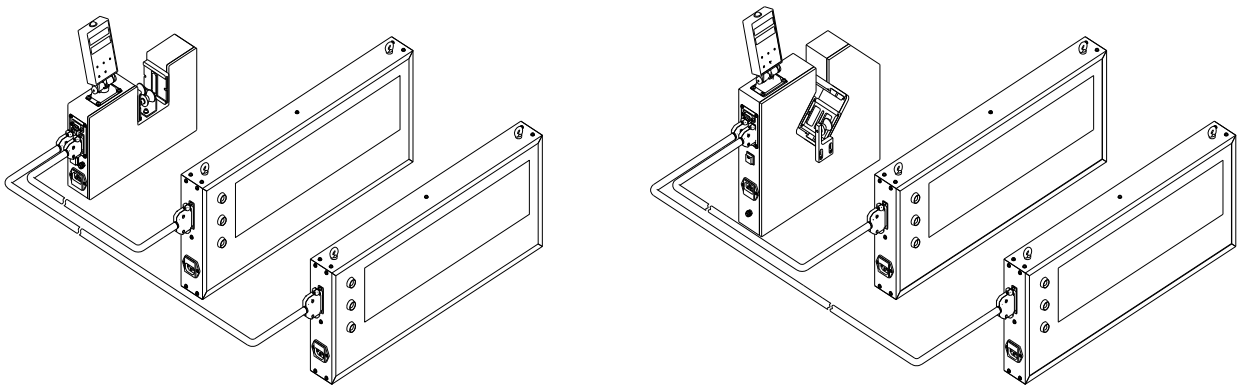


Figure 3-5

3.3.5 Serial I/O

The serial I/O is a standard serial communication port with RS485 protocol. The connecting cable function is indicated by Figure 3-6. See Chapter 8 for detail.

Pin	Pin Color	Function
2	Orange	A
3	Orange-white	B
5	Blue & Blue-white	DGND
Others	None	None

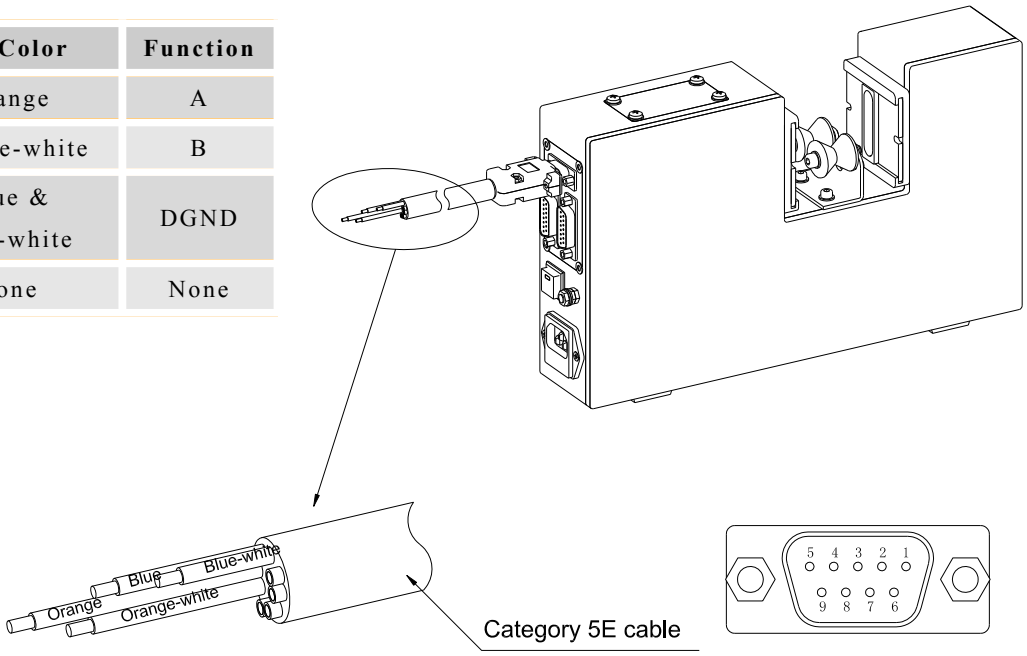


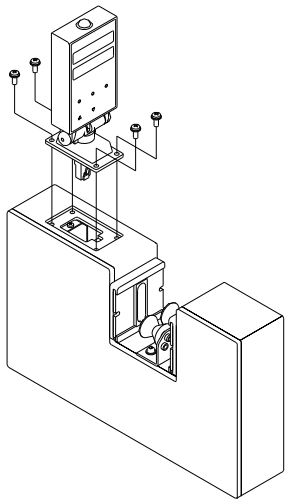
Figure 3-6

3.3.6 Grounding

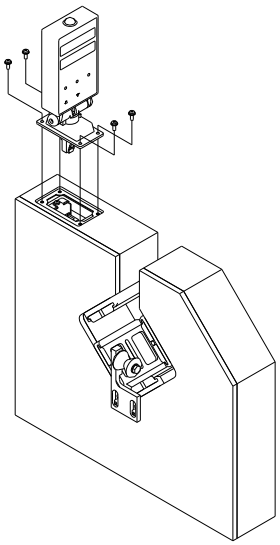
The laser gauge must be connected to earth by grounding bolt while working.

4 BX-1A Operation Panel

Operation panel is installed on top of the measurement instrument and connected with it through synchronized data channel 1 as indicated in Figure 4-1. Operation panel is applied for data display, parameter management, over-deviation indication and alarm. The panel's functional layout is indicated by Figure 4-2.



Single dimension Instrument



Two dimension Instrument

Figure 4-1

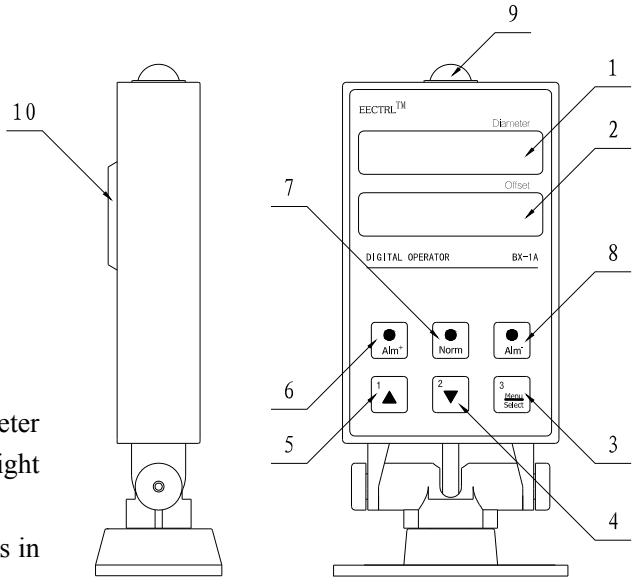


Figure 4-2

1. Main display screen: displaying diameter value and parameters
2. Sub display screen: displaying deviation value, offset, and parameter code
3. Functional key: menu/option/number 3
4. Functional key: turn down / number 2
5. Functional key: turn up /number 1
6. Upper deviation light: when measured diameter exceeds admissible deviation upper limit, orange light on.
7. None-deviation light: when measured diameter is in admissible deviation, green light on.
8. Lower deviation light: when measured diameter exceeds admissible deviation lower limit, red light on.
9. Over-deviation light: when measured diameter exceeds deviation, light flickers.
10. Over-deviation alarm: when measured diameter exceeds deviation, alarm on.

4.1 Parameters

Although the parameters of the two categories are different, yet the operating method of them is the same. In the next section, we will take one axis instrument for example.

Parameter code	Description	Model	Setting range	Factory default
PrE-A PrE-E	Reference diameter Reference diameter of average	5☐	0~5.2mm	0.5mm
		25☐	0~27mm	5mm
		40☐	0~42mm	10mm
		50☐	0~52mm	10mm
		70☐	0~72mm	50mm
		90☐	0~100mm	50mm
		100☐	0~120mm	50mm
ALr-U AL-EU	Upper deviation[1] limit Upper deviation limit of average	☐L3	0~2mm	0.1mm
		☐L2	0~20mm	1mm
ALr-d AL-Ed	Lower deviation limit Lower deviation limit of average	☐L3	0~2mm	0.1mm
		☐L2	0~20mm	1mm
PrE-J	Reference diameter of X axis	5☐	0~5.2mm	0.5mm
		25☐	0~27mm	5mm
		40☐	0~42mm	10mm
		50☐	0~52mm	10mm
		70☐	0~72mm	50mm
		90☐	0~100mm	50mm
		100☐	0~120mm	50mm
AL-JU	Upper deviation[1] limit of X axis	☐L3	0~2mm	0.1mm
		☐L2	0~20mm	1mm
AL-Jd	Lower deviation limit of X axis	☐L3	0~2mm	0.1mm
		☐L2	0~20mm	1mm
PrE-Y	Reference diameter of Y axis	5☐	0~5.2mm	0.5mm
		25☐	0~27mm	5mm
		40☐	0~42mm	10mm
		50☐	0~52mm	10mm
		70☐	0~72mm	50mm
		90☐	0~100mm	50mm
		100☐	0~120mm	50mm
AL-YU	Upper deviation[1] limit of Y axis	☐L3	0~2mm	0.1mm
		☐L2	0~20mm	1mm

AL-yd	Lower deviation limit of Y axis	☐ L3 ☐ L2	0~2mm 0~20mm	0.1mm 1mm
dP 1-5	Main display option: 0: display the average value of X and Y 1: display the average deviation value of X and Y 2: display ellipticity(f),f=short axis/long axis 3: display the diameter value of axis X 4: display the diameter value of axis Y 5: display the deviation value of axis X 6: display the deviation value of axis Y 7: display the position[2] value of axis X 8: display the position value of axis Y	Two dimension	0~8	0
	Main display option: 0: automatically display measurement value.[3] 1: display value of upper axis if in one axis measure mode using upper axis; in other situation it will display - - - - 2: display value of lower axis if in one axis measure mode using lower axis; in other situation it will display - - - - 3,4,5: correspond to the deviation value of option 0,1,2, respectively. 6,7,8: correspond to the laser axis position value of option 0,1,2, respectively.	Single dimension of biaxial	0~8	0
	Sub display option: 0: display the deviation value. 1: displaying the position value.	Single dimension	0,1	0
dP2-5	Sub display option: 0: display the average value of X and Y 1: display the average deviation value of X and Y 2: display ellipticity(f),f=short axis/long axis 3: display the diameter value of axis X 4: display the diameter value of axis Y 5: display the deviation value of axis X 6: display the deviation value of axis Y	Two dimension	0~8	1

	7: display the position[2] value of axis X 8: display the position value of axis Y			
dP2-S	Sub display option: 0: automatically display measurement value.[3] 1: display value of upper axis if in one axis measure mode using upper axis; in other situation it will display - - - 2: display value of lower axis if in one axis measure mode using lower axis; in other situation it will display - - - 3,4,5: correspond to the deviation value of option 0,1,2, respectively. 6,7,8: correspond to the laser axis position value of 0,1,2, respectively.	Single dimension of biaxial	0~8	3
	Alarm control: 0: alarm disabled, 1: alarm enabled.	Single dimension	0、1	0
SHH-b	Alarm control: 0: alarm disabled, 1: alarm enabled when the average value is out of tolerance, 2: alarm enabled when the value from X(up) or Y(low) axis is out of tolerance, 3: alarm enabled when the value from X(up) axis is out of tolerance, 4: alarm enabled when the value from Y(low) axis is out of tolerance.	Two dimension & Single dimension of biaxial	0—4	0
AdSEt	Advanced setting: input password to enter sub menu	All	5 digits	12312
EuEn	Average times: sampling speed for display value	All	1~1000	10
obJ-t	The type of the measured objective: 0: non-transparent objective; 1: transparent objective	Two dimension	0,1	0
	The type of the measured objective: 0: non-transparent objective; 1: the edge measurement of transparent objectives	Single dimension of biaxial	0,1	0
Add	Device address for serial communication	All	0~127	1

bAUd	Baud rate for serial communication	All	19200 9600 4800 2400 1200	9600
CH-t	Checksum method: 0 for CRC checksum; 1 for exclusive-or checksum; 2 for Modbus RTU; 3~5 for ODD checksum; 6~8 for EVEN checksum	all	0,1	0
rEPAS	Modify password: change password of advanced setting.	All		
dot 1	Zero point 1: set before sold, user shouldn't set it.	Single dimension & two dimension		
dot2	Zero point 2: set before sold, user shouldn't set it.			
dot3	Zero point 3: set before sold, user shouldn't set it.			
dot4	Zero point 4: set before sold, user shouldn't set it.			
dot5	Zero point 5: set before sold, user shouldn't set it.			
-----	Initial status after power on	All		
- - -	Waiting or EUT beyond measure area	All		
FAUL	Fault	All		
oFL	Upper deviation value exceeds 9.999	All		
- oFL	Lower deviation value exceeds 9.999	All		
u 2.00 oP2SA	version number (secondary display screen display the instrument model)	All		
-dot0	The size of the up-axis measurement area;meanwhile,press "up" and "down"and to save	Single dimension of biaxial		
-dot 1	zero point 1 of up-axis			
-dot2	zero point 2 of up-axis			
-dot3	zero point 3 of up-axis			
-dot4	zero point 4 of up-axis			
-dot5	zero point 5 of up-axis			
_dot0	The size of the low-axis measurement area;meanwhile,press "up" and "down"and to save			
_dot 1	zero point 1 of low-axis			

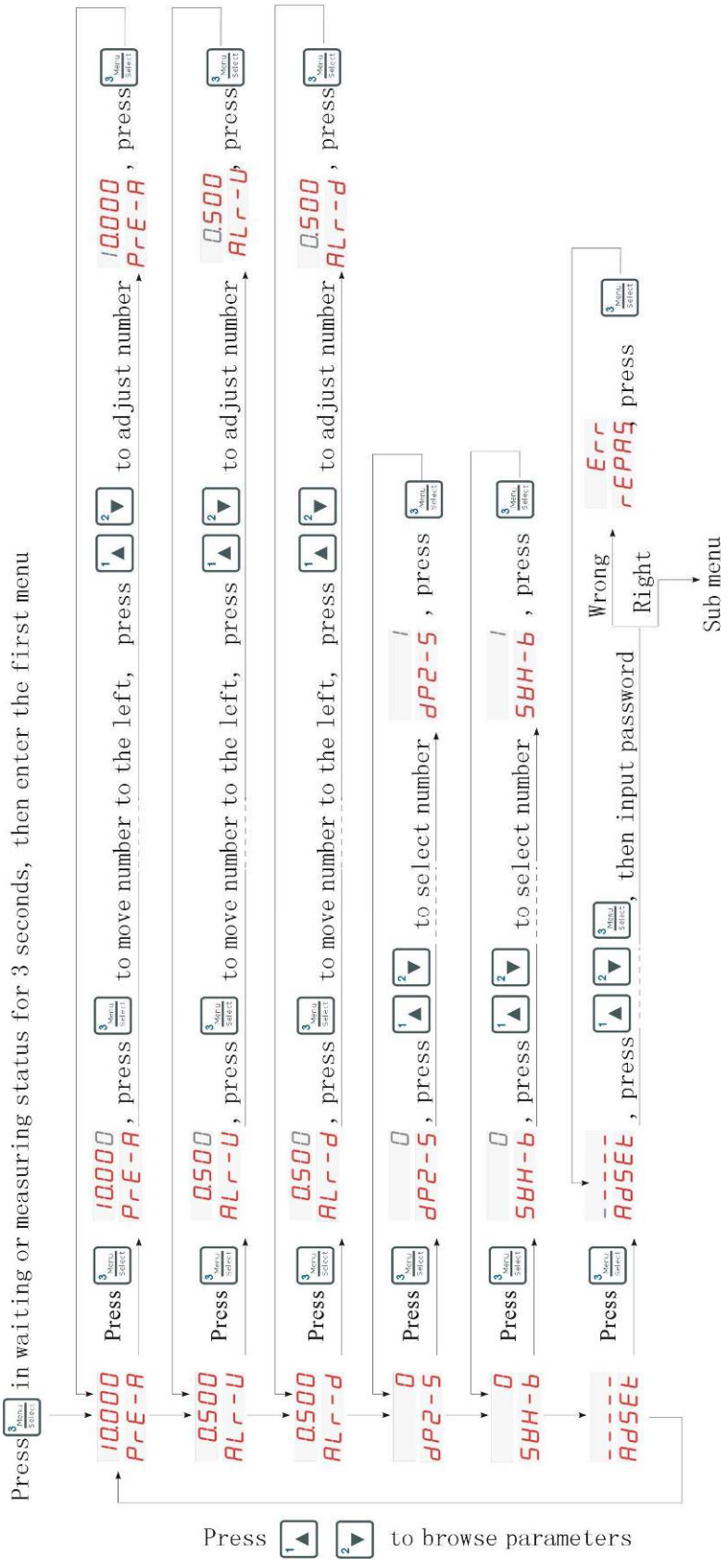
_dot2	zero point 2 of low-axis			
_dot3	zero point 3 of low-axis			
_dot4	zero point 4 of low-axis			
_dot5	zero point 5 of low-axis			
⌐dot 1	zero point 1 for mid-up measurement, for user adjustment	100AL3		
⌐dot2	zero point 2 for mid-up measurement, for user adjustment			
¬dot 1	zero point 1 for mid-low measurement, for user adjustment			
¬dot2	zero point 2 for mid-low measurement, for user adjustment			
-dot 1	The middle proofread point 1	Single dimension of biaxial		
-dot2	The middle proofread point 2			
-dot3	The middle proofread point 3			
-dot4	The middle proofread point 4			

Note:

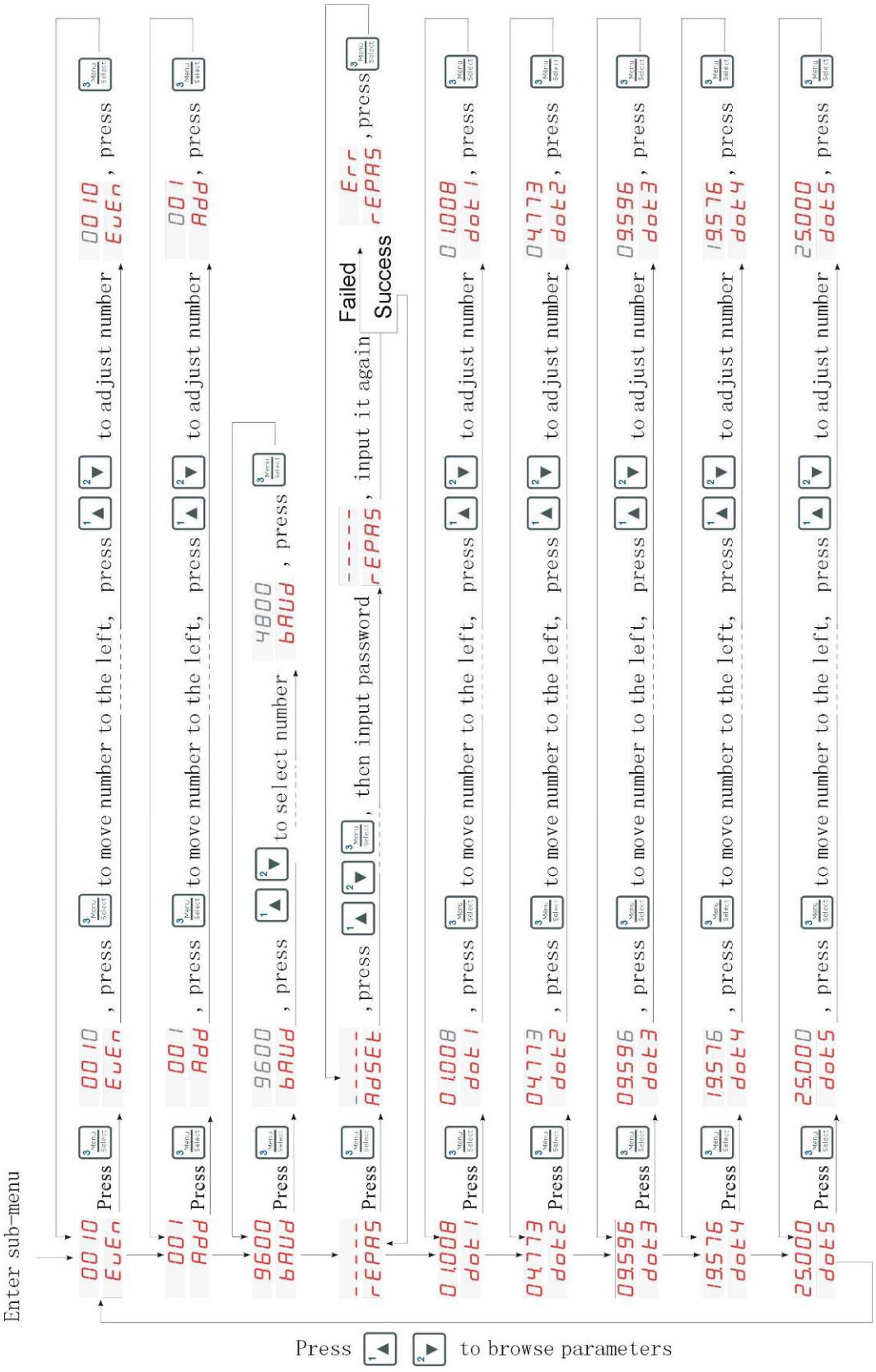
1. The deviation value is the difference of the actual measurement diameter and the reference diameter.
2. The position value is the difference of the center of the measured objective and the center of the beam.
3. The last decimal fraction is not displayed if the value exceeds 99.999. The displayed value depends on measure mode. If it is edge measurement, it will display edge measurement value; if it is one axis measurement, it will display one axis measurement value; if it is two axes measurement, it will display the average value of the two axes measurement.

4.2 Operation flow chart of BX-1A operation panel

Main menu, take one axis instrument for example:



Sub menu, take one axis instrument for example:



4.2.1 Under any circumstance, press 3 Menu Select for 3 seconds, the displayer returns to measuring status and saves parameter simultaneously. Without any operation, it returns to measuring status after one minute without saving of parameter.

10.000: The grey figure means flickering.

4.3 The alarm

The status of the alarm is controlled by main menu item "SWH-B".

The alarm will beep and flash when there is over deviation if the alarm is on. During the alarm, if the measured objective is removed or any key in the operation panel is pressed, the alarm will be automatically shut down for the time being. Until there is a measured objective or no over deviation,the alarm is automatically recovered.

The instrument of model Opmac25□ and Opmac40□ can't shut down alarm automatically if whose firmware version is older than V1.05 or can't be displayed.

4.4 Calibration

When the instrument measure value and the fact value have large discrepancy,user can adjust personally.Take the Opmac 100AL3 for example, explain the emendation method.

Preparation:take 2~5 master bar,clean up the surface of the master bar,emendation point "dot□" correspond with five master bar respectively. Arrange orderly from small to large.

- one axis emendation:enter into the second class menu,put the menu interface switch to "¯dot1",put the most small master bar into the measure area,adjust the show value equal to the standard ctick value, at the same time press "up key" and "down key"to affirm.according to this method, put the menu interface switch to "¯dot2"、"¯dot3"、"¯dot4"、"¯dot5" respectively, put the other master bars to adjust. If the master bars are less than five, then the after points are unwanted to adjust. Emendation of Opmac 25□、Opmac 40□according to this method is OK. Opmac 100AL3's emendation also accordding to this method, adjust the nether axes emendation point "_dot□".After the completion of emendation,prss "menu" key for a certain time,until the display measure interface save the parameter.

- edge measurement emendation:don't place any measured good in the measure area, put the menu interface switch to "¯dot0" and "_dot0" , at the same time press "up key" and "down key"to affirm the measure area.put the menu interface switch to "-dot1"、"-dot2"、"-dot1"、"-dot2" in turn.Put the stardand stick into the measure area(see figure 4-3) ,emendate the value of master bar according to the one axes emendation method, and save.

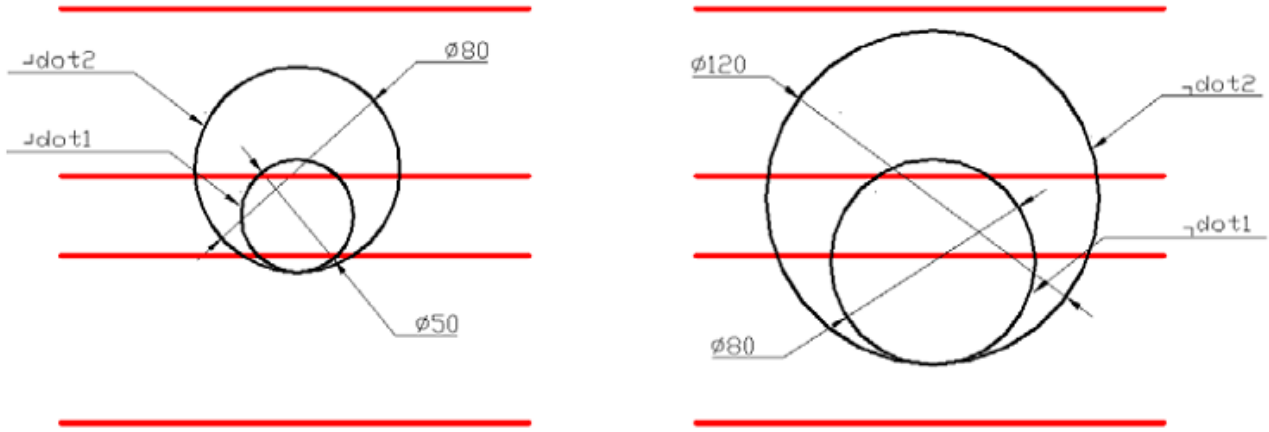


Figure 4-3

5 BX-1B Operation Panel

BX-1B operation panel is the upgrading of BX-1A. BX-1B is made of metal and is more robust. Compared with BX-1A, this panel has more keys and can display more data. The panel's functional layout is indicated by Figure 5-1.

DIS1: the first display screen. It displays real-time diameter for one-axis gauge, and optional data for two-axes gauge according to the value of parameter "dP1-S".

DIS2: the second display screen. It displays optional data according to the value of parameter "dP2-S".

DIS3: the third display screen. It displays optional data according to the value of parameter "dP3-S".

MD: Indicator of the display ratio. If the light is on, the data displayed in DIS1~3 isn't the real measured diameter but the multiple of the real measured diameter and the display ratio.

Auto: The light is on when the remote controller is working in automatic control mode.

Upper deviation indicator: when measured diameter exceeds admissible deviation upper limit, the light is on.

None-deviation indicator: when measured diameter is in admissible deviation, the light is on.

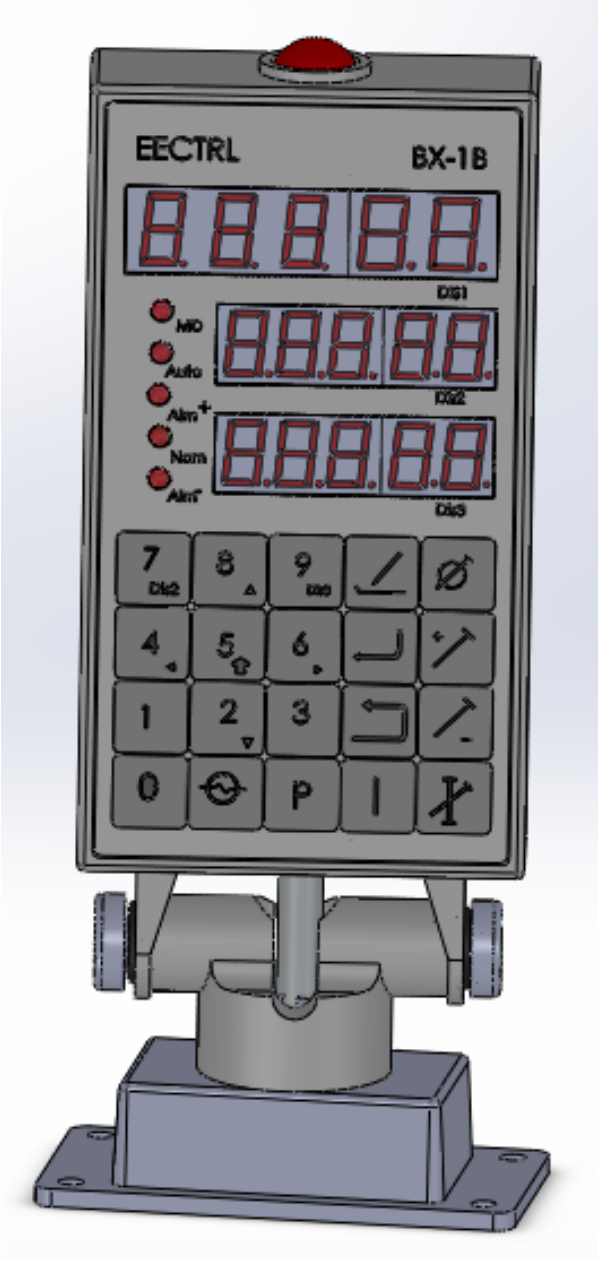


Figure 5-1

Lower deviation indicator: when measured diameter exceeds admissible deviation lower limit, the light on.

See table 5.2 for detailed features of the keys.

Most of the parameters of BX-1B are the same with BX-1A. See table 5.3 for detail features of special parameters of BX-1B.

5.1 Operating Instructions

After powered on, the panel is in the measurement mode. It will enter the menu mode if the [5] is pressed for about 3 seconds. In this mode the parameter's code is shown in DIS2 and the parameter's value is shown in DIS3 and the content in DIS1 remains unaffected. Then users can browse parameters by [4] and [6]. If pressing the [edit], the content in DIS3 will flash then users can modify the value of the selected parameter. If a parameter's value is numeric value then the leftmost digital in DIS2 will flash when pressing the [edit]. Users can modify the value of the flashing digital directly by digital keys then this digital will stop flashing and the right one will do. Users can repeat these operations to modify the parameter's value till the rightmost digital is modified. If a parameter's value is a item of a list then all digitals in DIS3 will flash when pressing the [edit]. Users can scroll to select another item by [8] and [2]. When users complete the modification they can press [enter] to save the value then the digitals stop flashing. If users want to cancel the modification they can press [esc], then the previous parameter's value is recovered and all digitals stop flashing.

The operations for accessing the advanced parameters in the BX-1B are the same with the BX-1A. Users can find detail information about these in section 4.

Users can locate frequently used parameters directly by using shortcuts showed in the table in section 5.1 instead of browsing the parameters.

If users want to read or change the displaying content of DIS2 temporarily, they can press [7] for about 3 seconds in the measurement mode. Then users can press [8] or [2] to select the displaying content, which is defined by parameter dP2-S. Users can find the content in DIS2 is changed when they press [8] or [2]. Users can't see the number representing the display option but can find out what is displayed according the content. The new value of parameters "dP2-S" is valid till power-off. The panel will restore previous settings when powered on next time.

If users want to read or change the displaying content of DIS3 temporarily, they can press [9] for about 3 seconds in the measurement mode. Then users can press [8] or [2] to select the displaying content, which is defined by parameter dP3-S. Users can find the content in DIS2 is changed when they press [8] or [2]. Users can't see the number representing the display option but can find out what is displayed according the content. The new value of parameters "dP3-S" is valid till power-off. The panel will restore previous settings when powered on next time.

5.2 Functions of Keys

Key	Description
	Number 0 in modification mode. Clear the current maximum and minimum value of the measured value and restart calculating them in
	Number 1 in modification mode, not used in other modes.
	Number 2 in modification mode. Scroll down to select a listed item for parameters DIS1, DIS2, BAUD.
	Number 3 in modification mode, not used in other modes.
	Number 4 in modification mode. Scroll to the previous parameter in
	Number 5 in modification mode. Enter the menu mode by holding it for about 3 seconds in the measurement mode.
	Number 6 in modification mode. Scroll to the next parameter in
	Number 7 in modification mode. Change the value of DP2-S temporarily by holding it for about 3 seconds in the measurement
	Number 8 in modification mode. Scroll up to select a listed item for parameters DIS1, DIS2, BAUD.
	Number 9 in modification mode. Change the value of DP3-S temporarily by holding it for about 3 seconds in the measurement
	Enter the modification mode.
	Save the value of the current parameter.
	Abort modification and return to previous menu.
	Shortcut key for parameter “**Reference diameter**”, valid in the measurement mode.
	Shortcut key for parameter “**Upper deviation limit**”, valid in the measurement mode.

	Shortcut key for parameter "**Lower deviation limit**", valid in the measurement mode.
	Switch for automatic control mode of the remote controller,valid in measuring mode.
	Coefficient P for PID control of the remote controller, valid in measuring mode.
	Coefficient I for PID control of the remote controller, valid in measuring mode.
	Switch for the display ratio, valid in measuring mode.

5.3 Special parameters

Parameter code	Description	Model	Setting range	Factory default
SHr In	Display ratio. 1 means displaying the real value, 0.8 means the displayed value is the multiple of the real value and 0.8.	All	0.8—1	1
	Display options: 0: display the average value of X and Y 1: display the diameter value of axis X 2: display the diameter value of axis Y	Two dimension	0—2	0
dP 1-S	Display options: 0: automatically display measurement value.[1] 1: display value of upper axis if in one axis measure mode using upper axis; in other situation it will display - - - 2: display value of lower axis if in one axis measure mode using lower axis; in other situation it will display - - -	**Single dimension of biaxial**	0—2	0
	Display options: 0: the deviation value. 1: the position value. 2: the reference diameter. 3:the minimum value. 4:the maximum value	Single dimension	0—4	0
dP2-S	Display options: 0: the average value of X and Y 1: the average deviation value of X and Y 2: ellipticity(f),f=short axis/long axis 3: the diameter value of axis X 4: the diameter value of axis Y 5: the deviation value of axis X 6: the deviation value of axis Y 7: the position value of axis X 8: the position value of axis Y 9: reference diameter of average	Two dimension	0—11	1

Parameter code	Description	Model	Setting range	Factory default
	10: the minimum diameter of average X and Y 11: the maximum diameter of average X and Y			
dP2-5	Display options: 0: automatically display measurement value.1 1: value of upper axis if in one axis measure mode using upper axis; in other situation it will display - - - 2: value of lower axis if in one axis measure mode using lower axis; in other situation it will display - - - 3: correspond to the deviation value2 of option 0. 4: correspond to the deviation value2 of option 1. 5: correspond to the deviation value2 of option 2. 6: correspond to the position value3 of option 0. 7: correspond to the position value3 of option 1. 8: correspond to the position value3 of option 2. 9: reference diameter of average 10: the minimum diameter of average X and Y 11: the maximum diameter of average X and Y	**Single dimension of biaxial**	0—11	3
dP3-5	Display options: 0: the deviation value2. 1: the position value3. 2: the reference diameter.	Single dimension	0—4	0

Parameter code	Description	Model	Setting range	Factory default
	3:the minimum value. 4:the maximum value			
	Display options: 0: the average value of X and Y 1: the average deviation value of X and Y 2: ellipticity(f),f=short axis/long axis 3: the diameter value of axis X 4: the diameter value of axis Y 5: the deviation value of axis X 6: the deviation value of axis Y 7: the position value of axis X 8: the position value of axis Y 9: reference diameter of average 10: the minimum diameter of average X and Y 11: the maximum diameter of average X and Y	Two dimension	0—11	1
dP3-5	Display options: 0: automatically display measurement value.1 1: value of upper axis if in one axis measure mode using upper axis; in other situation it will display - - - 2: value of lower axis if in one axis measure mode using lower axis; in other situation it will display - - - 3: correspond to the deviation value2 of option 0. 4: correspond to the deviation value2 of option 1. 5: correspond to the deviation value2 of option 2.	**Single dimension of biaxial**	0—11	3

Parameter code	Description	Model	Setting range	Factory default
	6: correspond to the position value3 of option 0. 7: correspond to the position value3 of option 1. 8: correspond to the position value3 of option 2. 9: reference diameter of average 10: the minimum diameter of average X and Y 11: the maximum diameter of average X and Y			
Unit	Measurement interface unit option: 0:millimeter; 1:inch	ALL	0,1	0
dECIn	Decimal point option: Inch display a decimal more than mm	ALL	0—display precision	Display precision
CH-t	Checksum method: 0,3,6 for CRC checksum; 1,4,7 for exclusive-or checksum; 2,5,8 for Modbus RTU 0 to 2 for NONE checkout 3 to 5 for ODD checkout 6 to 8 for EVEN checkout	ALL	0-8	0

Note：

1. The last decimal fraction is not displayed if the value exceeds 99.999. The displayed value depends on measure mode. If it is edge measurement, it will display edge measurement value; if it is one axis measurement, it will display one axis measurement value; if it is two axes measurement, it will display the average value of the two axes measurement.
2. The deviation value is the difference of the actual measurement diameter and the reference diameter.
3. The position value is the difference of the center of the measured objective and the center of the beam.

6 YK-1A Remote Controller

Remote controller collects diameter value and parameters from measurement instrument, and it is mainly applied for feedback control and communication with peripheral device. The functional layout is indicated by Figure 6-1.

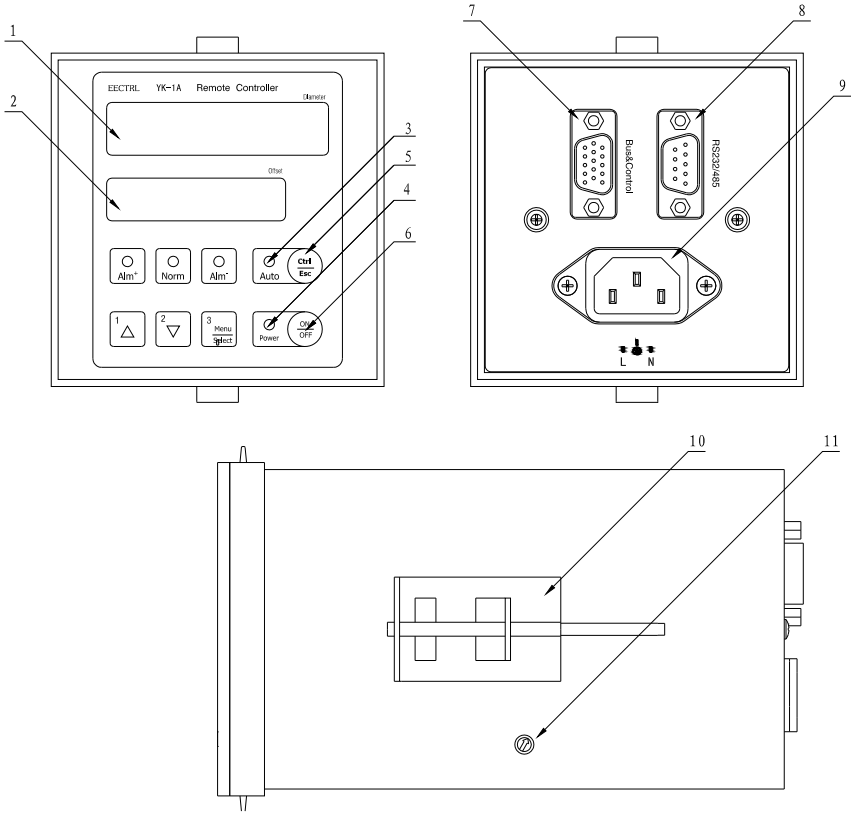


Figure 6-1

1. Main display screen: displaying diameter and parameter.
2. Sub display screen: displaying deviation, offset and parameter code.
3. Automatic control light: light on in automatic control mode.
4. Power supply light: light on while powering on.
5. Automatic control key: press this key to enter automatic control mode, repress it to exit.
6. Power supply key: press for 0.5 second to power on and repress it for 0.5 second to power off.
7. Bus & control: serial I/O for the gauge, analog output, over-deviation alarm output.
8. RS232/485: serial I/O for peripheral equipments.
9. Power supply socket
10. Installation rack
11. Output setting: adjust voltage range of analog output when in deviation / PID control mode. The adjustable range is ±0.2V~2.3V, and the default value is ±2V.

6.1 Parameters

Parameter code	Description	Model	Setting range	Factory default
PrE-A PrE-E	Reference diameter Reference diameter of average		See the table 4.1	
ALr-U AL-EU	Upper deviation limit Upper deviation limit of average		See the table 4.1	
ALr-d AL-Ed	Lower deviation limit Lower deviation limit of average		See the table 4.1	
PrE-ū	Reference diameter of X axis		See the table 4.1	
AL-ūU	Upper deviation limit of X axis		See the table 4.1	
AL-ūd	Lower deviation limit of X axis		See the table 4.1	
PrE-y	Reference diameter of Y axis		See the table 4.1	
AL-yU	Upper deviation limit of Y axis		See the table 4.1	
AL-yd	Lower deviation limit of Y axis		See the table 4.1	
yArP	Deviation output ratio, enabled when parameter "con_s" is 1. The deviation and the analog output is a linear relationship, and the parameter's value is corresponding to the max analog output value.		The setting range is the same as the upper(low) deviation	

dP 1-5	Main display option: 0: display XY average value 1: display XY average deviation value 2: display ellipticity(f),f=short axis/long axis 3: display the diameter value of axis X 4: display the diameter value of axis Y 5: display the deviation value of axis X 6: display the deviation value of axis Y 7: display the position value of axis X 8: display the position value of axis Y	Two dimension	0~8	0
	Main display option: 0: automatically display measurement value.When the value exceeds 99.999. The last decimal fraction is not displayed.If it is edge measurement, it will display edge measurement value; if it is one axis measurement, it will display one axis measurement value; if it is two axes measurement, it will display the average value of the two axes measurement. 1: if it is up measurement, it will display up measurement value; in other situation it will display - - - 2: if it is down measurement, it will display down measurement value; in other situation it will display - - - 3,4,5: correspond to the deviation value of 0,1,2 6,7,8: correspond to the laser axis position value of 0,1,2	Single dimension of biaxial	0~8	0
	Sub display option: 0: display the deviation value(the difference of the actual measurement diameter and the reference diameter) 1: display the position value(the measured objective is located in the vertical position of the beam)	Single dimension	0,1	0
dP2-5	Sub display option: 0: display XY average value 1: display XY average deviation value 2: display ellipticity(f),f=short axis/long axis	Two dimension	0~8	1

	3: display the diameter value of axis X 4: display the diameter value of axis Y 5: display the deviation value of axis X 6: display the deviation value of axis Y 7: display the position value of axis X 8: display the position value of axis Y			
dP2-5	Sub display option: 0: automatically display measurement value.When the value exceeds 99.999. The last decimal fraction is not displayed.If it is edge measurement, it will display edge measurement value; if it is one axis measurement, it will display one axis measurement value; if it is two axes measurement, it will display the average value of the two axes measurement. 1: if it is up measurement, it will display up measurement value; in other situation it will display - - - 2: if it is down measurement, it will display down measurement value; in other situation it will display - - - 3,4,5: correspond to the deviation value of 0,1,2 6,7,8: correspond to the laser axis position value of 0,1,2	Single dimension of biaxial	0~8	3

	Alarm control: 0: alarm disabled, 1: alarm enabled.	Single dimension	0、1	0
SHH-b	Alarm output relay control: 0: alarm disabled, 1: alarm enabled when the average value is out of tolerance, 2: alarm enabled when the value from X(up) or Y(low) axis is out of tolerance, 3: alarm enabled when the value from X(up) axis is out of tolerance, 4: alarm enabled when the value from Y(low) axis is out of tolerance.	Single dimension & Single dimension of biaxial	0—4	0
AdSEt	Advanced setting: input password to enter sub menu	All	5 digits	12312
EuEn	Average time: sampling speed for diameter display	All	1~1000	10
PAr-P	PID control mode parameter P	All	1~255	27
PAr-I	PID control mode parameter I	All	0~255	10
PAr-d	PID control mode parameter D	All	0~255	0
PAr-A	PID control mode parameter A	All	0~255	250
PoLA	Voltage polarity: 0: positive (higher voltage for larger deviation value); 1: negative (lower voltage for larger deviation value).	All	0, 1	0
Con-S	Control mode: 0 for PID control, 1 for deviation value control	All	0, 1	0
I-Add	The gauge's address in serial communication	All	0~127	1
I-bAU	Baud rate for serial communication with the gauge	All	19200 9600 4800 2400 1200	9600
Add	Self-address for serial communication with peripheral equipments	All	0~127	1
bAUd	Baud rate for serial communication with peripheral equipments	All	19200 9600 4800 2400 1200	9600
CH-t	Framecheck method: CRC checksum only.	All	0,1	0
rEPAS	Password change: change password to enter advanced setting	All		
u 2.00 oP25A	version number (secondary display screen display the instrument model)	All		

- - - - -	Initial status after power on	All		
- _ - _ -	Waiting or EUT beyond measure area	All		
FAUL	Fault	All		
oFL	Upper deviation value exceeds 9.999	All		
- oFL	Lower deviation value exceeds 9.999	All		

Although the parameters of the two categories are different, yet the operating method of them is the same. In the next section, we will take one axis instrument for example.

6.2 Operation flow chart of remote controller

The menu setting method of the remote controller is the same with the method of laser measurement instrument.

6.3 Output interface

6.3.1 Bus & control

A standard 15-pin D-type socket contains serial I/O, analog output and over-deviation alarm switch. See Figure 6-2 for pins' function.

Pin	Pin color	Function
2	Orange	A
3	Orange-white	B
5	Blue & Blue-white	DGND
11	Brown	Deviation/PID
12	Red	Diameter
13	White	GND
14	Yellow	Over-deviation alarm output
15	Green	Over-deviation alarm output
Others	None	None

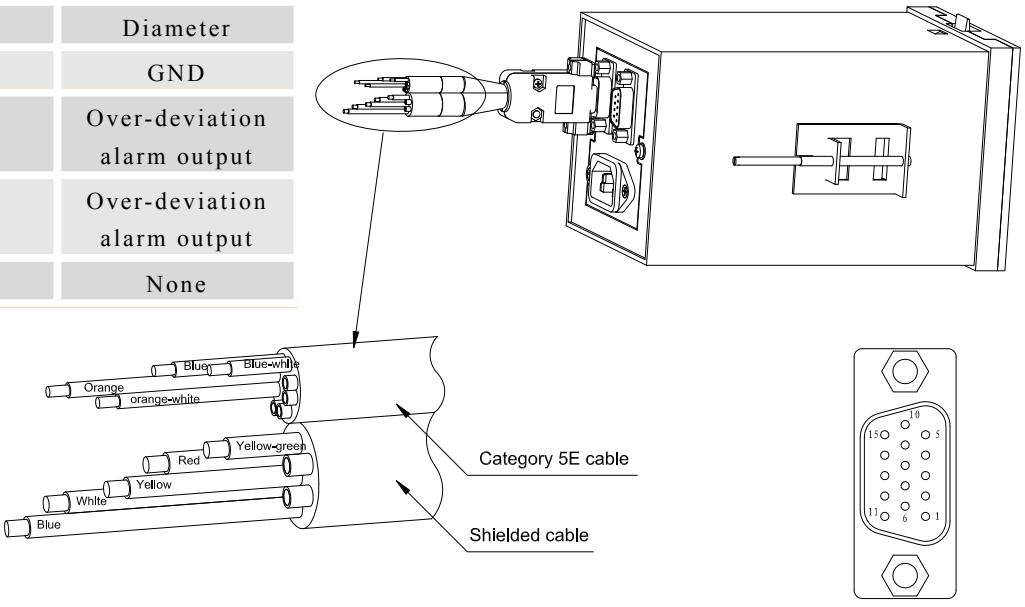


Figure 6-2

- Serial I/O: for communicating with the gauge, using RS485, see Chapter 8 for detail.
- Analog output: two independent 12 bits D/A output (photoelectric isolation), 100 Ω output impedance.
    1. Diameter output: 0~10V, which can be calculated by the following formula:

       Output Voltage = $\frac{Dim}{25.000} \times 10V$, here *Dim* is the measured diameter, 25.000 is the upper diameter range, and 10V is the maximum output voltage.
    2. Deviation/PID output: the adjustable range is determined by "Output setting", the default range is -2V~+2V. The output voltage can be calculated by the following formula:

Output Voltage = $\frac{D_m - D_{ref}}{V_{dev}} \times V_{\max}$, here D_m is the measured diameter, D_{ref} is the reference value, V_{dev} is the deviation limit (use upper limit if $D_m \geq D_{ref}$, or lower limit if $D_m < D_{ref}$), and V_{max} is the maximum output voltage, the default value of which is 2V.

- Over-deviation alarm output: the output contact points of the relay are normally opened, relay's capacity: AC120V 1A/DC24V 1A.

6.3.2 RS232/RS485

The serial interface communicates with peripheral device using RS232/RS485 (customer could select while purchasing). Please see Chapter 8 for detail. The function of connecting cable is indicated by Figure 6-3.

Pin	Pin color	Function
2	Orange	A(TX)
3	Orange-white	B(RX)
5	Blue & Blue-white	DGND
others	None	None

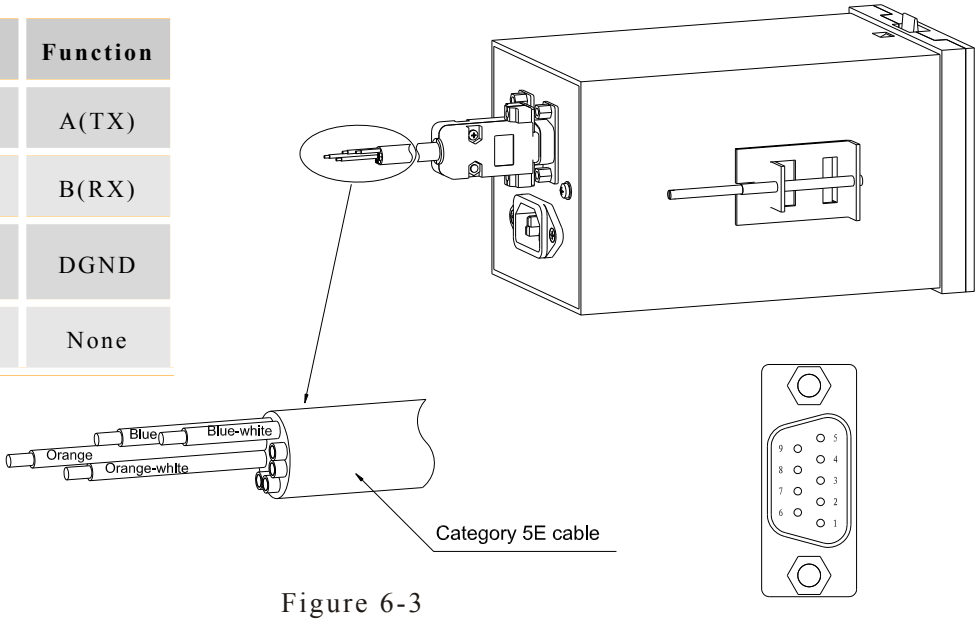


Figure 6-3

7 YK-1B Remote Controller

The YK-1B remote controller has same functions with YK-1A. The functional layout is indicated by Figure 7-1.

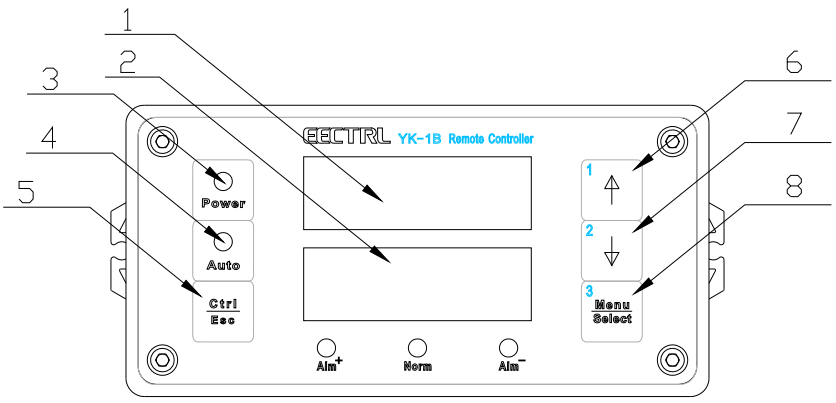


Figure 7-1 (a)

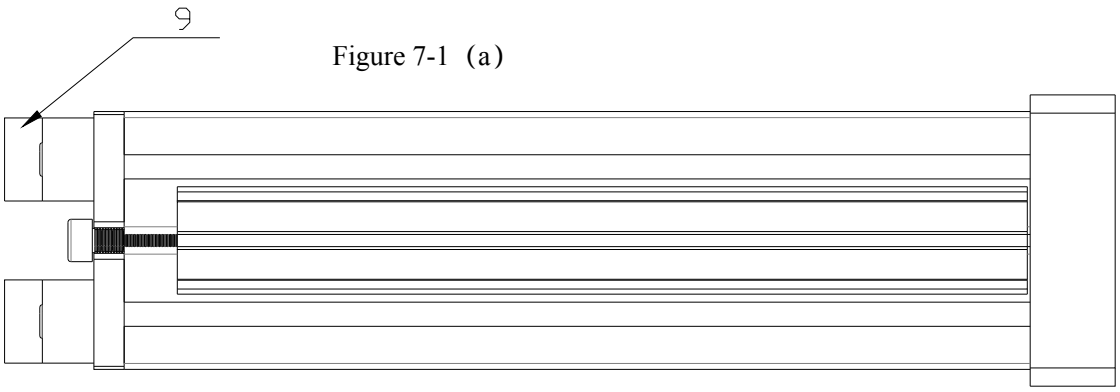


Figure 7-1 (b)

1. Main display screen: displaying diameter value and parameters
2. Sub display screen: displaying deviation value, offset, and parameter code
3. Power indicator: the indicator is on when powered on
4. Auto control indicator: the indicator is on when the PID function is enabled
5. Auto control key: press this key to enable the PID function, press again to disable it
6. Functional key: turn up
7. Functional key: turn down
8. Menu key:
9. Terminals.

7.1 Control panel

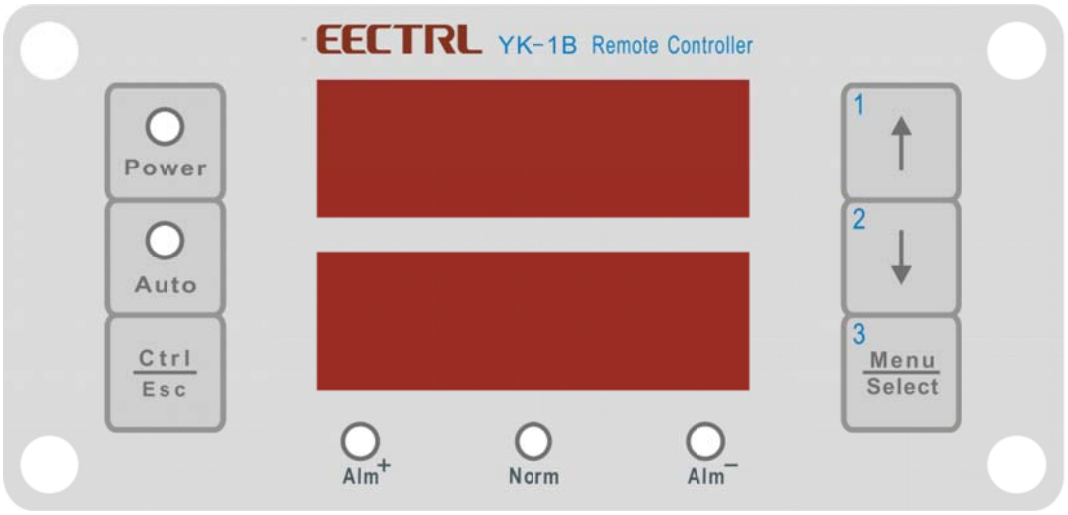


Figure 7-2

7.2 Terminals

Analog Output PID DIA		Peripheral Devices RS485/RS232			Laser Diameter Gauge RS485		
V2	V1	G2	HB2	HA2	G1	HB1	HA1

PE	L	N	K1	K1	K2	K2	VG
Ground	220VAC Power Supply		X/Upper Relay1 Contact		Y/Lower Relay2 Contact		Analog GND

Figure 7-3

8 YK-2A Remote Controller

YX-2A remote controller is made of metal and is more robust. Compared with YK-1A and YK-1B, this controller has more keys and can display more data. The controller has same output interface with YK-1B. The controller's functional layout is indicated by Figure 8-1.

DIS1: the first display screen. It displays real-time diameter for one-axis gauge, and optional data for two-axes gauge according to the settings.

DIS2: the second display screen. It displays optional data according to the settings.

DIS3: the third display screen. It displays optional data according to the settings.

MD: Indicator of the display ratio. If the light is on, the data displayed in DIS1~3 isn't the real measured diameter but the multiple of the real measured diameter and the display ratio.

Auto: Light is on when the remote controller is working in automatic control mode.

Upper deviation indicator: when measured diameter exceeds admissible deviation upper limit, the light is on.

None-deviation indicator: when measured diameter is in admissible deviation, the light is on.

Lower deviation indicator: when measured diameter exceeds admissible deviation lower limit, the light on.

See table 5.2 for detailed features of the keys.

Most of the parameters of YK-2A are the same with BX-1B. See table 8.1 for detail features of special parameters of YK-2A.

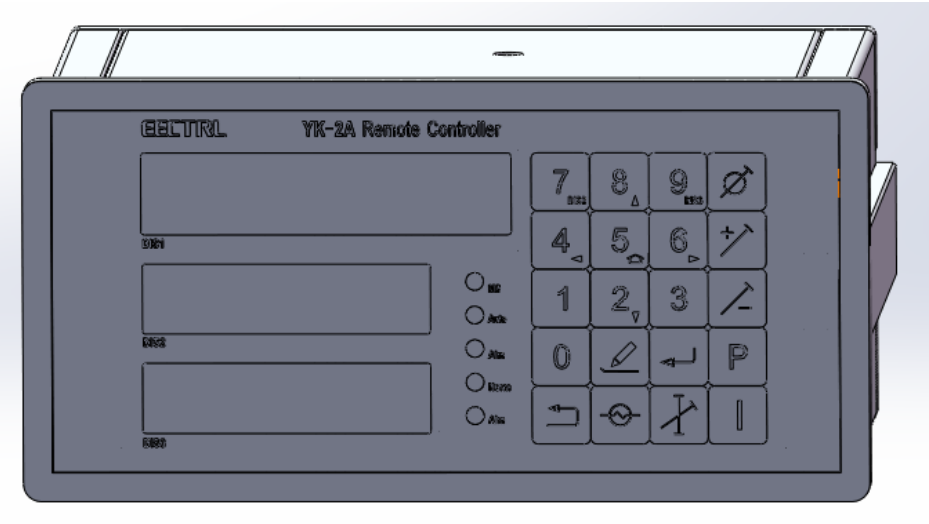


Figure 8-1

8.1 Special parameters

Parameter code	Description	Model	Setting range	Factory default
SHr In	Display ratio. 1 means displaying the real value, 0.8 means the displayed value is the multiple of the real value and 0.8.	All	0.8—1	1
	Display options: 0: display the average value of X and Y 1: display the diameter value of axis X 2: display the diameter value of axis Y	Two dimension	0—2	0
dP 1-S	Display options: 0: automatically display measurement value.[1] 1: display value of upper axis if in one axis measure mode using upper axis; in other situation it will display - - - 2: display value of lower axis if in one axis measure mode using lower axis; in other situation it will display - - -	**Single dimension of biaxial**	0—2	0
	Display options: 0: the deviation value. 1: the position value. 2: the rate of analog output. 3: the reference diameter. 4:the minimum value. 5:the maximum value	Single dimension	0—4	0
dP2-S	Display options: 0: the average value of X and Y 1: the average deviation value of X and Y 2: ellipticity(f),f=short axis/long axis 3: the diameter value of axis X 4: the diameter value of axis Y 5: the deviation value of axis X 6: the deviation value of axis Y 7: the position value of axis X 8: the position value of axis Y	Two dimension	0—11	1

Parameter code	Description	Model	Setting range	Factory default
	9: the rate of analog output. 10: reference diameter of average 11: the minimum diameter of average X and Y 12: the maximum diameter of average X and Y			
dP2-5	Display options: 0: automatically display measurement value.1 1: value of upper axis if in one axis measure mode using upper axis; in other situation it will display - - - 2: value of lower axis if in one axis measure mode using lower axis; in other situation it will display - - - 3,4,5: correspond to the deviation value2 of option 0,1,2, respectively. 6,7,8: correspond to the position value3 of option 0,1,2, respectively. 9: the rate of analog output. 10: reference diameter of average 11: the minimum diameter of average X and Y 12: the maximum diameter of average X and Y	**Single dimension of biaxial**	0—11	3
dP3-5	Display options: 0: the deviation value2. 1: the position value3. 2: the rate of analog output. 3: the reference diameter. 4:the minimum value. 5:the maximum value	Single dimension	0—4	0
	Display options: 0: the average value of X and Y	Two dimension	0—11	1

Parameter code	Description	Model	Setting range	Factory default
	1: the average deviation value of X and Y 2: ellipticity(f),f=short axis/long axis 3: the diameter value of axis X 4: the diameter value of axis Y 5: the deviation value of axis X 6: the deviation value of axis Y 7: the position value of axis X 8: the position value of axis Y 9: the rate of analog output. 10: reference diameter of average 11: the minimum diameter of average X and Y 12: the maximum diameter of average X and Y			
dP3-5	Display options: 0: automatically display measurement value.1 1: value of upper axis if in one axis measure mode using upper axis; in other situation it will display - - - 2: value of lower axis if in one axis measure mode using lower axis; in other situation it will display - - - 3,4,5: correspond to the deviation value2 of option 0,1,2, respectively. 6,7,8: correspond to the position value3 of option 0,1,2, respectively. 9: the rate of analog output. 10: reference diameter of average 11: the minimum diameter of average X and Y 12: the maximum diameter of average X and Y	**Single dimension of biaxial**	0—11	3

Parameter code	Description	Model	Setting range	Factory default
Unit	Measurement interface unit option: 0:millimeter; 1:inch	ALL	0,1	0
dECIn	Decimal point option: Inch display a decimal more than mm	ALL	0—display precision	Display precision
CH-t	Checksum method: 0,3,6 for CRC checksum; 1,4,7 for exclusive-or checksum; 2,5,8 for Modbus RTU 0 to 2 for NONE checkout 3 to 5 for ODD checkout 6 to 8 for EVEN checkout	ALL	0-8	0
	Alarm control: 0: alarm disabled, 1: alarm enabled.	Single dimension	0、1	0
SHH-b	Alarm control: 0: alarm disabled, 1: alarm enabled when the average value is out of tolerance, 2: alarm enabled when the value from X(up) or Y(low) axis is out of tolerance, 3: alarm enabled when the value from X(up) axis is out of tolerance, 4: alarm enabled when the value from Y(low) axis is out of tolerance. 5: two relays correspond to X and Y alarm	Two dimension & **Single dimension of biaxial**	0—5	0

9 Remote Display

Remote displayer is applied for displaying in long distance, which is connected with laser gauge by D-type socket (15pins/25pins).The transmission distance can amount to 200 meters.

Remote displayer （YX－□A） is connected by electric current loop, but user needs to provide connecting wire.YX-0.5B is the dual Remote displayer, which displaying content is in accordance with the date of laser gauge.

Connecting: the D-type socket(15pins)'s 2-pin 、10-pin or D-type socket(25pins)'s 12-pin 、24-pin connect with the D-type socket(15pins)'s 2-pin 、10-pin of the laser gauge at random, no need to distinguish voltage polarity.

The functional layout of 4 Inch Displayer is indicated in Figure 9-1.

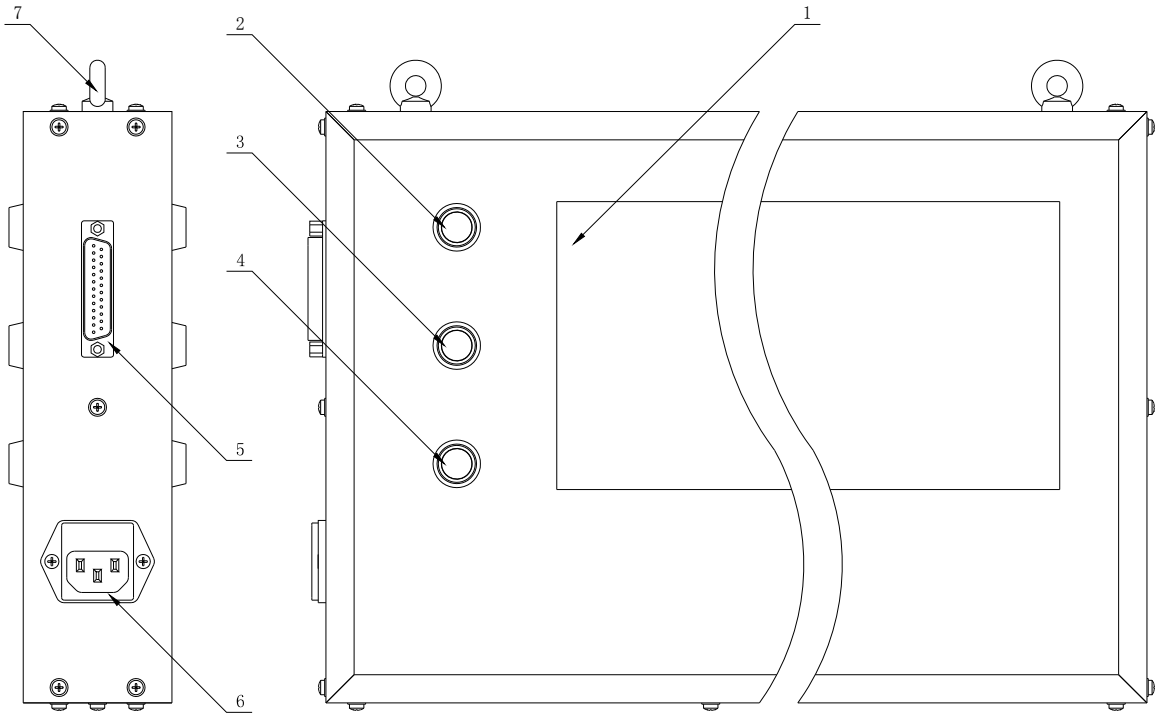


Figure 9-1

1. Display screen
2. Upper deviation light
3. None deviation light
4. Lower deviation light
5. Synchronized data channel
6. Power socket
7. Swinging ring

10 Installation and Operation

10.1 Installation

The installation of laser gauge has two forms---laying and standing[See Figure 10-1].When installing bracket, first lock the fastness staff on the ground with an expanding **bolt** ; put in the adjustment staff; lock the splint to the adjustment pole with locking screws; lock the measurement instrument on the splint; adjust the height;lock the handle knob.

⚠ When loosing the handle knob,be careful that the adjustment pole will spring.

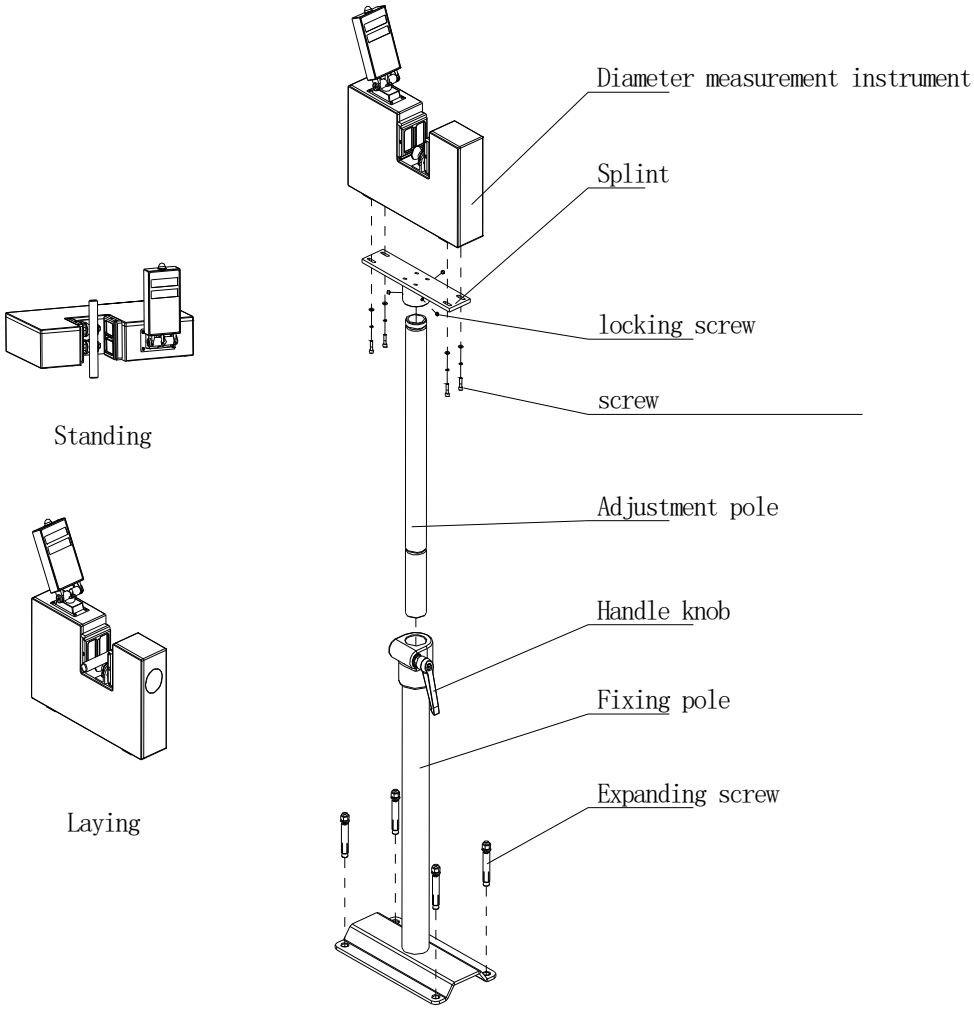
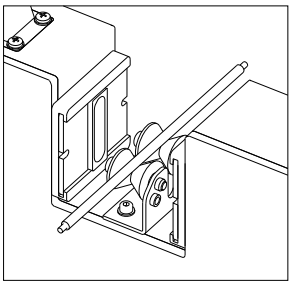
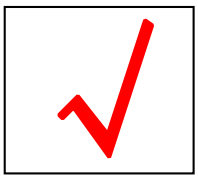


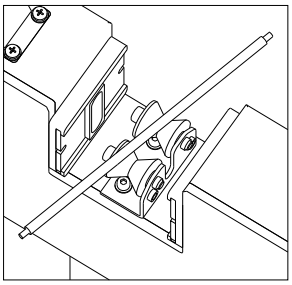
Figure 10-1

The measured objective should be in the guide roller and vertical to beam. Adjust the holder to making guide roller hold wire slightly, which can reduce objective

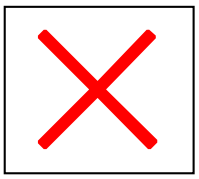
dithering when moving. See Figure 10-2(25AL for example).

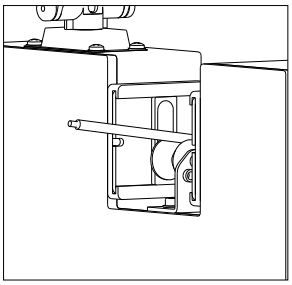






Measured wire is not in the center of guide roller





Incline of the wire results in the measured di ameter value larger than the real one

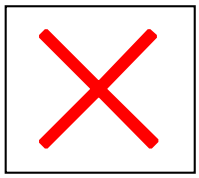
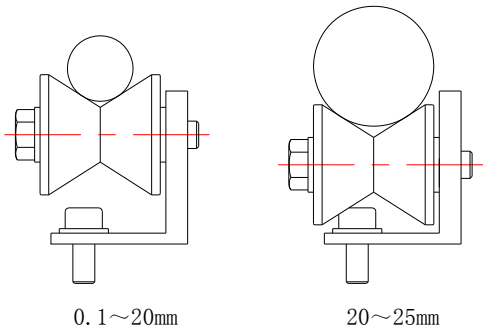


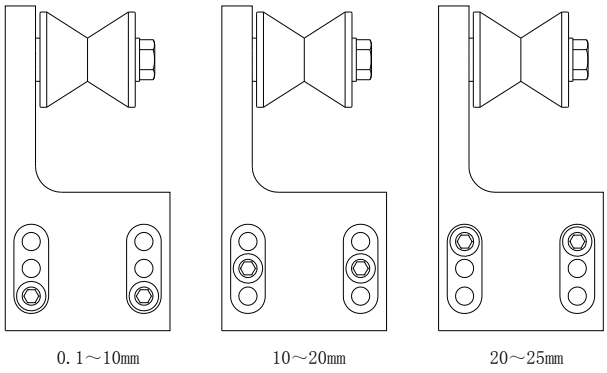
Figure 10-2(a)

For objectives of different diameters, the installation height of guide roller should be 0.1-20mm,20-25mm or 0.1-10mm,10-20mm,20-25mm on purpose of placing the objective near the center of beam to measure exact value.



Opmac 25AL

Figure 10-2(b)



Opmac 25BL

Figure 10-2(c)

10.2 Basic operation

When powering on, the measurement instrument is in initialization status, showing - - - - - on screen and enters measuring status after 3 seconds, showing - - - on main display screen. Placing wire in measuring area, the value on main screen is the diameter of wire and value on sub display screen is offset.

When powering on traction machine, the wire moves forward and diameter changes accordingly. The changing speed is depending on the average time [See Section 6.1]. The higher the value is ,the slower the diameter changes. Usually it is set to 10.

Set proper reference diameter, upper over-deviation limit and lower over-deviation limit. [See Section 4.2] when measured diameter is larger than reference diameter plus high over-deviation limit, "  " light on; when measured diameter is less than reference diameter subtracted by low over-deviation limit, "  " light on; when reference diameter subtracted by low over-deviation limit is less than or equals to measured diameter is larger than or equals to reference diameter plus high over-deviation limit, "  " light on.

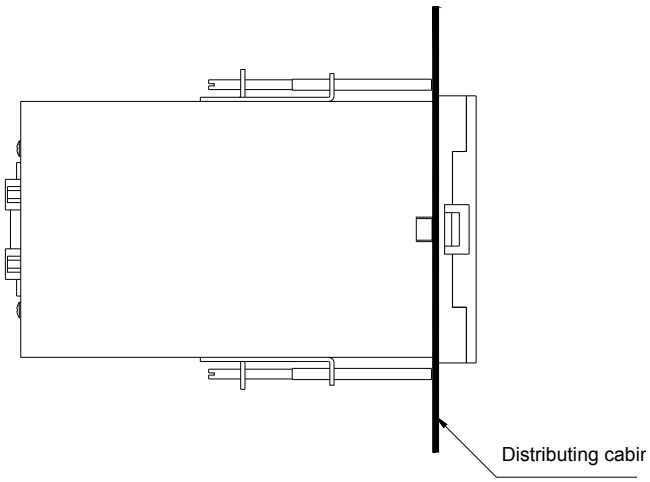
Once measured diameter exceeds upper and lower limits, over-deviation alarm contact closes. When sound and light alarm enables, operation panel gives an alarm and at same time the over-deviation light on top flickers.

10.3 Feedback control

The laser gauge and remote controller compose of feedback system, which adjusts speed of traction machine or extruder according to deviation of measured value and pre-set wire dimension. Here is an example of the control of wire/cable production line and please follow this one for others applications.

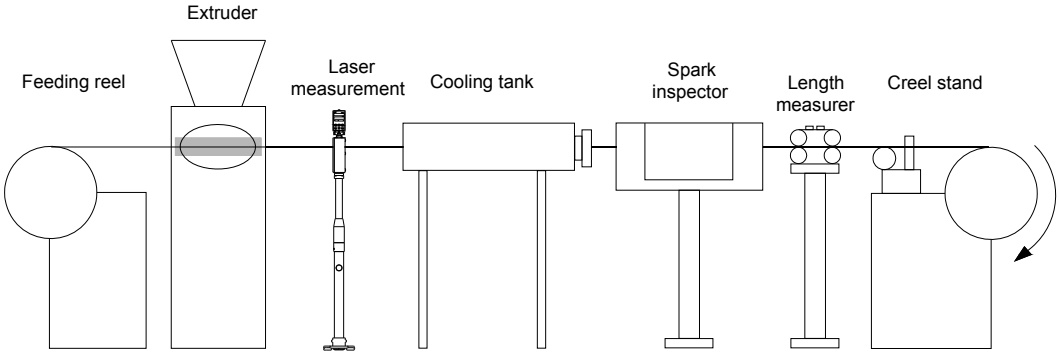
10.3.1 Installation position

The measurement instrument [See Figure 10-3 for installation position] can be installed in front of cooling flume [See Figure 10-3(b)], that is good position for rapid feedback control but the measured diameter is heated value of wire with a certain difference from cooled value(real value). In addition, due to the soft scarfskin of high temperature near extrusion port, guide roller cannot be installed. If the measurement instrument is installed behind cooling flume and dryer [See Figure 10-3(c)], the measured value is real value after cooling but the delayed feedback on dimension change effects control precision. Remote controller usually is installed on the electric cabinet and connected with measurement instrument through cable [See Figure 10-3(a)].



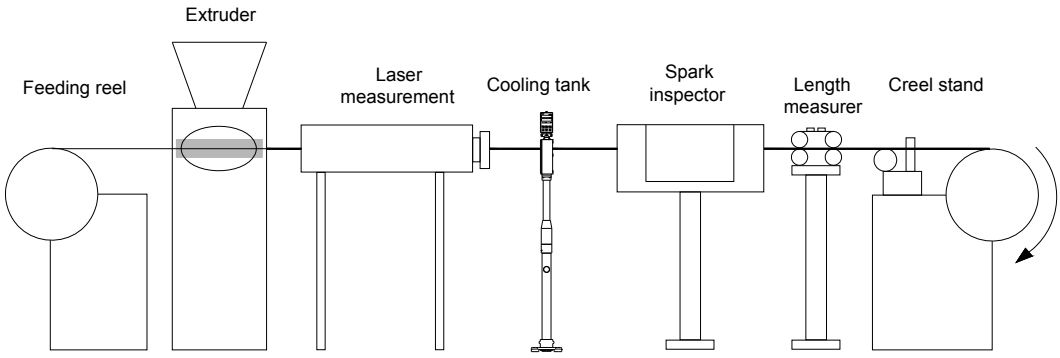
(a)

Measurer installed in front of flume



(b)

Measurer installed behind flume



(c)

Figure 10-3

10.3.2 Connection

First of all, power off measurement instrument, remote controller and traction machine and open traction machine controller (could be DC motor controller or inverter), and then break the connection between the 10V power supply to the power pin of the regulation resistance and after

this, connect the white cable of “bus & control” interface on remote controller to that power pin, and the brown one to the 10V power supply. [See Figure 10-4]

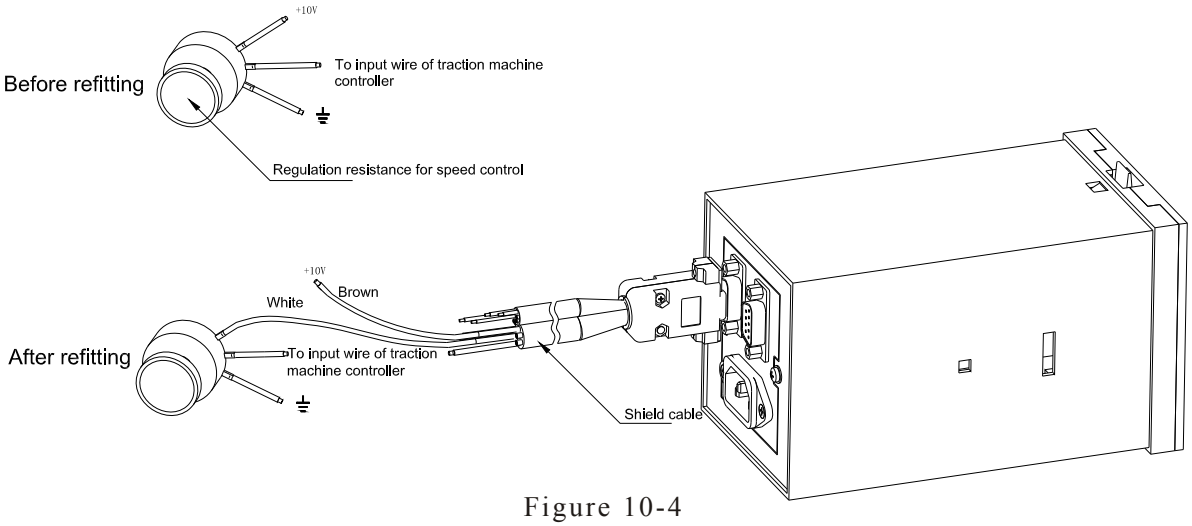


Figure 10-4

Note: when connected with the regulation resistance of the inverter, analog output cable should be as short as possible and the shielding braid must be connected with shielding cables of the inverter.

10.3.3 Testing and manufacture

10.3.3.1 Power on measurement instrument and remote controller and check parameters: average time=50, voltage polarity=0, control mode=0, P=15、I=14、D=0.

10.3.3.2 Place a wire on the measurement instrument and set reference diameter, 1mm less than measured value. Power on traction machine controller and set traction speed to 0. Press 

to enter control mode. If within 20 seconds, the traction machine is not working, which means a wrong connection (see Section 10.3.2 for details), just exchange positive pin and negative pin of the analog output cable or set polarity to 1.

Because the feedback control can’t work with wrong connection, so user should follow the instructions in Section 10.3.3.1 and Section 10.3.3.2 to ensure right connection.

10.3.3.3 While starting to manufacture, first of all, power on measurement instrument and remote controller, not enter automatic control status. Set reference diameter according to technical demand. If the measurement instrument is installed behind flume, the reference diameter can be set as real diameter. If the measurement instrument is installed in front of flume (displaying heated value), the reference value can be set a little bit higher.

10.3.3.4 Manually adjust extruding and traction speed to make the measured data close to reference diameter and after a while, when measurement data is stable (there is inertia of extruding and traction speed), press “ 

” for automatic control. Under normal working circumstance, traction speed is about 1200r/m, should not be too high otherwise there is no adjusting scale of the remote controller. If the traction speed is too low while working, just manually set it at about 1200r/m. After completing manufacture, press “ 

” to stop automatic control and then power off extruder and traction machine.

10.3.3.5 The P and I parameters of remote controller decide the stability of control. The defaulted parameters could work well under most situations. When the control is too slow or non-stable with defaulted parameters, user should adjust these parameters:

a. When there is deviation between measured diameter and reference (positive or negative) lasting for a long time [see Figure 10-5(a)], it suggests that the system has “steady-state error”. Increase parameter I to remove “steady-state error”.

b. When measured diameter is changing constantly up and down near reference for a long time [see Figure 10-5 (b)], it suggests that system has “vibration”. Reduce parameter I to control “vibration”.

c. When measured diameter rapidly reaches reference and vibrates in control mode [see Figure 10-5(c)], it suggests that system is “overshoot”. Reduce parameter P to eliminate it.

d. When measured diameter costs long time to reach reference or could not reach in control mode [see Figure 10-5(d)], it suggests that system is “undershoot”. Increase parameter P to eliminate it

In a word, parameter P decides adjusting speed, parameter I decides control precision. The ideal control curve is indicated by Figure 10-5(e).

The parameter must be saved after adjustment in case of loss when powering on next time.

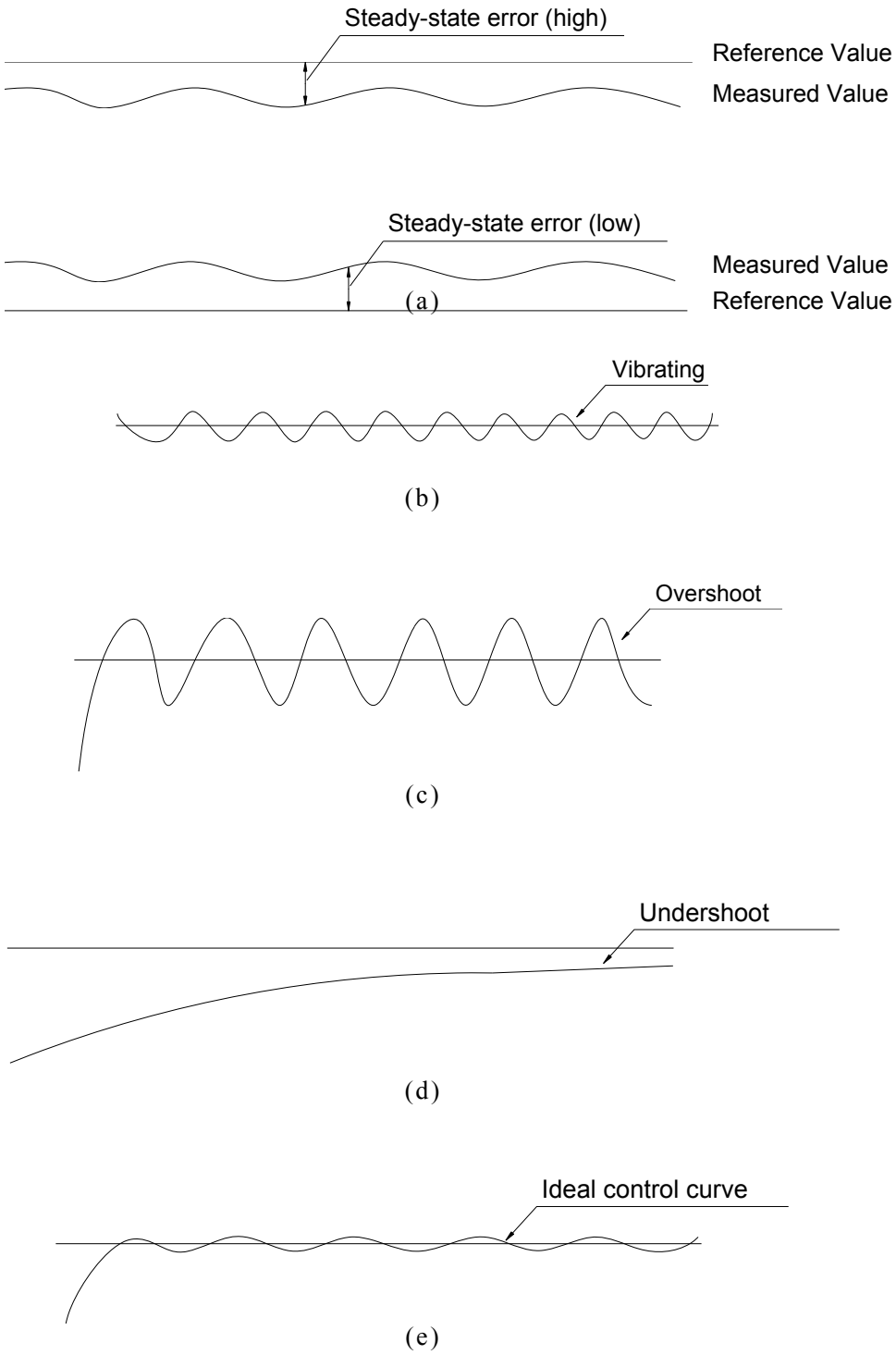


Figure 10-5

Note: "——" denotes reference diameter

"~~~" denotes measured diameter

11 Communication

The remote controller or peripheral device uses RS485 to communicate with the gauge, and peripheral devices use RS232/RS485 to communicate with remote controller. The protocols for both serial communications are the same, except some parameters are special for remote controller. Table 2 shows parameters for transmission and indicates those only for remote controller. See section 4.1 and 5.1 for detail of parameters' range.

When remote controller or peripheral device communicates with the gauge, the former is sender and the latter is receiver. When peripheral device communicates with remote controller, the former is sender and the latter is receiver. That means remote controller is a sender and a receiver in the same time when it is connected with peripheral device and the gauge.

Data format: 1 star bit, 8 data bits and 1 stop bit, no parity checkout.

Transmission format of the sender when reading parameters:

gauge address	parameter

Transmission format of acknowledge of the receiver:

gauge address	parameter	2-byte data (90/100AL are 3 bytes,from high to low)	CRC check sum

Transmission format of the sender when writing parameters:

gauge address	parameter	2-byte data (90/100AL are 3 bytes,from high to low)	CRC check sum

There is no acknowledge from the receiver when the sender writing parameters.

CRC check sum is the CRC sum (1-byte) of all bytes before it. CRC checking uses 8 digits CCITT cyclic redundancy check (CRC-CCITT) and its generator polynomial is: $G(x)=X^8+X^5+X^4+1$. The negative data is denoted in complement form.

- Example 1: reading diameter.

Suppose the address of the receiver is 1 (01H), and current diameter is 6.234(185AH), then the sender sends:

01H	41H

And the acknowledge of the receiver is:

01H	41H	18H	5AH	CRC-check-sum

- Example 2: reading offset

Suppose the address of the gauge is 1(01H), and current offset is -5 then the sender sends:

01H	44H

And the acknowledge of the receiver is:

01H	44H	FFH	FBH	CRC-check-sum

- Example 3: writing reference diameter

Suppose the address of laser diameter measurement instrument is 1(01H), and the sender is going to change reference diameter to 60.00(1770H) then it sends:

01H	66H	17H	70H	CRC-check-sum

And there is no acknowledge from the receiver.

- Example 4: reading the diameter value of 100A

Suppose the address of laser diameter measurement instrument is 1（01H），The value of current diameter is 106.350(19f6eH)， well then：

Input：

01H	41H

The laser diameter measurement instrument output：

01H	41H	01H	9FH	6EH	CRC-check-sum

For reading and writing other parameters, please follow the examples.

Read parameter		Write parameter		Single dimension	Two dimension	Type
ASCII	Hex	ASCII	Hex			
A	41H	NULL	NULL	Diameter Value	Average diameter value	Read only
B	42H	NULL	NULL	NULL	Diameter value of X axis	
C	43H	NULL	NULL	NULL	Diameter value of Y axis	
D	44H	NULL	NULL	Offset	Offset of X axis	
E	45H	NULL	NULL	NULL	Offset of Y axis	
F	46H	f	66H	Reference diameter		Read &write
G	47H	g	67H	Upper deviation preset		
H	48H	h	68H	Lower deviation preset		
I	49H	i	69H	Sub display option		
J	4aH	j	6aH	Alarm option[1]		
K	4bH	k	6bH	Average time		
L	4cH	l	6cH	*P parameter*		
M	4dH	m	6dH	*I parameter*		
N	4eH	n	6eH	*D parameter*		
O	4fH	o	6fH	*α parameter*		
P	50H	p	70H	*Voltage polarity*		
Q	51H	q	71H	*Control mode*		
R	52H	r	72H	*Automatic Control[2]*		

Table 2 parameters

Note: The *italic* parameters are only for remote controller.

Note[1]: It is the alarm option when communicating with the gauge and the over-deviation alarm output option when communicating with remote controller.

Note[2]: The *Automatic Control* parameter is the same as the automatic control key in the panel of remote controller, 1 for starting auto control, 0 for exit.

Additional parameters for Opmac 5AL:

Read parameter		Write parameter		Description	Type
ASCII	HEX	ASCII	HEX		
T	54H	t	74H	Address for serial communication. Rangle: 0~127. Default value: 1.	Read &write
U	55H	u	75H	Baud rate for serial communication. Default value: 19200. Rangle: 0 for 9600 1 for 19200 2 for38400 3 for 57600 4 for 115200	
V	56H	v	76H	Communication mode. Default value: 0. Rangle: 0 for CRC checksum 1 for XOR checksum 2 for MODBUS RTU mode	

MODBUS

Opmac series instruments with Version 3.02 or above can communicate with peripheral devices via Modbus(RTU mode). Users can select this protocol in the parameter menu, see section 4.1 for detail. Read parmeters in table 3 are the register address in Modbus.

- Example 5: reading diameter value via Modbus

  Suppose the address of laser diameter measurement instrument is 1（01H）, The value of current diameter is 6.234(185aH)， well then：

  Input：

01H	03H	00H	41H	00H	01H	D4H	1EH

  The laser diameter measurement instrument output：

01H	03H	02H	18H	5aH	32H	7FH

Single dimension diameter measuring instrument of biaxial (such as 100A) and some measurement data may be greater than 65535 of the diameter of the instrument, the data with two bytes, so the register address will be changed accordingly.

The MODBUS protocol provides that the register address is from 1, so if the instrument is communicating with the MODBUS standard module, the register address written by the standard module should be added to the 1.

Register address for Modbus:

Register Address (HEX)	Single dimension	Register Address (HEX)	Biaxial dimension	Register Address (HEX)	Single dimension of Biaxial	Type
41H	Diameter Value	41H	Average Value	41H	Automatic Value	Read only
42H	Null	42H	Diameter Value of X	43H	Diameter Value of upper	
43H	Null	43H	Diameter Value of Y	45H	Diameter Value of lower	
44H	Offset	44H	Offset of X	47H	Offset of upper	
45H	null	45H	Offset of Y	49H	Offset of lower	
46H	Reference diameter	46H	Reference diameter	4bH	Reference diameter	Read & write
47H	Upper deviation preset	47H	Upper deviation preset	4dH	Upper deviation preset	
48H	Lower deviation preset	48H	Lower deviation preset	4fH	Lower deviation preset	
49H	Display option	49H	Display option	51H	Display option	
4aH	Alarm option	4aH	Alarm option	53H	Alarm option	
4bH	Average time	4bH	Average time	55H	Average time	
4cH	PID-P	4cH	PID-P	57H	PID-P	
4dH	PID-I	4dH	PID-I	59H	PID-I	
4eH	PID-D	4eH	PID-D	5bH	PID-D	
4fH	PID-@	4fH	PID-@	5dH	PID-@	
50H	Voltage polarity	50H	Voltage polarity	5fH	Voltage polarity	
51H	Control mode	51H	Control mode	61H	Control mode	
52H	Automatic Control	52H	Automatic Control	63H	Automatic Control	
53H	Internal use	53H	Internal use	65H	Internal use	Read only
54H	Device ID	54H	Device ID	67H	Device ID	Read & write
55H	Communication baud	55H	Communication baud	69H	Communication baud	
56H	Communication mode	56H	Communication mode	6bH	Communication mode	

The instrument with software version V5.02 or later has two serial communication ports. The functions of serail port 1(5 in Figure 11-1) are the same as other models. The pins' definition of serial port 2 (6 or 7 in Figure 11-1) are shown in table 11-5.

The serial port 2 has multiple functions which are controlled by parameters "Add1, BAUD1 and Ch_t1". Functions of value 0~8 of parameter "Ch_t1" are the same as parameter "Ch_t" and enable serial communication, while value 9 sets the serial port 2 to remote displayer interface. The serial port 2 can be customized as Ethernet interface(RJ45) or WIFI antenna according to user's

requirement.

In the instrument with software version V5.02 or later the parameter “display option” is replaced with “PID output” which is a read only parameter. The value of the parameter is 0 if the PID control is not available. If the automatic mode button is pressed or the parameter “automatic control” is set the PID control is enabled and the value of parameter “PID output” varies between -32768 ~ 32767. The positive value means the real diameter is larger than the setting diameter, the negative value means the real diameter is smaller than the setting diameter.

Pin No.	Function
2	To remote Displayer
10	To remote Displayer
11	HA of serial port 2
12	HB of serial port 2
13	GND of serial port 2
14	N/A
15	N/A
8	N/A

Table 11-5

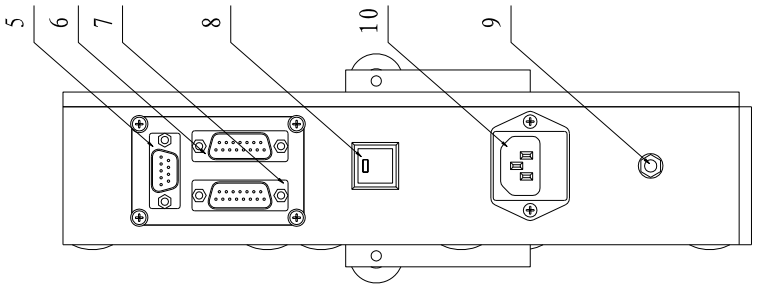
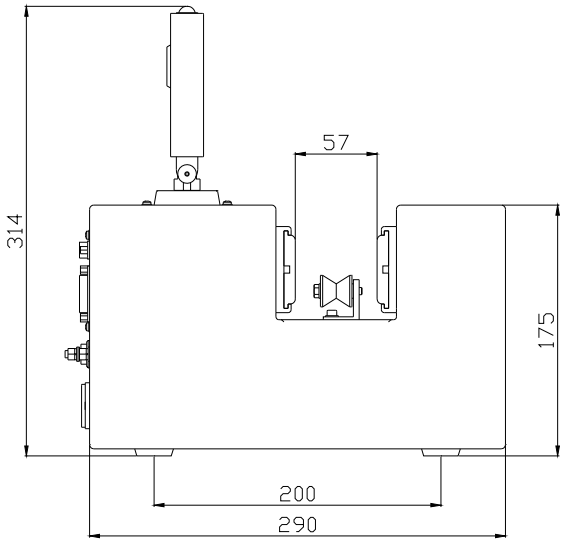


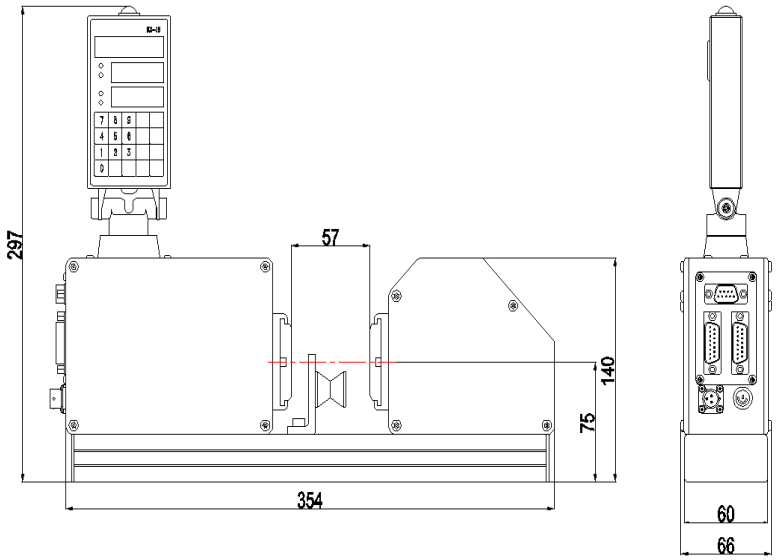
Figure 11-1

12 Overall Dimensions

The outline and overall dimensions of instrument are indicated by Figure 12-1.

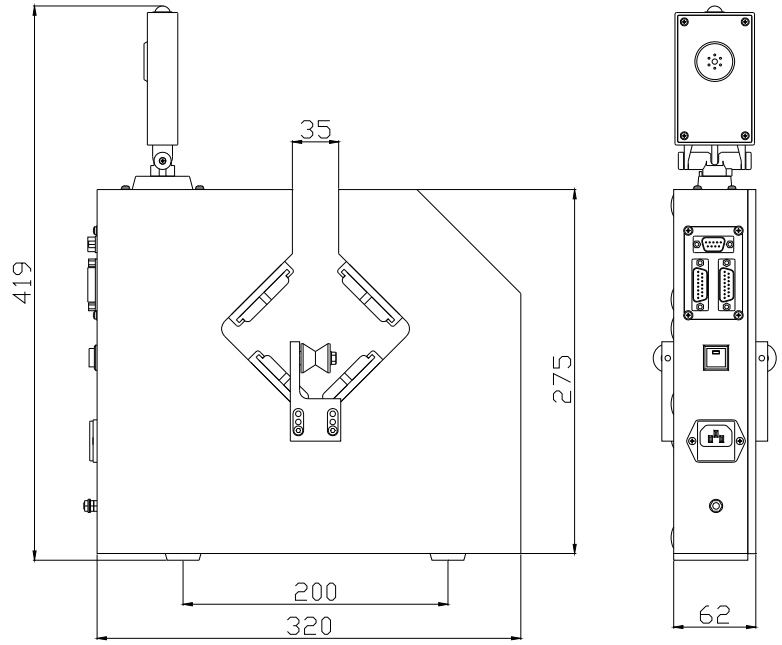


TYPE C

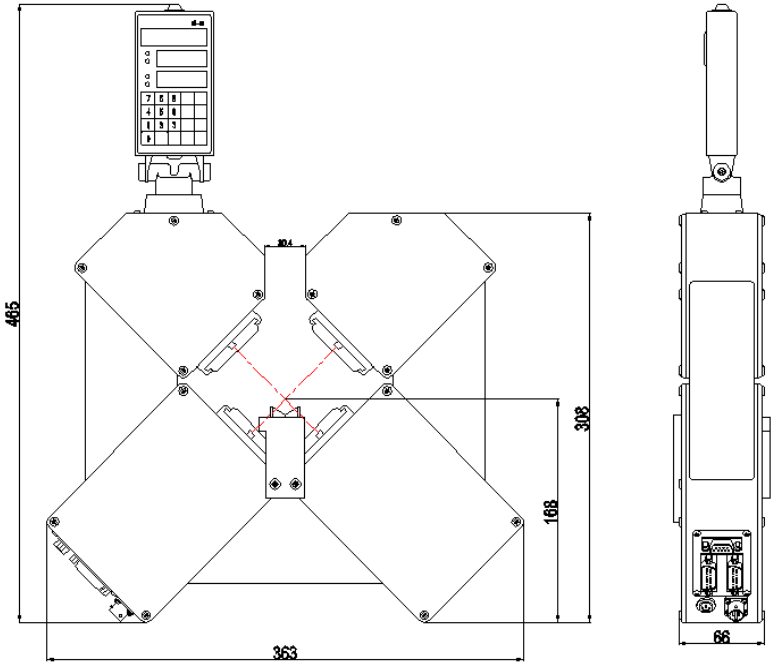


TYPE D

Figure 12-1 (a) Opmac 25AL



TYPE C



TYPE D

Figure 12-1 (b) Opmac 25BL

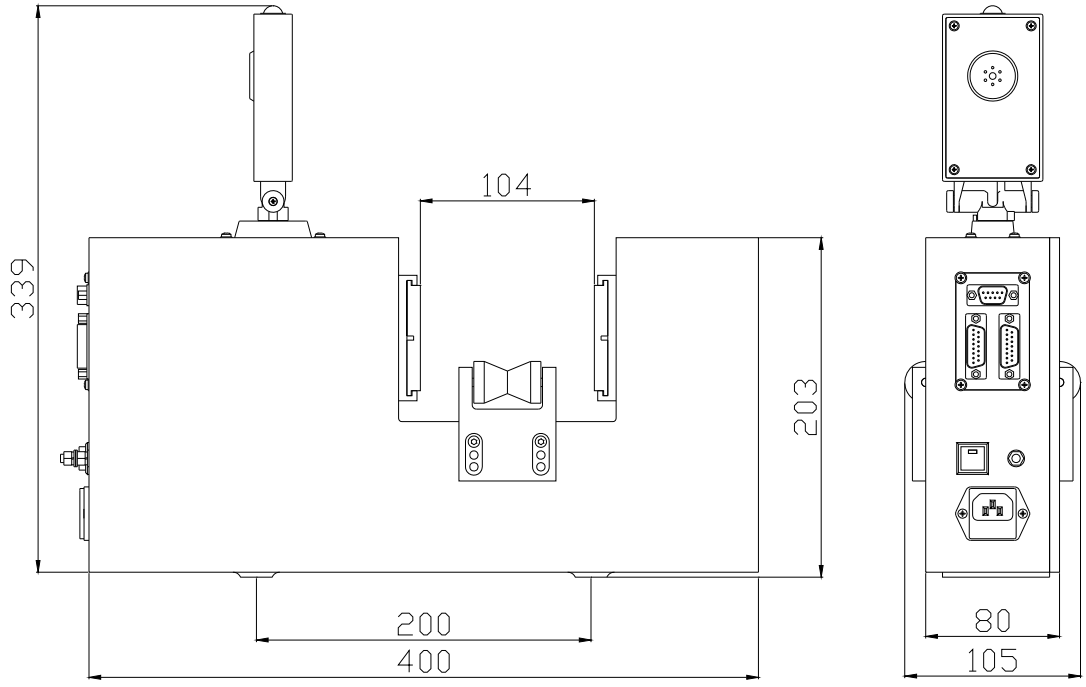


Figure 12-1（c）Opmac 40AL

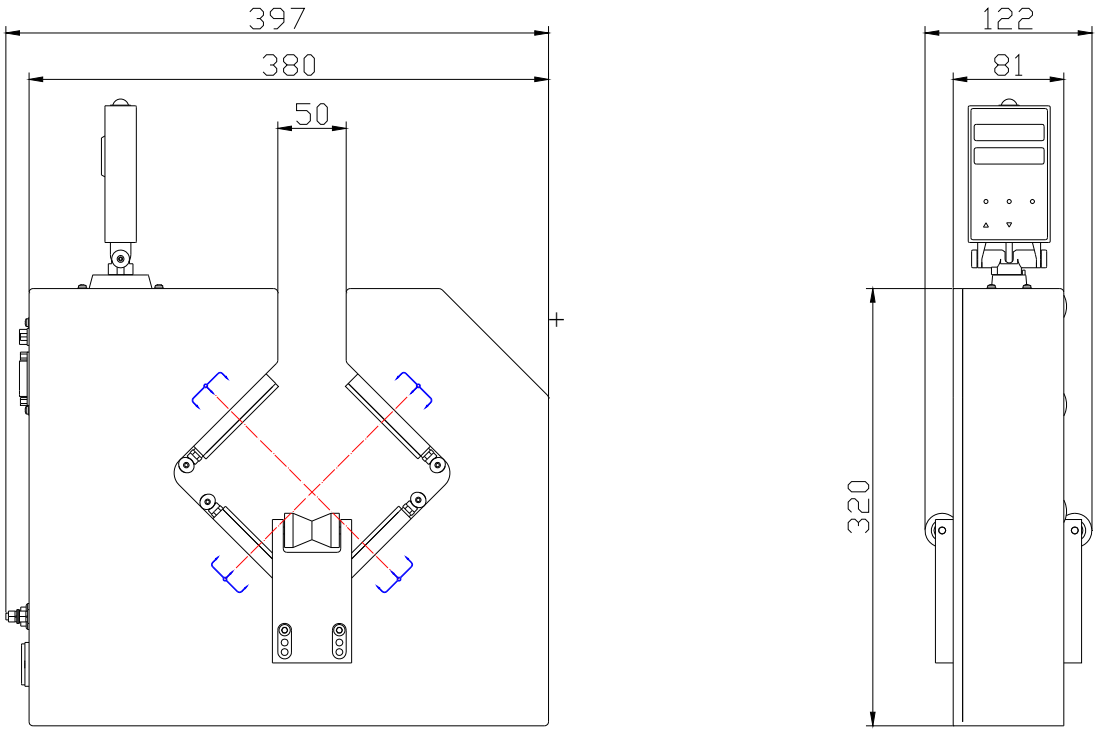


Figure 12-1（d）Opmac 40BL

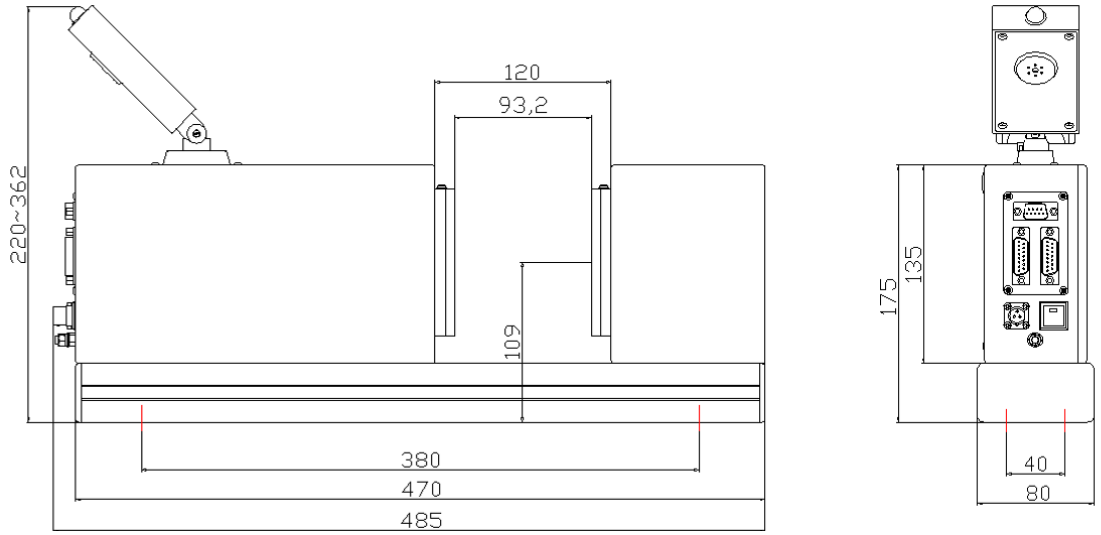


Figure 12-1（e）Opmac 50AL

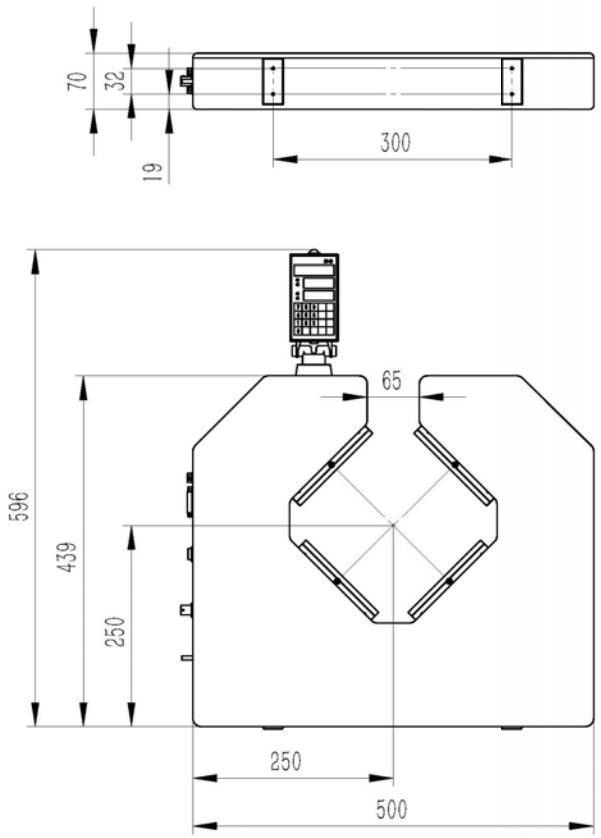


Figure 12-1（f）Opmac 50BL

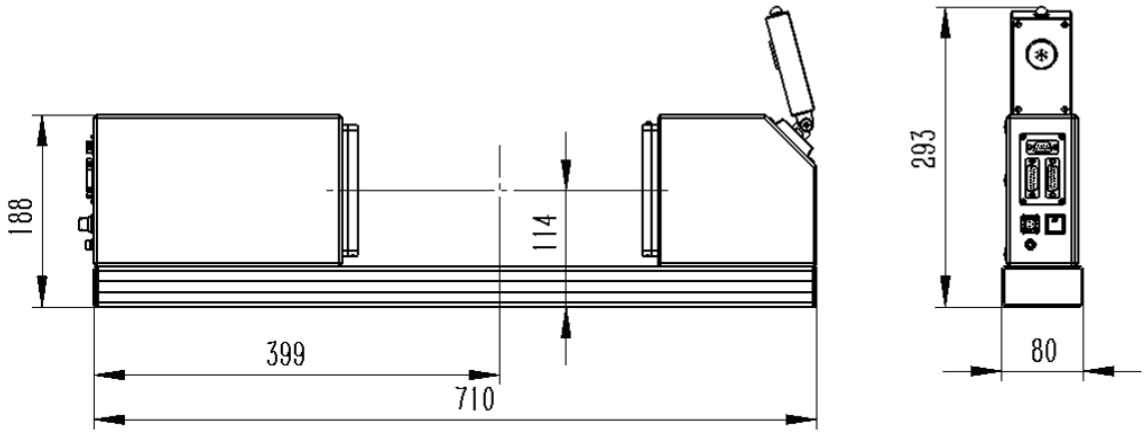


Figure 12-1 (g) Opmac 70AL

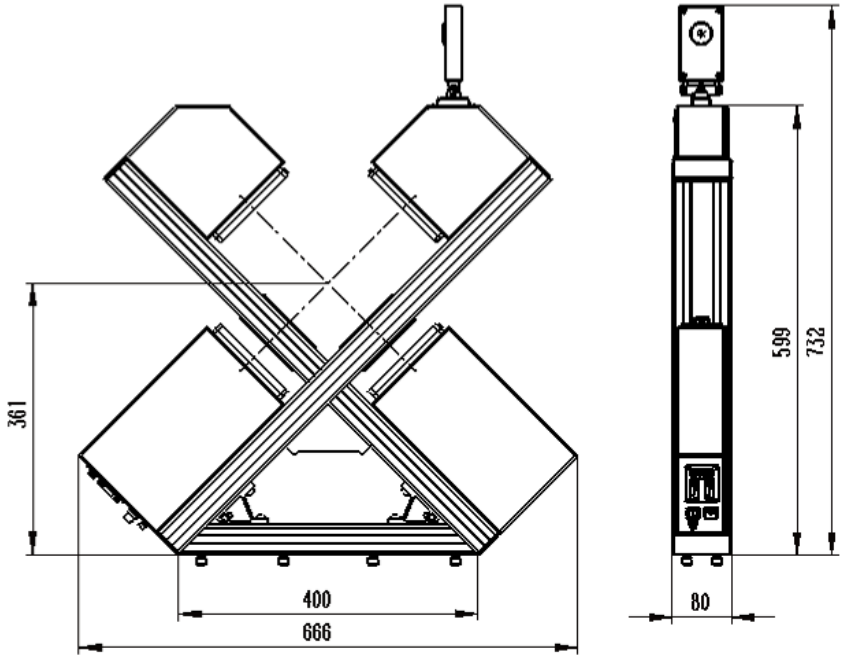


Figure 12-1 (h) Opmac 70BL

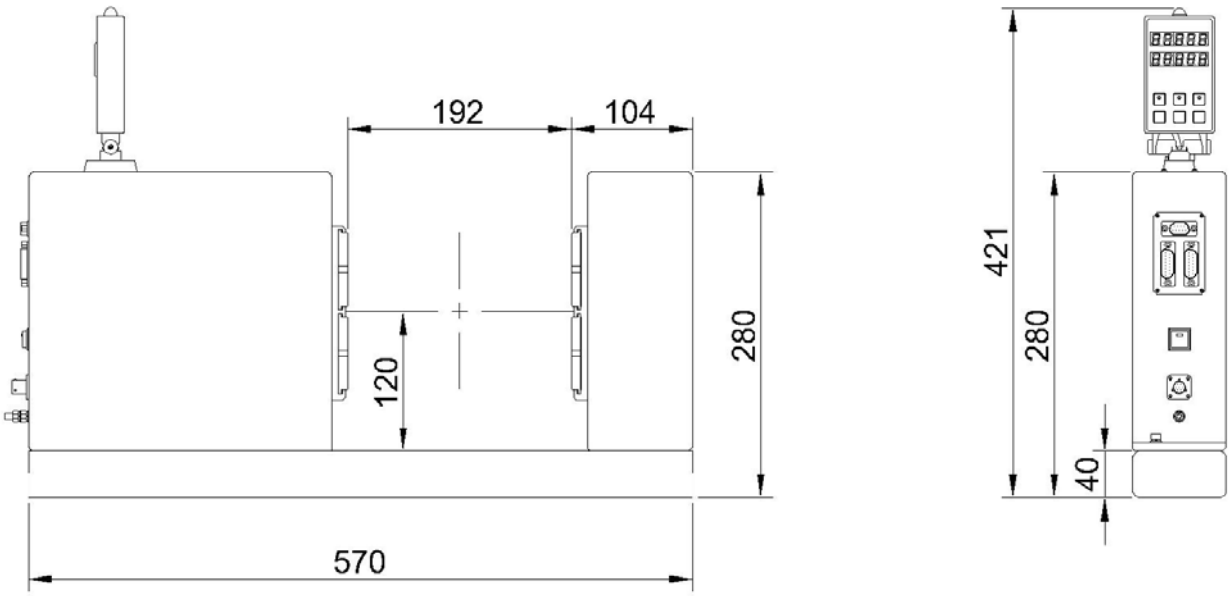


Figure 12-1 (i) Opmac 90AL

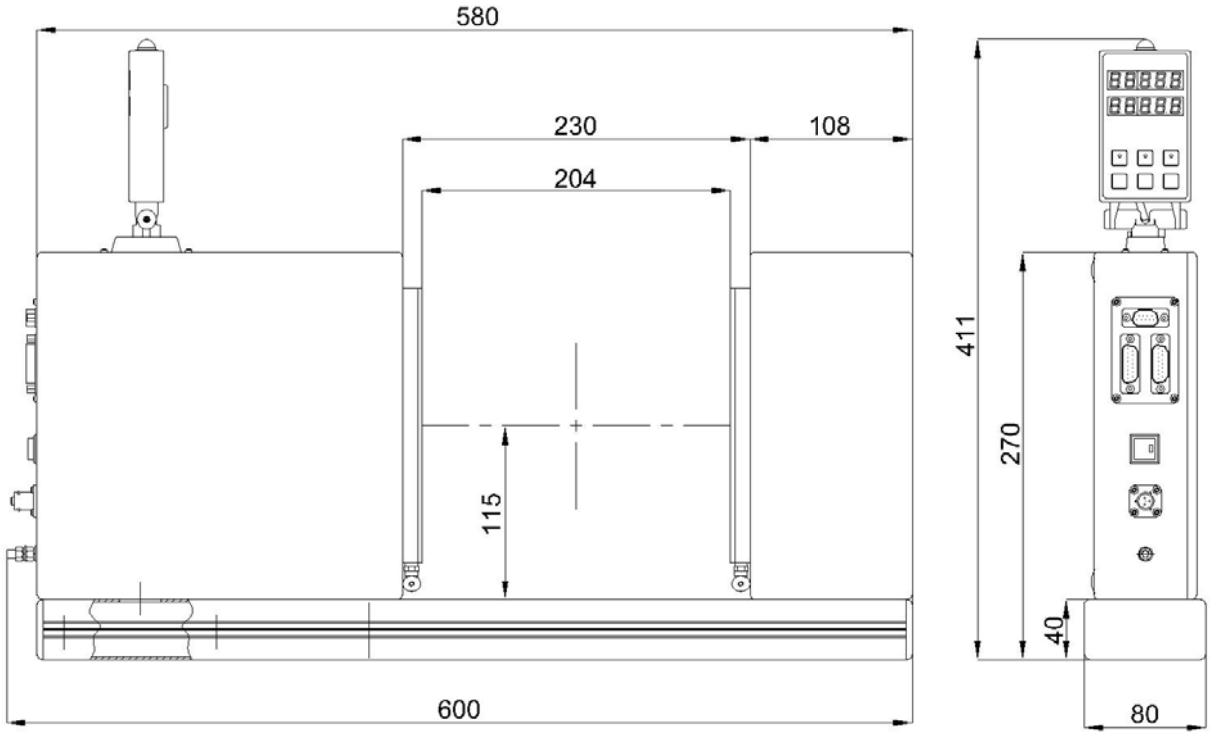


Figure 12-1 (j) Opmac 100AL

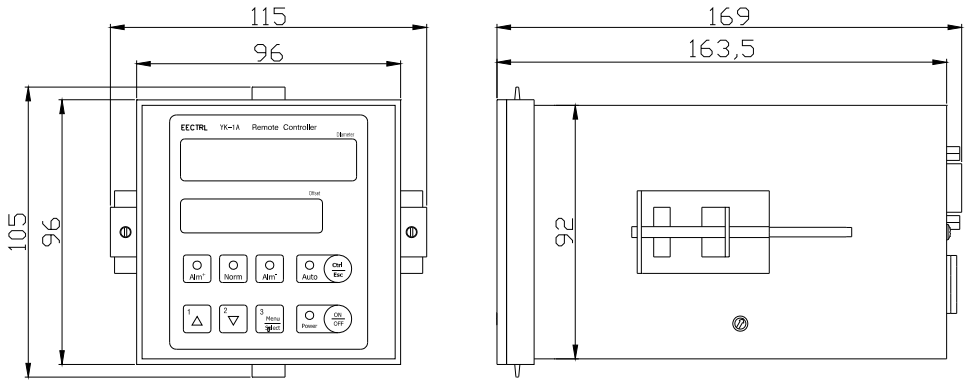


Figure 12-1 (k) YK－1A Remote Controller

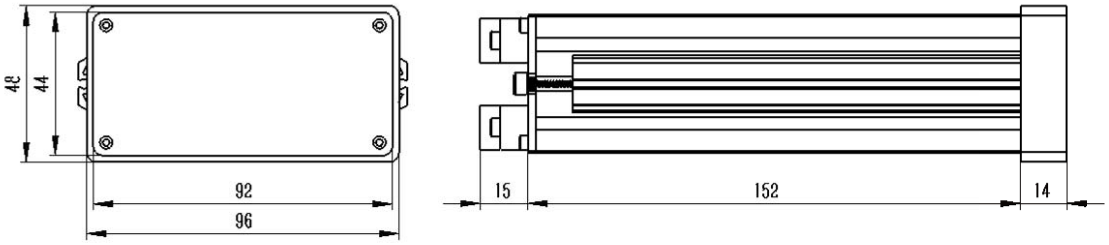


Figure 12-1 (l) YK-1B Remote Controller

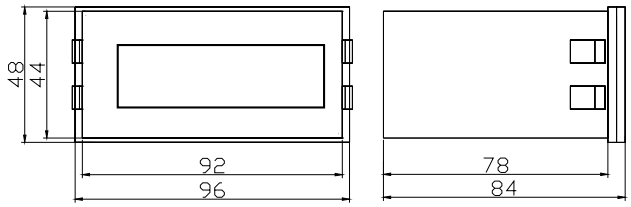


Figure 12-1 (m) YX-0.5A remote displayer

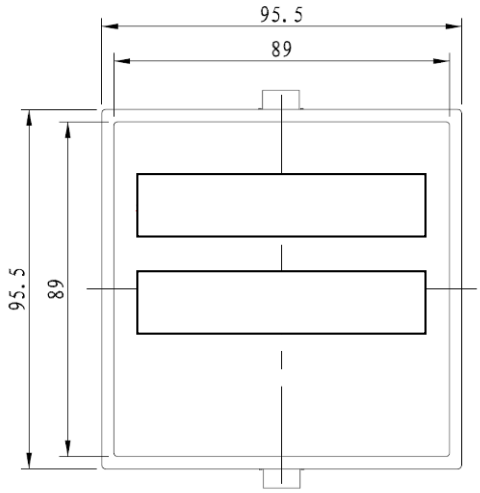


Figure 12-1 (n) YX-0.5B remote displayer

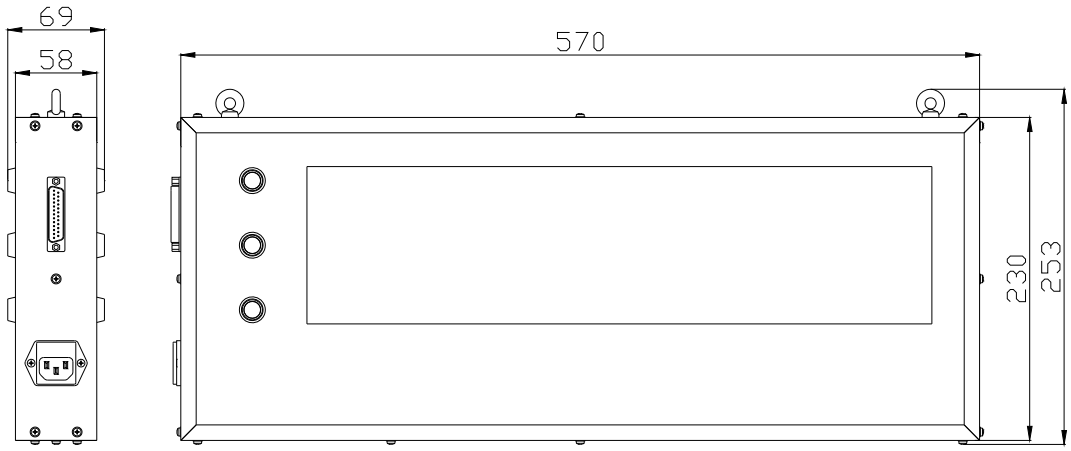


Figure 12-1(o) 4-inch remote displayer

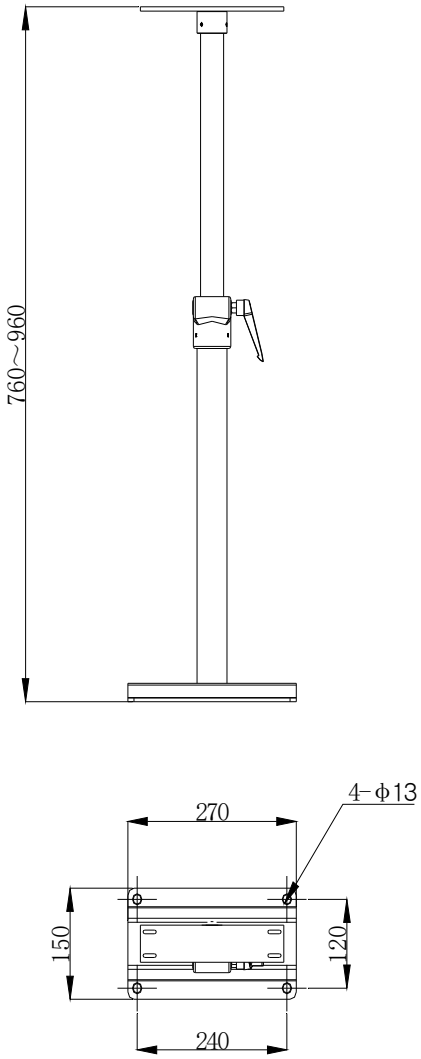


Figure 12-1(p)Bracket

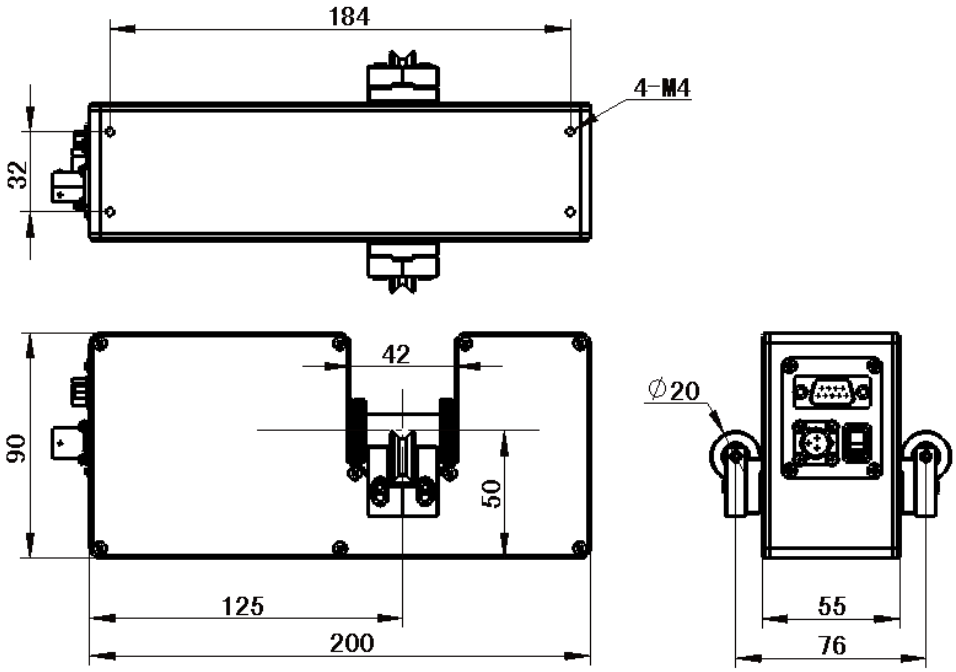


Figure 12-1(q) Opmac 5AL

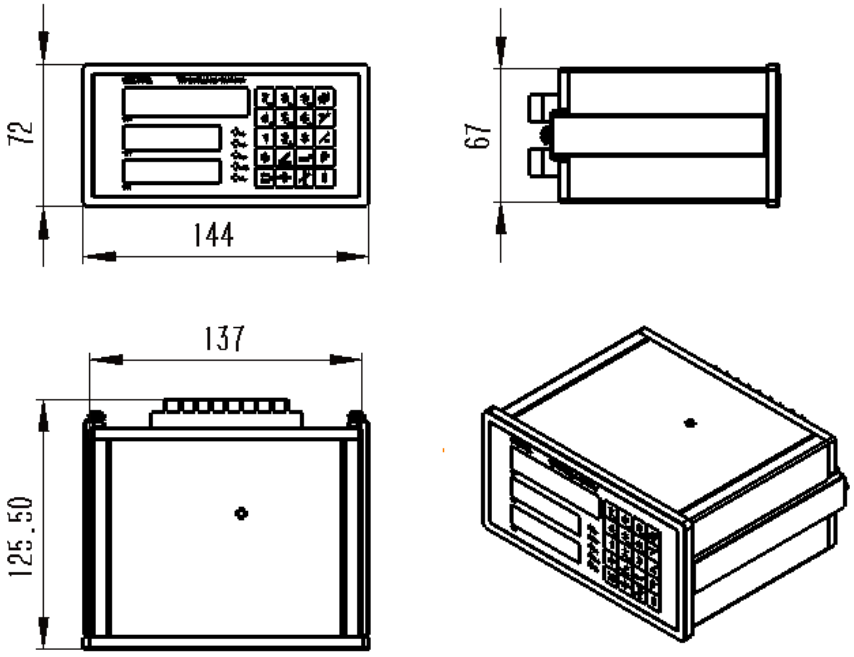


Figure 12-1 (r) YK-2A Remote Controller

13 Maintenance

13.1 Please keep the protection lens clean, which are at light-in area and light-out area of the measurement instrument while working. Use lens paper to clean dust**.**

13.2 Dry the wire from flume while using the production line in case of water on wire surface defect the measurement precision.

13.3 Reference bar should be cleaned with petrol or alcohol and rubbed with lens paper or absorbent cotton before use and smear oil after use to prevent rust.

13.4 FAUL suggests malfunction, maybe the scanning motor stopped, the laser generator fault or measuring area is blocked.

14 Malfunction and Solutions

14.1 No scanning light at light-in area, FAUL showing on screen.

- Scanner is not working or no output of laser---internal malfunction
- Dislocation of protection lens cover in light-out area blocks scanning beam, causing no scanning signal. Just loosen the fixing snail of lens and adjust its position.

14.2 Only part of the scanning light is on light-out area, while FAUL showing on screen.

- If there is any object on protection cover or lens which shields the scanning beam, just clean it with dehydrated alcohol and rub with lens paper.
- If the protection cover in light-in and light-out area is dislocated blocking scanning light, just re-locate the cover.

14.3 While EUT in measuring area but - - - showing on screen or flickering with measured value alternately.

- If there is any dust near light-in and light-out area which reduces light, just clean lens.
- If scanner's speed is low or laser beam is reduced, it is inner malfunction.

14.4 No display after powering on and no reaction pressing any key.

- Damage of display panel or inner malfunction.
- Dislocation of measurement instrument when powering on shortly after power off. Just power it off and again on it after 10 seconds.

14.5 Serious measuring error

- If there is dust on protection lens effecting precision, just clean lens.
- If EUT is dislocated from measuring center or dithering , just adjust bracket and place the object in center of measuring area of the gauge.

14.6 Communication fault

- Wrong connection,.
- Wrong communication format, please read Chapter 8 "communication" for details.

- Damage of inner communication module, please contact us for maintenance.

14.7 Analog output fault

- Wrong connection.
- Short circuit of peripheral interface, please check peripheral connection.
- Damage of measurement instrument's interface.

14.8 The instrument display"Err-1".

- The laser diameter measurement instrument of software after V1.07 version and the Remote controller of software after V1.06 version have this function.
- This phenomenon is caused by the within data of the instrument are littered by accident. At this time, enter into the second menu, check the parameters and the measuring data, under the condition of no problem, save the data, "Err-1" display disappear.

14.9 The instrument display "Err-2"。

- The laser diameter measurement instrument of software after V1.07 version and the Remote controller of software after V1.06 version have this function.
- This phenomenon is caused by that when read the exterior backup parameters, the exterior backup parameters come forth error. Please contact with our company's technician.

Note: If there is any inner malfunction of the measurement instrument, please contact us for maintenance.

15 Accessories

Power cable.	2 pcs
Master bar.	1 pcs
Cleaning ball.	1 pcs
Lens paper.	1 copy
Control cable.	1 pcs
Serial communication cable.	1 pcs

Conform to delivery list.

16 After-sale service

Within one year, if the machine has fault, we guarantee for maintenance and change if the measurement instrument is properly stored and used.

Attachment

ASC II character and code synopsis

Binary Number								0 0 0	0 0 1	0 1 0	0 1 1	1 0 0	1 0 1	1 1 0	1 1 1
B_7↓	B_6↓	B_5↓	B_4↓	B_3↓	B_2↓	B_1↓	HEX (high) HEX (low)	0	1	2	3	4	5	6	7
			0	0	0	0	0	NUT	DLE	SP	0	@	P	、	p
			0	0	0	0	1	SOH	DC1	!	1	A	Q	a	q
			0	0	1	0	2	SOH	DC2	″	2	B	R	b	r
			0	0	1	1	3	ETX	CD3	#	3	C	S	c	s
			0	1	0	0	4	EOT	CD4	$	4	D	T	d	t
			0	1	0	1	5	ENQ	NAK	%	5	E	U	e	u
			0	1	1	0	6	ACK	SYN		6	F	V	f	v
			0	1	1	1	7	BEL	ETB	’	7	G	W	g	w
			1	0	0	0	8	BS	CAN	(	8	H	X	h	x
			1	0	0	1	9	ET	EM	)	9	I	Y	i	y
			1	0	1	0	A	LF	SUB	★	:	J	Z	j	z
			1	0	1	1	B	VT	ESC	+	;	K	[	k	{
			1	0	0	0	C	FF	FS	,	<	L	\	l	!
			1	1	0	1	D	CR	GS	−	=	M	]	m	}
			1	1	1	0	E	S0	RS	.	>	N	(↑)^	n	~
			1	1	1	1	F	SI	US	/	?	O	(←)-	o	DEL