TMR360 Surface Roughness Tester Operating Manual

TMTeck Instrument Co.,Ltd.

1 Profile

TMR360 surface roughness tester is a type of stylus surface roughness measuring instrument,it is applied to

Production field,laboratory and measurement room,it can measure the surface roughness of various machined parts,it can count the corresponding parameters according to the selected measurement conditions,and it displays clearly all measurement parameters and outline figures on LCD display.

TMR360 surface roughness tester is accorded with the following standards:

GB/T 3505-2009 *Geometrical Product Specifications (GPS) Surface Texture Profile Method Terms Definition and Surface Structure Parameters*

GB/T 6062-2009 *Geometrical Product Specifications (GPS) Surface Texture Profile Method Nominal Characteristics of Contact (Stylus) Instrument*

Characteristics:

- Multiparameter measurement: Ra,Rz,Ry,Rq,Rp,Rv,Rt,R3z,Rmax, RSk,RS,RSm,Rmr
- High precision inductive sensor
- Four filter modes are respectively RC,PC-RC,GAUSS,D-P;
- Be compatible with TSO,DIN,ANSI,JIS;
- OLED liquid crystal can display Chinese characters,all parameters and figures;
- Built-in standard RS232 interface, USB interface;
- Two shutdown modes:manual shutdown, automatic shutdown;
- Split design,small drive,convenient use.

1.1 Measurement principle

When measuring the surface roughness of the workpieces,put the sensor on the workpiece surface to be measured,the driving mechanism in the drive drives the sensor to do a constant speed sliding movement along the surface to be measured,the sensor can feel the roughness of the surface to be measured by the built-in sharp stylus,at this time,the roughness of the workpiece surface to be measured causes the stylus displacement that can prompt the inductance of the sensor inductive coil to be changed,so as to generate the analog signal that is proportional to the roughness of the surface to be measured on the output terminal of sensor,this signal enters into data acquisition system after amplifying,and then count the digital filter and parameters of the acquired data,read the measured result on LCD display,or output on the printer,as well as communicate with PC computer.

1.2 Standard configuration

Name	Quantity	Name	Quantity
Standard sensor	1 piece	Nine-core plug docking cable	1 piece
Mainframe	1 unit	Test block positioning board	1 block
Drive	1 piece	Opener	1 piece
Standard template	1 piece	Magnetometer base connection parts	1 set (optional)
Power adapter	1 piece		

1.3 Each instrument component name

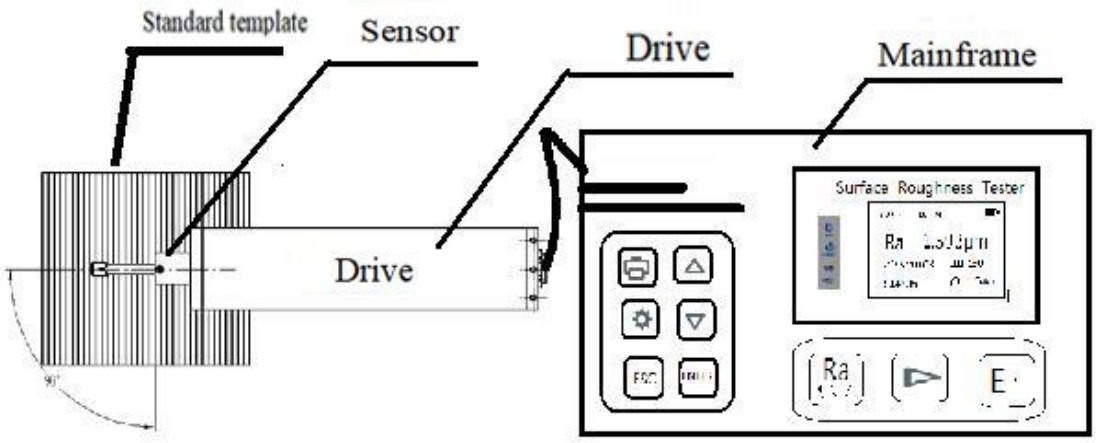


Figure 1-1-1 A complete unit

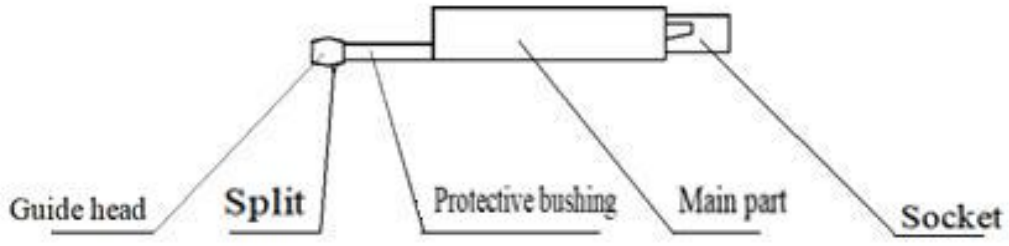


Figure 1-1-2 Sensor

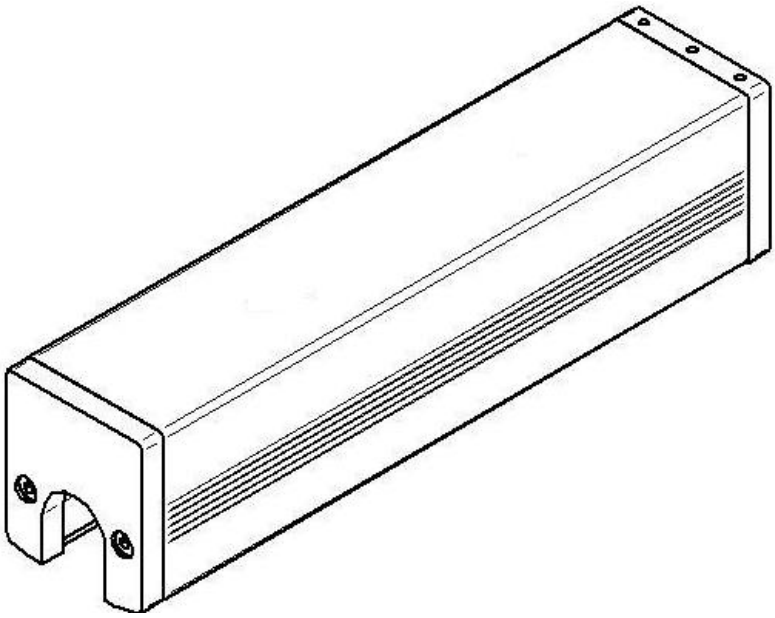


Figure 1-1-3 Drive

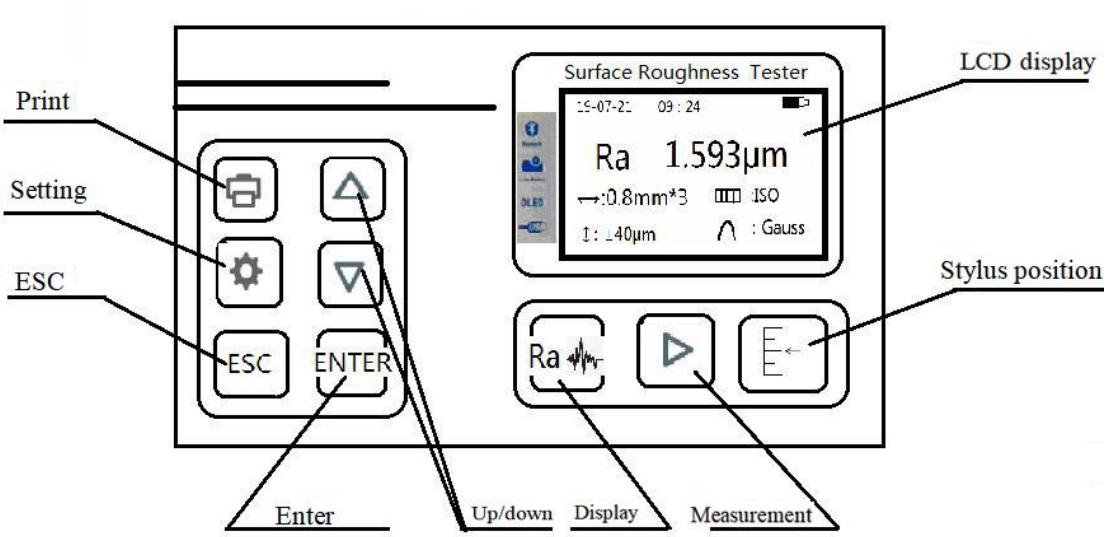


Figure 1-1-4 Front view of mainframe

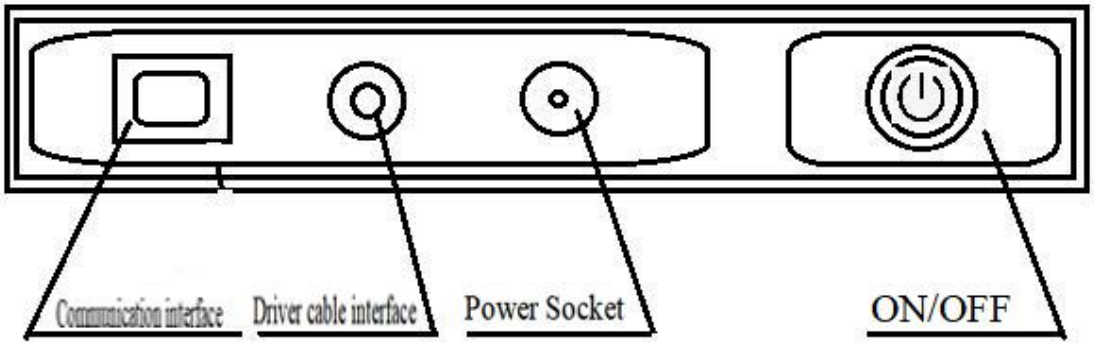


Figure 1-1-5 Side view of mainframe

1.4 Basic connection method

1.4.1 Installation and disassembly of the sensor

Hold the main part of the sensor in installing process,according to Figure 1-2, insert the sensor to the connecting sleeve of the sensor at the bottom of the drive,and then push slightly it to the bottom.Hold the main

part of the sensor or the base of the protective sleeve in disassembling process,and then slowly pull out.

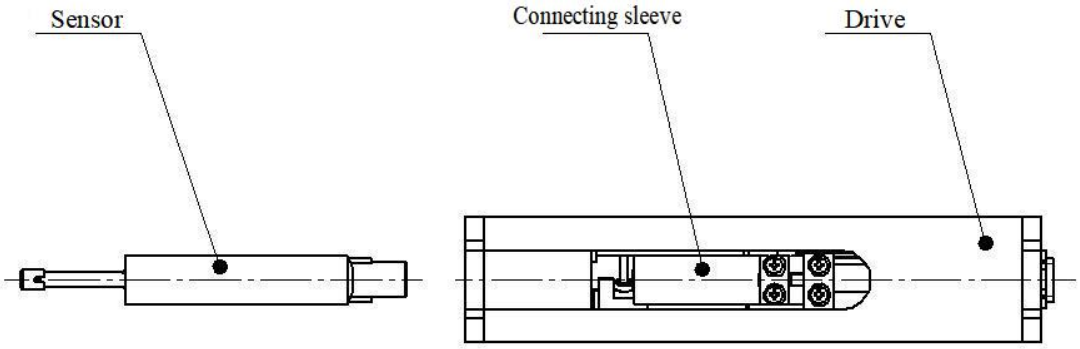


Figure 1-2 Installation and disassembly of the sensor

Tips: 1. The stylus of the sensor is a key part of this instrument,pay high attention to it.
2. Do not touch the stylus in disassembling process,avoid it getting damaged.
3. Make sure the connection is reliable when installing the sensor.

1.4.2 Power adapter and battery charging

When the battery sign on the display shows ,it means the voltage is too low,try to charge the instrument as soon as possible.Connect the power adapter to 220V 50Hz municipal electricity, and then insert the power plug of power adapter to power socket of the instrument, it will start to charge. The charging time is around 3.5h. The instrument can work normally in charging process.

Tips: 1. When measuring the workpieces in charging state,pay attention to the connecting line layout,avoid the measurement operation get affected.

2. Significance of battery voltage icon:

It shows the voltage is normal,the measurement operation can be carried on;the black part in the icon represents the battery capacity;It is charging;

The battery is full.

3. Insert the charger in power-off state, the instrument will automatically turn on.

4. Turn off the instrument in charging state,the instrument only displays the charging prompt.

5. If the instrument can not work normally,and the problem still exists when turn on,turn off the instrument, need to pull out the charger, turn off the battery switch,and then turn on after 10 seconds.

2 Measurement operation

2.1 Preparation before the measurement

a. Turn on the instrument and check if the battery voltage is normal;

b. Clean the workpiece surface to be measured;

c. According to Figure 2-1,Figure 2-2, put the drive correctly,stably and reliably on the workpiece surface to be measured.

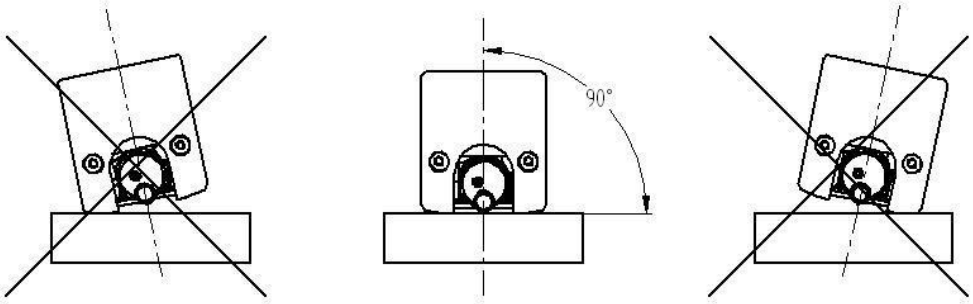


Figure 2-1 Front view

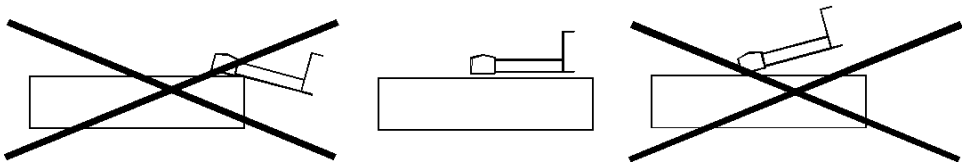


Figure 2-2 Side view

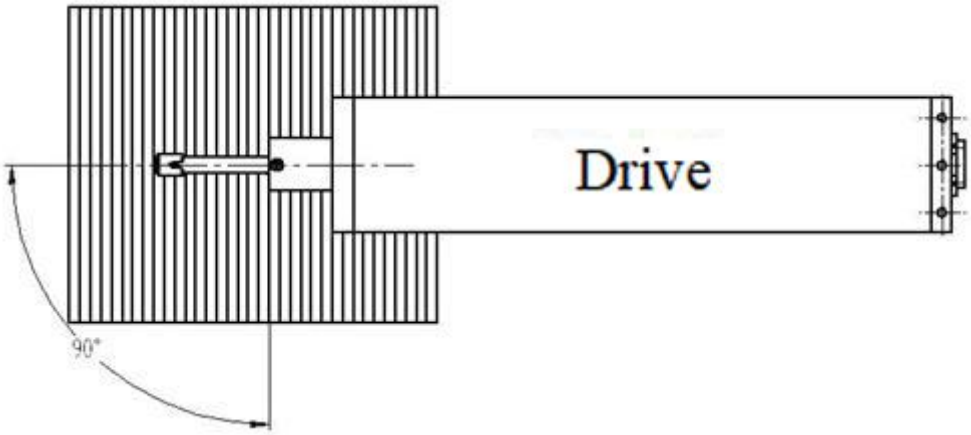


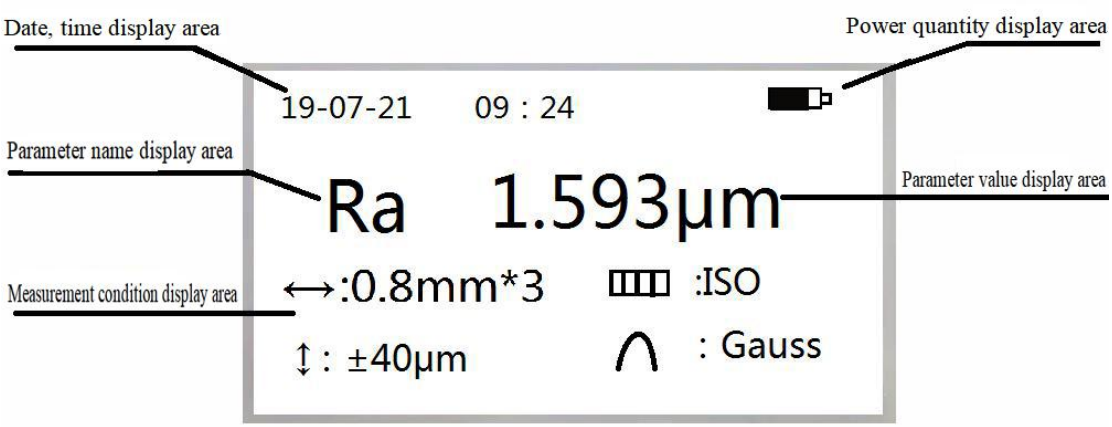
Figure 2-3 Measurement direction

Instructions: Correct,standard operation is the premise for obtaining the accurate measurement result,please comply with it.

2.2 Basic measurement state

Press power key ⏻ , the instrument is turned on,its model,name and manufacturer information will be automatically displayed,and then enter to the basic measurement state,as shown in Figure 2-4.

Start-up state



Basic measurement state

Figure 2-4 Start-up process

Instructions: The content displayed in basic measurement state after the first start-up operation is the default setting of this instrument,the previous content will be displayed after turned on the instrument in the next time,it will automatically enter the basic measurement state (as shown in Figure 2-4) after turned on the instrument every time

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In basic measurement state,the following operations can be carried on:

- Measurement

  Press Start key ▷,the measurement is starting,as shown in Figure 2-5

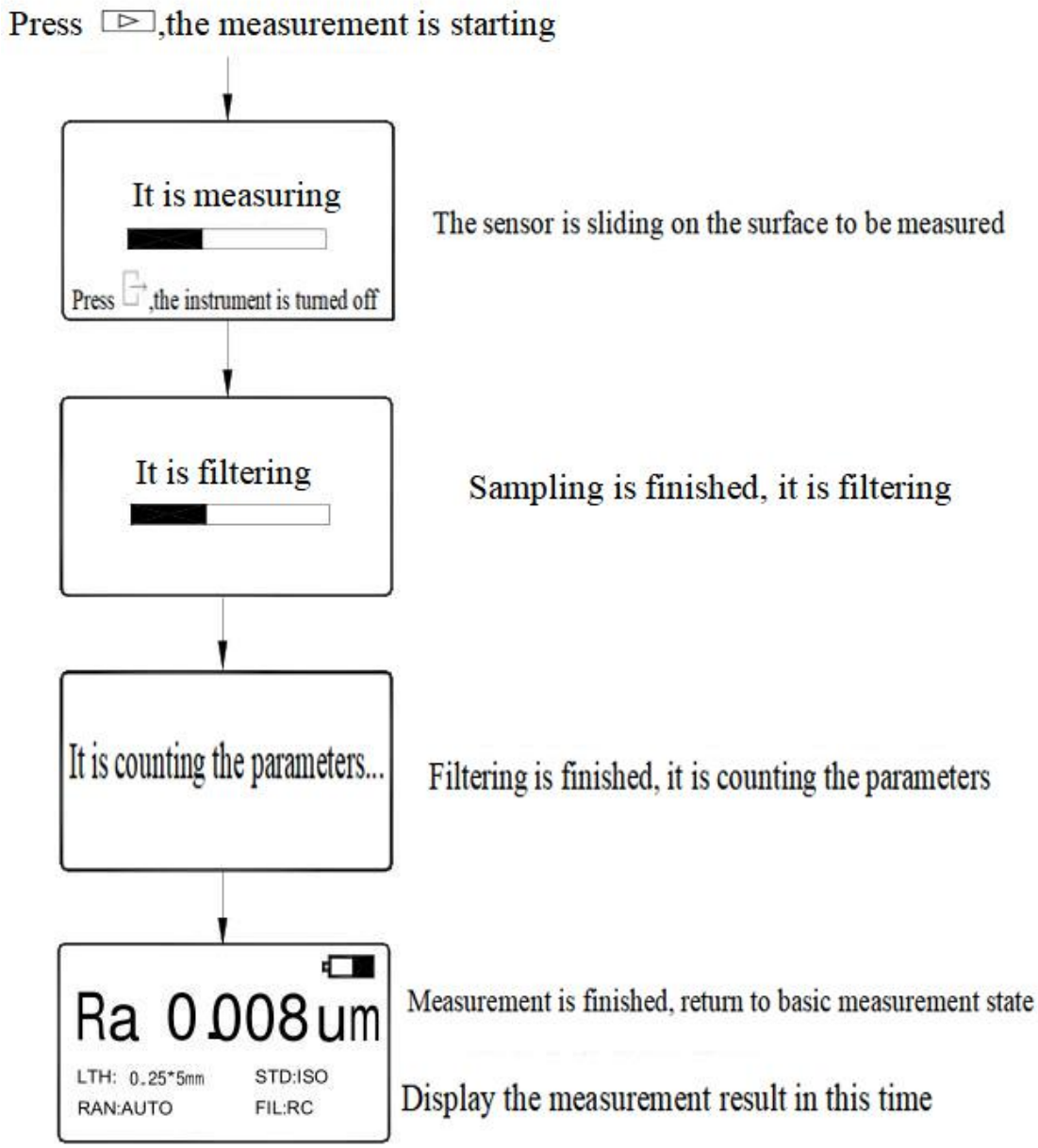


Figure 2-5 Measurement process

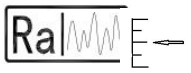
◆Enter the menu operation state

Press setting key ,enter the menu operation state,the specific operating steps can be referred to the Statement in the f w-up corresponding chapters and sections

◆Display the measurement parameters value

First press Ra displays all parameters value of this measurement, press roll key , it rolls the page up and down:

Second press Ra displays the profile curves of this measurement,press



,the other profile curves on the sampling length are displayed up and down; press again to repeat the above content, press ESC key in this state to return to the basic measurement state (as shown in Figure)

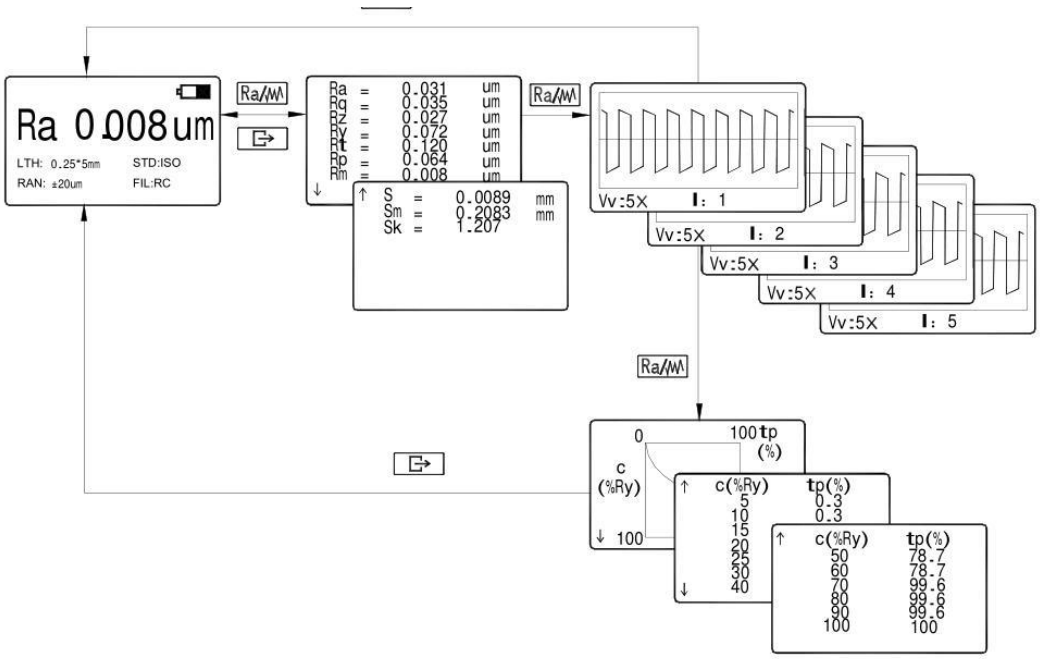


Figure **2-6** Parameter display

◆Display the stylus position

Press  , the stylus position can be displayed by shortcut mode, it is very convenient in actual measurement operation.

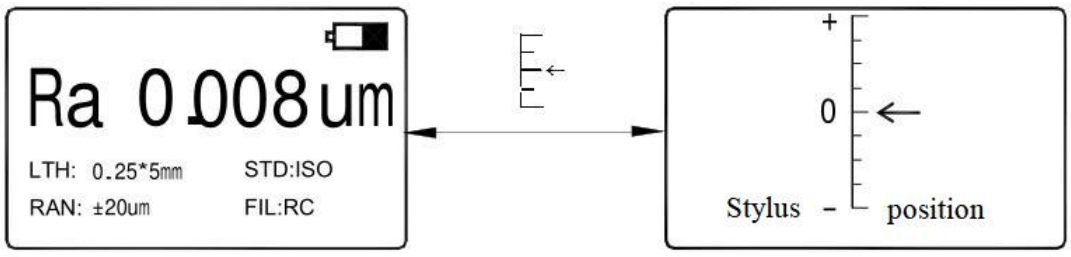


Figure 2-7 Stylus position

Instructions: 1. The instrument automatically saves the last measurement results and measurement conditions before turning off the instrument,it automatically enters this state after turned on the instrument in the next time; but all measurements data will be lost if the instrument is stopped in measuring process.

2. After turned on and entered the basic measurement state,if not need to change the measurement conditions,can directly press start key ▷ to carry on measurement.

3. When pressing Ra to display the profile figure,can press ENTER to change the figure magnification multiples,the magnification multiples are displayed in turn as 1× → 2× → 5× → 10× → 20× → 50×.

4. If the stylus approaches the limit position of the measurement range or exceeds the measurement range, it can be adjusted through moving slightly the position of the senor, but it must be accorded with the instructions in 2.1 Preparation before the measurement (the adjustment is usually not required)

2.3Change the measurement conditions

In basic measurement state, first press the setting key ⚙ ,enter to menu operation state,and then press △▽ to select measurement condition setting functions, later on, press ENTER key to enter the measurement condition setting state. All measurement conditions can be changed in this state (as shown in Figure 2-8)

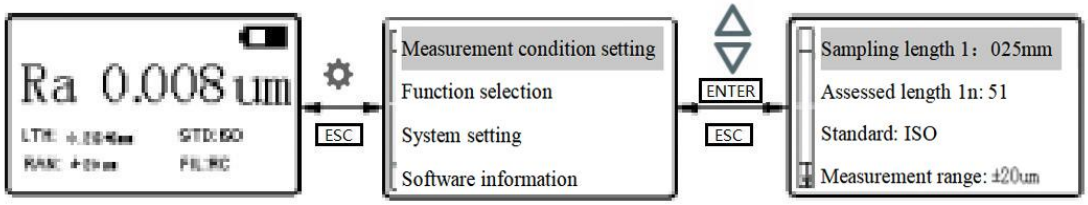


Figure 2-8 Select the measurement condition setting state

2.3.1 Sampling length

After entered the measurement setting state,press △▽ key to select sampling length setting function, press [ENTER] key,

0.8 mm ►2.5mm ►Automation►0.25mm

will be displayed in turn (as shown in Figure 2-8),after stopped to the required setting value, press △▽ key to change the other content.

2.3.2 Assessed length

After entered the measurement setting state, press △▽ to select sampling length setting function,press [ENTER] key to enter measurement setting state, and then press △▽ key to select the assessed length setting function, press [ENTER] key, 1/ ►2/ ►3/ ►4/ ►5/ are displayed in turn,they respectively represent the assessed length includes 1-5 sampling length (as shown in Figure 2-9)

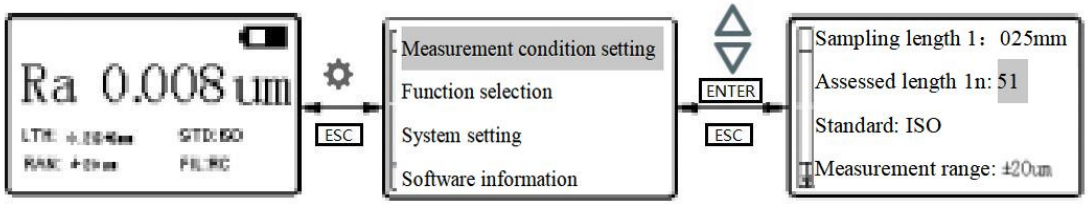


Figure 2-9 Change the assessed length

Instructions:When the sampling length is set as automatic mode,the assessed length will display 51 corresponding with it,and it can not be changed.

2.3.3 Standard

After entered the measurement setting state,press △▽ key to select the sampling length setting function, press [ENTER] key to enter the measurement setting state, and then press △▽ key to select the standard setting function, press [ENTER] key, ISO ► DIN ►JIS ► ANSI are displayed in turn.

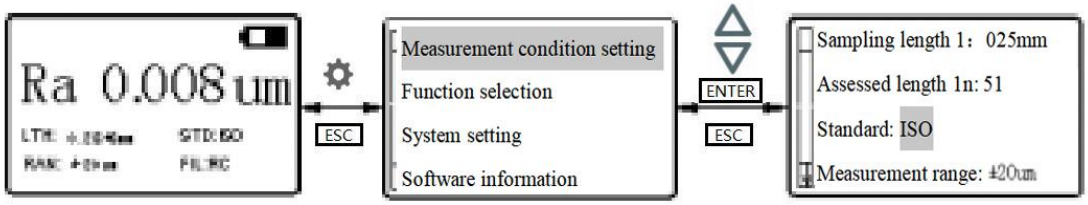


Figure 2-10 Change the standard

Table 2 Comparison of standard codes and names

Code	Standard name
ISO 4287	International standard
DIN 4768	German standard
JIS B601	Japanese industry standard
ANSI B46-1	American standard

2.3.4 Standard

After entered the measurement setting state,press △▽ key to select the measurement range setting function, press ENTER key, ±20μm；±40μm；±80μm are displayed in turn.

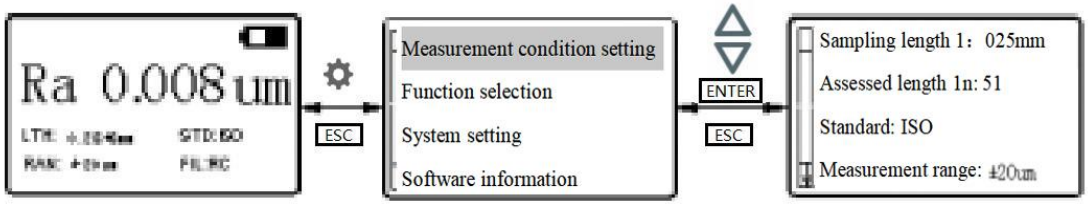


Figure 2-11 Change the measurement range

2.3.5 Filter

After entered the measurement setting state,press △▽ key to select the measurement range setting function, press ENTER key, RC;PC-RC;Gauss;D-P are displayed in turn.

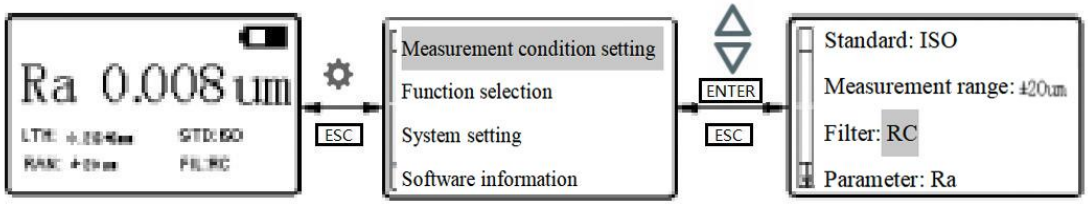


Figure 2-12 Change the filter

2.3.6 Parameters

After entered the measurement setting state,press △▽ key to select the parameter setting function, press ENTER key,

Ra;Rq;Rz;Rt;Rp;Rv;Rs;RSm;RSk;Rmr;Rpc are displayed in turn.

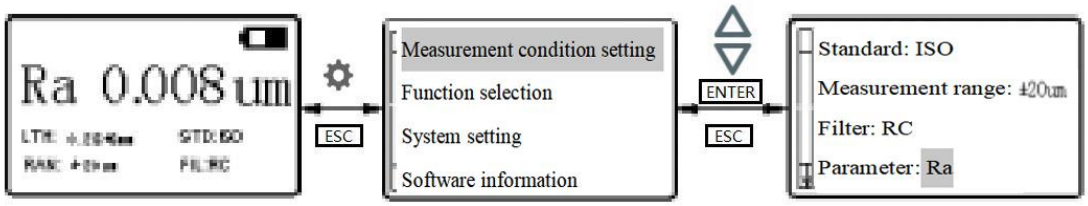


Figure 2-13 Change the display parameters

2.3.7 Unit

After entered the measurement setting state,press △▽ key to select the parameter setting function, press ENTER key, Metric/British are displayed in turn.

2.4 Print function

In basic measurement state, press key to enter menu operating state, and then press △▽ to select print function,at last, press ENTER key to enter print function setting state.

In print function setting state, firstly, press △▽ to select the printer matching, secondly, press ENTER key to match the selected printer;

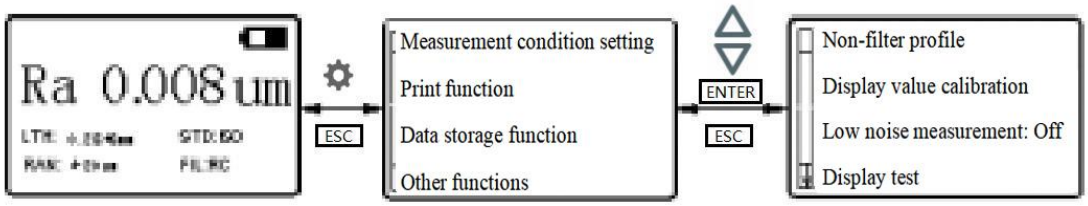
At last, press ESC key to return to print function setting interface,and select the required print content.

2.5 Data storage function

In basic measurement state,press key to enter menu operating state, and then press ▲▼ to select data storage function,later on, press ENTER key to enter data storage function setting state. At last, press ▲▼ key to select the item and press ENTER to read.

2.6 Other functions

In basic measurement state,press key to enter menu operating state,and then press ▲▼ to select the other functions, at last, press ENTER key to enter other functions setting state.



2.6.1Non-filter profile

In other function setting state, press ▲▼ to select non-filter profile and then press ENTER key.The figure of non-filter profile (also called direct profile or original profile) of this measurement will be displayed on LCD screen.

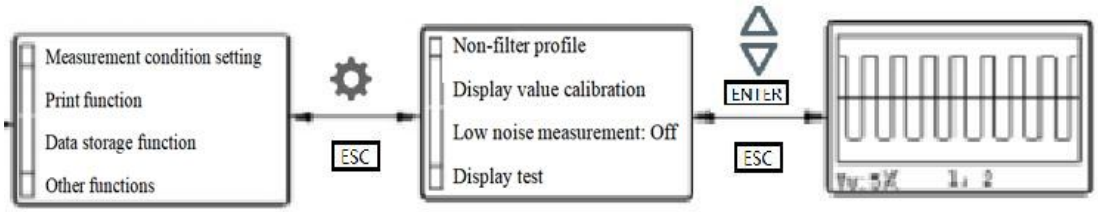


Figure 2-22 Select non-filter profile function

2.6.2 Display value calibration

In other function setting state, press △▽ to select the display value and then press ENTER key.After entered display value calibration function state, press △▽ to change the display value calibration coefficient,and then press ENTER key to move the cursor.

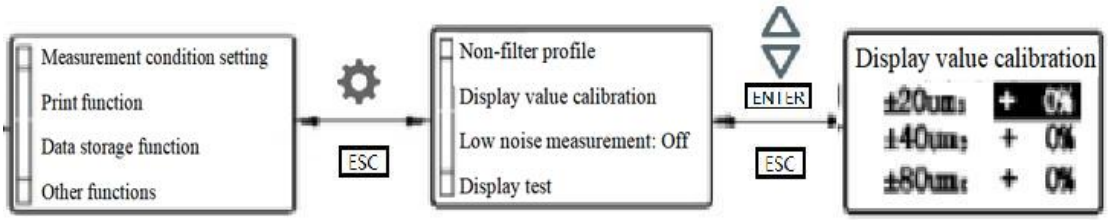
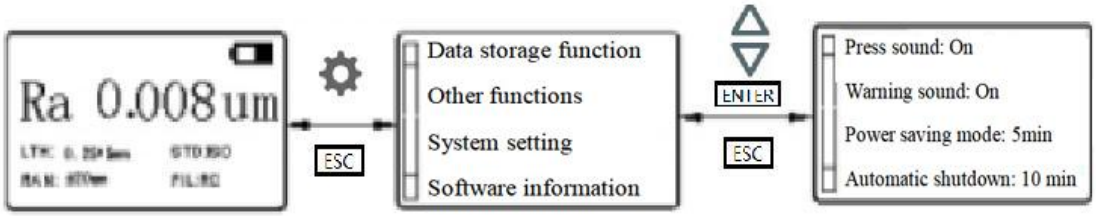


Figure 2-24 Select the display value calibration function

Instructions: 1. When testing the random template by a correct measurement method, if the actual measurement value exceeds the calibrated template value ±10%, according to the percentage of actual deviation, the calibration will be carried on by the display value calibration function, the calibration range will not exceed ±20%. 2. In general conditions, the instrument has been passed by the strict test before delivering, the display value error is far less than ±10%, in this condition, we recommend the users do not use frequently the display value calibration function.

2.7 System setting

In basic measurement state, press key to enter menu operation state,and then press △▽ to select system setting,later on, press ENTER key to enter system setting state.



Instructions: In system setting state, the following items can be set: press sound; warning sound; power saving mode;automatic shutdown; clock setting; screen brightness;language.

3 Optional accessories and use

3.1 Measurement platform

TA series measurement platform is more convenient to adjust the position between the instrument and the workpiece to be measured, the operation is more flexible,smooth, the using range becomes larger, the roughness of the complex part surface can be measured. The stylus position can be more accurately adjusted, and the measurement is more smooth when connecting with TA series measurement platform. When Ra value of the surface to be measured is smaller, measurement platform is the best choice.

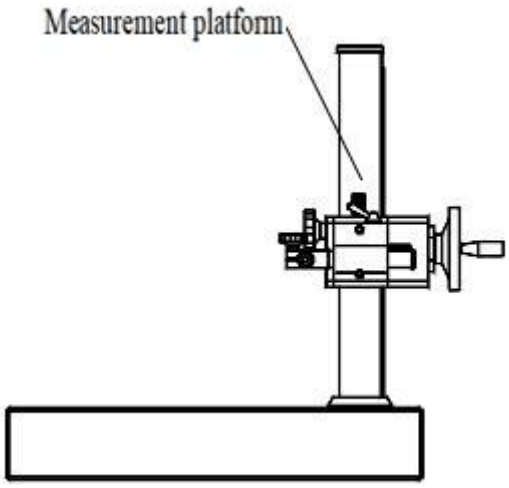


Figure 3-3 Measurement platform

3.2 Extension rod

Extension rod can increase the depth that the sensor enters inside workpiece, the extension rod length is 50mm.

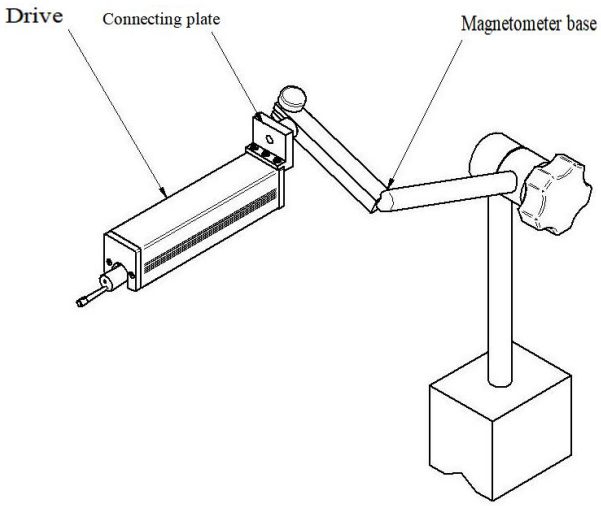


Figure 3-4 Extension rod

3.3 Magnetometer base connecting components

Magnetometer base connecting components can more flexibly measure the surface to be measured.

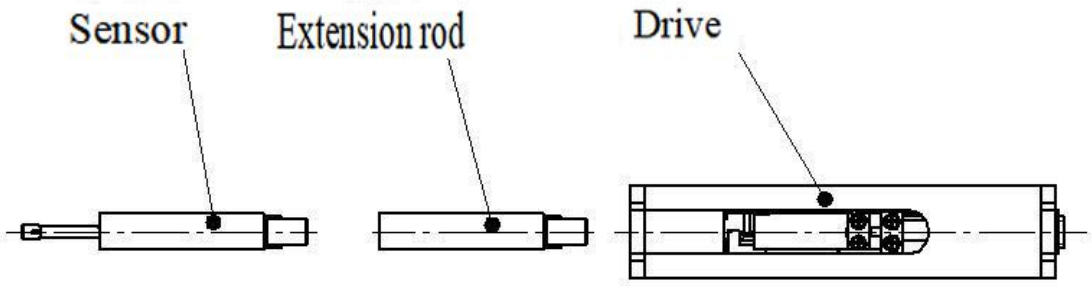


Figure 3-5 Magnetometer base connecting components

4 Technical parameters and functional characteristics

4.1 Sensor

Test principle: Inductive type
Measurement range: 160μm
Needle radius: 5μm
Needle material: diamond
Stylus dynamic: 4mN
Stylus angle: 90°
Vertical radius of guide head: 45mm

4.2 Drive parameters

Maximum drive travel：19mm/0.748inch
Driving speed: in measuring process

When sampling length = 0.25mm Vt=0. 25mm/s

When sampling length = 0.8mm Vt=0.5mm/s

When sampling length = 2.5mm Vt=1mm/s

Return V=1mm/s

4.3 Display value error

No more than ±10%

4.4 Display value repeatability

No more than 6%

4.5 Standard,profile and filter

Standard	Profile	
	P	R
ISO1997	GAUSS	GAUSS
JIS2001	GAUSS	GAUSS
ANSI		GAUSS 2RC

4.6 Sampling length 1

0.25mm，0.8mm，2.5mm optional

4.7 Assessed length 1n

1-5 optional

4.8 Measurement range and resolution

Table 5

Measurement range	Resolution
Automatic	0.01μm-0.04μm
±20μm	0.01μm
±40μm	0.02μm
±80μm	0.04μm

4.9 Power

Built-in battery: 1 lithium-ion charging battery

Power adapter: Input: 100 V～240VAC,50/60Hz

Output: 9V,1A

4.10 Temperature and humidity range

Working environment: Temperature: 0-40 ℃

Humidity: < 90% RH

Storage transport environment: Temperature: -25℃- 60℃

Humidity: < 90% RH

4.11 Roughness parameters and display range

Table 4

Parameters	Display range
Ra Rq	0.005 μ m ~ 16 μ m
Rz R3z Ry Rt Rp Rm	0.02 μ m ~ 160 μ m
Sk	0 ~ 100%
S Sm	1mm
tp	0 ~ 100%

5 Daily repair and maintenance

. Avoid collision,severe shock,dust,damp,oil pollution, strong magnetic field and other conditions;

. Sensor is a precision component of the instrument,please take care of it.The sensor must be put back to the packaging box after using;

. Take good care of the random template, avoid the calibration instrument is abnormal.

5.1 Failure processing

If the instrument appears failure, according to the measures in the next section Failure information, eliminate the failure, if still exist, send back to the manufacturer to repair. Users can not disassemble,repair by themselves. The instrument need to be sent to manufacturer should have the warranty card and the random matching standard template, in addition, the failure phenomenon must be stated.

7 Reference data

7.1 Profile and filter

7.1.1 Profile

a. Non-filter profile: The profile signal is obtained from the measured surface by sensor or the profile signal without filtering.

b. Filter profile: The profile signal after the original profile is eliminated the filter composition by filter.

7.1.2 Filter

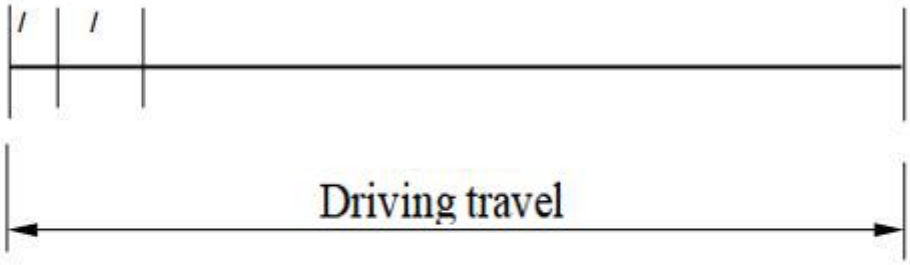
a. RC: Traditional second-order RC filter has phase difference;

b. PC-RC: Phase correction RC filter;

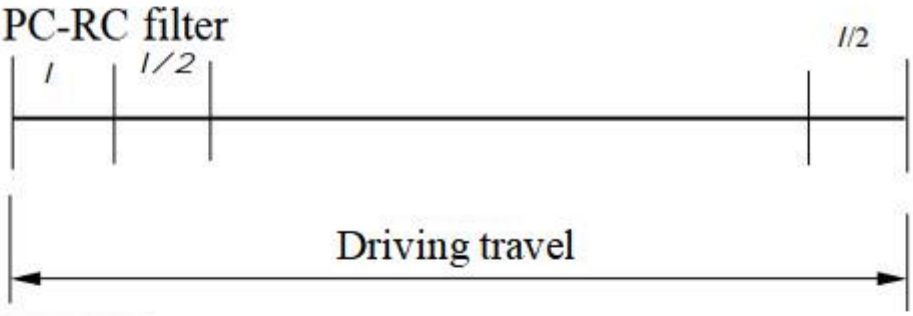
c. GAUSS (Gaussian filter): DIN4777

d. D-P (direct profile): Adopt least square method midline

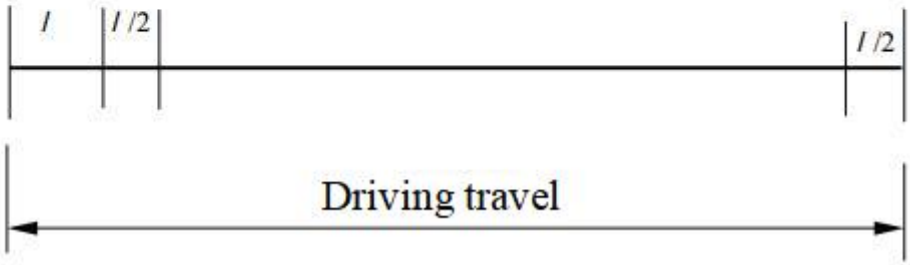
7.2.1 **RC filter**



7.2.2 PC-RC filter

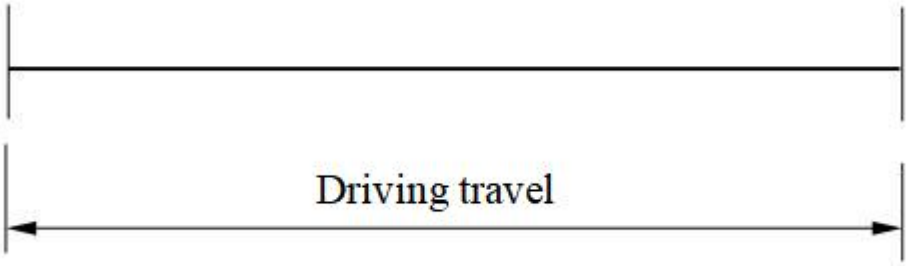


7.2.3 **Gaussian filter**



7.2 Driving travel length

7.2.4 D-P direct profile

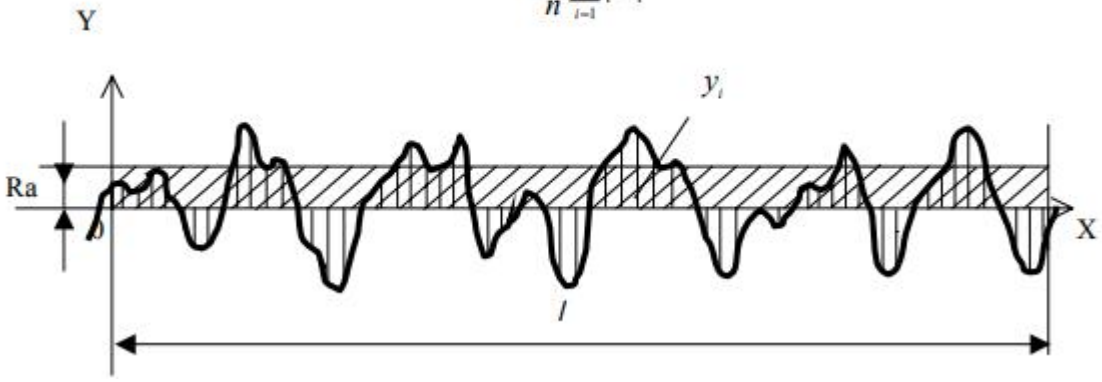


7.3 Roughness parameter definition

7.3.1 Arithmetic average deviation of profile Ra

Arithmetic average value of profile offset within the sampling length.

$$Ra = \frac{1}{n}\sum_{i=1}^{n}|y_i|$$



7.3.2 Root mean square deviation of profile Rq

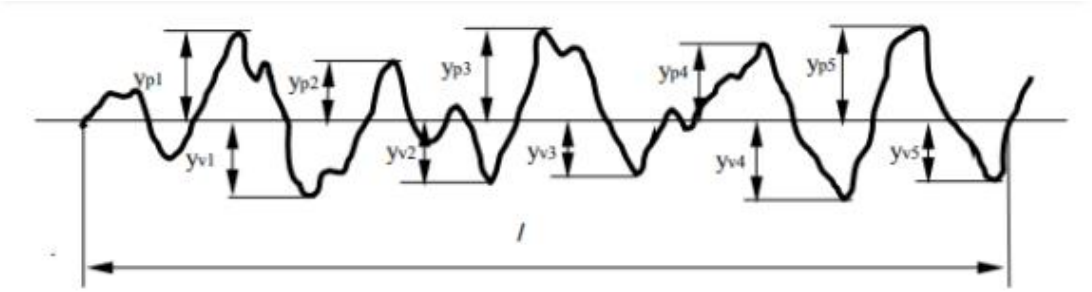
Root mean square of profile offset within the sampling length.

$$Rq = \left(\frac{1}{n}\sum_{i=1}^{n} y_i^{\,2}\right)^{\frac{1}{2}}$$

7.3.3 Ten point height of microcosmic unevenness Rz

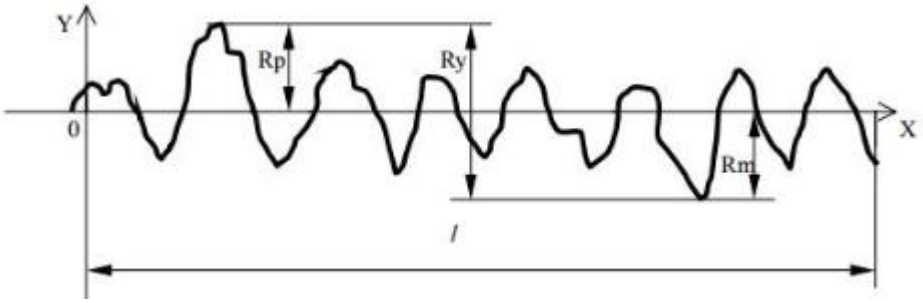
The sum of the average of 5 maximum profile peak height and the average of 5 maximum profile valley depth within the sampling length.

$$Rz = \frac{\sum_{i=1}^{5} y_{pi} - \sum_{i=1}^{5} y_{vi}}{5}$$



7.3.4 Maximum height of profile Ry (ISO)

The distance between profile peak line and profile valley line within the sampling length.



7.3.5 Maximum height of profile Ry (DIN)

Calculation method of Ry (DIN): First to calculate the distance value of profile peak line and profile valley line within each sampling length, secondly, take the maximum value in these values, that is to say Ry (DIN) within the assessed length.

7.3.6 Total height of profile peak and valley Rt

The distance between profile peak line and profile valley line within the assessed length.

7.3.7 Maximum peak height of profile Rp

The distance between profile peak line and midline within the sampling length.

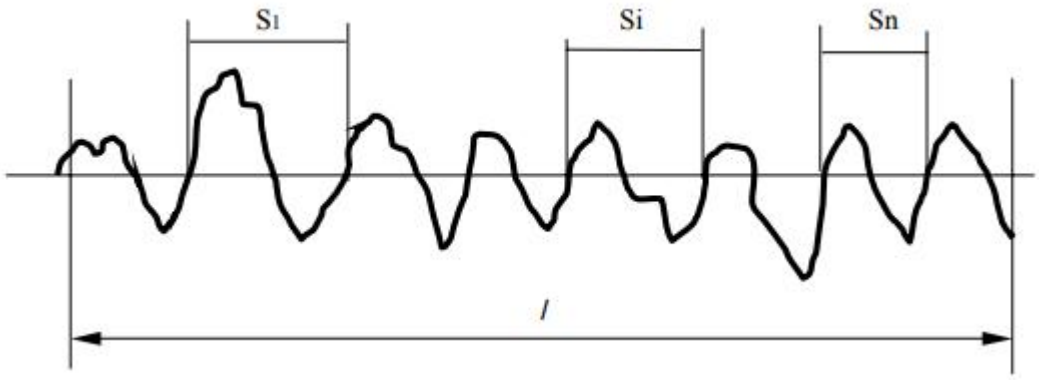
7.3.8 Maximum valley depth of profile Rm

The distance between profile valley line and midline within the sampling length.

7.3.9 Average spacing of contour micro irregularities Sm

The average of the spacing of the microirregularities within the sample length.

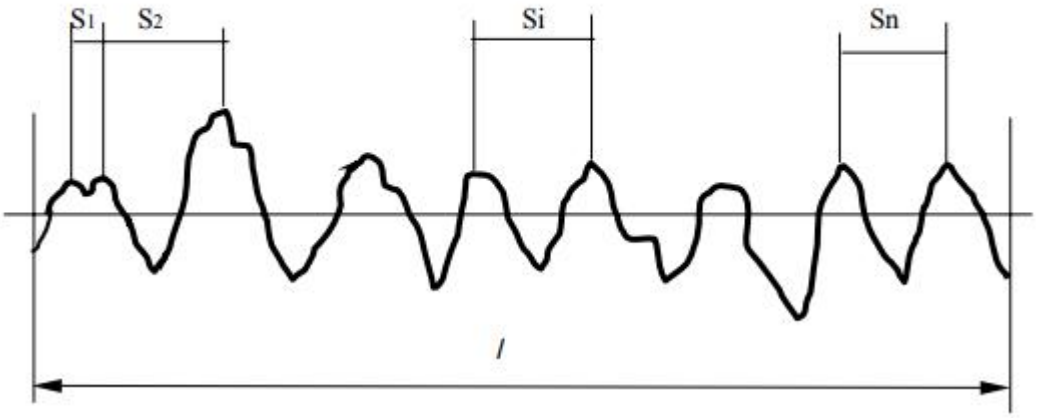
$$Sm = \frac{1}{n}\sum_{i=1}^{i=n} Si$$



7.3.10 Single peak average spacing of profile S

The average value of single peak spacing of the profile within the sampling length.

$$S=\frac{1}{n}\sum_{i=1}^{i=n}S_i$$

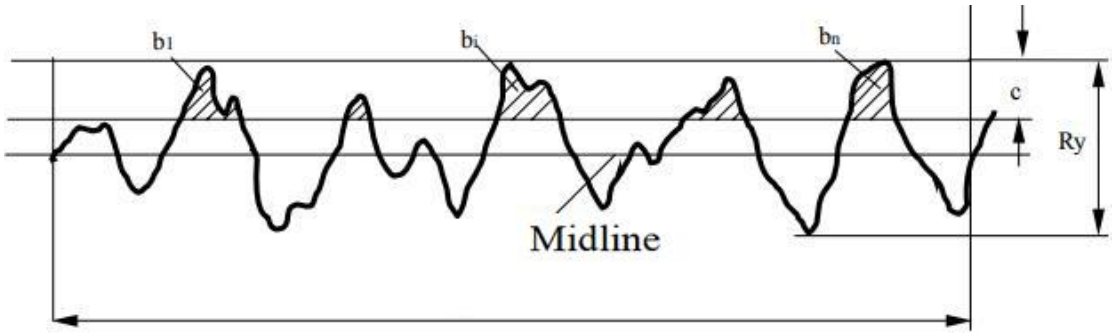


7.3.11 Profile support length rate tp

The ratio of profile support length and sampling length.

$$tp=\frac{\eta_p}{l}$$

$$\eta_p=b_1+\Lambda\ \Lambda+b_i+\Lambda\ \Lambda+b_n$$



7.3.12 Profile skewness Sk

Measurement of asymmetry of amplitude distribution.It is confirmed by n average of profile offset within the sampling length, and it is given out by the following formula.

$$S_k=\frac{1}{R_q^3}\times\frac{1}{n}\sum_{i=1}^{n}(y_i)^3$$

7.3.13 Average of third peak and valley height R3z

R3z is an average of the sum of the third profile peak height and the third profile valley depth on each sampling length within the assessed length.

8. Attached table: Magnification multiples displayed on screen

DOS / MR / FMR	×1	×2	×5	10×	20×	50×
±20μm	±20μm	±10μm	±4μm	±2μm	±1μm	±0.4μm
±40μm	±40μm	±20μm	±8μm	±4μm	±2μm	±0.8μm
±80μm	±80μm	±40μm	±16μm	±8μm	±4μm	±1.6μm