Newlead trade Suzhou Co.,Ltd
Suzhou Newlead Augmented Intelligence Equipment Co.Ltd

DDM-3020 Diameter Gauge for Measurement and Control

No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com

Operating Instructions

1 General

Type DDM-3020 is the third generation dynamic diameter gauge for measurement and control developed by Shanghai Online. Employing the measuring principle of high speed pulsed IR ray combined with high precision CCD sensor and aided by high speed digital image process technique, this generation gauge features high measurement accuracy, high stability, easy application and maintenance and extra-long service life. A complete set of the Gauge includes a DDM-3020 diameter measuring head, measuring head support and a separate DSP-3A Monitor.

DDM-3020 Dynamic Diameter Gauge is used mainly for online diameter measurement and control for electric wire and cable, optic fiber cable, tubes and wires. Compared with the previous generation products, the third generation gauge is characterized by

☆ All digital image process technique and dedicated ultra-large scale integrated circuit, which ensure high stability, compact size and low power consumption.

☆ Hardware acceleration, which provides high measuring speed up to 1800 measurements/s and makes it possible to use the Gauge as a lump & neck detector.

☆ RS-485 communication interface，which makes the Gauge to be connected easily to an industry computer, PLC and touch panel.

☆ Advanced feedback control system, which improves the control effect.

1.1 Service conditions and packing size

Power:	100～240VAC, 50～60Hz;
Operating temperatures:	0～45 □
Atmospheric humidity:	≤90%（free of condense water）
Ambient requirement:	The surrounding air shall free of corrosive gas, oil, steam and heavy dust
Packing size:	615 mm×330 mm×280 mm（L×W×H）
Weight of the complete machine:	11 kg

1.2 Principal technical data

Nominal measuring range:	20 mm
Recommended measuring range:	0.2～20 mm
Measuring accuracy:	±（0.002 + 0.02% gauge readout）
Measuring speed:	1800 measurements/s
Power consumption:	< 10W
Communication interface:	RS-485
Centre height（including support）:	850～1100 mm
Dimensions（excluding support）:	100 mm×100 mm×410 mm

1.3 Complete set of machine

No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com

Each package of standard configuration of DDM-3020 Diameter Gauge includes the following items：

DDM-3020 Diameter Gauge:	1
Column of the measuring head support:	1 set
Footing of the measuring head support:	1
Cushioning spring of the support:	1
2.5m power cord:	1
4-pin aircraft plug at the communication interface:	1
DSP-3A Monitor:	1
Output amplitude adjusting potentiometer of the feedback control system:	1
Operating manual:	1

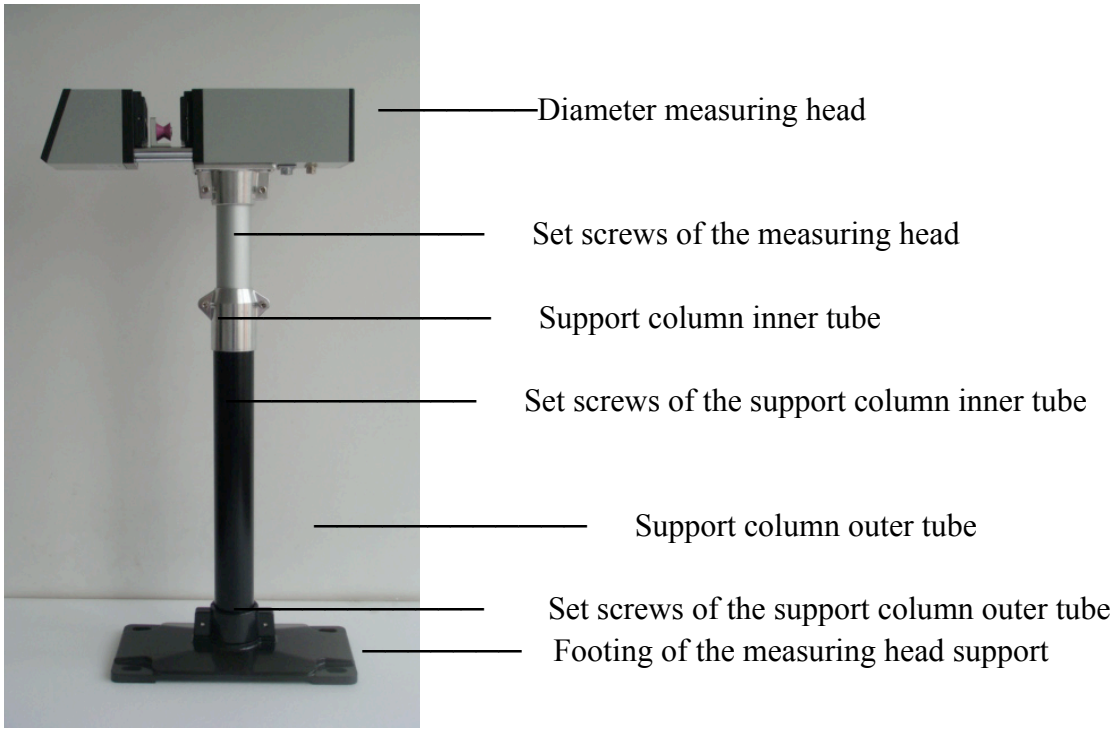


Figure 1-1 Mounting of the diameter measuring head and support

No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com

Figure1-2 Diameter gauge panel

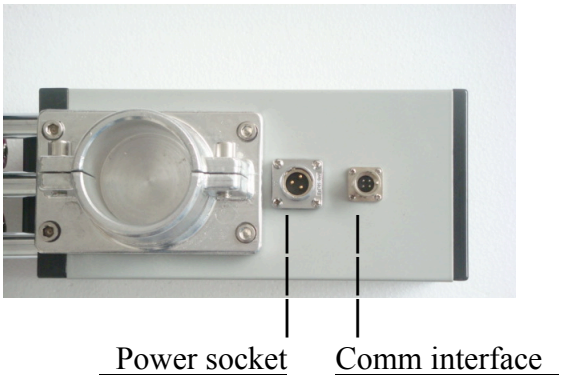


Figure1-3 Power socket and comm interface

2 Mounting

2.1 Mounting position

DDM-3020 Diameter Gauge may be mounted either before or after the cooling trough when it is used with the wire and cable production line. When the Gauge is mounted before the cooling trough, optimal control can be achieved due to in-time feedback resulting from short distance from the Gauge to the extruder. But the measurement at this position is usually somewhat larger than the actual diameter because the plastic melt has not been solidified and the measurement is the diameter of the hot-state wire or cable; for this reason, the set nominal shall be increased appropriately. When the Gauge is mounted after the cooling trough, the measurement will be more accurate because it reflects the actual diameter. But the control effect becomes worse due to large control lag. Besides, the tested wire or cable shall be wiped dry otherwise the water film on the surface of the wire or cable will affect adversely the measuring accuracy. In actual operation, the set nominal shall be increased appropriately according to the water content of the tested object.

2.2 Mounting procedures

（1）Open the package, inspect the Gauge and accessories according to the packing list.

（2）In reference of Figure1-1, mount the Gauge and support.

（3）Place the Gauge in an appropriate location of the line. Move the Gauge support so that the tested wire or cable is at the centre of the measuring window. Fix the Gauge by fixing the anchor bolts.

（4）Adjust the height of the Gauge support so that the tested wire or cable is at the centre of the measuring range. Tighten the related set screws.

（5）Plug the power cord into the power socket on the base of the Gauge（see Figure 1-3）. Switch on the power. The Gauge is ready to operate at this time.

3 Panel display and operation

3.1 Panel make-up

As shown in Figure1-2，DDM-3020 Diameter Gauge panel consists of the following components：

（1）**5-digit LED display,** used to displaymeasured diameter, lump & neck alarm count, gauge abnormality and set parameter.

No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com

（2）**20-segment LEB (light-emitting bar) display**, used to display diameter deviation, feedback control output , location of the tested object in the measuring range and abnormal alarm.

（3）**8 status indicators,** used to display the Gauge operating mode or display modes and parameters.

（4）**5 keys,** i.e., parameter key, shift key, increase key, decrease key and lump & neck key. They have different functions in different operating modes.

3.2 Gauge operating mode

DDM-3020 Diameter Gauge has three main operating modes as follows:

（1）**Normal operation：** In this operating mode, the diameter of the tested object is measured continuously at the speed of 1800 measurements/s. The results are displayed in digitals on the panel. At the same time, the diameter is inspected to see if it exceeds the tolerance limits and if the tested object has surface lump & neck based on the set working parameters. Besides, automatic feedback control quantity for the diameter is calculated and sent out. The communication task is performed.

（2）**Abnormal alarm**: The abnormal alarm mode is entered whenever abnormal operation is detected. In this operating mode, the abnormal or fault message is displayed on the panel and alarm is given.

（3）**Parameter setting：** This operating mode can be further divided into two sub-states, i.e., *parameter display* and *parameter setting*, used respectively for viewing and setting the individual working parameters. Press **【Parameter key】** in the normal operation mode to enter the parameter display/setting mode. For details, see chapter 4.

3.3 Status indicator

DDM-3020 Diameter Gauge has 8 status indicators on the panel. Their significance is as follows：

Indicator flashes, indicating that the difference between the measured diameter and nominal exceeds the negative tolerance (i.e., the wire is too thin).

Indicator flashes, indicating that the difference between the measured diameter and nominal exceeds the positive tolerance (i.e., the wire is too thick).

Indicator is bright, indicating that the current operating mode is *nominal display/setting*

Indicator is bright, indicating that the current operating mode is *tolerance display/setting*

Indicator is bright, indicating the feedback control is *on* in the normal operation mode and *feedback control parameter display/setting* in the parameter setting mode.

Indicator flashes, indicating the feedback control is *frozen* in the normal operating mode and *feedback control parameter error* in the abnormal alarm mode.

Indicator is bright, indicating that the *digital display is used for lump & neck alarm count* in the

No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com

normal operating mode and *lump & neck parameter display/setting* in the parameter setting mode.

Indicator flashes, indicating presence of non-reset lump & neck alarm output.

Indicator is bright, indicating that the current operating mode is *parameter display/setting*

Indicator is bright, indicating that the LEB displays the location of the tested object in the measuring range.

3.4 Function of the individual keys

【Parameter key】（1）Press this key in the normal operation mode to enter the parameter display mode.（2）Press this key in the parameter display mode to return to the normal operation mode.（3）Press this key in the parameter setting mode to confirm and save the current setting and return to the parameter display mode.

【Shift key】（1）Press this key in the normal operation mode to make the LEB display the location of the tested object in the measuring range for ca. 20s. Press this key once more to return to the original indication.（2）Press this key in the parameter display mode to enter the parameter setting mode.（3）Press this key in the parameter setting mode to make the cursor (i.e., the flashing number) move one digit to the right.

【Increase key】（1）Press this key in the normal operation mode to turn on the feedback control (provided the control mode is *manual* and feedback control work mode is not *disabled*).（2）Press this key in the parameter display mode to diaplay the previous parameter in the parameter menu.（3）Press this key in the parameter setting mode to increase the number indicated by the cursor by 1.

【Decrease key】（1）Press this key in the normal operation mode to turn off the feedback control (provided the control mode is *manual* and feedback control is turned on).（2）Press this key in the parameter display mode to display the next parameter in the parameter menu.（3）Press this key in the parameter setting mode to decrease the number indicated the cursor by 1.

【Lump & neck key】 This key functions only in the normal operation mode and when lump & neck detection is enabled. Press this key when the measured diameter is displayed on the digital display to display the lump & neck alarm count and reset the lump & neck alarm (if any). Press this key once more to clear the lump & neck alarm count and return to the measured diameter display mode. If the key is not pressed, the system returns automatically to the measured diameter

No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com

display mode in 20s but the lump & neck alarm count will not be cleared.

3.5 Normal operation

3.5.1 Digital display

In the normal operation mode, the digital display is used to display measured diameter or lump & neck alarm count.

（1） Usually, the measured diameter is displayed. Display format：5-digit decimal number, unit：mm，unit of inch is also available（by system parameter setting, for details, see Chapter 4）. For example, for a measured diameter of 4.5mm, the following will be displayd：

（2） When lump & neck detection is enabled, press【Lump & neck key】when the measured diameter is displayed to indicate the lump & neck alarm count for ca. 20s. Display format：mark for lump & neck alarm count“□” followed by a *4-digit decimal number*, which indicates the detected alarm count in the range of 0000～9999. If 9999 is exceeded，the number 9999 will flash. For example, for a current alarm count of 25, the following will be displayd：

Press 【Lump & neck key】once more when the lump & neck alarm count is displayed to clear the lump & neck alarm count and return to the *measured diameter display mode*.

To sum up, the digital display is used only to display the measured diameter when lump & neck detection is disabled. It is used to diaplay the measured diameter or lump & neck alarm count when lump & neck detection is enabled. Conversion from one display mode to another is shown below:

When measured diameter is displayed —Press【Lump & neck key】→ **to display the lump & neck alarm count.**

When lump & neck alarm count is displayed ←Press 【Lump & neck key】once more or wait for 20s— **to display the measured diameter.**

3.5.2 LEB (light-emitting bar) display

In the normal operation mode, the LEB display can be used to display respectively diameter deviation, feedback control output and location of the tested object in the measuring range.

（1）When feedback control is enabled, the LEB is used to display the output voltage of feedback control in the range of －100%～+100%. When ±90% is exceeded, the corresponding LEB segment will

No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com

flash，indicating that the automatic control ouput is near saturation (i.e., near the automatic control limit) and manual adjustment is necessary. The feedback control output is zero when the central 2 segments are bright

（2）When feedback control is disabled, the LEB is used to display the relative deviation of the diameter in the range of －100%～+100%, which is defined as

Positive relative deviation = 100% ×（measured diameter－nominal）÷ positive tolerance

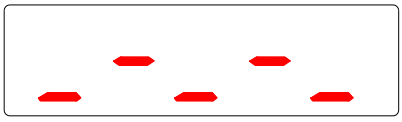
Negative relative deviation = 100% ×（measured diameter－nominal）÷ negative tolerance

（3） The LEB display can be used to view the location of the tested object in the measuring range to ease the adjustment of the height of the Gauge support. Press 【Shift key】 in the normal operation mode to display the location of the tested object in the measuring range with －100% as the lower limit and +100% as the upper limit. Press 【Shift key】 once more to return to the original indication. Or wait for 20s without pressing any key to return to the original indication.

3.6 Abnormal alarm

The diameter gauge enters the abnormal alarm mode whenever abnormal operation is detected. At this time, all segments of the LEB display flash and the digital display indicates a fault message for the operator to act accordingly.

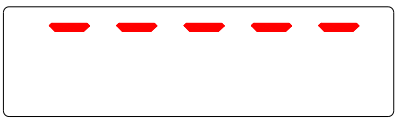
（1） **Fault message：**



Fault cause： Lens of the Gauge is badly polluted by dust etc.

Fault removal： Remove the dust cover before the lens. Wash the lens surface with lens detergent （or anhydrous alcohol）.

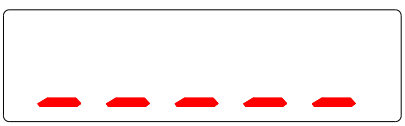
（2） **Fault message：**



Fault cause： The tested object is at a location too high exceeding the upper limit of the measuring range.

Fault removal： Lower the wire pulley or raise the diameter measuring head so that the tested wire or cable is located within the measuring range of the Gauge.

（3） **Fault message：**



Fault cause： The tested object is at a location too low exceeding the lower limit of the measuring range.

Fault removal： Raise the wire pulley or lower the diameter measuring head so that the tested wire or cable is located within the measuring range of the Gauge.

（4） **Fault message：**

No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com

Fault cause 1： The tested wire or cable has a diameter too large exceeding the measuring range of the Gauge

Fault removal 1： Use a larger size diameter gauge.

Fault cause 2： Displacement of the lens dust cover which blocks the measuring light

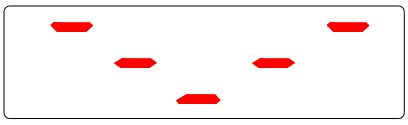
Fault removal 2： Mount the lens dust cover in the correct location.

Fault cause 3： Damage of light source or its driving circuit resulting in failure to emit light by the light source

Fault removal 3： Contact the after-sales department of Shanghai On-Line.

.

（5） Fault message：



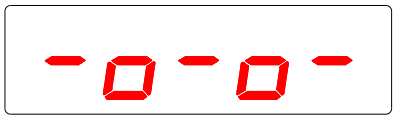
Fault cause 1： The lens is irradiated directly by an external strong light (e.g. sunlight).

Fault removal 1： Block any external strong light.

Fault cause 2： Displacement of the light source or lens system

Fault removal 2： Contact the after-sales department of Shanghai On-Line.

（6） Fault message：



Fault cause 1： Lens of the Gauge is badly polluted by dust etc resulting in partially blocked light emmission

Fault removal 1： Same as for fault（1）.

Fault cause 2： The tested object is transparent (e.g. glass tube) or more than one tested object in the measuring range.

Fault removal 2： Use the Gauge that can measure transparent object or more than one tested object at the same time.

（7） Fault message：

Fault cause： The tested object is too thin（below φ0.5mm）and located so far away from the centre (too near to the dust cover) that proper imaging by the optical system is not possible.

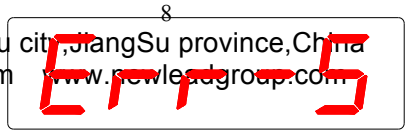
Fault removal： Locate the tested object at the centre（keeping equal distance from the dust cover at either side as far as possible）.

（8） Fault message：

Fault cause： Loose connection between the main board and display panel

Fault removal： Contact the after-sales department of Shanghai On-Line

No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com



（9） **Fault message：**

Fault cause： Fault of software
Fault removal： Contact the after-sales department of Shanghai On-Line.

（10）**Fault message：** 

Fault cause： Fault of hardware or circuit
Fault removal： Contact the after-sales department of Shanghai On-Line.

（11）**Fault message：** 

Fault cause： The Gauge is locked for over 30 inputs of wrong password.
Fault removal： Contact the after-sales department of Shanghai On-Line.

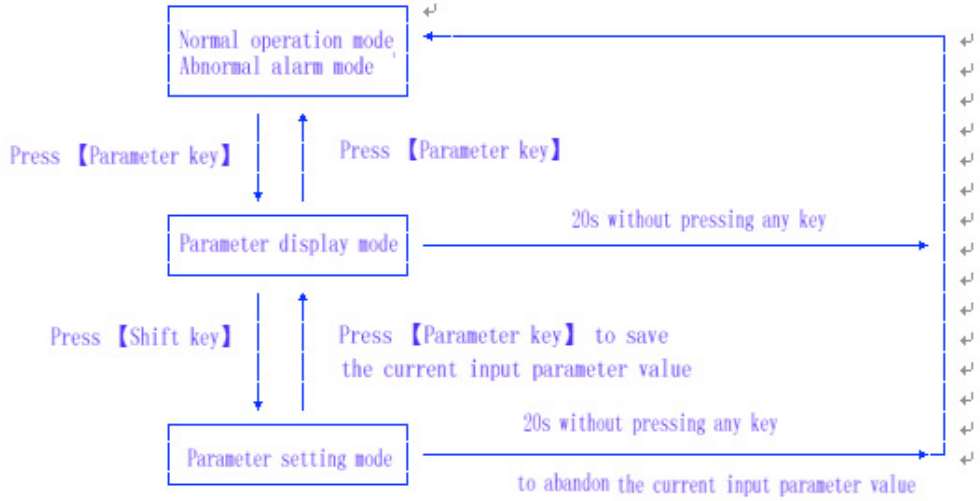
（12）**Fault message：** All segments of the LEB display and the feedback control indicator  flash simultaneously.

Fault cause： Wrong setting of the feedback control parameter
Fault removal： Check the parameters relating to feedback control. The nominal shall not be set at 0. Both the proportional coefficient and integral coefficient shall not be set at 0. Or, in the advanced feedback mode, change of product size shall be accompanied by self rectification

4 Parameter display/setting

The parameter display mode is used to view the individual parameters. While the parameter setting mode is used to change the existing parameter value and save the new parameter value. The parameters for DDM-3020 Diameter Gauge can be classified into three types, i.e., working parameters, feedback control parameters and system parameters. Press 【Parameter key】in the *normal operation mode* or *abnormal alarm mode* to enter directly the *working parameter display mode.* Password is necessary to enter the feedback control parameter or system parameter display/setting mode. Conversion among the normal operation mode（or abnormal alarm mode）, parameter display mode and parameter setting mode is shown below:

No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com

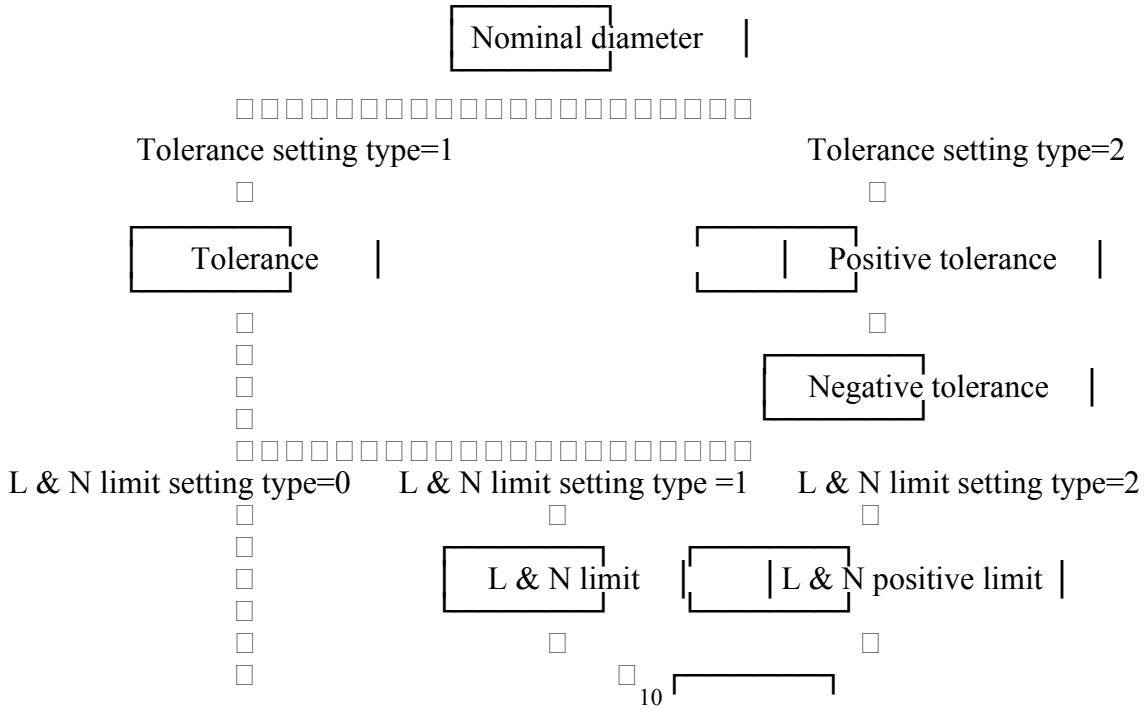


4.1 Working parameter

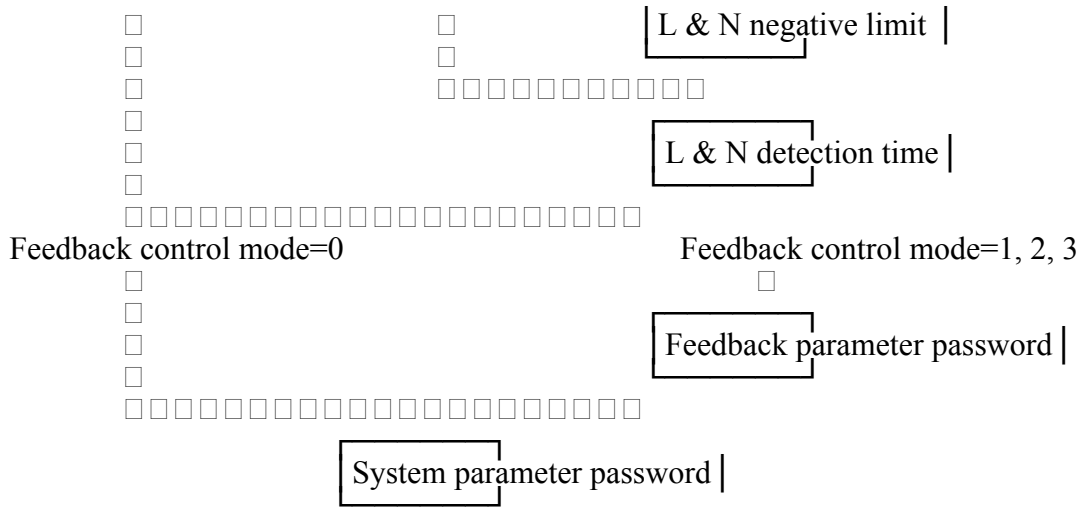
The working parameter menu contains nominal diameter, tolerance（or positive tolerance, negative tolerance）, lump & neck limit（or lump & neck positive limit, lump & neck negative limit）, lump & neck detection time, feedback parameter password and system parameter password.

Press 【Parameter key】in the *normal operation mode* or *abnormal alarm mode* to enter the *working parameter display mode*. The first parameter in the menu (i.e., nominal diameter) will be displayd immediately. Press 【Increase key】 to display the previous parameter in the menu. Press 【Decrease key】 to display the next parameter in the menu.

The parameters in the menu vary with different setting of *tolerance setting type*, *lump & neck limit setting type* and *feedback control mode.*



No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com



Note：（1） When tolerance setting type=1，the positive and negative tolerances are equal. They are combined into one single parameter *tolerance.*

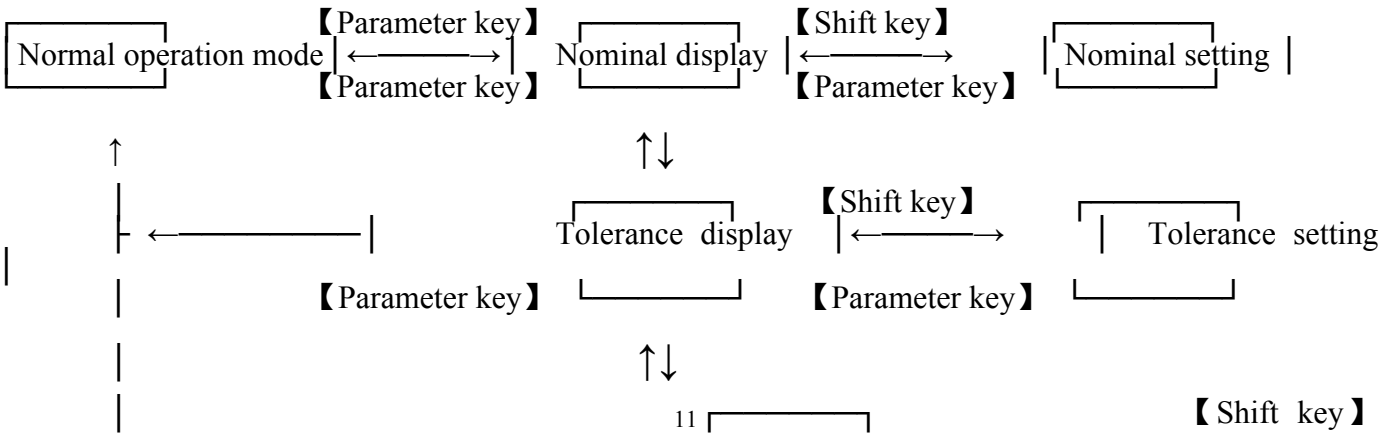
（2） When lump & neck limit setting type=0，lump & neck detection is disabled. At this time, no parameters relating to lump & neck detection will appear in the working parameter menu.

（3） When lump & neck limit setting type=1，the lump & neck positive and negative limits are equal. They are combined into one single *lump & neck limit*.

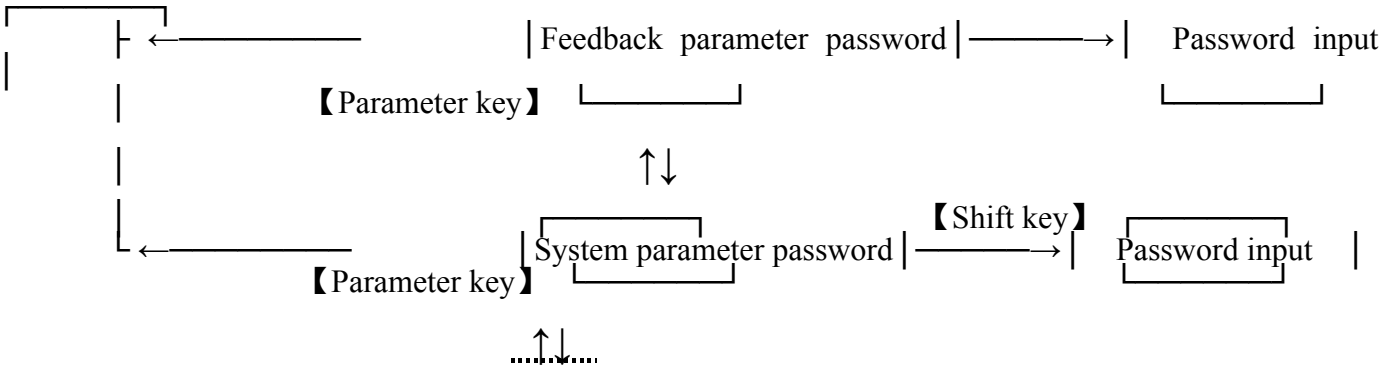
（4） When feedback control mode=0，feedback control is disabled. At this time, no feedback parameter password will appear in the working parameter menu, namely, the feedback control parameter menu cannot be entered.

Let us take two examples to explain the content of the working parameter menu in different conditions and related operating procedures. In the following chart, "↑" indicating "press 【Increase key】", "↓" indicating "press 【Decrease key】", the key above a horizontal line indicating operation from left to right, the key under a horizontal line indicating operation from right to left, the final "……" indicating return to the first option of the menu.

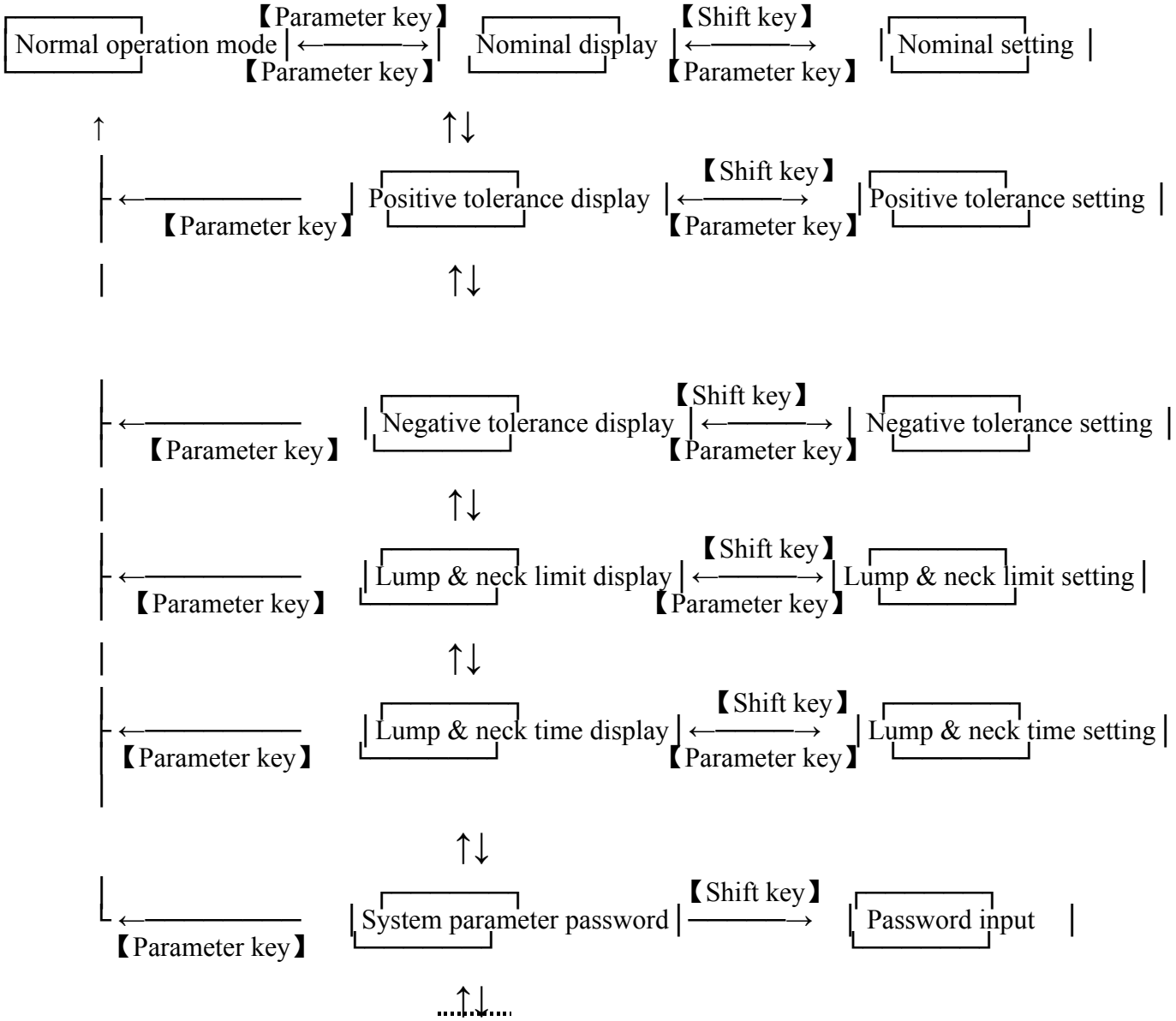
（1）Tolerance setting type=1, lump & neck limit setting type=0, feedback control mode=1（factory default）:



No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com



（2）Tolerance setting type=2, lump & neck limit setting type=1, feedback control mode=0：



4.1.1 Nominal diameter

Application： This nominal is used as the reference for diameter feedback control, out-of-tolerance alarm and lump & neck detection. When the nominal diameter is set at 0，then （1）No diameter out-of- tolerance detection and alarm will be carried out.（2）No lump & neck detection and alarm will be carried out.（3）

No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com

Feedback control parameter error will appear when diameter feedback control is turned on.
Numeric area：00.000 ～ 19.999 mm.
Setting procedures : In order to change the original nominal 0 into 4.8 mm（display: 04.800），proceed as follows:
（1）Press【Parameter key】in the *normal operation mode* to enter the *nominal display mode*:

Indicators   are bright

（2）Press【Shift key】to enter the *nominal setting mode*，the first digit on the display "0" flashes.
（3）Press【Shift key】，the second digit "0" flashes. Press【Increase key】4 times to change "0" into "4".
（4）Press【Shift key】，the third digit "0" flashes. Press【Increase key】 8 times （or press【Decrease key】 2 times）to change "0" into "8".
（5）Press【Parameter key】to save the change and return to the *nominal display mode.*
（6）If it is necessary to set another parameter，press【Increase key】or【Decrease key】to locate this parameter. Otherwise press【Parameter key】to return to the *normal operation mode*.

4.1.2 Diameter tolerance

Application： This tolerance is used for diameter out-of-tolerance alarm. Out-of-positive-tolerance alarm is given when the measured diameter > nominal+tolerance. Out-of-negative-tolerance alarm is given when the measured diameter <nominal－tolerance. If the tolerance is set at 0, no diameter out-of-tolerance detection and alarm will be carried out.
Numeric area： 0.000 ～ 9.999 mm.
Setting procedures : In order to change the original tolerance 0.015 mm into 0.120 mm，proceed as follows:
（1）Press【Parameter key】in the normal operation mode to enter the *nominal display mode*（see 4.1.1）.
（2）Press【Increase key】or【Decrease key】to locate the *tolerance display mode*:

Indicators   are bright.

The first digit "‾" in the above indication is the mark for *single tolerance*.
（3）Press【Shift key】to enter the *tolerance setting mode*". The second digit on the display "0" flashes.
（4）Press【Shift key】，the third digit "0" flashes. Press【Increase key】once to change "0" into "1".
（5）Press【Shift key】，the fourth digit "1"flashes. Press【Increase key】once to change "1" into "2".
（6）Press【Shift key】，the fifth digit "5" flashes. Press【Increase key】 5 times to change "5" into "0".，
（7）Press【Parameter key】to save the change and return to the *tolerance display mode.*
（8）If it is necessary to set another parameter，press【Increase key】or【Decrease key】to locate this parameter. Otherwise press【Parameter key】to return to the *normal operation mode*.

4.1.3 Diameter positive tolerance

Application： The positive tolerance is used for diameter out-of-tolerance alarm. Out-of-positive-tolerance alarm is given when the measured diameter > nominal+tolerance. If the tolerance is set at 0, no diameter out-of-positive-tolerance detection and alarm will be carried out.
Numeric area： 0.000 ～ 9.999 mm.

No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com

Setting procedures : In order to change the original positive tolerance 0.015 mm into 0.010 mm，proceed as follows:

（1）Press【Parameter key】in the normal operation mode to enter the *nominal display mode*（see 4.1.1）.

（2）Press【Increase key】or【Decrease key】to locate the *positive tolerance display mode.*

Indicators   are bright

The first digit "¯" in the above indication is the mark for *positive tolerance*.

（3）Press 【Shift key】to enter the *positive tolerance setting mode.* The second digit on the display "0" flashes.

（4）Press【Shift key】, the third digit "0" flashes.

（5）Press【Shift key】, the fourth digit "1" flashes.

（6）Press【Shift key】, the fifth digit "5" flashes. Press【Decrease key】5 times to change "5" into "0".

（7）Press【Parameter key】to save the change and return to the *positive tolerance display mode*.

（8）If it is necessary to set another parameter，press【Increase key】or【Decrease key】to locate this parameter. Otherwise press【Parameter key】to return to the *normal operation mode*.

4.1.4 Diameter negative tolerance

Application： The negative tolerance is used for diameter out-of-tolerance alarm. Out-of-negative-tolerance alarm is given when the measured diameter < nominal－negative tolerance. If the negative tolerance is set at 0, no diameter out-of-negative-tolerance detection and alarm will be carried out

Numeric area： 0.000 ～ 9.999 mm.

Setting procedures : In order to change the original positive tolerance 0.000 mm into 0.090 mm，proceed as follows:

（1）Press【Parameter key】in the normal operation mode to enter the *nominal display mode*"（see 4.1.1）.

（2）Press【Increase key】or【Decrease key】to locate the *negative tolerance display mode*.

Indicators   are bright

The first digit "_" in the above indication is the mark for *negative tolerance*.

（3） Press【Shift key】to enter the *negative tolerance setting mode*. The second digit on the display "0" flashes.

（4）Press【Shift key】, the third digit "0" flashes.

（5）Press【Shift key】, the fourth digit "0" flashes. Press【Decrease key】once to change "0" into"9".

（6）Press【Parameter key】to save the change and return to the *negative tolerance display mode.*

（7）If it is necessary to set another parameter，press【Increase key】or【Decrease key】to locate this parameter. Otherwise press【Parameter key】to return to the *normal operation mode*.

4.1.5 Lump & neck detection limit

Application： The lump & neck detection limit is used for lump & neck defect detection and alarm. The *lump & neck defect alarm* is given when the measured diameter > nominal + lump & neck

No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com

detection limit or the measured diameter < nominal－lump & neck detection limit. If the lump & neck detection limit is set at 0, no lump & neck defect detection and alarm will be carried out..

Numeric area： 0.00 ～ 9.99 mm.

Setting procedures : In order to change the original lump & neck detection limit 0.05 mm into 0.20 mm，proceed as follows:

（1）Press【Parameter key】in the normal operation mode to enter the *nominal display mode*（see 4.1.1）.

（2）Press【Increase key】or【Decrease key】to locate the *lump & neck limit display mode*.

Indicators   are bright

The first two digits “d_” in the above indication are the mark for *single lump & neck limit.*

（3） Press【Shift key】to enter the *lump & neck limit setting mode*. The third digit on the display “0” flashes.

（4）Press【Shift key】, the fourth digit “0” flashes. Press【Increase key】twice to change “0” into ”2”.

（5）Press【Shift key】, the fifth digit “5” flashes. Press【Decrease key】5 times to change “5” into ”0”.

（6）Press【Parameter key】to save the change and return to the *lump & neck limit display mode.*

（7）If it is necessary to set another parameter，press【Increase key】or【Decrease key】to locate this parameter. Otherwise press【Parameter key】to return to the *normal operation mode*.

4.1.6 Lump & neck positive limit

Application：The lump & neck positive limit is used for lump defect detection and alarm. The *lump & neck defect alarm* is given when the measured diameter > nominal+lump & neck positive limit. If the lump & neck positive limit is set at 0, no lump defect detection and alarm will be carried out.

Numeric area： 0.00 ～ 9.99 mm.

Setting procedures : In order to change the original lump & neck positive limit 0.25 mm to 0.00 mm，proceed as follows:

（1）Press【Parameter key】in the normal operation mode to enter the *nominal display mode*（see 4.1.1）.

（2）Press【Increase key】or【Decrease key】to locate the *display mode of lump & neck positive limit*.

Indicators   are bright

The first two digits “d” in the above indication are the mark for *lump & neck positive limit.*

（3）Press【Shift key】to enter the *setting mode* of *lump & neck positive limit*. The third digit on the display “0” flashes.

（4）Press【Shift key】, the fourth digit “2” flashes. Press【Decrease key】twice to change “2” into ”0”.

（5）Press【Shift key】, the fifth digit “5” flashes. Press【Decrease key】5 times to change “5” into ”0”.

（6）Press【Parameter key】to save the change and return to the *display mode of lump & neck positive limit*.

（7）If it is necessary to set another parameter，press【Increase key】or【Decrease key】to locate this parameter. Otherwise press【Parameter key】to return to the *normal operation mode*.

4.1.7 Lump & neck negative limit

Application： The lump & neck negative limit is used for neck defect detection and alarm. The *lump*

No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com

& neck defect alarm is given when the measured diameter < nominal－lump & neck negative limit. If the lump & neck negative limit is set at 0, no neck defect detection and alarm will be carried out.

Numeric area： 0.00 ～ 9.99 mm.

Setting procedures : In order to change the original lump & neck negative limit 0.20 mm into1.00 mm，proceed as follows:

（1）Press【Parameter key】in the normal operation mode to enter the *nominal display mode*（see 4.1.1）.

（2）Press【Increase key】or【Decrease key】to locate the *display mode of lump & neck negative limit*.

Indicators   are bright

The first two digits “d__” in the above indication are the mark for *lump & neck negative limit.*

（3）Press 【Shift key】to enter the *setting mode of lump & neck negative limit*. The third digit on the display “0” flashes. Press【Increase key】once to change “0” into ”1”.

（4）Press【Shift key】, the fourth digit “2” flashes. Press【Decrease key】twice to change “2” to ”0”.

（5）Press 【Parameter key】to save the change and return to the *display mode of lump & neck negative limit*.

（6）If it is necessary to set another parameter，press【Increase key】or【Decrease key】to locate this parameter. Otherwise press【Parameter key】to return to the *normal operation mode*.

4.1.8 Lump & neck detection time

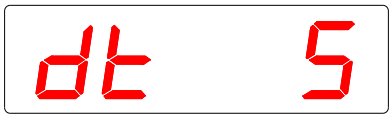
Application： The lump & neck detection time is used for lump & neck defect detection and alarm. The detected lump & neck defect is confirmed and the *lump & neck defect alarm* is given when the measured diameter > nominal + lump & neck positive limit or the measured diameter < nominal－lump & neck negative limit lasts for a time exceeding the lump & neck detection time.

Numeric area： 1 ～ 9 ms.

Setting procedures : In order to change the original lump & neck detection time 5 ms into 1 ms，proceed as follows:

（1）Press 【Parameter key】in the normal operation mode to enter the *nominal display mode*（see 4.1.1）.

（2）Press【Increase key】or【Decrease key】to locate the *display mode of lump & neck detection time*:



Indicators   are bright

The first two digits “dt” in the above indication are the mark for *lump & neck detection time.*

（3）Press【Shift key】to enter the *setting mode of lump & neck detection time*. The last digit on the display “5” flashes. Press【Decrease key】4 times to change “5” into “1”.

（4）Press【Parameter key】to save the change and return to the *display mode of lump & neck limit*.

（5）If it is necessary to set another parameter，press【Increase key】or【Decrease key】to locate this parameter. Otherwise press【Parameter key】to return to the *normal operation mode*.

4.1.9 Feedback parameter password

Application： The password is used to enter the feedback parameter menu (i.e., the display/setting mode of feedback control parameter) to view and change the parameter values.

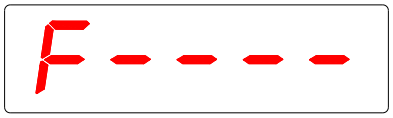
Numeric area： 0000 ～ 9999. The password can be set in the system parameter menu.

No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com

Input procedures： Suppose the feedback parameter password is 1234 （factory default），proceed as follows:

（1）Press【Parameter key】in the normal operation mode to enter the *nominal display mode*（see 4.1.1）.

（2）Press【Increase key】 or 【Decrease key】to locate the *input interface of feedback parameter password*”：



Indicators   are bright.

（3）Press 【Shift key】to enter the *input mode of feedback parameter password.* The first “—” after “F” becomes a flashing “0”. Press【Increase key】once to change “0” into “1”.

（4）Press 【Shift key】，the second “—” becomes a flashing “0”. Press【Increase key】 twice to change “0” into “2”.

（5）Press 【Shift key】，the third “—” becomes a flashing “0”. Press【Increase key】 3 times to change “0” into “3”.

（6）Press【Shift key】，the fourth “—” becomes a flashing “0”. Press【Increase key】 4 times to change “0” into “4”.

（7）Press【Parameter key】to confirm the input. When a correct password is input, the system enters the feedback parameter menu. When a wrong password is input, the system returns to the normal operation mode.

4.1.10 System parameter password

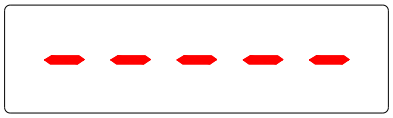
Application： The password is used to enter the system parameter menu to view or change the parameter values.

Numeric area： System parameter password is 74683.

Input procedures：

（1）Press 【Parameter key】in the normal operation mode to enter the *nominal display mode*（see 4.1.1）.

（2）Press【Increase key】or【Decrease key】to locate the *input interface of system parameter password*：



The indicator  is bright

（3）Press【Shift key】to enter the *input mode of system parameter password*. The first “—” from the left becomes a flashing “0”. Press【Increase key】7 times（or press【Decrease key】 3 times）to change “0” into “7”.

（4）Press【Shift key】，the second “—” becomes a flashing “0”. Press【Increase key】 4 times to change “0” into “4”.

（5）Press【Shift key】，the third “—” becomes a flashing “0”. Press【Increase key】 6 times to change “0” into “6”.

（6）Press【Shift key】，the fourth “—” becomes a flashing “0”. Press【Increase key】8 timesto change “0” into “8”.

（7）Press【Shift key】，the fifth “—” becomes a flashing “0”. Press【Increase key】 3 times to change “0” into “3”.

（8）Press【Parameter key】to confirm the input. When a correct password is input, the system enters the system parameter menu. When a wrong password is input, the system returns to the normal

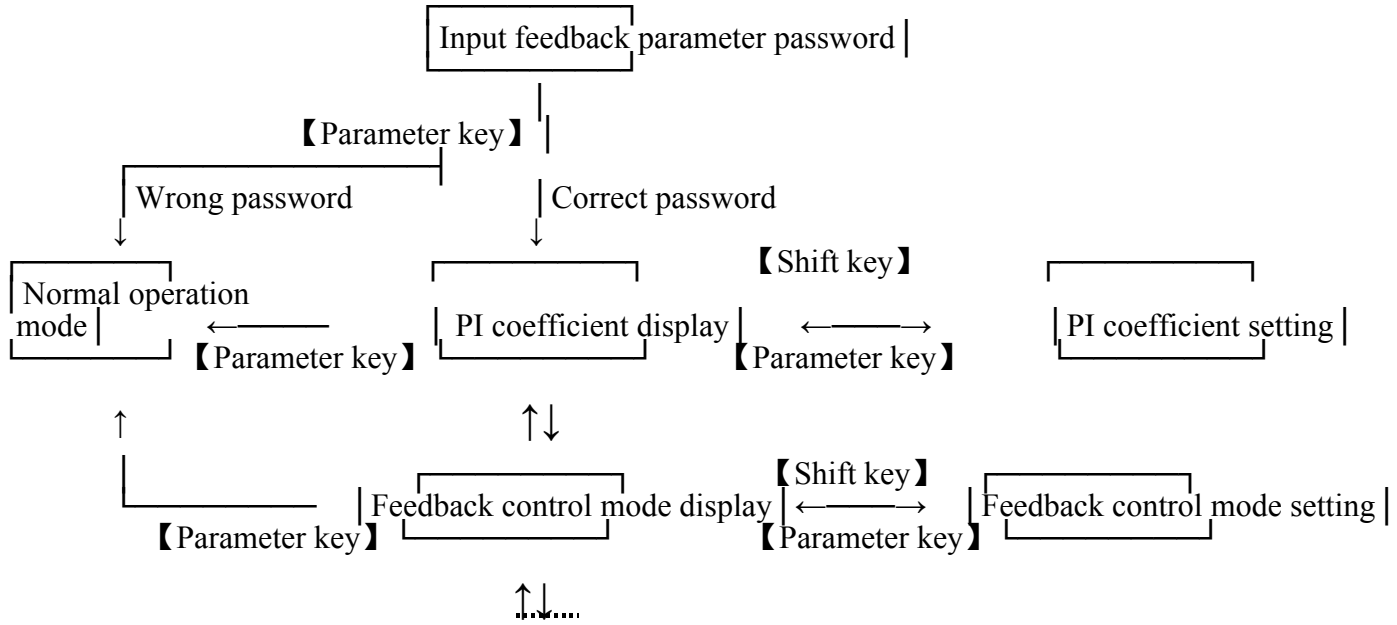
No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com

operation mode.

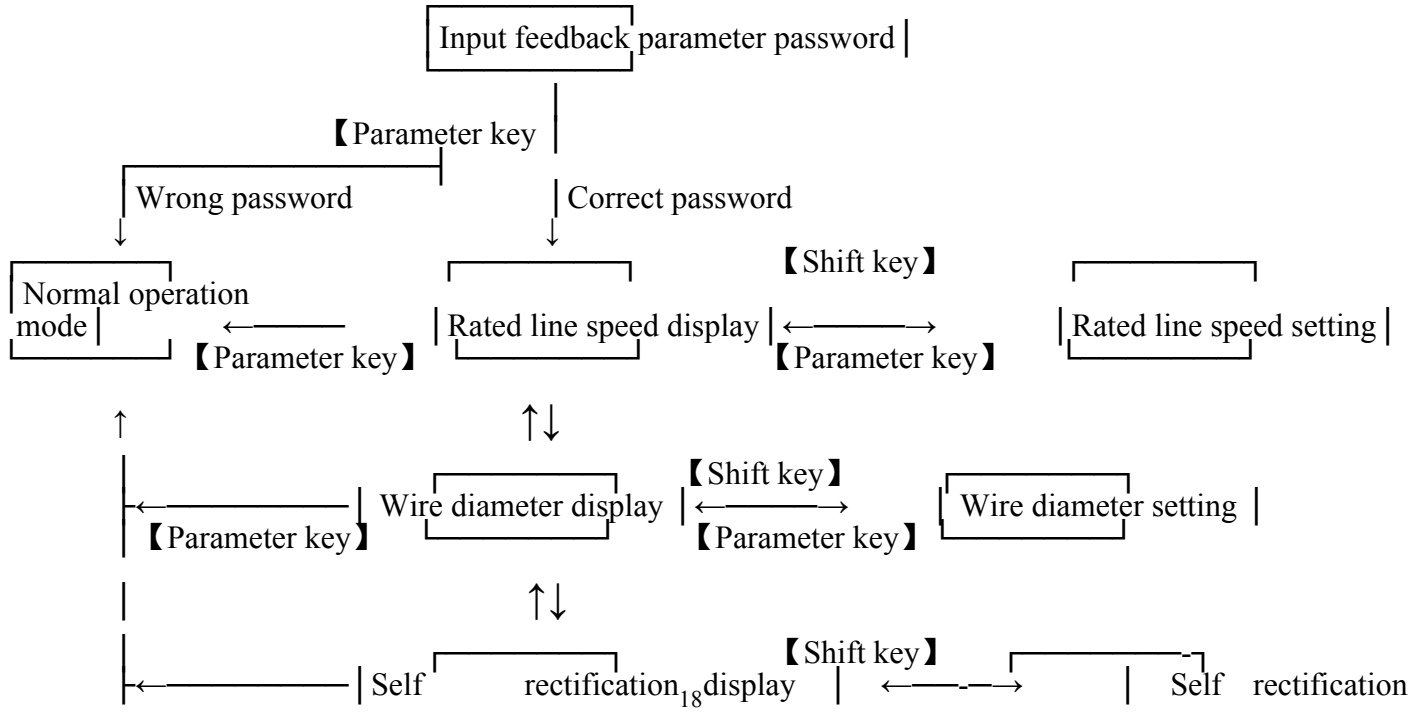
4.2 Feedback control parameter

The feedback parameter menu can only be entered when the feedback control mode（contained in the system parameter menu）=1, 2 or 3 and the correct password has been input.

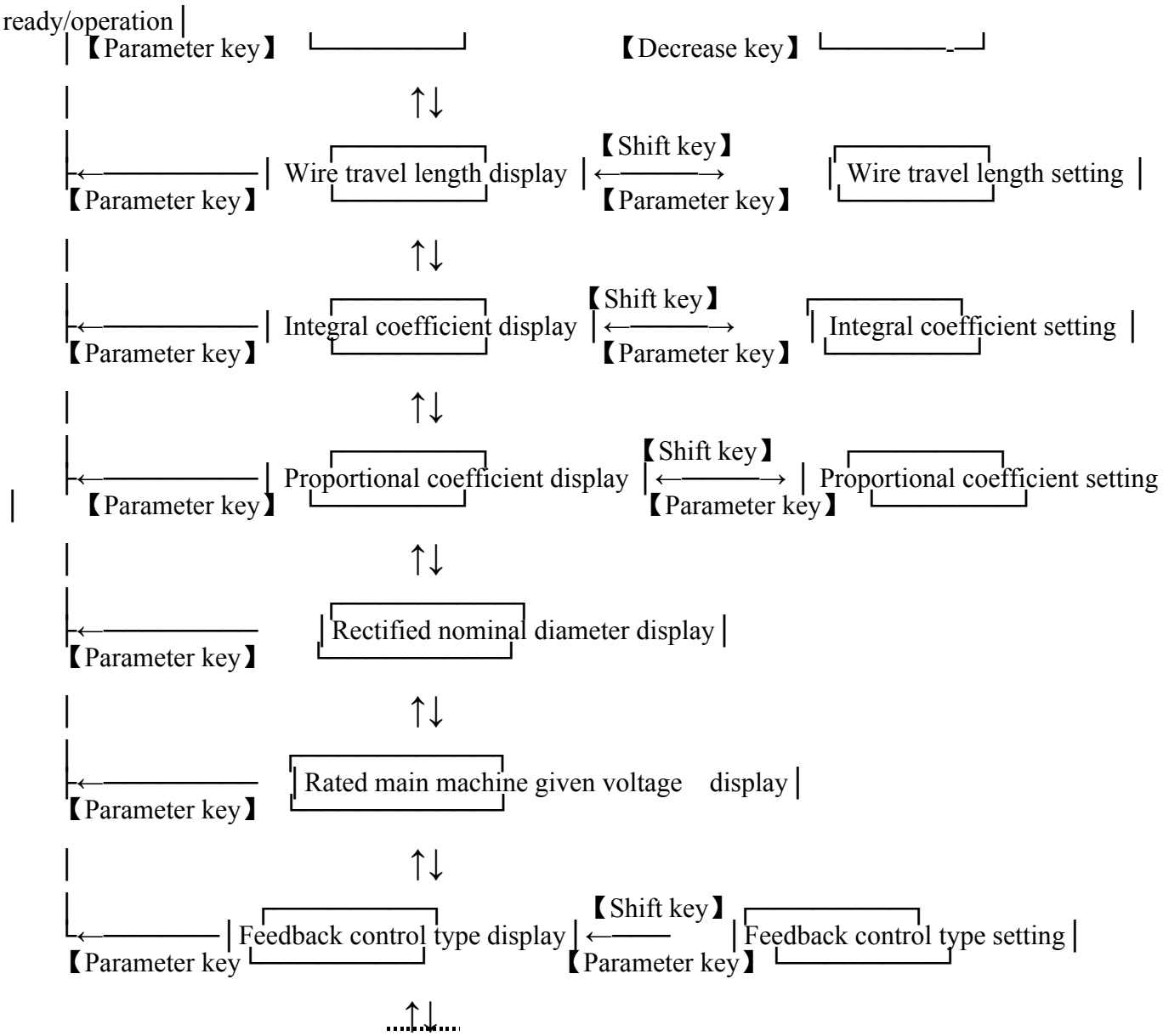
When the feedback control mode=1（basic feedback control mode compatible with DDM-2020 diameter gauge），the feedback parameter menu has the structure as follows：



When the feedback control mode = 2（advanced feedback control mode for extruder control）or = 3（advanced feedback control mode for capstan control），the feedback parameter menu has the structure as follows：:



No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com



4.2.1 Setting procedures for feedback control parameter

The general procedures for setting feedback control parameter is as follows：

（1）Input the correct feedback parameter password（see 4.1.9）. Press 【Parameter key】to confirm the input and enter the feedback parameter menu.

（2）Press【Increase key】or【Decrease key】to locate the corresponding parameter.

（3）Press【Shift key】to enter the parameter setting mode.

（4）Press【Increase key】or【Decrease key】and【Shift key】to change the parameter value.

（5）After the change has been made，press【Parameter key】to save the change and return to the parameter display mode.

（6）If it is necessary to set another feedback control parameter，press【Increase key】or【Decrease key】to locate the parameter. Otherwise press【Parameter key】to return to the *normal operation mode*.

4.2.2 Proportional-integral coefficient

Application：This parameter is used for diameter feedback control（basic mode），for details, see Chapter 5. This paramer appears only when feedback control mode = 1（basic mode）.

No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com

Numeric area： 0000 ～ 9999.

Setting procedures： In order to change the original proportional-integral coefficient 1515（factory default）into 1810，proceed as follows:

（1）Input the correct feedback parameter password（see 4.1.9）.

（2）Press【Parameter key】to confirm the input and enter the feedback parameter menu. When feedback control mode=1，the first of the displayd parameters is *proportional-integral coefficient*. The first digit "P" in the following indication is the mark for *proportional-integral coefficient*：

Indicators are bright.

（3）Press 【Shift key】to enter the *setting mode of proportional-integral coefficient.* The second digit on the display "1" flashes.

（4）Press【Shift key】，the third digit "5" flashes. Press【Increase key】 3 times to change "5" into "8".

（5）Press【Shift key】，the fourth digit "1" flashes.

（6）Press【Shift key】，the fifth digit "5" flashes. Press【Decrease key】 5 times to change "5" into "0".

（7）Press 【Parameter key】to save the change and return to the *display mode of proportional-integral coefficient*.

（8）If it is necessary to set another feedback control parameter，press【Increase key】or【Decrease key】to locate the parameter. Otherwise press【Parameter key】to return to the *normal operation mode*.

4.2.3 Feedback control type

Application： This parameter is used to determine the method to turn on/turn off diameter feedback control. For details, see Chapter 5.

Numeric area： Auto=automatic，NAnu=manual.

Input procedures： In order to change the original feedback control type "Manual" （factory default）into "Auto"，proceed as follows:

（1） Input the correct feedback parameter password (see 4.1.9). Press【Parameter key】to enter the feedback parameter menu.

（2）Press 【Increase key】or【Decrease key】to locate the *display mode of feedback control type.* For *manual control,* the following indication appears：

Indicators are bright.

（3）Press【Shift key】to enter the *setting mode of feedback control type*. At this time all the 4 letters *NAnu* flash simultaneously.

（4）Press【Increase key】to change *NAnu* into *Auto* (automatic). For *autmatic control,* the following indication appears：

Indicators are bright.

Note：Press 【Increase key】 to change the original *NAn*u（manual） into *Auto*（automatic）. Conversely, press【Decrease key】to change the original *Auto*（automatic）into *NAn*u（manual）.

No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com

（5）Press【Parameter key】to save the change and return to the *display mode of feedback control type*.
（6）If it is necessary to set another feedback control parameter，press【Increase key】or【Decrease key】to locate the parameter. Otherwise press【Parameter key】to return to the *normal operation mode*.

4.2.4 Rated line speed

Application： This parameter is the rated line spped of the production line. It is used for diameter feedback control（advanced mode）.
Numeric area： 0000 ～ 2999 m/min.
Display format： Suppose the pre-set rated line speed is1200 m/min, the corresponding indication will be as follows：

Indicators   are bright.

The letter *U* in the above indication is the mark for *rated line speed*.
Setting procedures： See 4.2.1.

4.2.5 Conductor diameter

Application： This parameter stands for the wire diameter before extrusion. It is used for diameter feedback control（advanced mode）.
Numeric area： 00.00 ～ 19.99 mm.
Display format： Suppose the pre-set conductor diameter is1.5 mm, the corresponding indication will be as follows：

Indicators   are bright.

The letter *d* in the above indication is the mark for *conductor diameter*
Setting procedures： See 4.2.1.

4.2.6 Self rectification interface

Application： When used for diameter feedback control（advanced mode），this interface determines automatically the control parameters including integral coefficient, proportional coefficient and conversion coefficient of line speed and saves nominal diameter and conductor diameter.
Display format： Self rectification interface consists of three modes, i.e., display, ready and operation.
（1）Press【Increase key】or【Decrease key】to locate the *self rectification display mode* in the feedback parameter menu：

Indicators   are bright.

（2）Press 【Shift key】 in the *self rectification display mode* to enter the *self rectification ready mode* where,
Indicators   are bright. The measured diameter flashes on the digital display. All segments of the LEB display are dark. Once the system enters this mode， it will not quit it automatically. It is only

No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com

possible to manualy press 【Increase key】 to enter the *self rectification operation mode* or press 【Decrease key】to return to the *self rectification display mode*.

（3）Press【Increase key】in the *self rectification ready mode* to enter the *self rectification operation mode* where,

Indicators  are bright. The measured diameter flashes on the digital display. The feedback control output is displayd on the LEB display. After self rectification has been completed, the system will save automatically the result of rectification and return to the *normal operation mode*. At the same time, it will turn on automatically diameter feedback control. Press【Decrease key】during self rectification to stop the operation and return to the *self rectification display mode*.

4.2.7 Wire travel length

Application： This parameter is used for diameter feedback control (advanced mode). It stands for the distance that the wire travels from the extruder to the Gauge. If the Gauge is mounted after the capstan, wire travel length will include the length of wire wound on the castan wheel.

Numeric area： 00.0 ～ 99.9 m.

Display format： Suppose the pre-set wire travel length is12.5 m, the corresponding indication will be as follows：

Indicators   are bright

"L—" in the above indication is the mark for *wire travel length*.

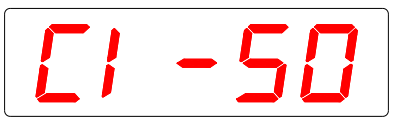
Setting procedures： See 4.2.1.

4.2.8 Integral coefficient

Application： This parameter is used for diameter feedback control（advanced mode）. It may be automatically set by the self rectification process or manually set..

Numeric area： 00 ～ 99%.

Display format： Suppose the pre-set integral coefficienti is 50%，the corresponding indication will be as follows：：



Indicators   are bright.

"CI—" in the above indication is the mark for *integral coefficient*

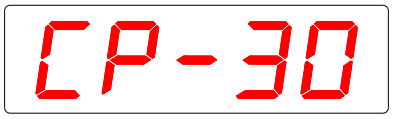
Setting procedures： See 4.2.1.

4.2.9 Proportional coefficient

Application： This parameter is used for diameter feedback control（advanced mode）. It may be

No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com

automatically set by the self rectification process or manually set.
Numeric area： 00 ～ 99%.
Display format： Suppose the pre-set proportional coefficient is 30%，the corresponding indication will be as follows：：



Indicators   are bright.

"CP—" in the above indication is the mark for *proportional coefficient*

Setting procedures： See 4.2.1.

4.2.9 Rectified nominal diameter

Application： This read-only parameter is used for diameter feedback control（advanced mode）. It is saved automaticallyby the self rectification process to mark the size of the rectified product.
Numeric area： 00.00 ～ 19.99 mm.
Display format： Suppose the rectified product has nominal diameter of 6.5 mm，the corresponding indication will be as follows：：

Indicators   are bright.

"—" in the above indication is the mark for *rectified nominal diameter*

4.2.10 Rated main machine given voltage

Application： This read-only parameter is used for diameter feedback control（advanced mode）. It is saved automatically by the self rectification process. The *main machine* here may refer to the extruder（when feedback control mode=2）or the capstan（when feedback control mode=3）.
Numeric area： 0.0 ～ 9.9 V.
Display format: Suppose the rated main machine given voltage saved by the self rectification process is 5V，the corresponding indication will be as follows：：

Indicators   are bright.

"EU—" in the above indication is the mark for *rated main machine given voltage.*

4.3 System parameters

Only when the correct system parameter password has been input can the system parameter menu be entered to view or change the parameter values. Some parameters cannot be changed due to the specific gauge configuration. The structure of the system parameter menu is shown below. In the following chart, "↑" indicating "press【Increase key】"， "↓" indicating "press【Decrease key】"，the key above a horizontal line indicating operation from left to right, the key under a horizontal line indicating operation from right to left, the final "……" indicating return to the first option of the menu（i.e., *communication work mode display*）.

No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com

4.3.1 System parameter setting

The general procedures to set system parameters are as follows：

（1）Input the correct system parameter password (see 4.1.10). Press 【Parameter key】to confirm the input and enter the system parameter menu.

（2）Press【Increase key】or【Decrease key】to locate the corresponding parameter.

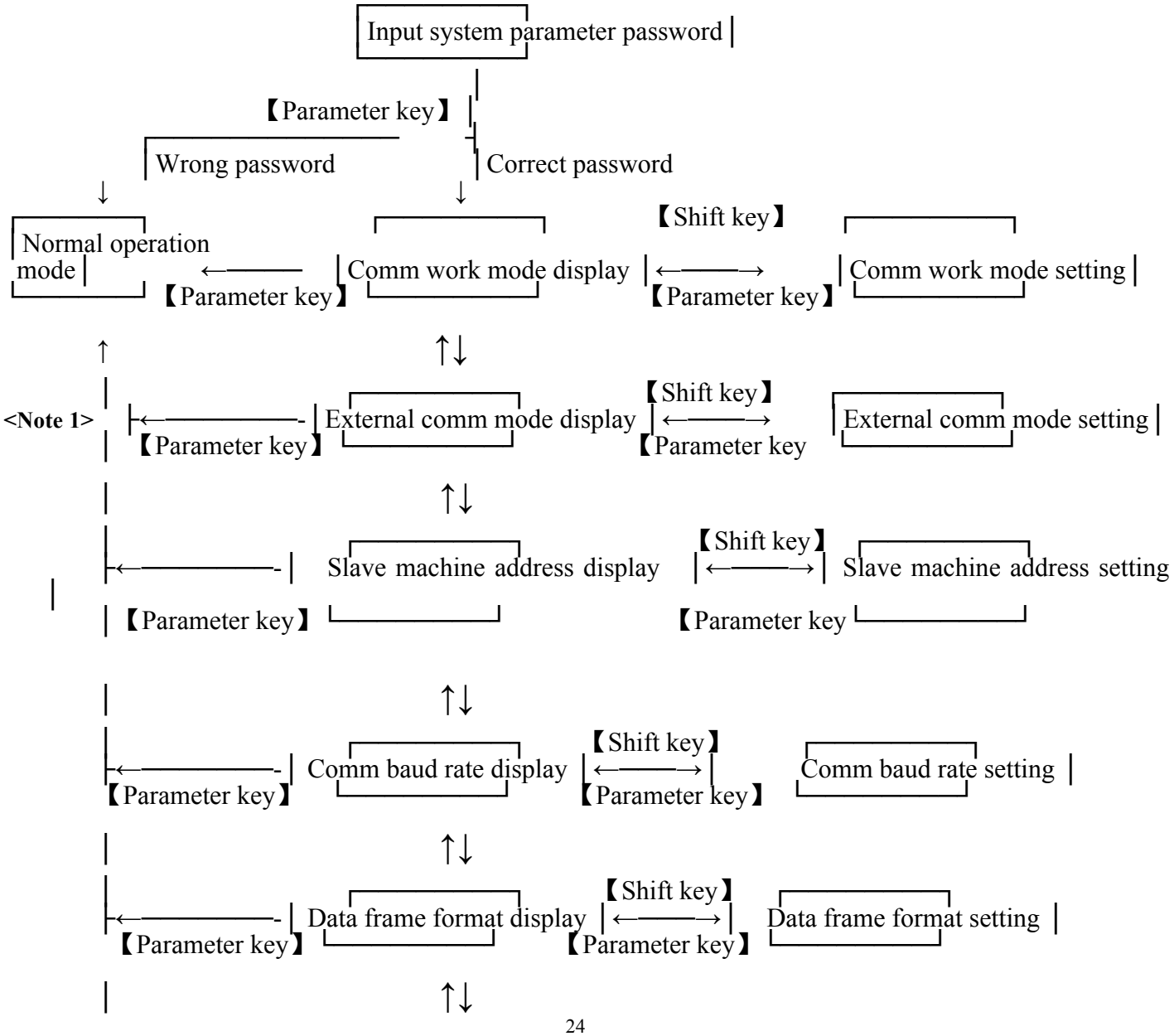
（3） If it is allowed to change the parameter value，press【Shift key】to enter the parameter setting mode.

（4）Press 【Increase key】or【Decrease key】and【Shift key】to change the parameter value.

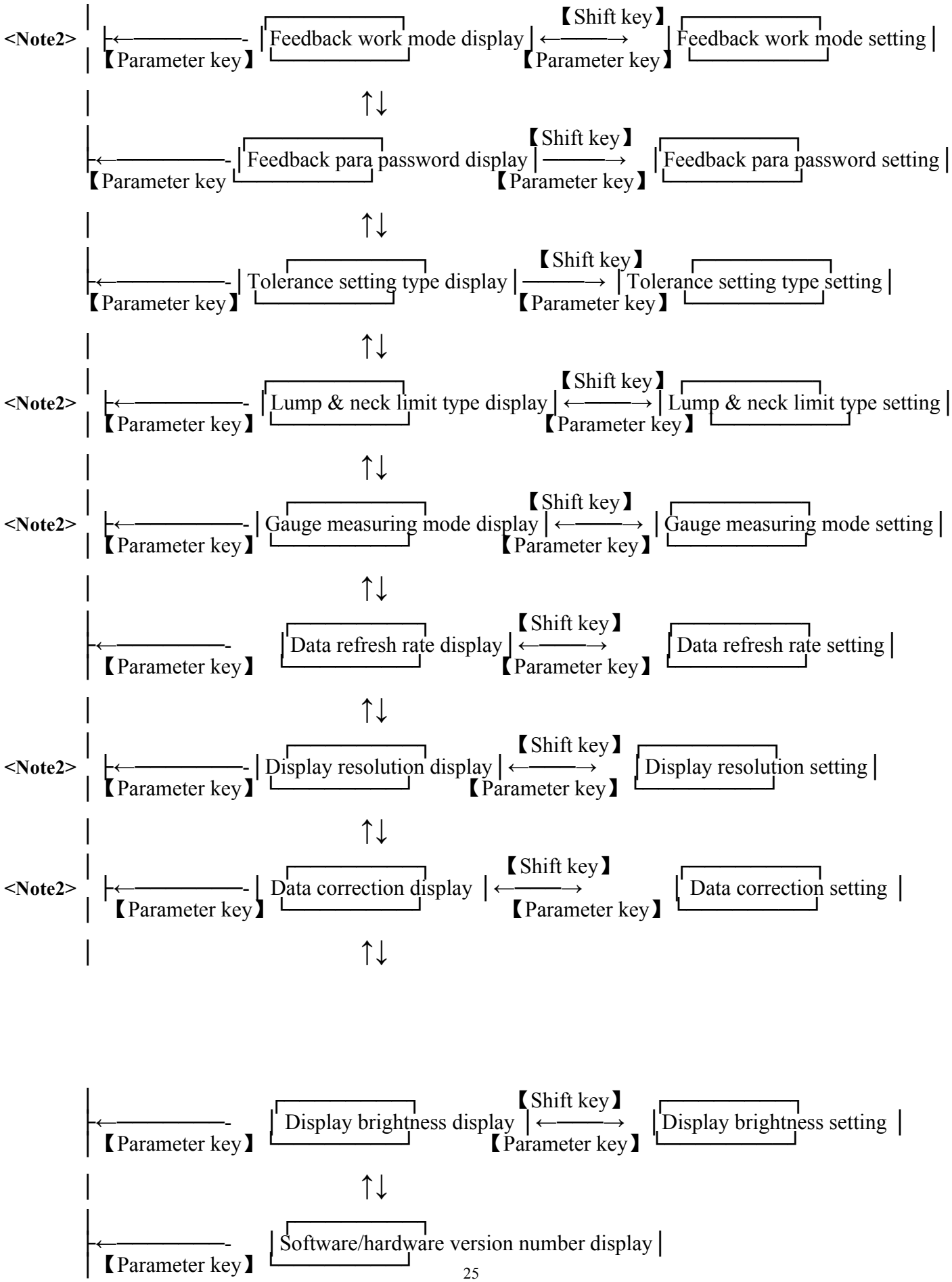
（5）After the change has been made, press 【Parameter key】 to save the change and return to the parameter display mode.

（6）If it is necessary to set another system parameter，press【Increase key】or【Decrease key】to locate the parameter. Otherwise press【Parameter key】to return to the *normal operation mode*.

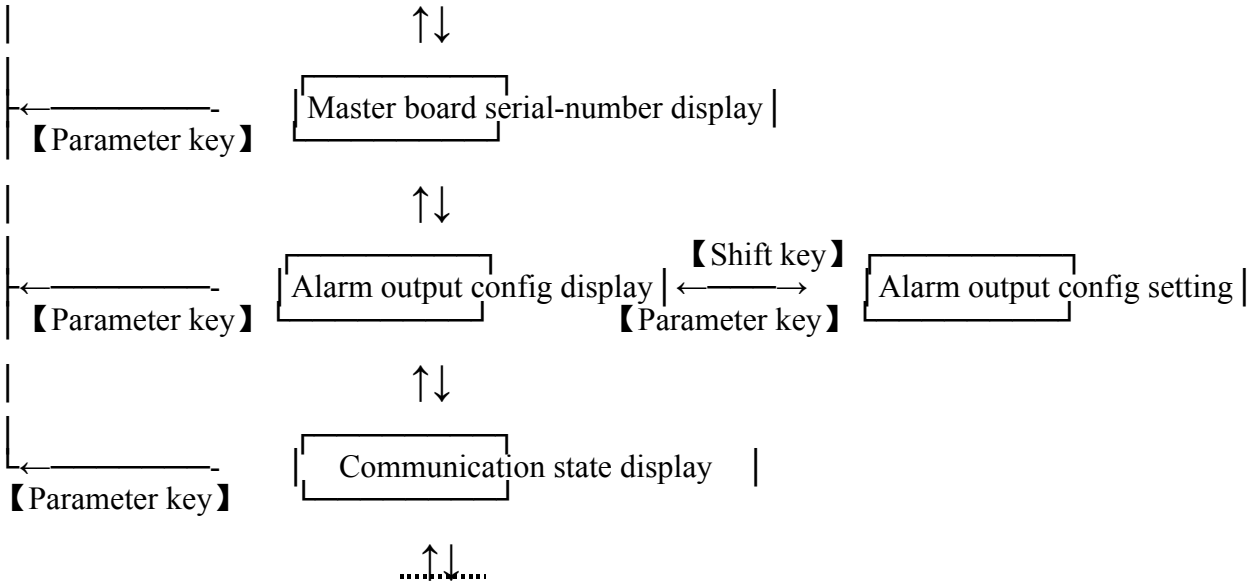
<Note 1> Only when the *communication work mode* is Con（peripheral equipment interface mode），can the the *external communication (adapter work) mode* be available.



No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com



No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com



<Note 2> Whether or not these parameters can be set depends on the Gauge configuration. Only when the Gauge has the corresponding function can the parameter value be changed.

4.3.2 Communication parameters

These system parameters include communication work mode, external communication (adapter work) mode, slave machine address, communication baud rate, communication data frame format（data bit, number of stop bits and parity check system）and communication state display. They are used to control the RS-485 serial comm. interface of the Gauge. For functions of the individual parameters, display format and setting procedures, see Chapter 6: Communication interface.

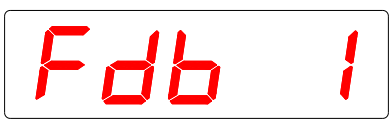
4.3.3 Feedback work mode

Application： This parameter is used to determine the work mode of diameter feedback control. Its setting depends on the Gauge configuration. Only when the Gauge has the *advanced feedback control work mode* can the parameter be set at 2 or 3.

Numeric area： 0=diameter feedback control disabled，1=basic feedback control mode（compatible with DDM-2020 diameter gauge），2=advanced feedback control mode（used to control the extruder），3=advanced feedback control mode（used for to control the capstan）.

Note: When the feedback work mode=0,（1）No *feedback parameter password* is contained in the working parameter menu，i.e., it is impossible to enter the feedback parameter menu.（2）In the normal operation mode, the LEB is used to display relative diameter deviation.

Display format： Suppose the pre-set feedback work mode is 1（basic feedback control mode），the corresponding indication will be as follows：：



The indicator is bright.

"Fdb" in the above indication is the mark for *feedback work mode.*

Setting procedures: See 4.3.1.

4.3.4 Feedback parameter password

No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com

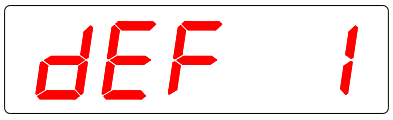
Application： This parameter is used to determine the password to enter the feedback control parameter menu.
Numeric area： 0000 ～ 9999.
Display format： Suppose the pre-set feedback parameter password is 1234（factory default），the corresponding indication will be as follows：：

The indicator is bright.

"F" in the above indication is the mark for *feedback parameter password.*
Setting procedures: See 4.3.1.

4.3.5 Diameter tolerance setting type

Application： This parameter is used to determine the diameter tolerance setting type in the working parameter menu.
Numeric area： 1=positive and negative tolerances are equal. They are combined into one single *tolerance*. 2= positive and negative tolerances are unequal. Positive and negative tolerances need to be set separately.
Display format： Suppose the pre-set tolerance setting is 1（factory default），the corresponding indication will be as follows：：



The indicator is bright.

"dEF" in the above indication is the mark for tolerance setting.
Setting procedures: See 4.3.1.

4.3.6 Setting type of lump & neck detection limit

Application： This parameter is used to determine the setting type of lump & neck detection limit in the working parameter menu. The setting depends on the Gauge configuration. Only when the Gauge has the function of lump & neck detection can the parameter be set at 1 or 2.
Numeric area： 0=Lump & neck detection disabled. 1= Positive and negative limits are equal. They are combined int one single *lump & neck detection limit*. 2= Positive and negative limits are unequal，they need to be set separately.
Note： When lump & neck detection limit=0, no parameters relating to lump & neck detection will be contained in the working parameter menu, including lump & neck detection limit（or positive limit and negative limit）and lump & neck detection time.
Display format： Suppose the pre-set *setting type of lump & neck detection limit* is 0（factory default），the corresponding indication will be as follows：：

The indicator is bright.

""LUP"" in the above indication is the mark for *setting type of lump & neck detection limit.*
Setting procedures: See 4.3.1.

No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com

4.3.7 Gauge measuring mode

Application： This parameter is used to determine the work mode of gauge measurement. The setting depends on the Gauge configuration. Only when the Gauge has the function of measuring transparent body can the parameter be set at 11.

Numeric area： 10=Normal measuring mode，11=Transparent body measuring mode.

Display format： Suppose the pre-set measuring mode is 10（normal measuring mode），the corresponding indication will be as follows：：

The indicator is bright.

"NN" in the above indication is the mark for *gauge measuring mode.*

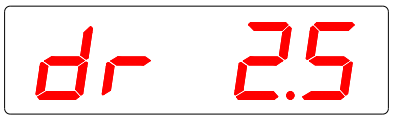
Setting procedures: See 4.3.1.

4.3.8 Display data refresh rate

Application： This parameter is used to determine the display data（measured diameter）refresh rate in the normal operation .

Numeric area： 2.5, 3.3, 5 and 10 indication/s

Display format： Suppose the pre-set *display data refresh rate* is 2.5（factory default），the corresponding indication will be as follows：：



The indicator is bright.

"dr" in the above indication is the mark for *display data refresh rate.*

Setting procedures： In order to set the *display data refresh rate* at 10 indication/s，proceed as follows:：

（1）Input the correct system parameter password （see 4.1.10）. Press 【Parameter key】to confirm the input and enter the system parameter menu.

（2）Press【Increase key】or【Decrease key】to locate the parameter *display data refresh rate*.

（3）Press【Shift key】to enter the parameter setting mode. The last two digits "2.5" flash.

（4）Press【Increase key】3 times to change "2.5" into"10".

（5）Press【Parameter key】to save the change and return to the parameter display mode.

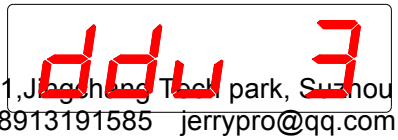
（6）If it is necessary to set another system parameter，press【Increase key】or【Decrease key】to locate the parameter. Otherwise press【Parameter key】to return to the *normal operation mode*.

4.3.9 Display resolution

Application： This parameter is used to determine the display data （measured diameter） resolution and unit. The setting depends on the Gauge configuration. Only when the Gauge allows changing the display resolution and unit can this parameter be set.

Numeric area: 2=0.01 mm, 3=0.001 mm, 4=0.0001 mm, 14=0.0001 in.

Display format： Suppose the pre-set *display resolution* is 3（factory default），the corresponding indication will be as follows：：



The indicator is bright.

No2401,Jingsheng Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com

"ddu" in the above indication is the mark for *display resolution.*

Setting procedures: See 4.3.1.

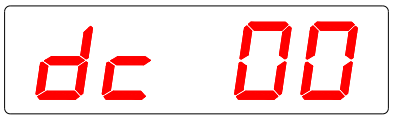
4.3.10 Display data correction

Application： This parameter is used to determine the display data（measured diameter）correction in the normal operation mode. The setting depends on the Gauge configuration. Only when the Gauge allows the display value correction can this parameter be set.

Numeric area： －99～0～+99 display readouts. The exact size depends on the display resolution and unit. For example, if the display resolution is 0.001 mm，the corresponding correction will be －0.099～+0.099 mm.

Note: This parameter is used mainly for correcting the measurement deviation caused by some factors (e.g., wet wire or cable and shrinkage by cooling). The correction is accomplished by adding a constant to or substracting a constant from the measurement. For this reason, this correction is not applicable universally. It shall be used separately for a specific size.

Display format： Suppose the pre-set *display data correction* is 0（factory default），the corresponding indication will be as follows:：



The indicator  is bright.

"dc" in the above indication is the mark for *display data correction.*

Setting procedures： In order to change the original *display data correction* "0" into "－12"，proceed as follows:：

（1）Input the correct system parameter password （see 4.1.10）. Press 【Parameter key】to confirm the input and enter the system parameter menu.

（2）Press【Increase key】or【Decrease key】to locate the parameter *display data correction*.

（3）If the setting is allowed，press 【Shift key】 to enter the parameter setting mode. The third digit "0" flashes.

（4）Press【Decrease key】to change "0" into "－".（if the original digit is "－"，press 【Increase key】to change "－" into "0"）.

（5）Press【Shift key】, the fourth digit "0" flashes. Press【Increase key】once to change "0" into "1".

（6）Press【Shift key】，the fifth digit "0" flashes. Press【Increase key】twice to change "0" into "2".

（7）Press【Parameter key】to save the change and return to the parameter display mode.

（8）If it is necessary to set another system parameter，press【Increase key】or【Decrease key】to locate the parameter. Otherwise press【Parameter key】to return to the *normal operation mode*.

4.3.11 Digital display brightness

Application： This parameter is used to set digital display brightness.

Numeric area： 0=50%，1=67%，2=75% and 3=100%.

Display format： Suppose the pre-set *digital display brightness* is 2（factory default），the corresponding indication will be as follows:：

No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
00861891319585 jerrypro@qq.com www.newleadgroup.com

The indicator is bright.

dbr" in the above indication is the mark for *digital display brightness*.

Setting procedures: See 4.3.1.

4.3.12 Software/hardware version number of the Gauge

Application： This read-only parameter stands for the version number of the hardware and programme of the Gauge main board.

Numeric area： 1.01～7.31，where the number before the decimal point is the the version number of hardware while that after the decimal point is the the version number of software

Display format： Suppose the current version number of hardware is 1 and that of the software is 3，the corresponding indication will be as follows：：

The indicator is bright.

"u " in the above indication is the mark for *software/hardware version number of the Gauge*.

4.3.13 Main board serial number of the Gauge

Application： This read-only parameter stands for the main board serial number of the Gauge.

Numeric area： The serial number is classified into 6 groups, i.e., A, B, C, D, E and F. Each group has numeric value of 0001～9999.

Display format： Suppose the current main board serial number of the Gauge is 0.0001 of group A，the corresponding indication will be as follows：：

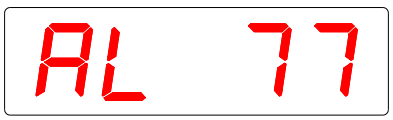
The indicator is bright.

4.3.14 Alarm output configuration

Application： This parameter is used to determine the action conditions of the alarm output contact of the DSP-3A Monitor，For details, see Chapter 5.

Numeric area： 00 ～ 77.

Display format： Suppose the pre-set alarm output configuration is 77（factory default），the corresponding indication will be as follows：：



The indicator is bright.

"AL" in the above indication is the mark for *alarm output configuration*.

Setting procedures: See 4.3.1.

5 Feedback control and out-of-tolerance alarm

No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com

Aided by DSP-3A Monitor, DDM-3020 Diameter Gauge can easily perform the function of diameter feedback control，i.e., to control the screw speed of the extruder or the capstan speed according to the deviation between the measured diameter and set nominal so that the actual diameter is as near to the nominal as possible.

5.1 DSP-3A Monitor

5.1.1 Main technical data

Power supply:	100～240V AC, 50～60Hz
Power consumption:	< 5W
Operating temperature:	0～45 □
Atmospheric humidity:	≤ 90%（free of condense water）
Display format:	5-digit LED digital display
Comm interface	RS-485
Max commun distance:	1000 m
Control input:	－10V～＋10V，input impedance 50 kΩ
Control output:	－10V～＋10V，max 10 mA
Alarm output:	Relay contact，max load 3A, 250VAC
Dimensions:	48 mm×96 mm×112 mm

5.1.2 Panel and display

Figure 5-1 Panel of DSP-3A Monitor

（1）**5-digit LED digital display** is used to display the measured diameter or fault message.

□ In normal operation, the measured diameter is displayd, which is equal to that displayd on the panel of the Gauge

□ When the Gauge is faulty, the fault message is displayd, which is equal to that displayd on the panel of the Gauge. For details, see 3.6.

□ When the communication with the Gauge is abnormal, the following is displayed:

No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com

（2）**10-segment LEB (light-emitting bar) display** is used to display the diameter feedback control output.

 When all the 10 segments are dark, the diameter feedback control is turned off.

 When the central two segments are bright, the diameter feedback control is turned on but the output is very small（near 0）.

 Beginning from the midpoint, when the segment(s) to the left is(are) bright, the diameter feedback control output is negative; when the segment(s) to the right is(are) bright, the diameter feedback control output is positive. The more number of segments are bright, the greater the output will be. When feedback control output is saturated, the 5 segments on the left flash (indicating saturation in the negative direction) or the 5 segments on the right flash (indicating saturation in the positive direction).

All the 10 segments flash simultaneously indicates abnormal operation of the Gauge or feedback control parameter error.

（3）**AL indicator (red)：** A bright indicator indicates that the alarm relay acted and thus the alarm contacts are closed. A dark indicator indicates that the alarm relay did not act and thus the alarm contacts are open.

（4）**CM indicator (green)：** A bright indicator indicates that the external control switch is open, enabling feedback control. A dark indicator indicates that the external control switch is closed, disabling feedback control.

5.1.3 Description of the terminals

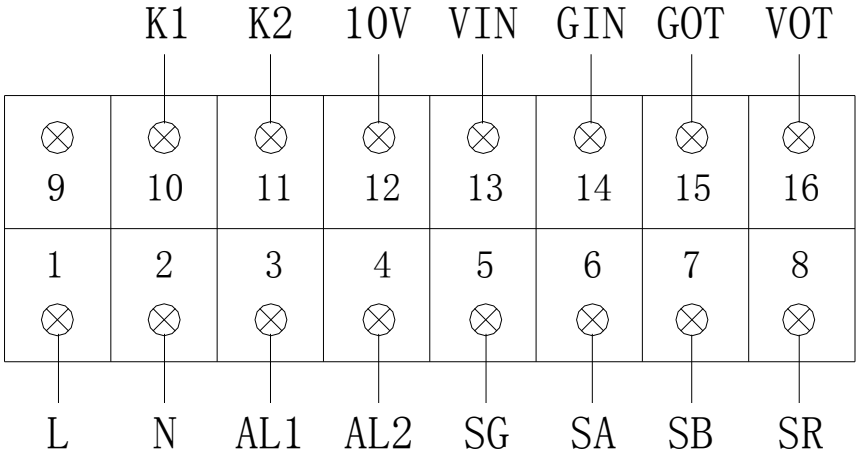


Figure 5-2 Terminal arrangement（back view）

No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com

Termminal No.	Name	Description
1	L	Phase wire of power supply（220VAC）
2	N	Neutral of power supply（220VAC）
3	AL1	Alarm contact output（the internal realy contacts are closed at alarm）
4	AL2	Alarm contact output （AL1 is connected to AL2 at alarm）
5	SG	RS-485 comm interface：Signal ground
6	SA	RS-485 comm interface：Bus A
7	SB	RS-485 comm interface：Bus B
8	SR	RS-485 comm interface：Terminal to connect the resistance for termination impedance match
9	—	Not used
10	K1	Signal to disable diameter feedback control（feedback control is disabled when K1 is connected to K2,）
11	K2	Signal to disable diameter feedback control
12	10V	－10V, 5mA voltage output（used for the basic mode of feedback control）
13	VIN	Given voltage input（signal end：－10V～+10V）
14	GIN	Given voltage input（ground end：0V）
15	GOT	Control voltage output（ground end：0V）
16	VOT	Control voltage output（signal end：－10V～+10V）

5.1.4 Mounting and wiring

DSP-3A Monitor employs a 48 mm×96 mm standard instrument chassis. In order to mount the monitor, a 44 mm（h）×92 mm（w）rectangular hole shall be cut on the control cabinet panel. Then the monitor shall be inserted into the hole from the front and fixed on the cabinet panel with the enclosed screws.

.

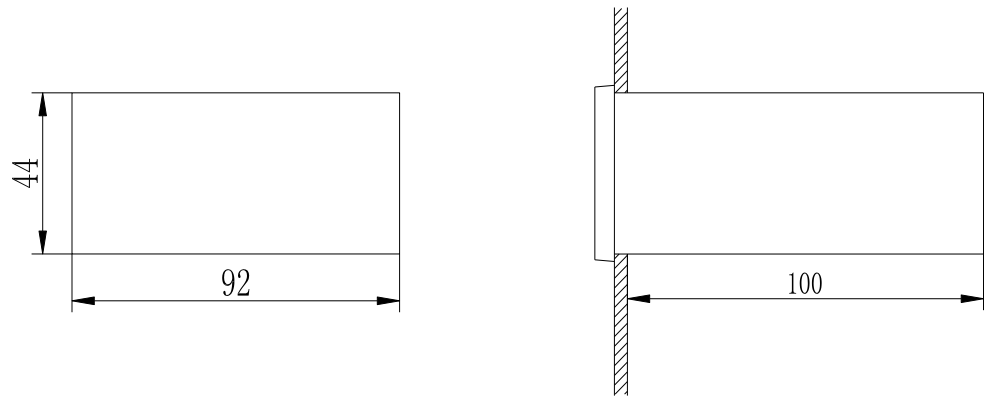


Figure 5-3 Mounting hole and monitor mounting

No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com

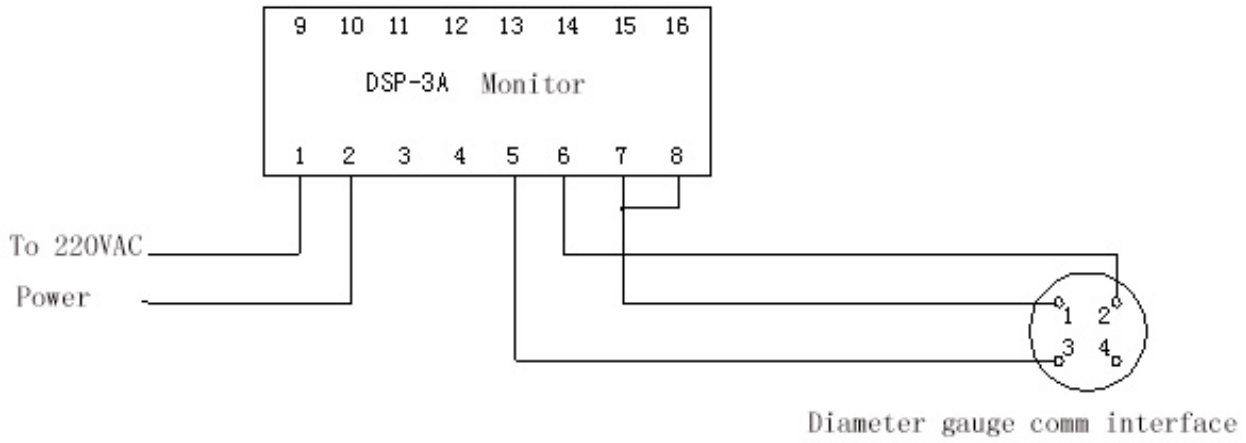


Figure 5-4 Wiring diagram 1：Only diameter display

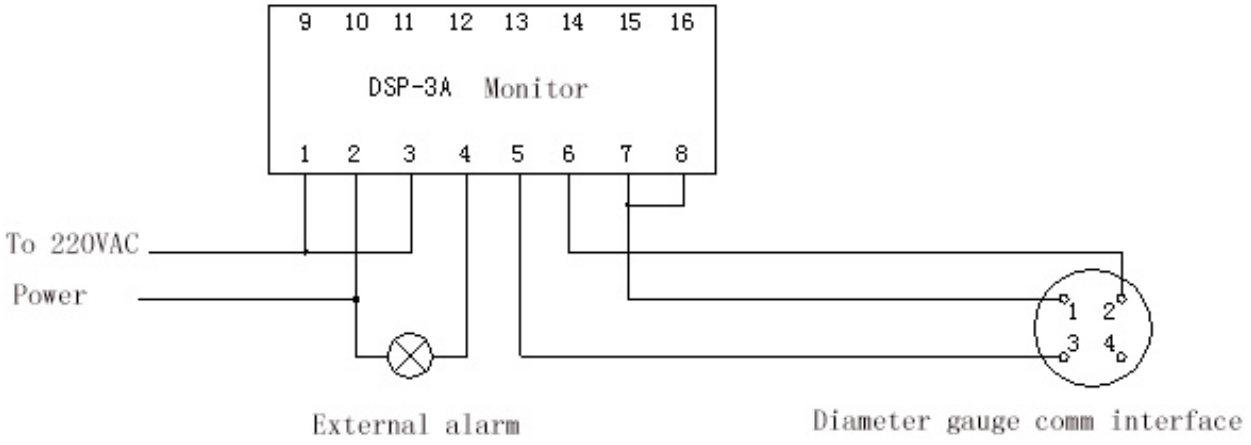
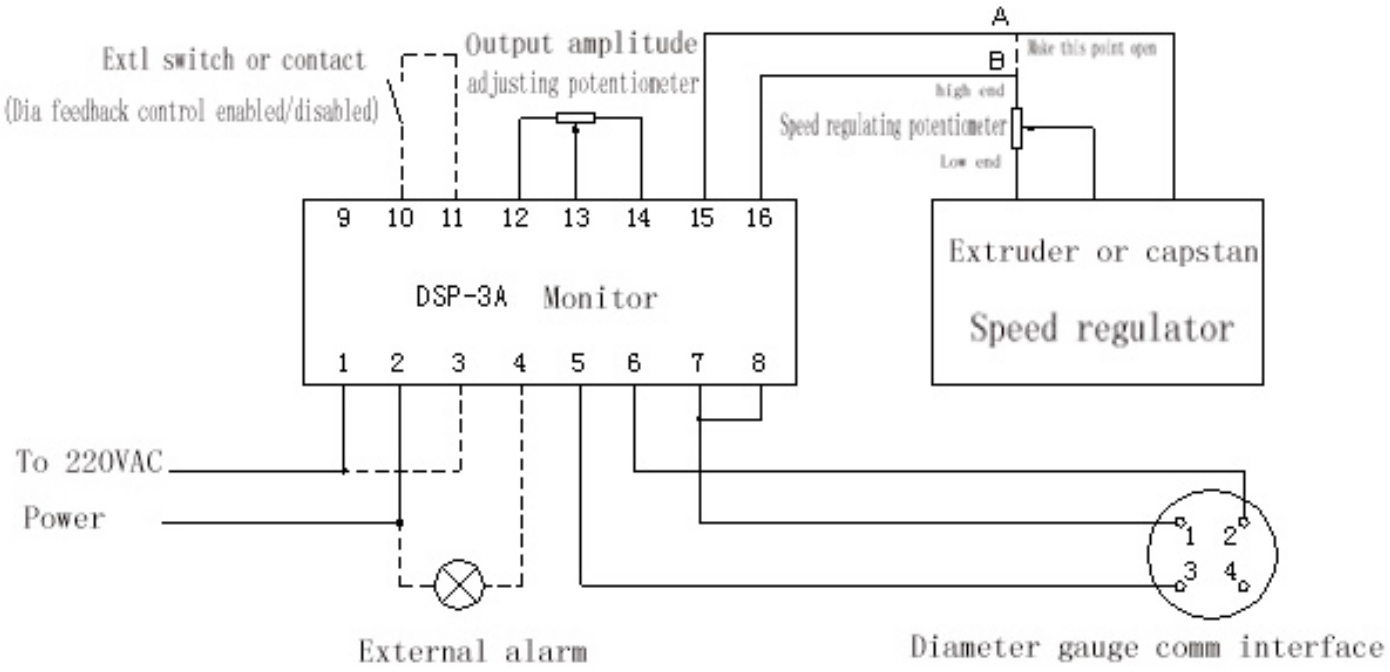


Figure 5-5 Wiring diagram 2：Diameter display and alarm



No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com

Figure 5-6 Wiring diagram 3: Basic mode of feedback control

Wiring discription：

（1）Connect pin ① and ② at the communication interface of the Diameter Gauge to the terminal 7 and 6 of DSP-3A Monitor respectively using a twisted pair having copper conductor size not samller than 0.5 mm^2 and characteristic impedance of 120 Ω.

（2）The signal ground（pin □ ── terminal 5）may be the shield of the twisted pair or another wire. The signal ground may be omitted with short bus length (up to 50m) and weak field interference.

（3）If DSP-3A Monitor is the *last peripheral equipment* on the RS-485 communication bus, terminal 7 shall be connected to terminal 8（connection of the resistance for termination impedance match）.

（4）The external alarm may be alarm lamp, buzzer or electric bell with operating voltage of 220VAC.

（5）Terminal 10 and 11 of the Monitor are used to turn on/off diameter feedback control in the *automatic mode*（see 4.2.3）: When they are disconnected, feedback control is enabled. When they are connected, feedback control is disabled. Generally, they are connected to the normally closed auxiliary contacts of the contactor in the main circuit of the motor under control or to the *feedback control* switch on the control cabinet panel.

（6）Terminal 12, 13 and 14 of the Monitor shall be connected to a potentiometer for adjusting the feedback control output amplitude. DSP-3A Monitor has a dedicated potentiometer in its accessories, which may be connected to these terminals.

（7）Terminal 15 and 16 of the Monitor are for feedback control output. They shall be connected in series to the high end of the motor speed regulating potentiometer（i.e., the end where the max given voltage is present）. The procedures are as follows：□ Locate the high end of the speed regulating potentiometer. Cut off the wire connected to this end to produce two cut ends A and B. □ If the feedback signal is to control the extruder, end A shall be connected to terminal 15 and end B to terminal16. □ If the feedback signal is to control the capstan, end A shall be connected to terminal 16 and end B to terminal 15.

5.2 Basic mode of diameter feedback control

The basic mode of feedback control has functions compatible with the previous generation diameter gauge. It may be substituted for the combination of DDM-2020（diameter gauge）and BFD-2（feedback control buffer）. In order to use the basic mode of feedback control，please wire the system according to Figure 5-6. The portions in the diagram represented by dotted lines are optional. They may be selected based on the practical conditions.

The related parameters must be set before diameter feedback control is used. These include feedback work mode, feedback control work mode, proportional-integral coefficient and nominal diameter.

5.2.1 Feedback work mode

This parameter is contained in the system parameter menu. It shall be set at 1 when the basic mode of feedback control is to be used.

5.2.2 Feedback control work mode

This parameter is contained in the feedback parameter menu. It shall be set at *manual mode* or *auto mode* as necessary.

（1）Manual mode: The advantages are simple wiring（the control contacts on Terminal 10 and 11 of the Monitor are not needed）and flexible control（diameter feedback control can be turned on/off at will by pressing【Increase key】/【Decrease key】on the Gauge panel）. The disadvantage is that diameter feedback control must be turned on/off by pressing【Increase key】/【Decrease key】on the Gauge panel by the

No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com

operator.

Be sure to turn off diameter feedback control when the line is stopped.

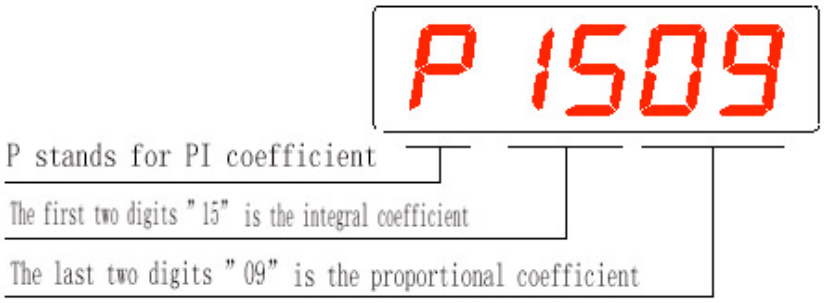
（2）Auto mode: The advantages are that manual intervention is not needed during normal operation and that turn-on/off of diameter feedback is controlled by the control contacts connected to Terminal 10 and 11 of the Monitor (When these contacts are closed, diameter feedback control will be turned off. When these contacts are open, diameter feedback control will be turned-on after 20s lag time). The disadvantage is relative complicated wiring (Terminal 10 and 11 of the Monitor must be connected to appropriate external control contacts. These contacts must be open when the line is started and closed when the line is stopped). Besides, a switch may be connected in parallel to these contacts to manually stop diameter feedback control if necessary.

（3）Warning： Diameter feedback control must be turned off when the line is stopped.

This is because the diameter feedback control system employs an improved PI adjuster containing in its interior an integral ring. If feedback control is not turned off when the line is stopped, the internal integrator will be saturated, resulting in unsteady system and large oscillation when the line is started again

5.2.3 Proportional-integral coefficient

This parameter is contained in the feedback parameter men. It consists of *Proportional coefficient* and *Integral coefficient* as shown below:



（1）The integral coefficient is the first two digits of the the parameter. Effective numeric area: 01～30. The integral coefficient determines the speed at which to eliminate the diameter deviation during the feedback control process. The greater the coefficient is, the faster the diameter deviation will be eliminated. But too fast elimination of the diameter deviation will result in unsteady system. Conversely, the smaller the coefficient is, the slower the diameter deviation will be eliminated and the steadier the system will be. For this reason, the value of the integral coefficient shall be selected considering both speed and stability. Generally, the integral coefficient can be determined by the following procedures：

Suppose the line speed during normal operation V（m/min）= V/60（m/s）and the wire travel length from the extruder head to the Gauge is L（m），then the time it takes for the wire to travel from the extruder head to the Gauge T = 60×L÷V（s）.

Therefore,

Integral coefficient = 30÷（2×T+1）= 30÷（120×L÷V +1）

This is the theoretic value of the integral coefficient. In practical application, this value must be modified appropriately based on the commissioning.

【Example 1】The line speed V=600m/min. The diameter gauge is mounted after the capstan. The length of the cooling trough is 6m. The length of the wire wound on the capstan wheel is 8m. Then the wire travel length L=6+8=14m.

No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com

Therefore,

Integral coefficient = 30÷（120×L÷V +1）= 30÷（120×14÷600 +1）=7.9

The integral coefficient after rounding=8.

【Example 2】 The line speed V=100 m/min. The diameter gauge is mounted before the cooling trough and 0.5m from the extruder head. Then the wire travel length L=0.5m.

Therefore,

Integral coefficient = 30÷（120×L÷V +1）= 30÷（120×0.5÷100 +1）=18.75

The integral coefficient after rounding=19

（2）The Proportional coefficient is the last two digits of the the parameter. Effective numeric area: 01～25.

The proportional coefficient determines the size of the proportional in the feedback control output. Its value can be calculated using the following equition：

Proportional coefficient = 25×（D^2 — d^2）÷ D^2

Where,

D=Insulation diameter，d=Conductor diameter before extrusion. In practical application, this value must be modified appropriately based on the commissioning.

【Example 3】Suppose the conductor diameter d=1.5 mm and the insulation diameter D=2.2 mm，then

Proportional coefficient = 25×（2.2^2 — 1.5^2）÷ 2.2^2 = 13.4

The proportional coefficient after rounding=13

5.2.4 Nominal diameter

This parameter is contained in the working parameter menu. It shall be set according to the requirement for the diameter of the wire or cable. In some cases, proper compensation shall be made（e.g., if the Gauge is mounted before the cooling trough, the set nominal diameter shall be increased somewhat due to shrinkage during the cooling process）.

5.2.5 Commissioning

After the Gauge and Monitor have been mounted and the wiring has been completed, commission the feedback control system with the following procedures：

（1）Set the related parameters according to 5.2.1—5.2.4. Be sure to set the *feedback control work mode* at *manual mode* during the commissioning.

（2） Take a sample wire having diameter slightly larger than the nominal（For example, if the nominal is set at 2mm，take a sample wire having diameter of 2.1～2.4mm）. Start the line and make it run at low speed. Mount the above sample wire on the guide pulley of the Gauge. Press【Increase key】to turn on feedback control.

（3）Observe the line operation. If the feedback control system controls the extruder, the screw shall turn at a lower speed. If the feedback control system controls the capstan, the capstan wheel shall turn at a higher speed. If the observed speed variation is contrary to the above mentioned, exchange the two wires connected to Terminal 15 and 16 of the Monitor.

（4）Press【Decrease key】to turn off feedback control. Start the line and make it run at normal speed until the wire diameter becomes stable and slightly larger than the set nominal. Press【Increase key】to turn on

No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com

diameter feedback control. Observe the variation of wire diameter.

（A）If the wire diameter approaches the set nomial fast and steadily without obvious fluctuation, the commissioing is finished.

（B）If the wire diameter approaches the set nomial slowly taking a long time, increase the proportional coefficient.

（C）If the wire diameter fluctuates sharply without reaching a steady value, decrease the proportional coefficient.

Adjust the proportional coefficient with the a.m. method to achieve a good feedback control effect.（If good effect can not be achieved by adjusting the proportional coefficient, adjust appropriately the the integral coefficient）

（5）After commissioning, set the *feedback control work mode* at *auto mode* if necessary.

Waring：The function of diameter feedback control shall be properly appreciated.

（1）Feedback control can only provide *fine adjustment* of the wire diameter. It is necessary to *roughly adjust* the wire diameter so that it is near the nominal (error ≤10%) and remains stable there before turning on diameter feedback control.（2）The function of diameter feedback is to control the mean wire diameter to the vicinity of the set nominal. It cannot eliminate fast fluctuation of the wire diameter, which can only be guaranteed by the stability of the equipment of the line.

6 Communication interface

The standard configuration of DDM-3020 Diameter Gauge includes a 2-wire half-duplex RS-485 communication interface. It is used for connection of the peripheral equipment produced by Shanghai On-Line, such as the Monitor, large screen remote display, analogue output unit and communication adapter. It may be also connected to an industry computer, PLC and touch panel.

6.1 Work mode

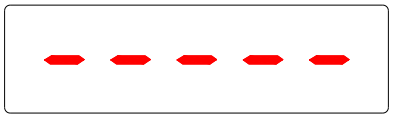
The communication interface can be configured to operate in one of the following two work modes：（1）The peripheral equipment interface mode, in which the Gauge acts as the master communication equipment and the communication protocol of Shanghai On-Line is employed. This mode is used for connection of the peripheral equipment produced by Shanghai On-Line.（2）Modbus RTU protocol mode, in which the Gauge acts as a slave communication equipment and Modbus RTU communication protocol of Modicon Inc is employed. This mode is used for connection of the industry computer, PLC and touch panel compatible with the protocol.

6.1.1 Setting of the communication interface work mode

The communication interface work mode shall be set by the parameter *communication work mode* contained in the *system parameter menu*. The factory default is the *peripheral equipment interface mode*. In order to change the setting, proceed as follows:

（1）Press【Parameter key】in the normal operation mode to enter the *working parameter display mode*.

（2）Press 【Increase key】 or 【Decrease key】to locate the input interface of the *system parameter password*, where:



The indicator  is bright.

No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com

（3）Input the system parameter password “74683”. The exact procedures are as follows:
Press 【Shift key】, the first “—” from the left on the digital display becomes a flashing “0”. Press 【Increase key】 or 【Decrease key】 to change “0” into “7”. Press 【Shift key】again，the first digit indicates “7” while the second “—” becomes a flashing“0”. Press【Increase key】or【Decrease key】to change “0” into “4”. Change the remaining three “—”’s into the required number in the same way and press【Parameter key】.
（4）The system enters the *system parameter display mode*, where the first displayd parameter is the *communication work mode*：

The first two digits indicating “C—” on the above indication are the mark for the *communication work mode*. The last three digits indicate the corresponding parameter value. “Con” stands for the *peripheral equipment interface mode* while “rtu” stands for the *Modbus RTU protocol mode*.

（5）In order to change the communication work mode，press 【Shift key】to enter the *system parameter setting mode*. At this time the last three digits flash. Press【Increase key】or【Decrease key】to change the value：Press【Increase key】 to change the original “Con” into “rtu”. Conversely, press【Decrease key】to change the original “rtu” into “Con”.
（6）After the change has been made，press 【Parameter key】 to save the change and return to the *system parameter display mode*.
（7） If it is not necessary to change another parameter，press【Parameter key】once more to return to the *normal operation mode*.
（8） If it is necessary to change another parameter, press【Increase key】or【Decrease key】in the *system parameter display mode* to locate the parameter to be changed. Then press 【Shift key】to enter the *system parameter setting mode* to make the change.

6.1.2 Setting of slave machine address

In the Modbus RTU protocol mode, the Gauge as a slave machine（or son machine as opposed to the master machine）in the RS-485 communication networks must have an exclusive address. The factory default of the slave machine address is 01. In order to change the setting, proceed as follows：
（1）Enter the *system parameter display mode*（see 6.1.1(1)—(3)）.
（2）Press【Increase key】or【Decrease key】to locate the display interface of the parameter *slave machine address*（Suppose the original slave machine address=01，i.e., factory default）：

The first two digits in the above indication “CA” is the mark for *slave machine address*. The last two digits “01” are the corresponding parameter value.

（3）Press 【Shift key】to enter the *system parameter setting mode*. At this time, the third digit “0” flashes. Press【Increase key】or【Decrease key】to change its value.
（4）After the change has been made, press【Shift key】, the fourh digit “1” flashes. Press【Increase key】or【Decrease key】to change its value.

No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com

（5） After the change has been made，press 【Parameter key】to save the change and return to the *system parameter display mode*.

（6） If it is not necessary to change another parameter，press【Parameter key】once more to return to the *normal operation mode*.

（7） If it is necessary to change another parameter, press【Increase key】or【Decrease key】in the *system parameter display mode* to locate the parameter to be changed. Then press【Shift key】to enter the *system parameter setting mode* to make the change.

6.1.3 Setting of communication baud rate

In the Modbus RTU protocol mode，the factory default of the communication baud rate of the Gauge is 19200 bps. In order to change the setting, proceed as follows:：

（1）Enter the *system parameter display mode*（see 6.1.1(1)—(3)）.

（2）Press【Increase key】or【Decrease key】to locate the display interface of the parameter *communication baud rate*（Suppose the original communication baud rate=19200 bps = 19.2 kbps，i.e., factory default）：

The first two digits in the above indication “Cb” is the mark for *communication baud rate.* The last three digits “19.2” are the corresponding parameter value.

（3）Press 【Shift key】to enter the *system parameter setting mode*. At this time, the last three digits “19.2” flash simultaneously. Press【Increase key】or【Decrease key】to change its value.

（4）After the change has been made，press【Parameter key】to save the change and return to the *system parameter display mode*.

（5） If it is not necessary to change another parameter，press【Parameter key】 once more to return to the *normal operation mode*.

（6） If it is necessary to change another parameter, press【Increase key】or【Decrease key】in the *system parameter display mode* to locate the parameter to be changed. Then press 【Shift key】to enter the *system parameter setting mode* to make the change.

6.1.4 Setting of communication data bit and parity check system

In the Modbus RTU protocol mode，the factory default of the Gauge is：8 data bits, 1 stop bit and even parity check. In order to change the setting，proceed as follows:：

（1）Enter the *system parameter display mode*（see 6.1.1(1)—(3)）.

（2） Press 【Increase key】or【Decrease key】 to locate the display interface of the parameter *communication data bit and parity check system*.（Suppose the oriniginal setting is 8 data bits,1 stop bit and even parity check = E81，i.e., factory default）：

The first two digits in the above indication “CC” is the mark for *communication data bit and parity check systeme.* The last three digits “E81” are the corresponding parameter value.

（3）Press【Shift key】to enter the *system parameter setting mode.* At this time, the last three digits “E81”

No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com

flash simultaneously. Press 【Increase key】or【Decrease key】to change the value. The Modbus RTU protocol allows three options as follows: E81（8 data bits, 1 stop bit and even parity check）, o81（8 data bits, 1 stop bit and odd parity check）and N82（8 data bits, 2 stop bits and no parity check）.

（4）After the change has been made，press【Parameter key】to save the change and return to the *system parameter display mode*.

（5） If it is not necessary to change another parameter，press【Parameter key】once more to return to the *normal operation mode*.

（6） If it is necessary to change another parameter, press【Increase key】or【Decrease key】in the *system parameter display mode* to locate the parameter to be changed. Then press【Shift key】to enter the *system parameter setting mode* to make the change.

6.2 Peripheral equipment interface mode

When the communication interface operates in the *peripheral equipment interface mode*，the Gauge as the master equipment in the RS-485 networks sends a read and write request every 0.5s to the slave equipment connected to the Gauge. The slave equipment, after having received the request, performs related operations and sends response data to DDM-3020 Diameter Gauge. A set of DDM-3020 Diameter Gauge can be connected to maximum 5 sets of peripheral equipment. The connections between the Gauge and sets of peripheral equipment are shown below:

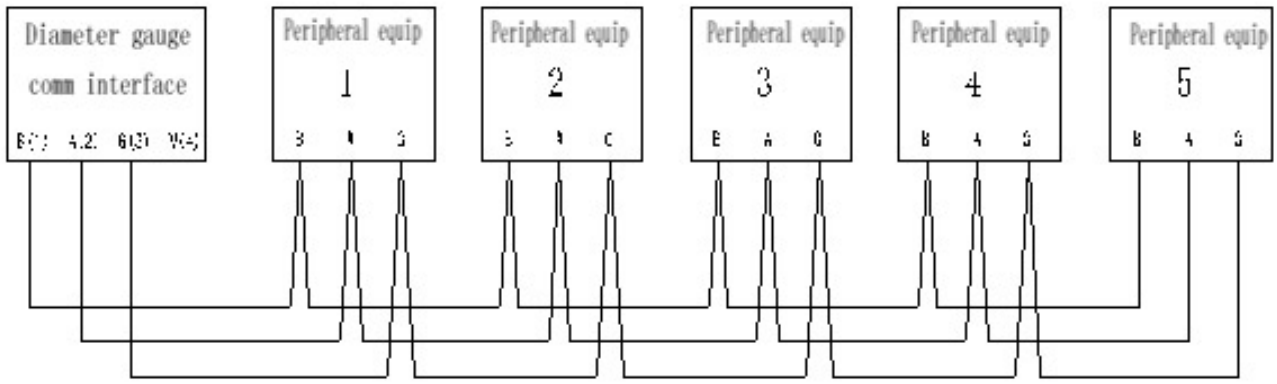


Figure 5 Communication connections between the Gauge and peripheral equipment

Note：

（1）End A and B of each equipment shall be connected using a twisted pair having copper conductor size not samller than 0.5 mm^2 and characteristic impedance of 120 Ω.

（2）The signal ground（wire G）may be the shield of the twisted pair or another wire. The signal ground may be omitted with short bus length (up to 50m) and weak field interference.

（3）The *last peripheral equipment* on the bus (peripheral equipment 5 in the above Figure) must be connected to a *resistance for termination impedance match*. Each peripheral equipment has in its interior this resistance. The only thing to do is to connect it to the related terminal according to the operating directions. Except for the last peripheral equipment, *no other peripheral equipment on the bus shall be connected to the resistance for termination impedance match*.

If normal communication is not possible between the Gauge and peripheral equipment when they are properly connected, check if the system parameter *communication work mode* is set at “Con”. For details, see 6.1.1.

No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com

6.2.1 Commonly used peripheral equipment

The peripheral equipment produced or being developed by Shanghai Online includes the following:

（1） DSP-3A Monitor, for remote display of the measured diameter and implementation of diameter feedback control.

（2）DSP-3S/DSP-3D large remote display（single /double side display）, in which large LED digitron is used to display the measured diameter for ease of monitoring

（3）COM-3S serial communication adapter.

6.2.2 Serial communication adapter

6.2.2.1 Application

COM-3S is the serial communication adapter produced specifically for DDM-3 Diameter Gauge by Shanghai Online. It is used mainly for the following cases:

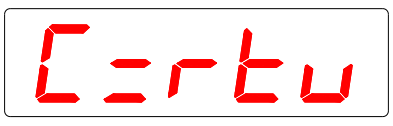
（1）If both connection of the peripheral equipment of Shanghai Online（e.g. connection of DSP-3A Monitor for feedback control） and communication with the upper computer（e.g. connection to the central control computer for remote data acquisition and processing）are necessary, set the work mode of the Gauge communication interface at ”Con”（peripheral equipment interface mode） to connect DSP-3A Monitor and COM-3S serial communication adapter. Communication with the master equipment such as induatry computer and PLC can be achieved by this adapter.

（2）One RS-485 communication bus allows connecting only one set of DDM-3020 Diameter Gauge. Because one RS-485 communication bus allows connecting only one set of the equipment with polarity bias circuit and only one of the bus ends can be connected to the resistance for termination impedance match while each set of DDM-3020 is provided with polarity bias circuit and resistance for termination impedance match inside its communication interface. COM-3S Adapter can be used to connect multiple sets of DDM-3020 Diameter Gauge to one RS-485 communication bus because it is not provided with polarity bias circuit and with the adapter it is possible to determine the connection of the resistance for termination impedance match from the outside.

6.2.2.2 Work mode

The work mode of the serial communication adapter is determined by the *external communication (adapter work) mode* contained in the system parameter menu of DDM-3020 Diameter Gauge. Such parameters in the menu as slave machine address, baude rate, data frame format（i.e., data bit, number of stop bit and parity check system）are employed, because at this time the work mode of the Gauge communication interface is set at “Con”（peripheral equipment interfacemode）and thus the above parameters are not employed.

The display format of the system parameter *external communication (adapter work) mode* is shown below（Suppose the setting is “rtu” mode）:



The indicator  is bright.

The first two digits in the above indication “C—” is the mark for *external communication (adapter work) mode*. This parameter is set in a similar way as that for the *communication work mode* in 6.1.1. But it has no Con（peripheral equipment interface）mode.

No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com

6.3 Modbus RTU mode

6.3.1 General description of the protocol

The data communication by DDM-3020 Diameter Gauge employs the Modbus serial link protocol. It is a master/slave protocol. The diameter gauge as a slave equipment can only accept the request and command by the master equipment（e.g., industry computer, PLC etc）and make response. At one time, only one master point (also called master machine) and one or more slave points (also called slave machine，max number 247) are connected to the same serial bus. Modbus communication is always initiated by the master point. A slave point will not send out data until it receives a request from the master point. A slave point will never communicate with another slave point. The master point will initiate only one Modbus transaction at one time.

6.3.2 Connection of physical layer

The physical layer for data communication of DDM-3020 Diameter Gauge is connected through RS-485 interface. If the master equipment employs a RS-232C communication interface，a RS232C/RS485 adapter shall be used to convert it into a RS-485 interface. Then the master equipment can be connected to the Gauge. A twisted pair with characteristic impedance of 120 Ω shall be used to connect the communication interface （4-pin aircraft plug）on the bottom of the Gauge to the communication interface of the master equipment.

The signal on the individual pins of the communication interface（4-pin aircraft plug）of DDM-3020 Diameter Gauge is as follow:

1：RS-485 signal B ---------- Connected to RS-485 bus B
2：RS-485 signal A ---------- Connected to RS-485 bus A
3：Signal ground GND ---------Connected to signal ground（Note1）
4：Power output（15V, 50mA）------ Not connected（Note 2）

Note 1: For short communication distance（≤ 50m），the signal ground may be not connected.

Note 2: The communication interface of the Gauge can provide a DC power supply of 15V 50mA to the outside to be used as a small capacity power supply for isolater-converter etc. When this kind of power supply is used, short circuit and overload shall be avoided to protect the power module in the Gauge.

Note 3: As DDM-3020 Diameter Gauge is provided with a 120Ω resistance for termination impedance match and polarity bias circuit inside the communication interface, it must be used as a termination of the RS-485 bus. The other end of the bus shall be also connected to a 120Ω resistance for termination impedance match.

6.3.3 Serial interface configuration

When the RS-485 serial communication interface of DDM-3020 Diameter Gauge is configured as the Modbus RTU mode，the default communication parameters will be：

Baud rate	19200 bps
Data bit	8 bit
Stop bit	1 bit
Parity check system	Even parity check

The default communication parameters can be changed if necessary. Baud rate can be set at 1200, 2400, 4800, 9600, 19200, 38400 and 57600 bps. Data bit and parity check system can be set at *Even parity check , 8 data bit and 1 stop bit*, *Odd parity check, 8 data bit and 1 stop bit* and *No parity check , 8 data bit and 2 stop bits.* For the setting procedures, see 6.1.

No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com

6.3.4 Modbus RTU protocol

During a communication, the master equipment on the RS-485 bus sends out a command. When this communication command reaches the slave equipment, the equipment with the corresponding address code will accept the command and perform the related task if there is no error. Then the slave equipment will send back the results of the performance to the sender. The information sent back includes address code, the function code to perform the operation and data and cyclic redundancy check (CRC) code after the operation has been performed. No information will be sent if there is any error.

6.3.4.1 Information frame format

START	Start structure	Lag（≥ the time to transmit 3.5 bytes）
ADDR	Address code	1 byte（8 bits）
CS	Function code	1 byte（8 bits）
DATA	Data field	N bytes（N×8 bits）
CRC	CRC code	2 bytes（16 bits）
END	End structure	Lag（≥ the time to transmit 3.5 bytes）

6.3.4.2 Start structure and end structure

The start/end structures indicate the start/end of a data frame. They are produced by the sender of the data frame by idling the RS-485 bus for at least the time to transmit 3.5 bytes. The data bytes in a data frame must be sent continuously. A frame with an interval ≥ the time to transmit 1.5 bytes will be regarded as invalid and abandoned.

That the bus is found to have idled for the time to transmit 3.5 bytes at the receiving-end means a new data frame starts. That the bus is found to have idled for the time to transmit 3.5 bytes during the process of receiving a data frame means the data frame has been received. If the bus is found to have idled for the time longer than the time to transmit 1.5 bytes but shorter than the time to transmit 3.5 bytes during the process of receiving a data frame, the data frame will be regarded as invalid and abandoned and the receiver will wait for the next start structure.

6.3.4.3 Address code

The address code is the first data byte in the information frame transmitted during each communication.
The standard Modbus RTU protocol supports the slave machine address codes of 1-247. The address codes allowed by DDM-3020 Diameter Gauge are 01-99. The address code can be set on the Gauge panel. For the setting procedures, see 6.1.

6.3.4.4 Function code

The function code is the second data byte in the information frame transmitted during each communication. The Modbus RTU communication protocol defines the function codes as 1～127 (0x01～0x7F). The following function codes are employed by DDM-2030 Diameter Gauge:

03 Read keep register Read one or more keep registers with contiuous addresses.
04 Read input register Read one or more input registers with contiuous addresses
06 Write single register Write a 16-bit data into a keep register

No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com

The function code 04 is used to read the content of the input register, a read-only register, e.g., diameter measurement, out-of-tolence alarm etc.
The function codes 03 and 06 are used to read and write the keep register, e.g., set nominal, tolerance etc.

6.3.4.5 Data field

（1）The data field of the request frame of function 03（read keep register）contains 4 bytes：

Byte 3： Register start address read（high byte）
Byte 4： Register start address read（low byte）
Byte 5： Register quantity read（high byte）
Byte 6： Register quantity read（low byte）

The data field of the response frame sent-back after the request has been properly performed contains 2N+1 bytes（N is the register quantity read）：

Byte 3： Number of bytes of subsequent data（=2N）
Byte 4～3+2N： Value of the N registers read（high byte followed by low byte）

（2） The data field of the request frame and response frame of function 04（read input register）has the same structure as that of function 03.

（3）The data field of the request frame of function 06（write single register）contains 4 bytes：

Byte 3： Register address（high byte）
Byte 4： Register address（low byte）
Byte 5： Register value to be wrriten（high byte）
Byte 6： Register value to be wrriten（low byte）

The response frame sent-back after the request has been properly performed has the same data field as that of the request frame.

6.3.4.6 Abnormal response frame

When the slave machine operates abnormally during the process of performing the request, an abnormal response frame will be sent back which has the following structure：

START	Start structure	Lag（≥ the time to transmit 3.5 bytes）
ADDR	Address code	1 byte，slave machine address
ES	Error code	1 byte, =The original function code+128（decimal）or +80h（hexadecimal）
EC	Abnormal code	1 byte
CRC	CRC code	2 bytes（16 bits）
END	End structure	Lag（≥ the time to transmit 3.5 bytes）

The error code= The original function code +128（decimal） or +80h（hexadecimal）. For example: For function 03 request，the error code=83h (hexadecimal). The abnormal code is defined as 01=Non-supported function code，02=Register address error，03= Data error，04=Performance failure.

6.3.4.7 CRC check

The Modbus RTU communication protocol employs cyclic redundancy check (CRC) to control the transmmission error. The sender calculates the CRC code of address code, function code and all the data in data field and sends it out with the data（The CRC code consists of 2 bytes. The low byte will be sent first）. The receiver after having received the data frame will re-calculate the CRC code and compare the result with the received CRC code. The data frame will be regarded as valid if the two CRC codes are equal. Otherwise the data frame will be regarded as invalid.

No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com

Method of calculating CRC code：At first a 16-bit register shall be pre-installed with all 1. Then the subsequent operations shall be performed between the register value and the contintious 8-bit bytes in the message. Note that only the 8 data bits participate in the operation to generate CRC code. The start bit, stop bit and parity check bit will not participate in the calculations. During the process to generate CRC code, an XOP operation is performed between each 8-bit character and the register value. Then the result shall be shifted to the least significant bit (LSB) for 1 bit while the maximum significant bit (MSB) shall be filled with 0. Then the least significant bit (LSB) shall be taken and checked. If LSB=1， an XOR operation shall be performed between the register value and a fixed pre-set value（binary 1010 0000 0000 0001 or hexadecimal A001h）. If LSB=0，no XOR operation shall be performed. This process shall be repeated until 8 shifts (for one byte) have been completed. After the last shift（the 8th shift）and related operations have been completed, an XOR operation shall be performed between the next 8-bit byte and the current register value and this process shall be repeated 8 times as above mentioned. The final register value obtained after all the bytes in the message have been used for operation will be the CRC code. In summary, the process to generate CRC code is as follows：

（1）Insall a 16-bit register with hexadecimal FFFFh (all1) and call it CRC Register.

（2） Perform an XOR operation between the first 8-bit byte in the message and the low byte of the 16-bit CRC register. The result shall be placed in the CRC register.

（3）Shift the CRC register to the right (to LSB) for one bit. Fill the maximum significant bit (MSB) with 0. Then taken and check the least significant bit (LSB).

（4）If LSB=0, repeat procedure（3）to start another shift.
If LSB=1, perform an XOR operation between the register value and a constant A001h (1010 0000 0000 0001).

（5）Repeat procedures 3 and 4 until 8 shifts have been completed. At this time the operation on this byte has been finished.

（6）Repeat procedures 2 ~ 5 on the next byte in the message. Continue this operation until all the bytes in the message have been processed.

（7）The final content of CRC register is CRC code.

6.4 Examples of information frame

Suppose the Gauge（slave machine）address is 01 and all data are expressed in the hexadecimal system.

（1）Read measured diameter
Request frame： 01 04 00 0B 00 01 40 08
Response frame： 01 04 02 XX YY RR RR
Of which, XX and YY are the high byte and low byte of the measured diameter，RR RR are 2-byte CRC codes.
Result：Measured diameter = 256×(XX) + (YY)，unit: micrometer（μm）.

（2）Read nominal diameter
Request frame： 01 03 00 65 00 01 94 15
Response frame： 01 03 02 XX YY RR RR
Of which, XX and YY are the high byte and low byte of the nominal diameter，RR RR are 2-byte CRC codes.
Result：Nominal diameter = 256×(XX) + (YY)，unit: micrometer（μm）.

（3）Write nominal diameter
Requirement：Write nominal diameter = 4.5 mm = 4500 μm（hexadecimal = 1194h）into the Gauge.
Request frame： 01 06 00 65 11 94 94 2A

No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com

Response frame： 01 06 00 65 11 94 94 2A

6.5 Register address assignment

The following table lists the register address, register name and data format for fuction codes 04, 03 and 06.
Note：（1）Register addresses are expresssed in decimal numbers beginning from 0000.**（2）**For certain configuration software（e.g. Kingview）and PLC，the register addresses begin from 0001. When these software are used, the given register address shall be added by 1. For example, the register address of the measured diameter shall be 0011+1=0012.**（3）** Read/write at the reserved register address （e.g., 0004, 0100 etc）will result in the abnormality *Register address error*（abnormal code=02）.（4） If the register value in the request frame to write into a register （function code 06）exceeds the numeric area allowed by the Gauge, an abnormal response *Data error* will be made（abnormal code=03）.

6.5.1 Registers（read-only）for function code 04

Address	Name	Data format and area
0000	（Reserved）	
0001	Gauge size code	0x0014=DDM-3020 Diameter Gauge
0002	Soft-/hardware version number	0x0102=Ver 1.02
0003	Gauge configuration	（Note1）
0004-0010	（Reserved）	
0011	Measured diameter	0～19999，unit: μm
0012	Gauge mode	（Note 2）
0013	Location of wire centre	0～65535，0=Lower end，65535=Upper end
0014	Alarm（out-of-tolerance, lump & neck）	（Note 3）
0015	Lump & neck counter	0～9999
0016	Feedback control output	-4095～+4095，bit 15 is the sign bit
0017	Feedback control mode	（Note 4）
0018-0099	（Reserved）	

6.5.2 Registers for function codes 03 and 06（read/write）

Address	Name	Data format and area
0100	（Reserved）	
0101	Nominal diameter	0～19999，unit: μm
0102	Positive tolerance	0～9999，unit: μm
0103	Negative tolerance	0～9999，unit: μm
0104	Lump & neck positive limit	0～9990，unit: μm
0105	Lump & neck negative limit	0～9990，unit: μm
0106	Lump & neck detection time resolution	1～9, unit: ms

No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com

0107-0119	（Reserved）	
0120	Feedback control work mode	（Note 5）
0121	Feedback PID proportional coefficient	0～99，meaning 00～99%
0122	Feedback PID integral coefficient	0～99，meaning 00～99%
0123	Wire diameter	0～19990，unit: μm
0124	Rated line speed	0～2999，unit: m/min
0125	Wire travel length	0～999，unit: ×0.1m
0126	Rectified nominal diameter	0～19990，unit: μm
0127	Rated master machine given voltage	0～99，unit: ×0.1V
0128	Basic mode PID coefficient	0～9999
0129-0139	（Reserved）	
0140	Work mode	10=Normal，11=Transparent body
0141	Display refresh rate	（Note 6）
0142	Display resolution and unit:	（Note 7）
0143	Display value correction	-99～+99
0144	Tolerance settingtype	（Note 8）
0145	Lump & neck detection setting type	（Note 9）
0146	External alarm contact setting	（Note 10）

Note 1: Indicating the functions of the Gauge. The binary bits have the meaning as follows：

Bit 0： 0=Absence of transparent body work mode，1=Presence of transparent body work mode.
Bit 1： 0=Absence of lump & neck detection， 1=Presence of lump & neck detection.
Bit 2： 0=Display resolution setting disabled， 1=Display resolution setting enabled.
Bit 3： 0=Display value correction disabled， 1=Display value correction enabled，
Bit 4： 0=Absence of feedback control， 1=Presence of feedback control
Bit 15-5 Reserved（=0）.

Note 2: Indicating the current work mode of the Gauge. The binary bits have the meaning as follows：

Bit 0=1：Absence of tested object Bit 1：（Reserved）
Bit 2=1：Tested object too high Bit 3=1：Tested object too low
Bit 4=1：Multiple wires Bit 5=1：Lens badly polluted
Bit 6=1：Inteference by ambient stray light Bit 7=1：Absence of measuring light
Bit 8=1：Gauge locked（over 31 inputs of wrong password）.
Bit 9=1：Software fault Bit 10=1：Hardware fault
Bit 11=1：Internal system fault Bit 12=1：Panel commuincation fault
Bit 15-13：Reserved

Note 3: Indicating the current alarm mode of the Gauge. The binary bits have the meaning as follows：

Bit 0=1：Alarm for too thick tested wire Bit 1=1：Alarm for too thin tested wire
Bit 2=1：Lump & neck defects detected during the current work cycle（100ms）
Bit 7-3：Reserved
Bit 8=1：Too thick alarm（hold） Bit 9=1：Too thin alarm（hold）
Bit 10=1：Lump & neck alarm（hold） Bit 11-14：Reserved
Bit 15： External alarm contacts output（0=open，1=closed）.

No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com

Note 4 Indicating the operating mode of the feedback control system. The binary bits have the meaning as follows：

Bit 1-0: Feedback operating mode（00=turn-off，01=self rectification，10=frozen，11=turn-on）

Bit 2=1：Positive output saturated Bit 3=1：Negative output saturated

Bit 6=0: Manual work mode， Bit 6=1: Auto work mode

Bit 7=1：Feedback control parameter error

Note 5: Feedback control work mode：

0=Absence of feedback control

1=Traditional control work mode（compatible with the previous generation DDM-2020）.

2=Advanced control work mode（to control the extruder）.

3=Advanced control work mode（to control the capstan）.

Note 6: Display data refresh rate：

0=2.5 indication/s, 1=3.3 indication/s, 2=5 indication/s, 3=10 indication/s

Note 7: Display resolution and unit:

0=0.01mm, 1=0.001mm, 2=0.0001 mm, 3=0.0001in

Note 8: Tolerance setting type：

1= Positive and negative tolerances are equal, hence only one tolerance needs to be set.

2= Positive and negative tolerances are unequal, hence they need to be set sepaerately.

Note 9: Lump & neck detection setting type：

0=Absence of lump & neck detection

1= Positive and negative tolerances of lump & neck detection are equal, hence only one tolerance needs to be set.

2= Positive and negative tolerances of lump & neck detection are unequal, hence they need to be set seperately.

Note 10: Used to set the behavour of the external alarm contacts. The binary bits have the meaning as follows：

Bit 0：Diameter out-of-positive-tolerance alarm

Bit 1：Diameter out-of-negative-tolerance alarm

Bit 2：Lump & neck alarm（hold, manual re-set needed）

Bit 3：Reserved

Bit 4：Abnormal operation by the Gauge

Bit 5：Abnormal feedback control（output saturation and feedback control parameter error）

Bit 6：Absence of tested object

Bit 7：Diameter out-of-tolerance alarm（hold, manual re-set needed）

Bit 15-8： Reserved

When a binary bit=1 and the abnormalury represented by it is detected by the Gauge, the external output alarm contacts will be closed. When a binary bit=0, the abnormalury represented by it will be ignored by the Gauge.

No2401,Jingchang Tech park, Suzhou city,JiangSu province,China
008618913191585 jerrypro@qq.com www.newleadgroup.com