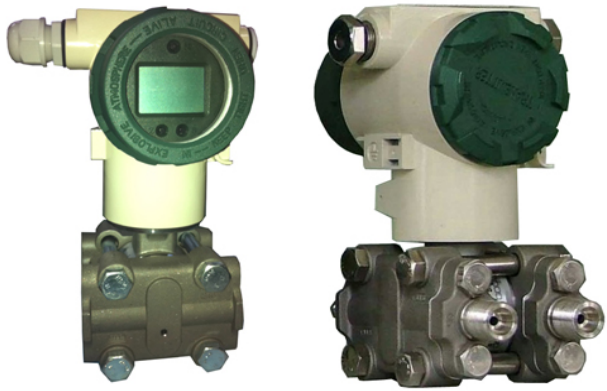
FB3351

Intelligent Capacitive Pressure/Differential

Transmitter

Operation Instruction



Contents

1、Introduction

1.1、Brief introduction

FB3351 capacitive pressure/differential intelligent transmitter series is a kind of multifunctional digital instruments. It's designed elaborately based on advanced、mature、reliable capacitive sensor technology, combined with advanced SCM and sensor digital conversion technology.

The critical components of the FB3351 capacitive pressure/differential intelligent transmitter series are all imported, it's performance is the same as advanced foreign products. The series product is much more perfect after been developed、produced and sold for so many years. It's leading in the domestic capacitive pressure/differential transmitter field whatever the performance or the quality reliability.

FB3351 capacitive pressure/differential intelligent transmitter series has the characteristic of advanced principle, full variety and specification, installing and using easily, and so on. Specially it's famous for high precision, small cubage, beautiful appearance, high stability, and low price, so it's prestigious in the field.

1.2、Application area and use

FB3351 capacitive pressure/differential intelligent transmitter series is applied to measure precisely from ultra-low differential to large differential, low pressure to high pressure, liquid level, vacuum grade and specific gravity. It's applied to measure flow too if matched with the corresponding equipments. It's suit for various occasions and medium, so it's applied widely in the industries of petroleum、chemical、metallurgy、electric power、grocery、paper making、medicine、textile，and so on.

1.3、Operation principle of the intelligent transmitter

1.3.1 Fig1-1 is the operation principle electric diagram of the intelligent transmitter. Hereinafter will describe the operation principle and each part's function.

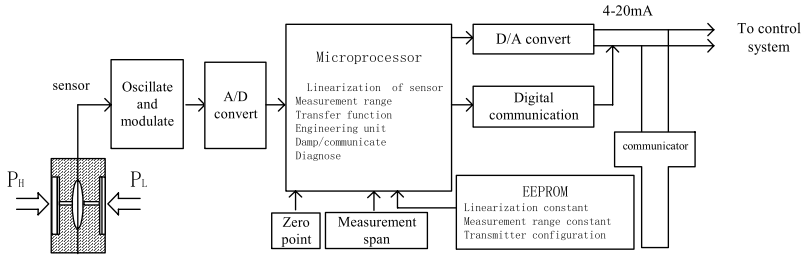


Fig1-1

1.3.2 “δ” chamber sensor(sensitive component)

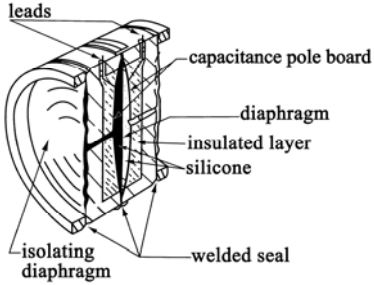


Fig 1-2 “δ” chamber

The hardcore of the intelligent transmitter is a capacitive pressure sensor, which is called “δ” chamber(see Fig1-2).The sensor is a sealed component. Through the isolating diaphragm and silicone filled, the process pressure conduct to the conduction diaphragm and bring shift in the diaphragm. The difference of the capacitance between the conduction diaphragm and the two capacitance pole boards transform to 4~20mADC electric signal of 2-wire through the electronic components.

1.3.3 Intelligent PCB

1) A/D conversion

A/D conversion circuit is adopted 16 bit low power IC, to convert the analog signal of module’s output to digital, which is used as the microprocessor’s input signal.

2) Microprocessor

The microprocessor of the intelligent transmitter controls the A/D and D/A conversion, it can diagnose by itself and carry out digital communication too. When operating, a digital pressure value is processed by microprocessor and saved as digit so as to assure the precision correction and engineering unit conversion. Moreover, the microprocessor can set the sensor’s parameters such as linearization、span ratio、damping time and other functions.

3) EEPROM memorizer

EEPROM memorizer saves all the configuration, characterization and digital trim parameters. The memorizer is not losable, so even if the power is broken, all data will keep perfectly so as to communicate intelligently at any moment.

4) D/A conversion

D/A conversion is to convert the digital signal to 4~20mA analog signal and output to loop. The digital signal is from microprocessor and has been calibrated already.

5) Digital communication

It can test and configure the intelligent transmitter by a communicator. It can communicate by any upper computer with HART protocol too. HART protocol adopts FSK(Frequency shift key) technology of the BELL202 Industry Standard. It carries out communication by overlaying 1200Hz or 2000Hz digital signal with 4～20mA signal. When communicating, the frequency signal has no any interference with process of 4～20mA.

2、Main technical parameters

Measurement range	0～0.125KPa～41.37MPa (see the table of span for details)
Medium applied	Liquid/Gas/Steam
Output signal	4～20mADC，linear or extraction output is decided by user(see Fig2-1)
Power supply	12～45VDC
Environment temperature	－20℃～+70℃
Storage temperature	－40℃～+100℃
Load characteristic	It's related with the power supply. When certain voltage, the load capability is shown as the Fig2-2. The relation formula between load impedance(RL) and power voltage(V) is RL ≤50(V-12) (Ω) Note: RL is 230Ω～600Ω when communicating with computer or handholding communicator.
Indicator	$3_{1/2}$ bit LCD display meter (0～100%)
Plus & minus shift	**Differential transmitter:** The most plus shift is the difference between URL and measurement span; The most minus shift is URL. **Pressure transmitter:** The most plus shift is the difference between URL and measurement span; The most minus shift is not more than atmospheric pressure. **Absolute pressure transmitter:** The most plus shift is the difference between URL and measurement span.
Static and overload pressure	4、10、25、32(Mpa)(see the table of order number for details)
Cubage change	≤0.16cm^3
Damping	It's adjustable continually between 0S~16S
Startup time	2S, Preheating is needless

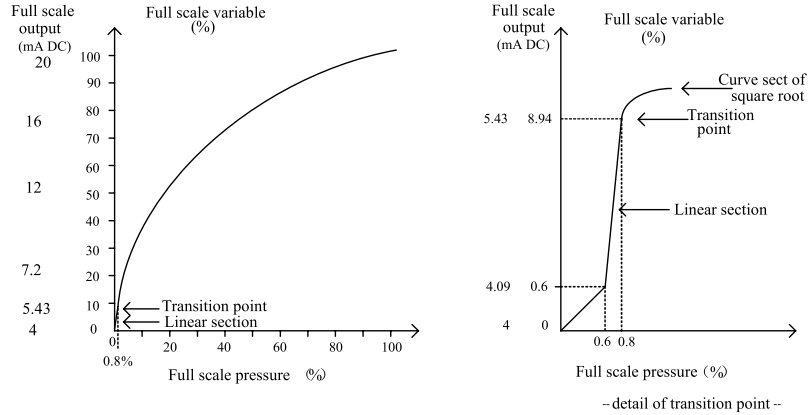


Fig2-1 output curve of square root

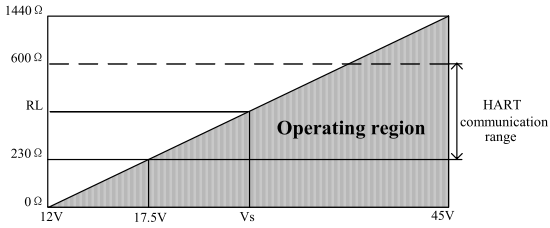


Fig2-2 load characteristic

3、Use condition and technical data

※No shift, when standard operating condition, fill silicone,316LSS isolating diaphragm

- Precision: For DP、GP transmitter, when measurement code is 4～8 and span ratio is 6:1, the precision is ±0.2%FS. When it is other transmitter, other measurement span and span ratio is 10:1, the precision is ±0.5%FS.
- Stability：It will not more than the absolute value of the intrinsic tolerance of the span within 12 months.
- Vibration effect：The tolerance will be ± 0.05%/g of URL on condition that vibration frequency is 200Hz at any axis.
- Power Supply effect：Less than 0.005%/V of the output span.
- Load effect：The load has no effect if the power supply is stable.
- Installation position effect：It will cause about 0.24KPa zero shift most if the diaphragm installation is out of the vertical, but it will not affect the span because the shift can be eliminated by adjusting the zero-point.

- Temperature effect:(For DP、GP type, span Code is 4～8),total shift is not more than ±0.2% of the span limit per 10℃. The shift will increase doubly for other type and span.
- Static pressure effect: Zero-point shift of the DP type:±0.2% of the span limit or ±0.4%(measurement span code is 3),it can be corrected by adjusting zero-point when it is under the line pressure.

4、Characteristic and material of construction

The transmitter's shell is made by aluminium alloy which content of magnesium is less than 6%, the protective grade is IP65. The surface temperature is not more than 80℃ when operating normally.

Isolating diaphragm: 316SS、Tantalum、Hastelloy C、Monel alloy

Drain/vent valve： 316SS、Hastelloy C、Monel alloy

Flange/adapter： 316SS、Hastelloy C、Monel alloy

O-ring： FPM

Fill fluid： Silicone or inert oil

Bolt： Nickel-plated carbon steel

Electronic shell: Aluminium alloy with low cuprum, the protective grade is IP65

Process connector: The center distance is 54mm when flange NPT1/4; the center distance is 50.8mm、54mm、57.2mm when with NPT1/2 connector or M20×1.5 male thread.

Conduit connection：M20×1.5

Weight(no accessories)：about 5Kg

5、Order information

FB3351GP type pressure transmitter (table 1)

FB3351AP type absolute pressure transmitter (table 2)

FB3351DP type differential transmitter (table 3)

FB3351HP type high static pressure transmitter (table4)

FB3351DR type ultra-low differential transmitter (table 5)

Note 1:The span should be indicated when ordering. It will be produced by rated span if the span hasn't been indicated.

Note 2:The unit label will match with the measurement span chosen by customer when customer select "M3" meter, and the unit label will be "%" if customer select minus measurement span.

Note 3：The maximum static pressure of FB3351DPDR type transmitter is 4Mpa.

Table1 FB3351GP capacitive gage pressure transmitter order number

FB3351GP	Pressure transmitter						
¦	Code	Measurement span					
¦	3	0 ~ 1.3 ~ 7.5KPa					
¦	4	0 ~ 6.2 ~ 37.4KPa					
¦	5	0 ~ 31.1 ~ 186.8KPa					
¦	6	0 ~ 117 ~ 690KPa					
¦	7	0 ~ 345 ~ 2068KPa					
¦	8	0 ~ 1170 ~ 6890KPa					
¦	9	0 ~ 3450 ~ 20680KPa					
¦	0	0 ~ 6890 ~ 41370KPa					
¦ ¦	Code	Output					
¦ ¦	S	Intelligent ,4 ~ 20mADC,2-wire+field bus of HART protocol					
¦ ¦	J	Intelligent,4 ~ 20mADC, $\sqrt{\triangle P}$ +field bus of HART protocol					
¦ ¦ ¦	Code	Material of construction					
¦ ¦ ¦		Flange adapter	Drain/Vent valve	Isolating diaphragm	Fill fluid		
¦ ¦ ¦	22	316SS	316SS	316SS	Silicone		
¦ ¦ ¦	23	316SS	316SS	Hastelloy C			
¦ ¦ ¦	24	316SS	316SS	Monel			
¦ ¦ ¦	25	316SS	316SS	Tantalum			
¦ ¦ ¦	33	HastelloyC	Hastelloy C	Hastelloy C			
¦ ¦ ¦	35	HastelloyC	Hastelloy C	Tantalum			
¦ ¦ ¦	44	Monel	Monel	Monel			
¦ ¦ ¦ ¦	Code	Options					
¦ ¦ ¦ ¦	M3	3 1/2 bit LCD meter					
¦ ¦ ¦ ¦	B1	Bend bracket for pipe mounting					
¦ ¦ ¦ ¦	B2	Bend bracket for panel mounting					
¦ ¦ ¦ ¦	B3	Flat bracket for pipe mounting					
¦ ¦ ¦ ¦	D0	The drain/vent valve is at back of the pressure chamber					
¦ ¦ ¦ ¦	D1	The side drain/vent valve is on top of the pressure chamber					
¦ ¦ ¦ ¦	D2	The side drain/vent valve is at bottom of the pressure chamber					
¦ ¦ ¦ ¦	C1	1/2NPT connector welded ϕ14 impulse pipe					
¦ ¦ ¦ ¦	C2	“T” shape adapter(M20 × 1.5)					
¦ ¦ ¦ ¦	C3	1/2NPT cone-shape female thread adapter					
¦ ¦ ¦ ¦	d	Explosion-proof type ExdIICT6					
¦ ¦ ¦ ¦	i	Intrinsic safety type ExiaIICT6					
FB3351GP	8	S	22	M1	Measurement span set at factory example of transmitter	←	Order number

Table2 FB3351AP capacitive absolute pressure transmitter order number

FB3351AP	Absolute pressure transmitter						
¦	Code	Measurement span					
¦	4	0 ~ 6.2 ~ 37.4KPa					
¦	5	0 ~ 31.1 ~ 186.8KPa					
¦	6	0 ~ 117 ~ 690KPa					
¦	7	0 ~ 345 ~ 2068KPa					
¦	8	0 ~ 1170 ~ 6890KPa					
¦ ¦		Code	Output				
¦ ¦		S	Intelligent,4 ~ 20mADC, 2-wire+fieldbus of HART protocol				
¦ ¦		J	Intelligent,4 ~ 20mADC, $\sqrt{\triangle P}$ +fieldbus of HART protocol				
¦ ¦ ¦			Code	Material of construction			
¦ ¦ ¦				Flange adapter	Drain/Vent valve	Isolating diaphragm	Fill fluid
¦ ¦ ¦			22	316SS	316SS	316SS	Silicone
¦ ¦ ¦			23	316SS	316SS	Hastelloy C	
¦ ¦ ¦			24	316SS	316SS	Monel	
¦ ¦ ¦			33	Hastelloy C	Hastelloy C	Hastelloy C	
¦ ¦ ¦			44	Monel	Monel	Monel	
¦ ¦ ¦			¦	Code	Options		
¦ ¦ ¦			¦	M3	3 1/2 bit LCD meter		
¦ ¦ ¦			¦	B1	Bend bracket for pipe mounting		
¦ ¦ ¦			¦	B2	Bend bracket for panel mounting		
¦ ¦ ¦			¦	B3	Flat bracket for pipe mounting		
¦ ¦ ¦			¦	D0	The drain/vent valve is at back of the pressure chamber		
¦ ¦ ¦			¦	D1	The side drain/vent valve is on top of the pressure chamber		
¦ ¦ ¦			¦	D2	The side drain/vent valve is at bottom of the pressure chamber		
¦ ¦ ¦			¦	C1	1/2NPT connector welded ϕ14 impulse pipe		
¦ ¦ ¦			¦	C2	“T” shape adapter(M20 × 1.5)		
¦ ¦ ¦			¦	C3	1/2NPT cone-shape female thread adapter		
¦ ¦ ¦			¦	d	Explosion-proof type ExdIICT6		
¦ ¦ ¦			¦	i	Intrinsic safety type ExiaIICT6		
FB3351AP	8	S	22	M1	Measurement span set at factory	Order number example of transmitter	

Table3 FB3351DP capacitive differential transmitter order number

FB3351DP	Differential transmitter						
¦	Code	Measurement span					
¦	3	0 ~ 1.3 ~ 7.5Kpa（the maximum operating pressure is 6.9MPa）					
¦	4	0 ~ 6.2 ~ 37.4KPa					
¦	5	0 ~ 31.1 ~ 186.8KPa					
¦	6	0 ~ 117 ~ 690KPa					
¦	7	0 ~ 345 ~ 2068KPa					
¦	8	0 ~ 1170 ~ 6890KPa					
¦	¦	Code	Output				
¦	¦	S	Intelligent,4 ~ 20mADC,2-wire+field bus of HART protocol				
¦	¦	J	Intelligent,4 ~ 20mADC, $\sqrt{\triangle P}$ +field bus of HART protocol				
¦	¦	¦	Code	Material of construction			
¦	¦	¦		Flange adapter	Drain/vent valve	Isolating diaphragm	Fill fluid
¦	¦	¦	22	316SS	316SS	316SS	Silicone
¦	¦	¦	23	316SS	316SS	Hastelloy C	
¦	¦	¦	24	316SS	316SS	Monel	
¦	¦	¦	33	Hastelloy C	Hastelloy C	Hastelloy C	
¦	¦	¦	35	Hastelloy C	Hastelloy C	Ta	
¦	¦	¦	44	Monel	Monel	Monel	
¦	¦	¦	¦	Code	The maximum operating pressure is (MPa)		
¦	¦	¦	¦	B-	4		
¦	¦	¦	¦	C-	10		
¦	¦	¦	¦	D-	14		
¦	¦	¦	¦	¦	Code	Options	
¦	¦	¦	¦	¦	M3	3 1/2 bit LCD meter	
¦	¦	¦	¦	¦	B1	Bend bracket for pipe mounting	
¦	¦	¦	¦	¦	B2	Bend bracket for panel mounting	
¦	¦	¦	¦	¦	B3	Flat bracket for pipe mounting	
¦	¦	¦	¦	¦	D0	The drain/vent valve is at back of the pressure chamber	
¦	¦	¦	¦	¦	D1	The side drain/vent valve is on top of the pressure chamber	
¦	¦	¦	¦	¦	D2	The side drain/vent valve is at bottom of the pressure chamber	
¦	¦	¦	¦	¦	C1	1/2NPT connector welded ϕ14 impulse pipe	
¦	¦	¦	¦	¦	C2	“T” shape adapter(M20 × 1.5)	
¦	¦	¦	¦	¦	C3	1/2NPT cone-shape female thread adapter	
¦	¦	¦	¦	¦	d	Explosion-proof type ExdIICT6	
¦	¦	¦	¦	¦	i	Intrinsic safety type ExiaIICT6	
FB3351DP	8	S	22	C-	M1	Measurement span set at factory	Order number example of transmitter

Table4 FB3351HP capacitive high static pressure transmitter order number

FB3351HP	High static pressure differential transmitter							
¦	Code	Measurement span						
¦	4	0 ~ 6.2 ~ 37.4KPa						
¦	5	0 ~ 31.1 ~ 186.8KPa						
¦	6	0 ~ 117 ~ 690KPa						
¦	7	0 ~ 345 ~ 2068KPa						
¦	¦	Code	Output					
¦	¦	S	Intelligent,4 ~ 20mADC,2-wire+field bus of HART protocol					
¦	¦	J	Intelligent,4 ~ 20mADC, $\sqrt{\triangle P}$ +field bus of HART protocol					
¦	¦	¦	Code	Material of construction				
¦	¦	¦		Flange adapter	Drain/vent valve	isolating diaphragm	Fill fluid	
¦	¦	¦	22	316SS	316SS	316SS	Silicon	
¦	¦	¦	¦	Code	The maximum operating pressure is (Mpa)			
¦	¦	¦	¦	E-	25			
¦	¦	¦	¦	F-	32			
¦	¦	¦	¦	¦	Code	Options		
¦	¦	¦	¦	¦	M3	3 1/2 bit LCD meter		
¦	¦	¦	¦	¦	B1	Bend bracket for pipe mounting		
¦	¦	¦	¦	¦	B2	Bend bracket for panel mounting		
¦	¦	¦	¦	¦	B3	Flat bracket for pipe mounting		
¦	¦	¦	¦	¦	D0	The drain/vent valve is at back of the pressure chamber		
¦	¦	¦	¦	¦	D1	The side drain/vent valve is on top of the pressure chamber		
¦	¦	¦	¦	¦	D2	The side drain/vent valve is at bottom of the pressure chamber		
¦	¦	¦	¦	¦	C1	1/2NPT connector welded ϕ14 impulse pipe		
¦	¦	¦	¦	¦	C2	“T” shape adapter(M20 × 1.5)		
¦	¦	¦	¦	¦	C3	1/2NPT cone-shape female thread adapter		
¦	¦	¦	¦	¦	d	Explosion-proof type ExdIICT6		
¦	¦	¦	¦	¦	i	Intrinsic safety type iaIICT6		
FB3351HP	8	S	22	E-	M1	Measurement span set at factory	Order number example of transmitter	

Table5 FB3351DR capacitive ultra-low differential transmitter order number

FB3351DR	Ultra-low differential transmitter						
¦	Code	Measurement span					
¦	2	0 ~ 0.125 ~ 1.5KPa					
¦ ¦	Code	Output					
¦ ¦	S	Intelligent 4 ~ 20mADC 2-wire+fieldbus of HART protocol					
¦ ¦	E	Intelligent,4 ~ 20mADC, $\sqrt{\triangle P}$ +field bus of HART protocol					
¦ ¦ ¦	Code	Material of construction					
¦ ¦ ¦		Flange adapter		Drain/vent valve	isolating diaphragm	Fill fluid	
¦ ¦ ¦	22	316SS		316SS	316SS	Silicon	
¦ ¦ ¦ ¦	Code	The maximum operating pressure is (MPa)					
¦ ¦ ¦ ¦	A-	1					
¦ ¦ ¦ ¦	B-	4 (Special is 6.9 MPa)					
¦ ¦ ¦ ¦ ¦	Code	Options					
¦ ¦ ¦ ¦ ¦	M3	3 1/2 bit LCD meter					
¦ ¦ ¦ ¦ ¦	B1	Bend bracket for pipe mounting					
¦ ¦ ¦ ¦ ¦	B2	Bend bracket for panel mounting					
¦ ¦ ¦ ¦ ¦	B3	Flat bracket for pipe mounting					
¦ ¦ ¦ ¦ ¦	D0	The drain/vent valve is at back of the pressure chamber					
¦ ¦ ¦ ¦ ¦	D1	The side drain/vent valve is on top of the pressure chamber					
¦ ¦ ¦ ¦ ¦	D2	The side drain/vent valve is at bottom of the pressure chamber					
¦ ¦ ¦ ¦ ¦	C1	1/2NPT connector welded ϕ14 impulse pipe					
¦ ¦ ¦ ¦ ¦	C2	“T” shape adapter(M20 × 1.5)					
¦ ¦ ¦ ¦ ¦	C3	1/2NPT cone-shape female thread adapter					
¦ ¦ ¦ ¦ ¦	d	Explosion-proof type ExdIICT6					
¦ ¦ ¦ ¦ ¦	i	Intrinsic safety type ExiaIICT6					
FB3351DR	2	S	22	B-	M1	Measurement span set at factory	Order number example of transmitter

6、Installation and use

6.1、Overview

Because of technical demand or saving the impulse piping sometimes, the differential transmitter is often installed in the field that operating environment is very bad. The installation of transmitter and impulse piping is right or wrong will affect the measurement precision directly. So it's very important to master the installation of transmitter and impulse piping.

Something should notice when installing the transmitter：

1） When it's explosion-proof transmitter, the installation should accord with the explosion-proof criterion;

2） The medium measured should not ice up, or else the isolating diaphragm will be damaged which will cause the damage of transmitter.

3） It's best to install the transmitter in position which variety of temperature is small and has no vibration or impact.

6.2、Impulse piping

1) Installation position

The right installation position of the transmitter is related with the medium measured. The following thing should be considered for getting the best installation effect：

a. Prevent the transmitter from contacting the corrosive or overheating medium measured;

b. Prevent the dreg from depositing inside the impulse piping;

c. Keep the impulse piping as short as possible；

d. Keep the liquid heads balanced;

e. It's best to install the impulse piping in position which variety of temperature is small and has no vibration or impact.

When measuring liquid flow, place the taps in the side of the process line to prevent sediment deposit on it. Mount the transmitter beside or below the taps so air bubble vent into the process line.

When measuring the gas flow, place the taps in the top or side of the process line and mount the transmitter beside or below the taps so liquid drain into the process line. If use the transmitter with drain/vent valve in the pressure chamber, the taps should be placed in the side of the process line. When medium measured is liquid, the drain/vent valve should be placed in the top so as to vent the gas in the medium.

When medium measured is gas, the drain/vent valve should be mounted in the bottom so as to drain the accumulative liquid. The drain/vent can be turn from up to down by rotating the pressure chamber 180 degree.

2）Steam flow measurement

When measuring steam flow, place the taps in the side of the process line and mount transmitter in the bottom of taps for that the impulse pipe fills with condensate.

When measuring steam or other high temperature medium, the temperature shouldn't be over the operating temperature limit of the transmitter.

When the medium measured is steam, the impulse pipe should fill with water to prevent steam from contacting the transmitter directly. The cubage change inconsiderably when transmitter working, so it's unnecessary to install condenser.

3） Error causation

The impulse piping joins the transmitter with process line and transfers the pressure of taps in the process line into transmitter. It may cause error in the course of pressure transfer. The causation may be as following.

a. Leakage
b. There's gas in the liquid pipe(cause error of pressure head)
c. There's liquid in the gas pipe(cause error of pressure head)
d. The density is different because of temperature different between two impulse pipes(cause error of pressure head)

4） Methods of reducing error are as following：

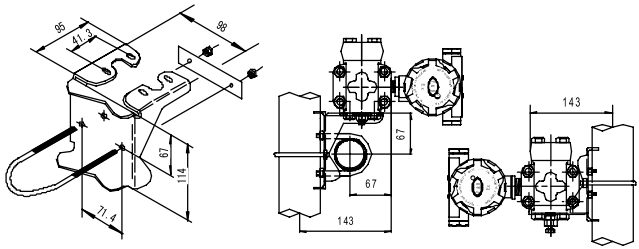
a. Keep impulse piping as short as possible；
b. When measure steam, the impulse pipe should connect upward with process line and the pitch shouldn't be less than 1/12；
c. When measure gas, the impulse pipe should connect downward with process line and the pitch shouldn't be less than 1/12；
d. Avoid high position when installing liquid impulse piping and avoid low position when installing gas impulse piping;
e. Make sure both impulse legs are the same temperature;
f. Use impulse piping large enough to avoid friction effect;
g. Make sure there's no gas in the impulse piping filled with liquid;
h. Make sure both impulse pipes are the same liquid level when use isolating liquid;

6.3、Installation

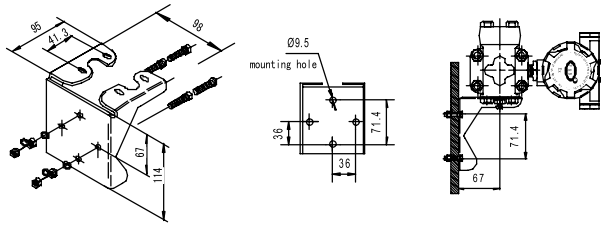
The transmitter can be fixed in 60mm pipe or wallboard with bracket. There are 3 kinds brackets for user to select. The bracket dimension and installation method see Fig6-1.

The conduit connector in the transmitter pressure chamber is NPT1/4，the two kinds impulse connectors are NPT1/2 cone-shaped and M20×1.5，the connectors construction and outline dimension are as fig 6-2.

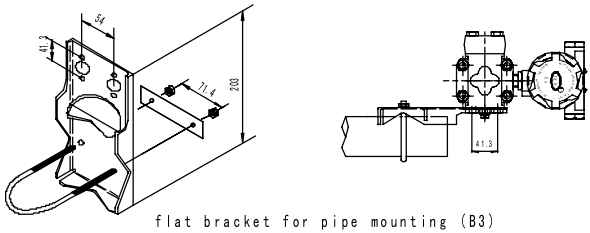
The transmitter can be removed easily by screwing the two bolts. Rotate the connectors to change the center distance between the connectors as 50.8mm、54mm、57.2 mm so as to install in the flange directly. The outline dimension of 3351 transmitter is as fig 6-3.



bend bracket for pipe mounting(B1)

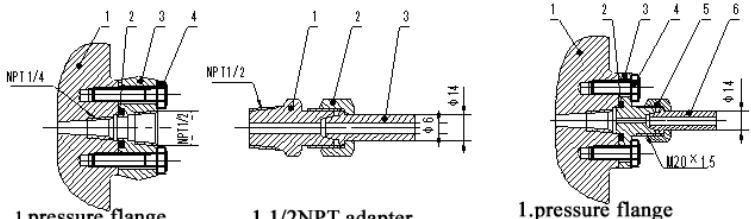


bend bracket for panel mounting (B2)



flat bracket for pipe mounting (B3)

Fig 6-1 sketch map of mounting bracket dimension and mounting configuration



1.pressure flange
2.O-ring
3.M20×1.5′ adapter
4.bolt
NPT1/4 interface is afforded to connect pressure pipe by user

1.1/2NPT adapter
2.M20×1.5 nut
3.ball-shape adapter(Φ14 position can weld with pressuer pipe)

1.pressure flange
2.O-ring
3.M20×1.5′ adapter
4.bolt
5.M20×1.5 nut
6. ball-shape adapter(Φ14 position can weld with pressure pipe)

Fig 6-2 pressure connection adapter

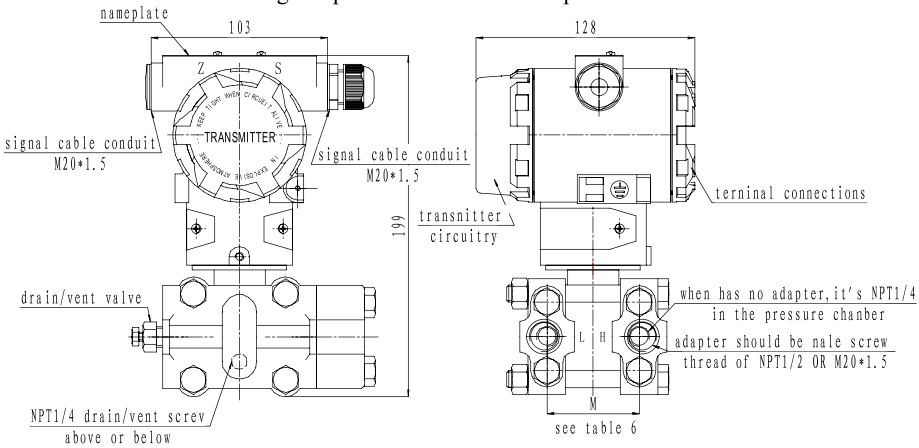


Fig6-3 3351 outline dimension

Table 6

Span code	Center distance between pressure screws（M）	
	Between pressure chambers	Between flange adapters
2、3、4、5	$2\frac{1}{8}$”（54mm）	50.8mm～57.2mm
6、7	$2\frac{3}{16}$”（55.6mm）	52.4mm～58.7mm
8	$2\frac{1}{4}$”（57.2mm）	54mm～60.3mm
Note：It’s suitable for DP/HP type transmitters		

To ensure sealed of the tie-in, you should operate by following steps when fixing: Screw down the two fixing bolts alternately with spanner and moment of 40N.m(29ft-1bs). Be sure not to screw down one of the screws in a lump. To install conveniently, you can turn the pressure chamber of the transmitter. If only the pressure chamber is at the vertical, the turning of the transmitter noumenon will not cause the change of zero-point. If pressure chamber is installed horizontally(for example, measure the flux in the vertical pipe)，it should eliminate the pressure effect caused by difference of pipe height and adjust the zero-point over again.

When medium measured is steam、gas or liquid, the sketch map of installation position is as Fig6-4.

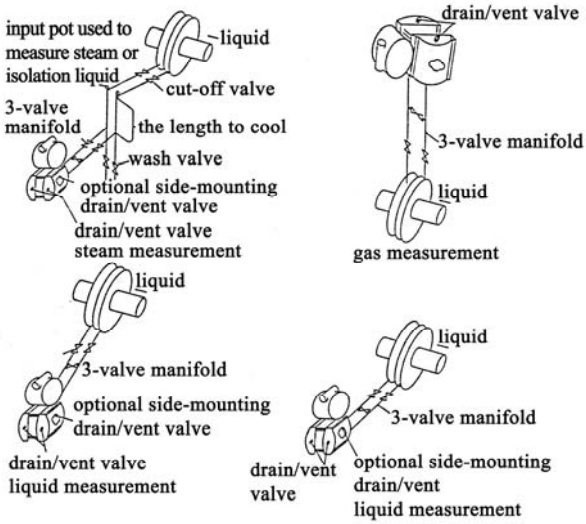


Fig6-4 sketch map of installation

6.4、Wiring

External circuit wiring of the transmitter sees the Fig6-5，the signal loop can connect with GND or hang in the air at any point.

The signal terminal block lies in an independent cabin of the electronics housing. Uncover the cover of the wiring side when connect. The left is signal terminal block, the right is testing or indicator terminal block（Fig6-5 shows position of the terminal block. Testing terminal block is applied to connect any indicator or test. It needn't connect power independently because the power is supplied over the signal cable）.

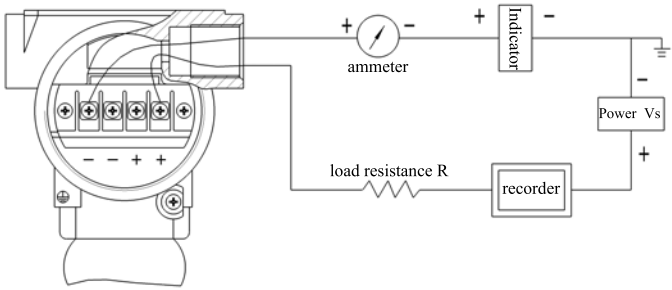


Fig 6-5 External circuit wiring of the transmitter

It needn't connect power independently because all power to transmitter is supplied over the signal wire.

The signal wire is needn't be in shielded, but if use twisted pair, the effect will be perfect. Don't run the signal wire in the conduit or through the metal pipe with power wire, and don't be near heavy electrical equipment too.

The conduit in the electronic shell should be sealed to prevent humidity gather in the shell. If the conduit hasn't be sealed, the conduit should be downward so as to drain easily when install transmitter.

Ground the signal wire at any point on the signal loop or leave it ungrounded. The transmitter shell is can be grounded or ungrounded. The power supply can be not always stable, because even if the voltage fluctuates 1V（peak-peak）,the effect to output signal can be ignored.

The transmitter grounded by capacitor coupling, so use mega-ohm meter which is not more than 100V/100MΩ when checking the insulation resistance.

6.5、Liquid level measurement

The differential transmitter for measure liquid level is a static pressure head for measuring liquid column in fact. The pressure is determined by height of liquid level and liquid density，and the value=(level height above the taps)*(liquid density)*g, it has no relation with cubage(or shape) of tank.

1）Liquid level measurement of open tank

When measuring the liquid level of open tank, the transmitter should be installed in the bottom of the tank, measure the corresponding pressure of the tank 's top liquid level, see fig 6-7.

The liquid level pressure connects with high pressure side of the transmitter and the low pressure side opens into atmosphere. If the low liquid level measured is above the transmitter position, the transmitter should make plus-shift.

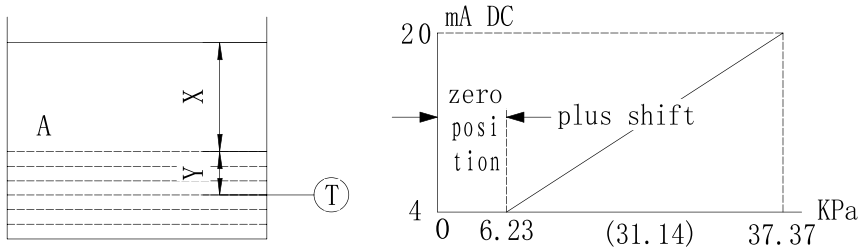


Fig 6-7 Liquid level measurement of open tank

Example：

On the assumption that X is vertical distance between the highest and the lowest liquid level, X=3175mm;

Y is the vertical distance between the taps and the lowest liquid level, Y=635mm;

R is the liquid density，r=1g/ cm^3

h is the maximum pressure head caused by X，unit is KPa

e is the pressure head caused by Y，unit is KPa

Measurement span from e to e+h，then：

h=X×r×g =3175×1×9.80665=31.14KPa

e=Y×r×g=635×1×9.80665=6.23 KPa

ie, measurement span is：6.23 KPa-37.37 KPa

2）Liquid level measurement of close tank

In the close tank, the top pressure affects the bottom pressure measured, and acts on the high-low pressure side of the transmitter, the differential pressure gained from it is direct ration with height of liquid level.

a、Dry impulse piping connection

The pipe at the low pressure side of the transmitter keeps dry if the gas above the liquid is not condensed. The condition is called dry impulse piping connection. The method to determine the measurement span of the transmitter is the same as liquid level measurement of open tank.

b、Damp impulse piping connection

If the gas above the liquid is condensed, the impulse pipe of the low pressure side will deposit liquid, which will cause error. Pre-fill some liquid in the low pressure side of the transmitter to eliminate the error. The condition is called damp impulse piping connection.

The condition above causes pressure head in the low pressure side of the transmitter,

so it should make minus shift(see Fig 6-8).

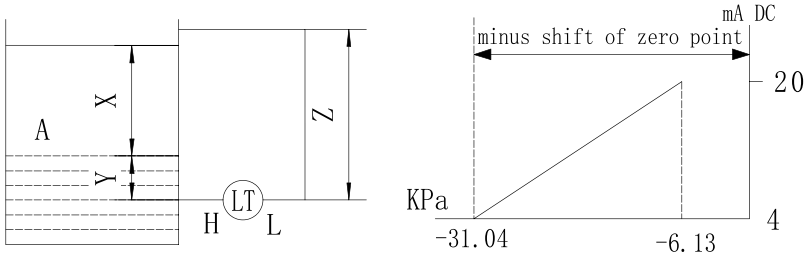


Fig 6-8 Measurement of impulse piping connection of close tank

Example：

On the assumption that X is the upright distance between the lowest and highest liquid level: X=2540mm；

Y is the distance between transmitter's datum line and the lowest liquid level，Y=635mm；

Z is the distance between top of impulse piping filled liquid and transmitter's datum line，Z=3800mm；

R_1 is density of the measured liquid，R_1=1g/cm^3

R_2 is density of the liquid filled in the impulse piping at the low pressure side，R_2=1g/cm^3

H is the maximum pressure head caused by X，unit is KPa；

e is the pressure head caused by Y，unit is KPa；

S is the pressure head caused by Z，unit is KPa；

Measurement span from（e-S）to（h+e-S），then

h=X×R_1×g=2540×1×9.80665=24.91KPa

e=Y×R_1×g=635×1×9.80665=6.23KPa

S=Z×R_1×g=3800×1×9.80665=37.27KPa

So：

e-S=6.23-37.27=－31.04 KPa

h+e-S=24.91+6.23－37.27=－6.13 KPa

So the measurement span of the transmitter is：－31.04 KPa~－6.13 Kpa

3）Liquid level measurement with blowing

It also can use "blowing" to measure liquid level of open tank. Here the transmitter should be installed above the open tank. See Fig 6-9

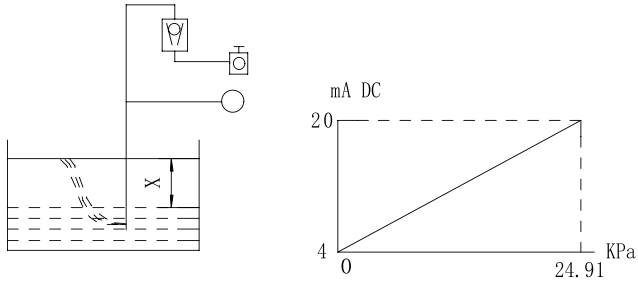


Fig6-9 Liquid level measurement with blowing

The equipment consists of gas source、pressure-stabilize valve、constant flowmeter、transmitter and the pipe inserted in the bottom of the tank. Because the flow velocity of gas through the pipe is constant, the pressure to keep the flow velocity of gas constant (ie, the pressure passed to the transmitter) is equal to the pressure caused by the liquid in the nozzle.

Example：

On the assumption that X is the distance between the lowest level of the measured liquid and the highest level，X=2540mm；

R_1 is density of liquid，R_1=1g/ cm^3；

h is the maximum pressure head caused by X，unit is KPa；

Measurement span from 0 to h，then

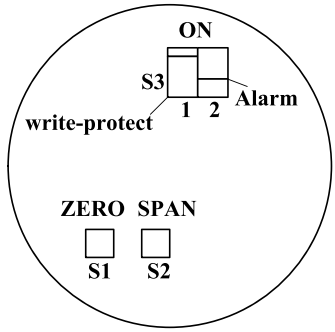
h= Y×R_1×g=2540×1×9.80665=24.91KPa

So measurement span of the transmitter is：0 ~24.91 Kpa

7、Debug and calibrate

FB3351 intelligent transmitter has already been characterized before leaving the factory. The configuration information has been stored in the electrical components too. Please refer to explanation in this section if user need change the instrument's calibration. With handholding communicator, user can set the parameters such as output unit、analog span、output type、damp、standard zero point of sensor、standard output of "4~20mA", and so on(see Fig7-1,the universal mode menu tree of HART handholding communicator, consult the communicator's instruction for detail).It can adjust analog span only or calibrate by intelligent software of upper computer if there is no handholding communicator.

7.1、Adjust the measurement span by keys on the panel



1）“S1”(Zero keystroke) and “S2” (span keystroke) are on the component of the transmitter（Note：if there is LCD meter, the “Z” and“S”on the meter are equal to “S1” and “S2”）;

2） Press “S1” and “S2” together for more than 5s，the two keystrokes will be activated;

3） Press “S1” for 5s to output 4 mA current after applying pressure corresponding with 4 mA to “H” cavity of transmitter;

4） Press “S2” for 5s to output 20 mA current after applying pressure corresponding with 20 mA to “H” cavity of transmitter;

Explanation：

a) Pressing“S1”is to shift analog span. For example: When the analog span is “0-30KPa” before adjusted, the transmitter’s output current is 4-20mA. When apply 5KPa pressure to “H” cavity of transmitter, the analog span will be 5-35KPa after pressing “S1” to adjust.

b) The analog span after adjusting should be within the maximum span of transmitter(there is some surplus), or the keystroke will be useless. For example, the maximum adjustable range is “-40KPa～+40KPa”，and the analog span before adjusted is “0～35KPa”，when apply 20KPa pressure to transmitter, “S1” will be useless because that pressing “S1” is attempting to adjust the analog span from “0～35KPa” to “20KPa～55Kpa”.

c) The minimum range of analog span should accord with limit of maximum span-ratio, or the keystroke will be useless. For example, the analog span can’t be adjusted to “0～2.5KPa” if the instrument’s maximum adjustable range is “-40KPa～+40Kpa”.

d) The keystroke will be relocked after the two keystrokes have been aviated and the instrument adjustment has been finished for 5 min.

7.2、The universal mode menu tree of HART handholding communicator

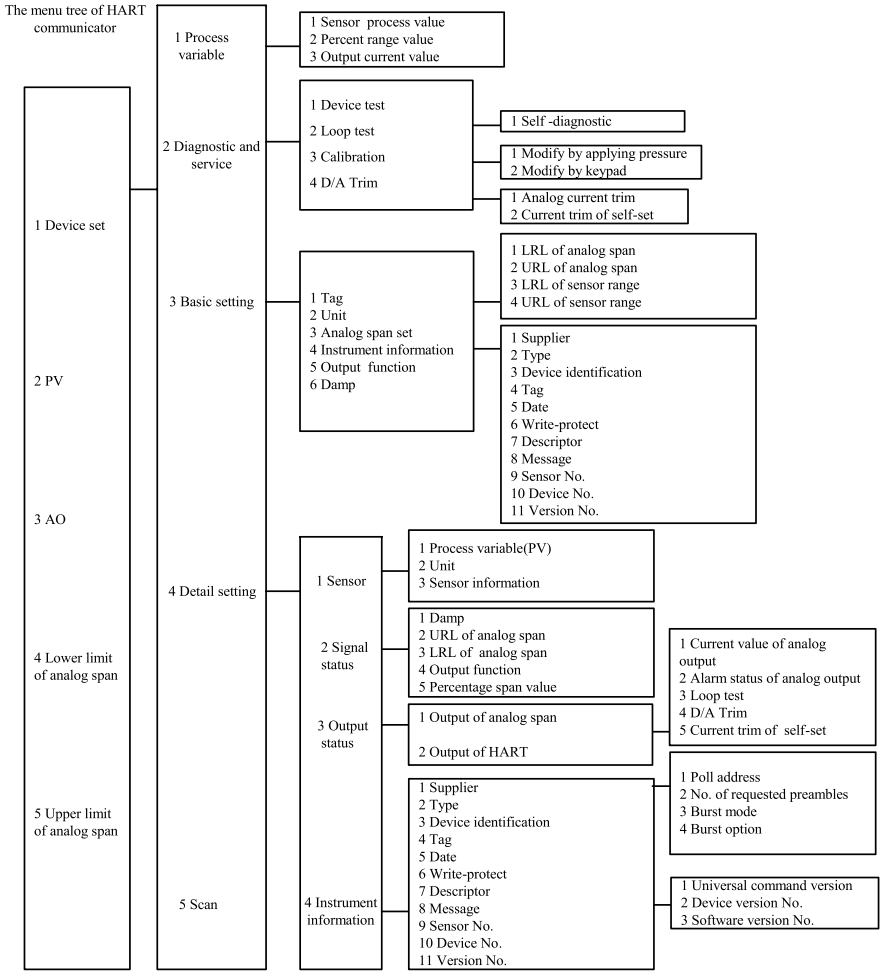


Fig7-1

7.3、Calibrated by intelligent software of upper computer

RS232 COM port *1pcs Modem with HART protocol *1pcs

7.3.1 Connection diagram

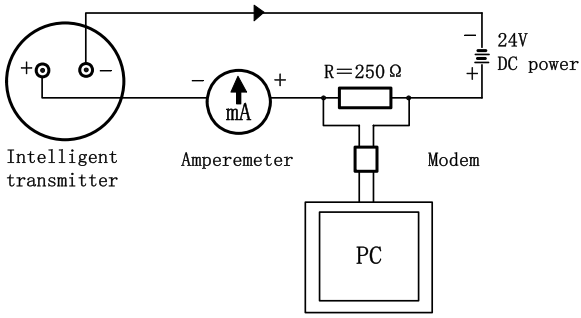


Fig7-2

7.3.2 Software interface presentation

The transmitter's configuration software is showed as the following figure.

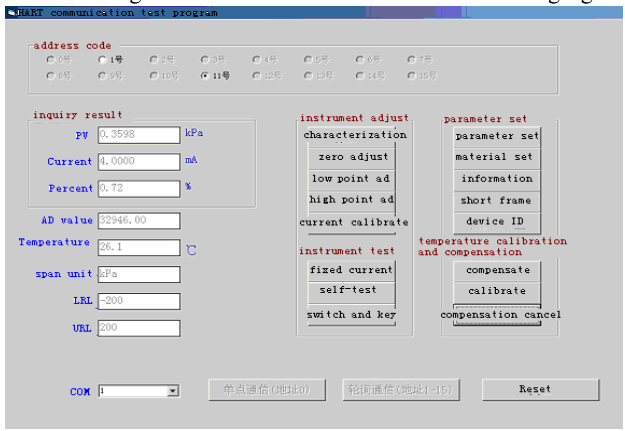


Fig 7-3

- **PV 、current value、percent:**

  Display the pressure、current、percent that calculated.

- **AD value:**

  Display result of A/D conversion

- **Temperature value:**

  Display result of temperature measurement

- **Span unit:**

  Display instrument's span unit

- **Minimum/maximum span:**

  Display the limit span of the transmitter. It's related with measurement span code set in the characterization process.

■ **Instrument adjusting group:**

It includes "characterization"、"sensor trim" "current calibrate".See the next section for details.

■ **Check group:**

It includes "fixed output current" "self-test" "switch and key"

Fixed output current input box: it can input current value to check whether the instrument output current there's deviation. Press "current calibrate" in the "instrument adjusting group" to calibrate if there's deviation.

Self-test: It can check whether the instrument has problem.

Switch and key: To check whether the keystrokes in the instrument are good or not, interface is shown as Fig 7-4.The corresponding parts on the interface will change when switches or keystrokes on the intelligent parts change.

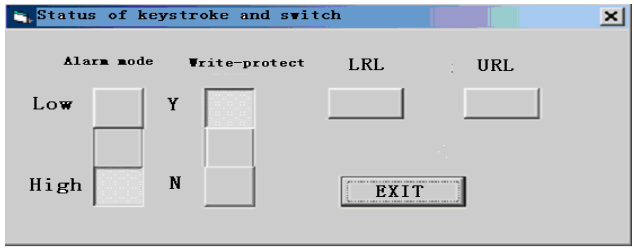


Fig 7-4

■ **Parameter set group:**

It includes "parameter set"、"material set"、"information "、"short frame "、"Device ID" and "compensate"

Parameter set: it can set the URL and LRL,(note: it can't be over 10% limit span of the sensor); The common pressure unit is afford to select; The output function can be selected as "linearity" or "nonlinearity"; The reasonable range of damping time is 0.1~16s。The interface is shown as Fig 7-5.

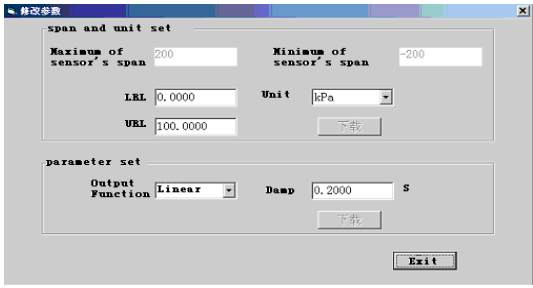


Fig7-5

Material set: It includes the material parameter set and construct parameter set such as "flange type"、"display instrument",and so on. The interface sees Fig7-6.

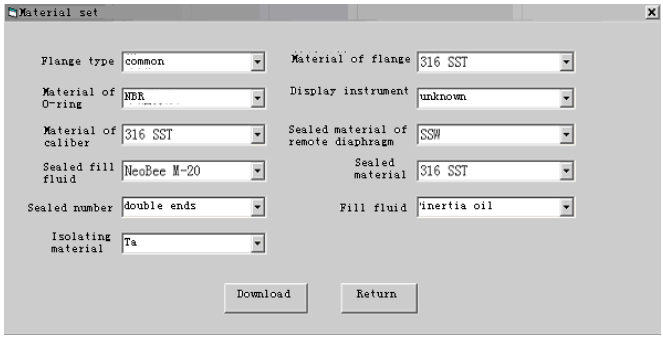


Fig7-6

Information: It includes edit box such as label. See Fig7-7. Note: All information should be capital English letter or numeral.

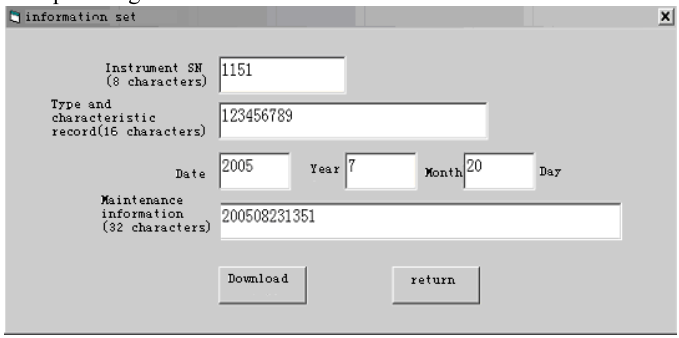


Fig7-7

Short frame: It is applied to set instrument's network number (0-15), and this operation should mate with network link. To select correct number according to instrument's link (point to point or net multi-drop). The number of "0" means point

to point mode, ie, the common status of "4-20mA"; The numbers of "1-15" mean net multi-drop mode and the output is fixed as 4mA; Besides instruments with same number can't exit in one network.

Device ID number: When transmitter communicate in multi-drop, the set of transmitter's ID number should be different; If the ID number is the same, the communication of the transmitter will be interfered each other; The set range of ID number is "0-255".

Temperature calibrate and compensate: It is applied for calibration and compensation of temperature. Detail steps see the next section.

- **Single-drop、multi-drop communicate** Pressing "Single-drop communicate(address is 0)" , the program will communicate with transmitter which address is set as "0", and the analog output current of transmitter will be in normal status; When a group of intelligent transmitters that not more than 15 pcs are connected in parallel to one communication wire, pressing "Polling communicate(address is set as "1-15")", the program will search the transmitters by address code of "1-15"; The corresponding address code "X" icon will turn white when the program detects one transmitter each. Click the icon corresponding to the transmitter's address code if you want to supervise one certain transmitter, and the analog output current is fixed for 4mA. Press "reset" to reenter into initial status.

7.3.3 Calibration steps

1）Output current calibrate

"Current calibrate":

It's applied for adjusting analog current. It will keep the current of "4～20mA" loop same as which read on the handholding terminal by this adjustment. It will adjust two points of "4mA" and "20mA" in this process. Before adjusting, connect a precision amperemeter or 250Ω resistor in the loop in series, and connect a voltage-meter in parallel at the same time.

Detail steps: Press "current calibrate", the loop current will be fixed for 4mA first, and a dialog box to prompt that "loop current is standard 4mA or not" will appear at the same time. If answer is negative, press "No", and a new interface will appear, shown as Fig7-8. Input the amperemeter's reading into the textbox and press "download", it will return to prompt dialog box; Repeat the step until the adjustment of "4mA" is done. Press "Yes" and then the loop current will be fixed for 20mA. Adjust the 20mA as the adjustment of "4mA". All the adjustment process will not finish until 20mA adjustment is done.

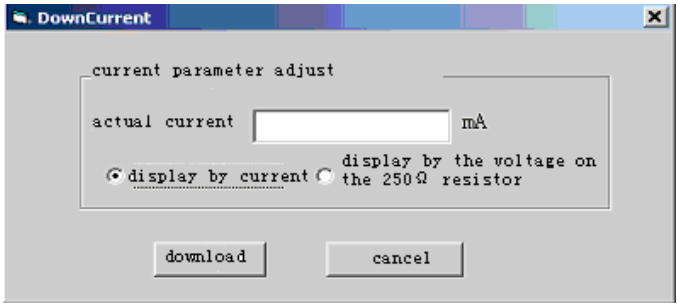


Fig7-8

2）Input signal calibrate

Click the “characterization” in the instrument adjusting group, and then will appear a dialog box, see Fig7-9:

The dialog box includes：

“Span code”drop down menu： Optional:3,4,5,6,7,8,9,0.The number denotes the operation range of 6kPa，40kPa、200kPa、800kPa、2MPa、8Mpa、20MPa、42Mpa（or around the range）respectively.

“operation mode” drop down menu： Optional: GP、DP、AP、HP 、LT，and so on, which denotes operation mode of gauge、differential、absolute、high pressure and flange-mounted respectively.

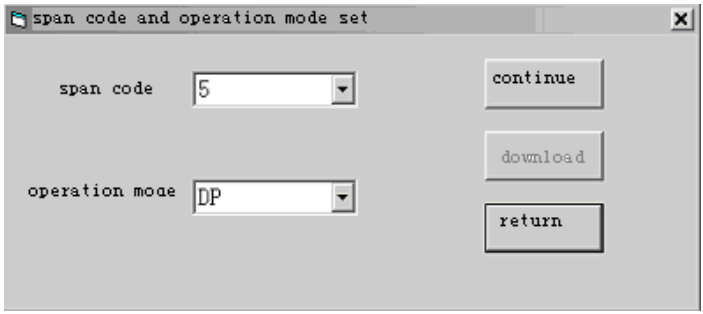


Fig7-9

“continue”: press this keystroke to eject the dialog-box of “plus characterization”.

The dialog-box of “plus characterization” see fig 7-10:

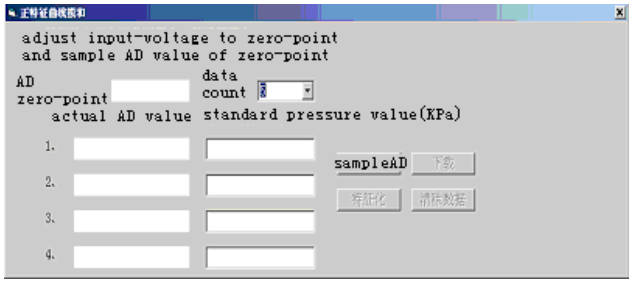


Fig7-10

The contents in the dialog-box as follows:

"AD zero-point" means the A/D value when doesn't apply pressure.

"data count" it can change the marked numbers of the characterization operating.

"actual AD value" means the A/D value when the pressure is nonzero.

"standard pressure value" standard pressure output value corresponding to the A/D value.

"sample AD" keystroke: take the AD value from the main box and put into the edit box of "AD zero-point" and "AD value" **.**

"characterization" :

"download": download the characteristic data to instrument.

When took the AD value and the "standard value" edit box had corresponding value already ,press the "characterization" keystroke, then "download" keystroke becomes bright. There is a choice of "enter into characterization operating or not" after pressing the keystroke. If choose "YES", it will eject the dialog-box of "minus characterization" like "plus characterization". If choose "NO", the characterization operating is finished.

Notice: it must add "-" before the data input into the "standard value" edit box if "minus characterization".

"sensor trim" :

"zero-point adjust" Keep the instrument no pressure, and press this keystroke to make PV equal to zero when it's stable.

"low-point adjust" The edit box of "input standard value of low point pressure" appears after press the keystroke. Just input the standard value of pressure applied here.

"high-point adjust" The step is the same as "low-point adjust".

3) Temperature compensate

1、Read the zero data in common temperature: Don't apply pressure first until the pressure and temperature are stable, ie, the AD and diode output are stable, then press

“zero point” in the common temperature bar, and then the AD values of pressure and temperature will fill into the corresponding textbox automatically.

2、Read full span data in common temperature：Apply full span pressure(it’s best to apply full span pressure of the sensor), then press “plus span” in the common temperature bar, or input the number into the textbox with keyboard.

3、Heat up to the temperature needed, and don’t apply pressure until the pressure and temperature are stable, and then press “zero point” in the high temperature bar; Apply full span pressure (the same as step 2), and then press “plus span” in the high temperature bar. Fill the AD value of full span pressure in common temperature (AD value of step2) into corresponding textbox if the pressure can’t be applied in high temperature, and fill the same diode output as zero point in the “out of diode” textbox.

4、Adjust temperature to low, and repeat step 3. If low temperature is incapable, press “calculate low temperature” after step3 finished, then the data in the low temperature bar will be filled automatically.

When the three groups temperature data are all filled (12 white textboxes), press “download”, and then the temperature compensation is finished. Just repeat above steps if necessary.

“temperature compensate” supplement：

a．If there’s no low temperature equipment and low temperature compensation is incapable, press “calculate low temperature” after took the high temperature data, and then the program will calculate the low temperature data linearly by 1/2 variety from common to high temperature.

b．It’s the best to aging sensor before compensate for better compensation effect.

c．Adjust with “sensor trim” if zero-point or span has shifted in common temperature after compensated, it’s unnecessary to repeat characterization once again.

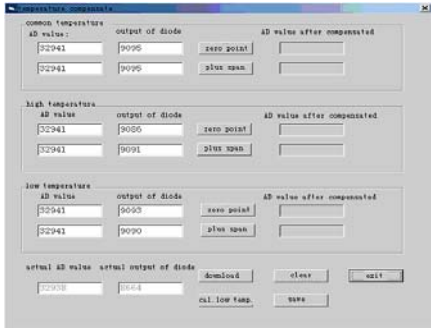
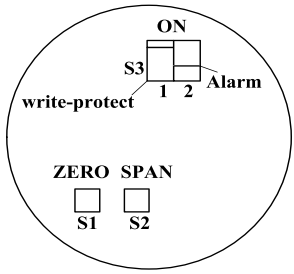


Fig 7-11

8、Failure alarm and write-protect switch

User can select the position of DIP-switch in the electronic component to carry out failure alarm and write-protect by user's demand.



8.1 Failure alarm

FB-3351 intelligent transmitters can self-diagnose continuously. If the transmitter's failure is tested, the output of transmitter can be selected 22mA or less than 3.8mA by user, and any HART upper computer can display the special information code of changing the transmitter's self-diagnose.

If failure is tested by self-diagnose program, the analog output will alarm by 22mA (High) or 3.8mA (Low).The symbols "High" and "Low" in the electronic components are used for selecting "High alarm" or "Low alarm".

8.2 Switch of write-protect

When you want to modify the transmitter's parameter, you can put the write-protect switch on the "OFF" position; When it needn't modify the transmitter's parameter, you can put the write-protect switch on the "ON" position.

9、The common problems and troubleshooting

No.	Problem description	Cause	Corrective actions
1	Indicating value is inaccurate	Shift caused by time、temperature、vibration	Calibrated termly again
2	Io is zero	a. Power failure b. Wire is broken	a. Repair the power b. Check the wire
3	Io goes beyond 3.8mA～22mA	There is problem in the connection between sensor and PCB	Check the connection between the sensor and the PCB
4	The current is settled as 4mA,Io has no response when add pressure	a. The instrument is on the multi-drop mode b. Leak	a. Modify the address of the sub-computer in the stand-alone mode b.Check the wire of gas pipe
5	The instrument can't communicate	a. The connection has failure b. Multi-drop mode	a. Check the connection b. Check the network

10、Notice of maintenance and storage

10.1 The transmitter is field instrument, operating condition is worse, so it should be maintained termly.

10.2 When in the field, the transmitter is the best to be installed in the protector(it's the best to use the instrument heat preservation box if environment temperature is low) .

10.3 The transmitter should be stored indoor and the environment should be normal temperature、dry and ventilated、no caustic gas、insulated, and no other dangerous factors. The spare transmitter should be stored in the packing box;

10.4 Shouldn't keep the transmitter in the place with high temperature and high humidity;

10.5 The transmitter shouldn't be impacted or drop in the process of storing or installing, or else it will damage IC in the transmitter.

11、Maintenance

11.1 The structure of the transmitter is simple, and there is no mechanism gearing, so it's unnecessary to maintain in the field.

11.2 Test should be according to the steps presented above.

11.3 If you are not the professional, don't remove the transmitter's cover at random, say nothing of testing and repairing.

If the transmitter goes wrong, send it back to our company or repair it instructed by our technician, please!