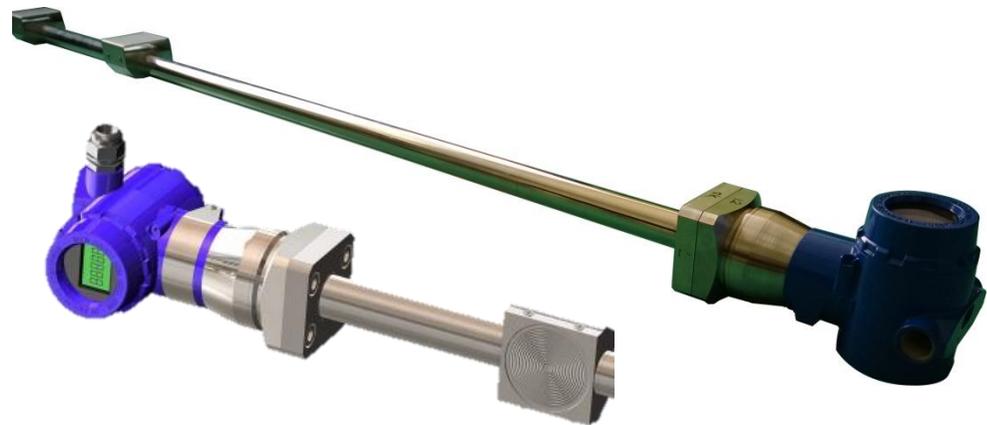


General Specifications

Model TM Differential Pressure Type Mud Density Meter

TM series Density Meter is specialized in measuring density of wide range of media. TM series meter is a newly smart 2-wire transmitter adopting the theory of differential pressure measurement. The two capacitive sensors combined provide the output of differential pressure and give density or specific gravity.

The whole unit is compactly designed in the consideration of harsh environment. The application of TM series has been covering a wide range of industries including Drilling Oil, Power Station, Food Industry, Pharmaceutical Industry, Chemical Industry etc.



Standard Specifications

Application: Drilling Mud in Open Tank; S.G. = 0.8 to 2.5

Output - Communications: 4 ... 20 mA w/ HART; PROFIBUS PA; FOUNDATION FIELDBUS

Total Accuracy: +/-0.25%

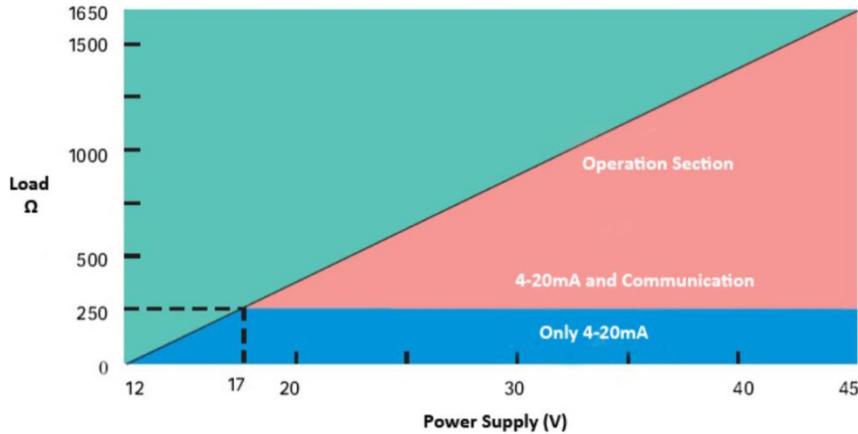
Fill Fluid: Dow Corning 200 - CS10 (DC200-10)

Weight: 8 ft. probe = 11.0 kg

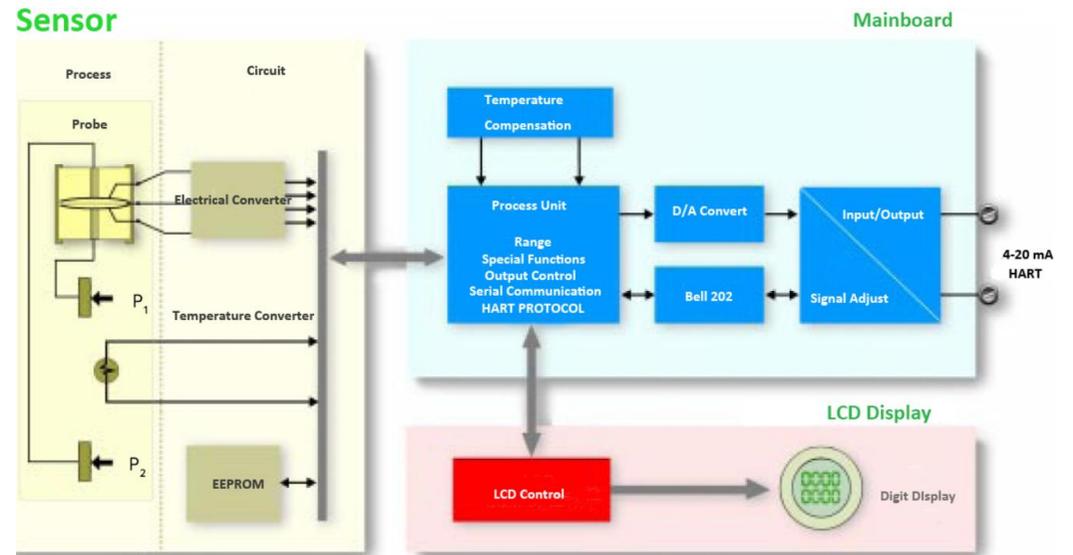
Features

- Full stainless steel construction;
- Laser Welding for Diaphragm
- 5-digit LCD Display;
- Static or Fluid Media Available;
- Temperature Compensation Available;
- HART PROTOCOL Available;

Load Chart



Working Principle



Physical Index

Electrical Connection	1/2NPT-14
Process Connection	DN50 Flange
Filled Fluid	Dow Corning 200 - CS10 (DC200-10)
Material of Diaphragm	SS316L

Transport and Storage

- Available for land carriage, sea transportation, air transportation.
- The goods should be kept indoor as factory package
- Temperature: -10 ~ +55℃
- Relative Humidity: 0-100%

Operating Ambient Range

-30° to 82°C (-22°F to 180 °F)
0 to 100% R.H.

Max. Process Pressure (static)

at 20 °C: 100 bar (1.450 psi)

Power Supply

12-30V DC; Reverse polarity protected

Vibration Effect

<+0.1% of URL shift per test condition of SAMA PMC 31.1

Communication Requirement

HART

Transmission Type

2-wire

Stability

0.25%F.S

Process Tube Diameter

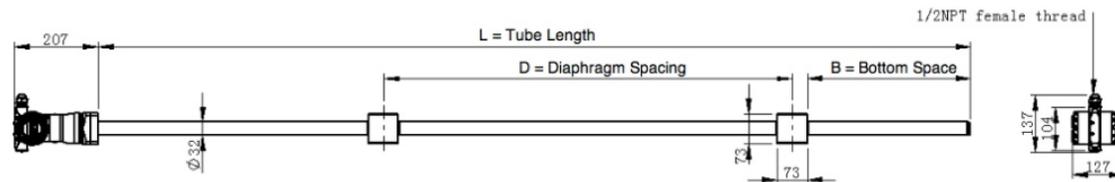
32.0mm

Measuring Range Adjustment

Please refer to the OPERATION MANUEL

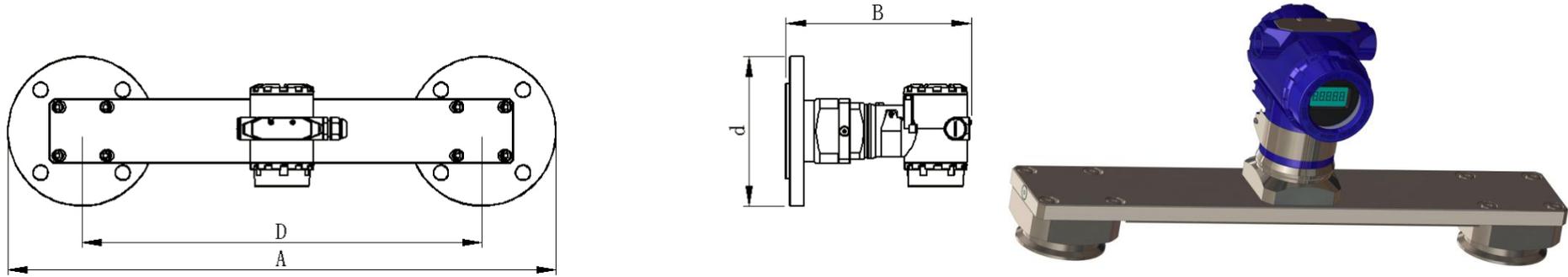
Outline Structure

Plug-in Type



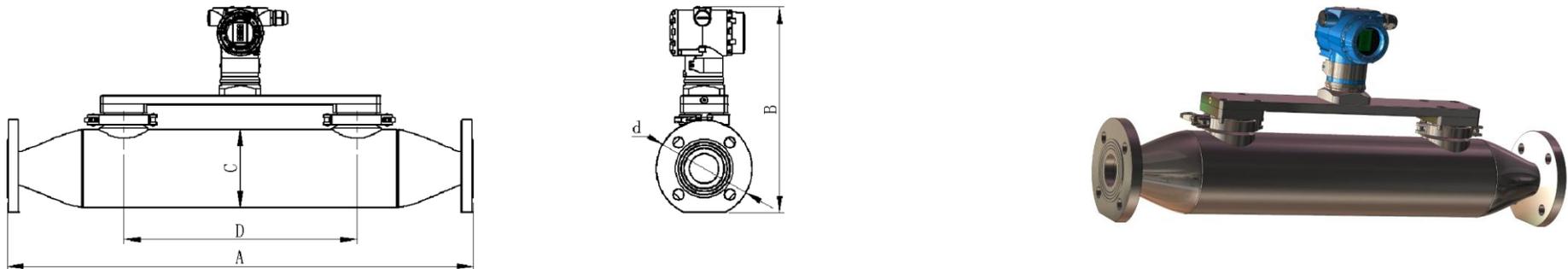
Note: Please confirm the parameters “L””D””B”, the 2 diaphragms should be totally submerged in the media measured. Once the density meter is made, the position of the 2 diaphragms cannot be changed.

Side-Mounted Type



Note: Please confirm the parameters "A""D""B""d", the 2 diaphragms should be totally submerged in the media measured. Once the density meter is made, the position of the 2 diaphragms cannot be changed.

Pipe-Type



Note: Please confirm the parameters "A""D""C""B""d", the 2 diaphragms should be totally submerged in the media measured. Once the density meter is made, the position of the 2 diaphragms cannot be changed.

Anti-Corrosive Type

Anti-corrosion Type, pneumatic type, is designed and performed by the Gas Sources in the field.

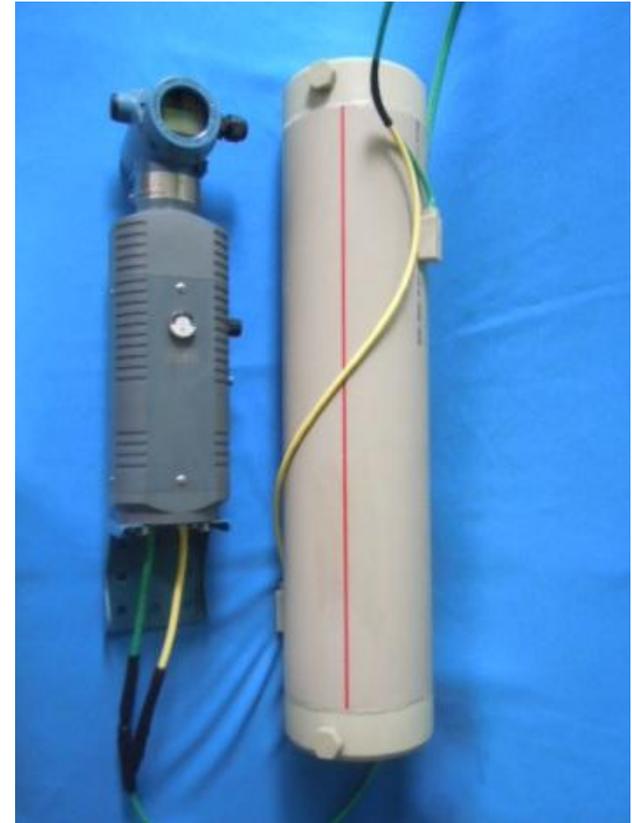
It can be applied in opened tank, Low pressure closed tank, pipe. The design of this new type is Ex-proof and is specialized in the application of sewage, easy scaling, strong acid & alkali, high temperature, viscous media. The performance of this new type doesn't require mechanical drive and displacement. Compared with traditional density meter, the new type density meter is advanced in easy installation, high accuracy, etc.

The components of the Ex-Part, Closed tank are as follows:

Air Tube (Teflon, $\geq\Phi 32\text{mm}$, length $\leq 2\text{m}$)

After the leaking testing, power is turned on. Then throttle valve is fully opened. Compressed air is continuously injected in the gas port until the gas is fully injected. Then the density meter begin to exhaust gas. After 3mins of gas injection, the air pressure within the converter is determined by the level of the media contained in the tank. As the venting process stops, the pressure given by the level of the media contained in the tank equal to the pressure within the gas converter and the static air tube. Then the values of the level and the differential pressure are measured and converted to the density.

Anti-corrosion Type can be classified into plug-in type, side-mounted type, pipe type. All types include Standard Type, Sanitary Type, High temperature Type. Required by the field, the density meter is able to be customized. The contacted material can be customized as PP-R、PTFE, etc.



MODEL AND SUFFIX CODES

Model	Suffix Codes	Description
TM	North American style - Chemical Density Transmitter; Differential Pressure with Chem Seal Technique
Application	MUD	Drilling Mud in Open Tank; S.G. = 0.8 to 2.5
	CHM	Chemicals in Closed Tank; S.G. = Specify
Enclosure Style	E3	3.5" Aluminium - without display; NEMA 4 / IP67
	E4	3.5" Alu - screwed cover w. chain
	E5	3.5" Alu - screwed cover with Glass Window - grey -Class 1, Division 1, Group B-G
	E6	3.5" 316SS - screwed cover w. chain - Grp. B-G
Process Tube Diameter	T10	1" (25,40 mm)
	T15	1.5" (37 mm)
Electrical Connection	F50	NPT1/2" (Female Threads)
	F34	NPT3/4" (Female Threads)
Process connection	N10	NPT 1" (for 1" dia pipe) (Male thread)
	N20	NPT 2" (for 1.5" dia pipe) (Male thread)
	AF	ANSI Flange: Specify dimensions (Male thread)
	W	No Fitting / Weld or Clamp In Type (Male thread)
Material - Process Tube	16	1.4401 (316L)
	4	1.7335 (13CrMo4-5; F-11)
	4A	1.7380 (10CrMo9-10; F-22)
	I	Inconel 600 (2.4816)
	T	Titan Gr2 (3.7035)
	M	Monel 400

<<Contents>> <<Index>>

Process Tube Overall Length	L	Tube stock - Length in mm (base of termination enclosure to end of probe)
Pressure Differential in mm between Diaphragm Centers	D X (X=1219mm)	Center to Center distance of Process Diaphragms (in mm)
Bottom Diaphragm from Probe End	B X (X=500mm)	Probe end to center distance of bottom process diaphragm (in mm)
Total Accuracy (of factory calibrated span, including non-linearity, hysteresis & repeatability)	A25	+/-0.25%
	A100	+/-1.00%
Output - Communications	C1	4 ... 20 mA; (28 mA maximum)
	C2	4 ... 20 mA w/ HART; PROFIBUS PA; FOUNDATION FIELDBUS (future)
	C3	Wireless HART (future)
Ex - approvals	F1	FM XP (future)
	U1	UL/CSA XP, Cl. 1, Div 1, A-D (pending)
	F2	FM IS, Cl 1, Div 1, Grp A-D (future)
	U2	UL/CSA IS Cl. 1, Div 1, A-D (pending)
	AX	ATEX IS (pending)

Troubleshooting and Solutions

Inspection	Troubleshooting	Solution	
Configuration Problem	Inspect the connection of the return circuit of the density meter by adding a ampere-meter in series	The current range of the density meter is 1.000-3.000g/cm ³ . The alarm-status of the density meter in the open air is under low-state of alarm. The current is around 3.90mA that can be displayed by the ampere-meter. In this case, the system will recognize that there is no current output.	
		Changing the measuring range of the density meter to 0-3.000g/cm ³ . Place the density meter in the media, then monitoring the changing current.	
		The measuring range can be set: $X\text{-}Y\text{g}/\text{cm}^3$; $0 \leq X < 3.000$ $1 \leq Y \leq 3.000$	
Master variable zero setting	Before the Master variable setting, place the density meter upright in the air. Make sure that there is no object (media) in the surface of the diaphragm.	Screwing off the cap-seal of the LCD. Keep pressing button "M+Z" in 5seconds, then the LCD will show the interface of the master variable zero setting. Then change "No" to "Yes" shown by the LCD by pressing "S". Then, press "M". Then press "Z". After the calibration, the LCD will automatically return to the main interface.	
Return Circuit Problem	LCD-Display cannot work	Inspect the power supply and voltage. 24V DC is required	
	Incorrect volume of current	A. the current is below 4mA	Place the density meter into high-density media. Then check if there is any change of the current
		B. the current is kept 4mA	Regarding the problem of the configuration within the density meter, please change the communication address to "0" by using Potable Data Setter

Installation

Due to the project requirements, density meters are often required to be installed in hazardous Location. Please note the following considerations to guarantee the accuracy of the density meter.

1. Please keep the density meter upright (vertical angle $<5^{\circ}$)
2. Keep the density meter a distance from the frequency converter or big-power consumed generator. Apply shielding power line if necessary
3. If possible, please insert the density meter in the media where there is no big change of temperature, vibration, fewer bubble.

Ordering Information

1. Please follow the suffix codes of the product
2. Customization is available
3. Product Warranty: 24 months from time of installation date
4.
5.
6.
7.
8.

Customization

Based on the actual requirements,
DNM series density meter can be customized for differential application.



User Manuel

Index

General Description on LCD

Button Function

Introduction on Button Function Code

Introduction on Mode of Button

Method on Date Setting

Directions on Button Operating

Main Variable Setting Zero (Reset) Function

Configuration Function

Function Overview

Setting Unit

Setting Range

Setting Damping

Setting Characters of Output

Zero Migration [Setting Zero] and Range Migration [Setting Full]

Display Variable Setting

Restoring Factory Settings



1. LCD Display Function Overview

Users can set variables and decimal point displayed by LCD through the configuration software. Please refer to the setting part “**Instrument configuration**” → “**Output Characteristic**”.

LCD supports double variables display. The showing variables users can set include “**Current**” and “**Density**”. And each variable can be independently set to display decimal point position “**0**”, “**1**”, “**2**”, “**3**”, “**4**”.

If two variables shown are the same, LCD only shows one variable. Otherwise, two variables will be alternately displayed by 3 seconds intervals.

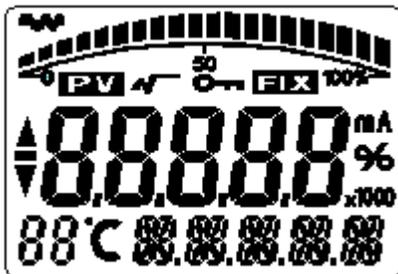


Figure 1-1
All Lights Showing of LCD

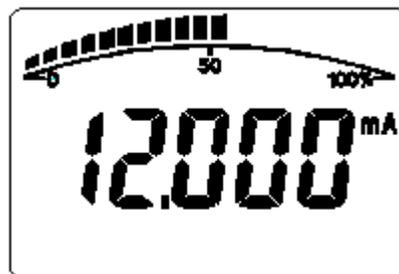


Figure 1-2
Current Showing

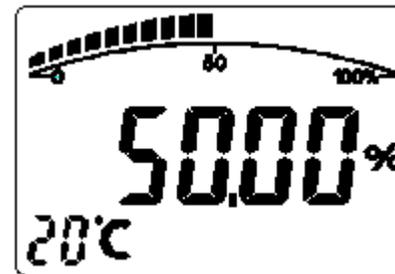


Figure 1-3
Main Variable Percentage Showing

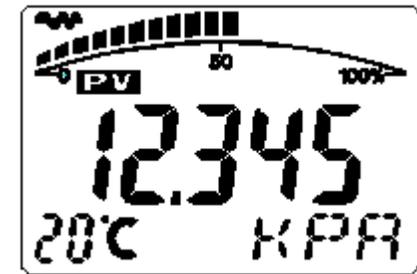


Figure 1-4
Main Variable Showing

Other display directions are as follows:

- 1). “” means “**Communication Status**”.
- 2). “” means “**Square Root Output**”.
- 3). “” means “**Fixed Output Current**”.
- 4). If “**display temperature**” is started, the character “**88**” on the lower left corner of LCD displays temperature in a real-time and normal display state. “ ” means that either below -19℃ or above 99℃ is not able to be shown.

2. Button Function

Through buttons, users can perform [**setting zero of main variable**], [**zero migration**], [**setting zero**], and [**range migration**], [**setting full**]. Also you can set units, ranges, damping, and showing variables.

2.1 Button Function Codes Table

When button configuration is being used on site, the character “88” on the lower left corner of LCD indicate the type of current setting variables, which is the setting function of current buttons.

The corresponding relations are as follows:

The Character“88” displayed on the lower left corner of LCD	Setting Variables
0 or blank	Normal Display
1	Inputting the following Operating Codes
2	Setting Unit
3	Setting the lower Limit of Ranges
4	Setting the upper Limit of Ranges
5	Setting Damping
6	Main Variable Setting Zero
7	Zero Migration and Range Migration [Zero and Full]
8	Outputting Characteristic [Setting Linear Output and Square Root Output]

Notes

Inputting each operating code can quickly enter the corresponding function. For example, if you input “5”, it will go directly to the function of setting damping.

2.2 Button Mode Descriptions

This product supports the “**Three-Button**” .

The “**Three-Button**” operating mode is more efficient than others, and it is applied to products with three buttons on LCD. At this time, the button “**Z**” is used for going into the “**Prompting Setting Data**” interface and shifting. The button “**S**” is used to enter the setting data interface, add digitals and save data. And the button “**M**” is mainly used for data storage.

2.3 Setting Data Methods

When the character “**88**” on the lower left corner of LCD shows “**1**” to “**7**”, it means the product is in *on-site* configuration mode.

During the process of setting data, the button “**S**” is used to adjust digitals and decimal points, “**Z**” is for shifting, and “**M**” is for storing data.

Setting steps are as follows:

- 1). Press “**S**” to enter the “**Setting Data**” interface, and meanwhile the sign bit starts flashing, which means the sign bit can be altered.
- 2). Press “**S**” again, you can switch the positive sign “**+**” or negative sign “**-**” of digitals (up arrow “**↑**” means positive sign “**+**”).
- 3). Pressing “**Z**” makes the first digital bit starts flashing, which means it can be altered. Then the longtime or continuous repeatedly pressing “**S**” can set digitals from “**0**” to “**9**”.
- 4). Pressing “**Z**” once again can set digitals from the second bit to the fifth one orderly. The setting method is same as that of the first one.
- 5). After setting the fifth digital, please press “**Z**” to set the decimal points. Four decimal points flashing at the same time means you can set the decimal points now. Then press “**S**” to switch the decimal point position circularly.
- 6). After setting the decimal points, please press “**Z**”, and down arrow “**↓**” flickering on prompts you to save settings.
- 7). Press “**S**” to save settings. You can make the sign bit flicker on and reset by pressing “**Z**”.

Notes:

In the “**Three-Button**” operating mode, “**M**” can be pressed anytime to save settings quickly during the setting process. So you do not have to wait to save settings until down arrow “**↓**” starts flashing.

3. Operating Directions

3.1 Main Variable Setting Zero (Reset) Function

In the real-time and normal display state, keep pressing the combination buttons “**M**” and “**Z**” (“**M**” + “**Z**”) in 5 seconds can go directly into the function of “**Main Variable Zeroing**”.

Notes:

1). Only the circuit boards above software version 1.4 can support the function of “**M**” + “**Z**” meanwhile.

After entering the “**Main Variable Zeroing**” function, the function code displayed on the lower left corner of LCD is “**6**”, the value showed in the middle of LCD screen is the current main variable , and “**YES**” or “**NO**” is at below area.

- When “**YES**” is displayed, please press “**M**” or “**Z**” to execute the operation “**Main Variable Zeroing**”. After that, the output density will be “**0**”. (note: the performance should be done before the application)
- When “**NO**” is displayed, please press “**M**” or “**Z**” to end the operation “**Main Variable Zeroing**”.
- Pressing “**S**” can switch between “**YES**” and “**NO**”.

3.2 Configuration Function

3.2.1 Function Overview

In the real-time and normal display status, pressing “Z” can go into configuration data setting state. After that, “01” shown on the lower left corner of LCD prompts you to input operating codes. Different operating codes lead to different setting function interfaces. After setting corresponding functions, it will proceed cyclic settings automatically.

the character “88” displayed on the lower left corner of LCD	setting variables
0 or blank	Normal Display
1	Inputting the Following Operating Codes
2	Setting Units
3	Setting the Lower Limit of Ranges
4	Setting the Upper Limit of Ranges
5	Setting Damping
6 (“M” + “Z”)	Main Variable Setting Zero
7 (“S” + “Z”)	Zero Migration and Range Migration [Zero and Full]
8	Outputting Characteristic [Setting Linear Output and Square Root Output]

Users can finish inputting operating codes, setting the upper and lower limits of ranges and damping.

Directions:

- If the data setting overrun, LCD displays “**OVER**”, then press “**S**” or “**Z**” to reset.
- After entering the configuration data setting, if no button is pressed within two minutes, it will return to normal display.
- The interface will return to the main display from the setting mode when the button keep un-pressed in 2 minutes.

In the “Function 1”, the following functions will be executed after inputting operating codes.

- Input “* * * * 2” (the first four digits are arbitrary) to set units.
- Input “* * * * 3” (the first four digits are arbitrary) to set the lower limit of ranges.
- Input “* * * * 5” (the first four digits are arbitrary) to set damping.
- Input “* * * * 6” (the first four digits are arbitrary) to set main variable zeroing.
- Input “* * * * 8” (the first four digits are arbitrary) to adjust output characteristic.

If other data are input, it will return to normal display. This can avoid factitious errors.

3.2.2 Setting Units

During the process of setting units, the current selected unit is shown on the lower right corner of LCD.

The steps of setting units are as follows:

- 1). Press “S” to set main variable units in turn. The units include kPa, Torr, atm, MPa, inHO, inHG, ftHO, mmHO, mmHG, psi, bar, mbar, gcm, kgcm, Pa, etc.
- 2). Press “Z” or “M” to confirm the current selected unit of main variable. Then go directly into the function interface of “Setting the Lower Limit of Ranges”.

Directions:

The unit “**l4H2O**” means 4°C inch water column.

The unit “**m4H2O**” means 4°C millimeter water column.

3.2.3 Setting Ranges

When setting ranges, you have to input “**the Lower Limit of Ranges**” first, then input “**the Upper Limit of Ranges**”.

During the process, the operating code on the lower left corner indicating “**03**” or “**04**” prompts you to input respectively “**the Lower Limit**” and “**the Upper Limit**”. After setting the lower limit, it goes to “**Setting the Upper Limit**”

automatically. Please refer “**2.3 Setting Data Methods**”. (Factory Parameter is 1-3, it is adjustable according from 0-3)

3.2.4 Setting Damping

Users can go into the setting damping interface by inputting the operating code “**5**”. Also you can go directly to set damping after setting the upper limit of ranges. Both ways are available.

The operating code “**05**” shown on the lower left corner of LCD means you should set damping. The inputting damping range is 0 to 32 seconds. Please refer “**2.3 Setting Data Methods**”.

Special Notes:

If you input damping value “**05678**”, it will return to “**Restore Factory Settings**”. So the operation “**Backup Data**” is necessary before leaving factory.

3.2.5 Setting Output Characteristic

During the process of setting output characteristic, the current selected output characteristic (linear output “**LIN**” and square root output “**SQRT**”) is shown on the lower right corner of LCD.

The setting procedures are as follows:

- 1). Press “**S**” and select the current output mode (**LIN** or **SQRT**).
- 2). Press “**Z**” or “**M**” to confirm the current output characteristic and end this round of settings, then return to the function interface “**Ending Setting**” [The function code “**0**” is displayed on the lower left corner of LCD]. If no button is pressed within 10 seconds, it will return to normal display. Otherwise, a new round of settings will begin. [Do not need to input operating codes again]. It will continue to begin with setting units.

Notes:

“**LIN**” is linear current output and “**SQRT**” is square root current output.

3.3 Zero Migration [**Setting Zero**] and Range Migration [**Setting Full**]

In the real-time and normal display state, pressing the combination buttons “**Z**” + “**S**” meanwhile and keeping 5 seconds go directly into the migration state of “**Zero Migration**” and “**Range Migration**”. At this time, the operating code “**07**” is shown on the lower left corner of LCD to prompt you to set zero and full.

“**Zero Migration**” means setting zero. The current density is set to the lower limit value of ranges, and the output

current value is adjusted to 4 mA.

“Range Migration” means setting full. The current density is set to the upper limit value of ranges and the output current value is adjusted to 20 mA.

If no button is pressed within two minutes during the process, it will return to the normal display state.

3.4 Display Variable Setting

LCD display screen can show one of three variables “**Current**”, “**Percentage**”, and “**Main Variable**” or alternately show two of them (4 seconds interval). In real-time and normal display state, you can modify the two variables by pressing “**S**”. When two variables are set to be same, the screen only shows one fixed variable. If two variables are set to be different, the screen shows two values alternatively.

The method is as follows:

Press the button “**S**”, and the current showing variable (such as “**Current**”) changes, then it will circularly display “**Current**”, “**Percentage**”, and “**Main Variable**”. When the showing variable you need (such as “**Main Variable**”) appears on the screen, please loosen the button “**S**” to realize the operation of showing variable “**Current**” changing into “**Main Variable**”.

Example:

The current showing variable “**Current**” needs to be set to show “**Main Variable**” and “**Percentage**” alternately.

Steps:

You should press “**S**” to modify the first showing variable. LCD circularly displays “**Current**”, “**Percentage**”, “**Main Variable**”. Loosen the button “**S**” after showing “**Main Variable**”. At this time, “**Main Variable**” and “**Current**” are alternately displayed.

Same way, when LCD displays “**Current**”, please press “**S**” to modify the second showing variable. At this time, LCD circularly displays “**Current**”, “**Percentage**”, “**Main Variable**”. Then loosen the button “**S**” after showing “**Percentage**”. It means successful setting.

Notes:

This function can only be supported by the circuit boards above software version 2.5. Moreover, the decimal point digits of “**Current**” and “**Main Variable**” will be automatically switched to three after being adjusted by buttons, and that of “**Percentage**” will also be automatically switched to one at the same time.

3.5 Restoring Factory Settings

If the configuration data of products have been backup before leaving factory, users can input the damping value “**5678**” by buttons to restore data on site.

The recovery methods of backup data are as follows:

1). Through “**HART-CONFIG Tool**” software

In the “**Output Characteristic**” page of “**Instrument Configuration**”, input damping “**5678**” first, then click on “**Writing**”, it will restore the backup data. [Tip: The showing of “**Communication Failure**” is normal and does not affect the data recovery during the process of writing data. Because “**5678**” is not an effective damping value]

2). Through “**HART375**” handheld device

Select “**Damping**” in the option “**Signal status**” of “**Detailed Setting**”, and input damping “**5678**” first, then click on “**Writing**”, it can restore the backup data. [Tip: The showing of “**Communication Failure**” is normal and does not affect the data recovery during the process of writing data. Because “**5678**” is not an effective damping value]

3). Through Buttons

Select the fifth option and input damping “**05678**”, then save data. It will restore the backup data. [This operation does not affect the real damping value]