NANOAI TECHNOLOGY PRIVATE LIMITED
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FF-08, Omaxe CP, Beta –II, Greater Noida 201310, IN

DIGITAL FLOW SENSOR SMKB-DFS1000

CONTENTS

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SMKB-DFS-1000

I. Summary

The Digital flow sensor series is portable instrument flow designed for the flow velocity/rate measurement. It's professional for agricultural irrigation, hydrologic monitoring, rivers flow monitoring, municipal water.

The low-power design and full digital signal processing technology make measurement more stable and reliable. The range is wide and high accuracy. It widely applies to the measurement of flow velocity and rate for industry requires moving frequently such as agricultural irrigation, hydrology and water conservancy.

II. Main Feature

- No movable parts, no winding. No choked flow, no maintenance, avoid troubles of other calibration and testing;
- Micro-power design can last 80 hours when replace the battery (Ⅱ-model, optional for level sensor);
- LCD big screen back light displays shows measuring data clearly in sunlight and night;
- The instrument interface displays velocity flow(Ⅱ-model), accumulative total(Ⅱ-model), level(Ⅱ-model), flow direction, electric quantity, alarm information, running time, running status;

➢ Simple operation, wading rod measurement, wire measurement and sailing measurement are available choice.

➢ Auto power shut off.

III. Main Technical Parameters

✧ Range: Velocity 0.005m/s～10m/s (resolution 5mm/s);

✧ Accuracy: ±1.0%FR+0.005m/s;

✧ Acquisition time: Auto 10S～900S adjustable, hand control time;

✧ Power: 1.5V*5pcs NO.5 battery;

✧ Display: LCD big screen back light display velocity, flow(Ⅱ-model), accumulative total (Ⅱ-model), level(Ⅱ-model), flow direction, electric quantity, alarm information, running time, running status;

✧ Physical interface: RS485(optional);

✧ Conductivity: >20μs/cm;

✧ Medium temperature: 0℃～60℃;

✧ Ambient temperature: -10℃～50℃;

✧ Display digits: 3 digits (X.XXX);

✧ Size：204*100*35mm (Display);

✧ Size：Φ32×460(mm)(Sensor);

✧ Measuring rod Normal 500mm×Sections (500mm×optional sections) or lifting accessories.

IV. Working Principle

The SMKB-DFS1000 depends on the Faraday's law of electromagnetic induction. The conductive liquid cut the magnetic line and cause induced electromotive force when do the direction perpendicular to the magnetic field lines in the alternating magnetic field along the measuring pipe. So we install a pair of electrodes on the pipe wall which orthogonal with sounding pipe axis and magnetic line. The electrodes can detect the induced electromotive force.

It should be directly proportional with the flow. Then the liquid's flow will be exported by the detection. The induced electromotive force signal will be converted to standard DC current signal (0~10) mA, (4~20) mA or (0~5) kHz frequency output which was directly proportional with flow signal by amplification of converter. So the measurement comes out.

The velocity equation

E KBD (K is induced electric potential magnification); E-

-- Induced potential (V);

V --- Mean velocity when the fluid crosses the electrode surface in range; B --

- Magnetic induction intensity;

D --- Induction electric potential spacing.

V. Structure

The instrument structure divides into three parts: electromagnetic velocity sensor (III-model includes level sensor), flow display and wading rod (or suspension wire).

VI. Assemble and Introduction

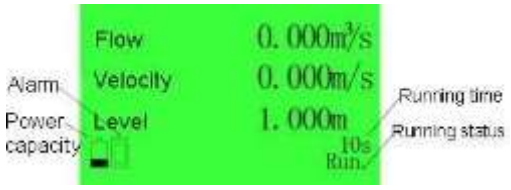
6.1 Flow display terminals

6.1.1 Display port

It uses for connecting the electromagnetic sensor. The outgoing line of electromagnetic velocity sensor has completed coupler plug. Please directly insert the plug and tighten the screws.

6.1.2 Display interface

Ⅱ-Model、Ⅲ-Model display interface:



Ⅰ-Model display interface:

6.1.3 Battery and communication port

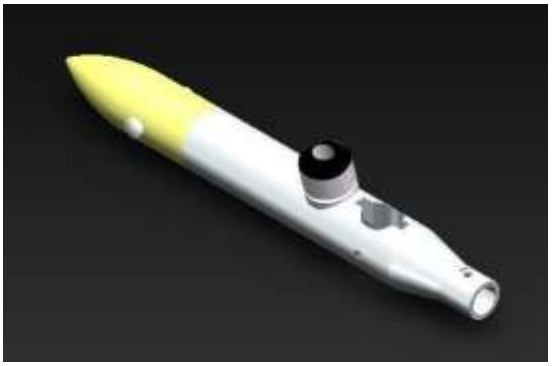
The battery is 5*1.5V alkaline battery (convenient buy from market). The bottom is communication port.

6.1.4 Switch Port

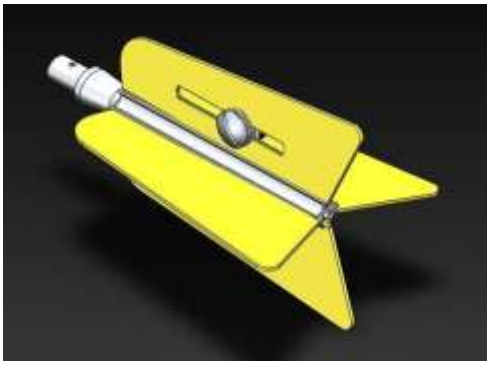
It uses for turning on and off.

6.2 Velocity sensor

The velocity sensor consists of velocity sensor and tail cable.

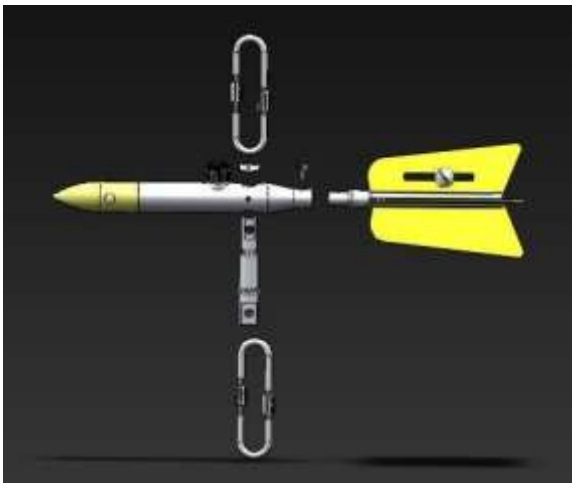


Velocity Sensor



the Tail

Suspension Loop



Axial Parts

VII. Menu, Keyboard and Parameter Setting

Key description (One key is multi-purpose)

EXIT: Long press 6 seconds exit setting and return work interface in parameter setting status.

+: Page up or +1 key. Ⅱ-Model long press in main interface will enter basic parameter modification interface.

-: Page down or -1 key.

SET: Save: press it to remove the cursor after parameter setting. The parameter will be completed and saved. Setting/Shifting: press it enter parameter setting/modification in parameter setting status, then use for shifting. Long press 6 seconds enter password interface.

Password input (Under Engineering Mode)

The password must be inputted when modify status and parameter. Password can be set arbitrarily in 5digit number between 00000~99999, the default is 00000. In the working status, long press “set” key more than 6 seconds, the converter password state “password 000000” will come out, press again “set” key and the first password digit display by white line. Then use “+/-” to modify. Press “set” again to remove the white line below next digit. Repeat 5 times and press “set” after complete to return parameter setting status.

Parameter setting and modification

When the instrument enters setting status, find the parameter you want to modify on the display. Press “set” enter the position. Use “+/-” to add or minus and page turning on different parameter. Use “EXIT” to ignore the parameter not be modified.

Modifying measuring time for example:

Enter Setting/Modification, use “+/-” to page up and down, find the measuring time. Press “set” and there is white line under the time. Then use “+/-” to modify the parameter. After completion press “set” again to remove the cursor and the parameter setting will be saved at th same time. After all parameters settings completion, long press “EXIT” 6 seconds, the program returns to the normal measuring status (The program will automatically return to normal measuring status if there is not any operation).

7.1 Velocity meter model menu

Page	Ⅱ, Ⅲ-Model menu	Set/Unit	Ⅰ-Model Menu	Set/Unit
User interface	Calibration	0=clear 1=Calibration	Calibration	0=clear 1=Calibration
	Level	0～20.000m		
	Measuring height	0～20.000m		
	Bottom width	0～20.000m		
	Side wall	0～10.000		
	Edge distance	0～10.000m		
	Damping	0～60		
	Flow unit	0=m³/s;1=m³/h		
	Velocity digit	(0～3)=(0～0.000)		

	Time	1(10s)	Time	1(10s)
	Interval	1(10s)	Interval	1(10s)
	Value number	0～999	Reverse	0=off,1=on

	Record	0～999	adjustment	

	Auto shutdown	0=off,1=on	Auto shutdown	0=on,1=off
	Backlight	0=off,1=on	Backlight	0=off,1=on

Note: “on” means the function turn on. “off” means the function turn off.

7.1.2. Usage menu and parameter details

Calibration: This parameter is zero calibration function. If there is zero deviation, please use this parameter. This menu will be automatically calibrating on 01H 60S;

Level: Ⅱ-Model is manual input liquid level depth value. Ⅲ-Model is liquid depth correction;

Measuring height: The height from velocity sensor to channel bottom (Necessary setting);

Bottom width: The width of channel bottom (Necessary setting);

Side wall: The factor of side wall which means aspect ratio of trapezoid side wall (Necessary α=B/H);

Edge distance: The distance parameter from velocity sensor to channel side. (Necessary setting);

Damping: Long measurement filtering time can improve the stability of flow display and signal output. Short measurement filtering time shows fast corresponding speed.

Flow unit: Instantaneous flow divides m^3/s and m^3/h;

Velocity digit: The display of converter is 3-digit for choice according to the need;

Time: The velocity meter will send average data within a certain period to display. This is measurement period. Setting 0 means manual set measurement control time (Long measurement period can improve stability of velocity display and signal output. It uses for pulsating flow measurement field. Short measurement period means fast corresponding speed uses for instant velocity measurement);

Interval: Interval between twice measuring 0～900s;

Value number: This parameter is for serial number which can be inputted by

user. It uses for recognizing value property. The value number auto adds 1 every time;

Record: This parameter uses for historical data inquiry of value through page turning to judge value property;

Auto shutdown: 1 is Time-limited model (1800s auto shutdown), 60s auto shutdown

without any operation. 0 is continuous working model;

Backlight: 0 is auto backlight shutdown when faulty operation. 1 is keep running.

Page	Ⅱ/Ⅲ-Model	Setting/Unit	Ⅰ-Model menu	Setting/Unit
Engineering interface	Conversion factor	Factory calibration	Conversion factor	Real value
	Instrument factor	Factory calibration	Zero calibration	Manually set the zero point
	Model	Factory setting	Velocity cutoff	Small velocity cutoff
	Level range	Factory setting	Velocity digit	0～3
	Max voltage	0～6.000v	Transmission address	1～255
	Min voltage	0～1.600v	Transmission speed	1200～9600
	Linear allow	0 or 1	Filter factor	10～200s
	Velocity value	1～5	Linear correction	0=off；1=on
	Velocity Calibration	1～5	Velocity value	Factory setting
	Sensor factor	0～6.0000	Sensor factor	Real value
	Flow factor	0～6.0000		
	Language	0=Chinese；1=English		
	Password	0000～9999	Password	0000

7.2.1 Engineering interface and parameters introduction

Conversion factor: This parameter is special factor of display manufacturer for unify the circuitry of display measurement. Ensure every display consistency (irrevocable parameter); Instrument factor: It reserve factor; it shows product relationship with velocity;

Model: Irrevocable parameter only for factory;

Level range: Ⅲ-Model have water level measurement function. Level meter range; Max voltage: Ⅲ-Model output correction of max voltage;

Min voltage: Ⅲ-Model output correction of min voltage; Linear

allow: Control linear allow function. 0 is off, 1 is on;

Velocity value 1: The first point velocity measured value of linear correction;

Velocity calibration 1: The first point velocity corrected value of linear correction; Velocity value 8: The first point velocity measured value of linear correction; Velocity calibration 8: The first point velocity corrected value of linear correction;

Sensor factor: This parameter is velocity sensor calibration coefficient. Each sensor has unique calibration coefficient which comes from actual calibration and marked on the product certificate. It has been imbedding before delivery (irrevocable parameter);

Password: It is adjustable parameter, the factory default is 0000; Velocity cutoff: Low velocity cutoff display, unit is m/s(Ⅰ-Model)；

Transmission address. The range of mailing address is 1～255, default is 1(Ⅰ-Model);

Transmission speed: 1200～9600bps is optional. The default is 9600. This menu corresponds equipment with RS485 instrument(Ⅰ-Model).

Note: The address model of Ⅱ/Ⅲ-Model instrument is 1, baud rate default is 9600 and cannot be set.

Nonlinear velocity correction function instruction:

Nonlinear velocity correction function adopts below low velocity (0.5m/s) linear correction in principle. It has eight section correction including eight velocity point and eight corrections co-efficient.

Nonlinear correction coefficient means to be revised base on the original sensor calibration coefficient. So please turn off nonlinear correction function and mark the sensor factor, then turn on the function. According to nonlinear section of sensor, measuring the velocity and correcting the setting. If the setting is suitable, no need to calibrate.

Suppose: The original velocity is rate which has been calculated according to sensor factor. The correcting velocity is rate which has been nonlinear corrected. Then the velocity

after correction has correspondence as following;

Notice: When setting velocity, please keep the relation as following:

Velocity 1>Velocity 2>Velocity 3>Velocity 4>Velocity 5.... >velocity 8

VIII. Instrument Usage

8.1 Velocity measuring

This instrument is advanced measuring instruments uses for conductive liquid, simple operation and convenient maintenance. Please connect the sensor and display exactly and turn on the power on the display. Then put the velocity sensor into the measuring channel point.

8.2 Flow measuring

The flow measuring needs to input channel measuring parameters: velocity measuring margin, velocity measuring height, side slope ratio, channel bottom width, water depth (water level adjustment, Ⅲ-Model water level can be automatically collected by depth sensor).

Note: The measuring method includes one-point method and multi-point method. The one-point method choose 0.6 times water depth and 0.5 times channel width. The multi-point method chooses as following:

8.2.1 Velocity distribution line within velocity of vertical distribution and vertical direction of the water depth (Table 1):

Table 1

Water width(m)	Vertical number
>0 and ＜0.5	3-4
>0.5 and ＜1	4-5
>1 and ＜3	5-8
>3 and ＜5	8-10
>5 and ＜10	10-20
>10	＞20

Depth(m)	Point number
＜1	3-4
1-3	4-6
4-7	5-8
＞7	6-10

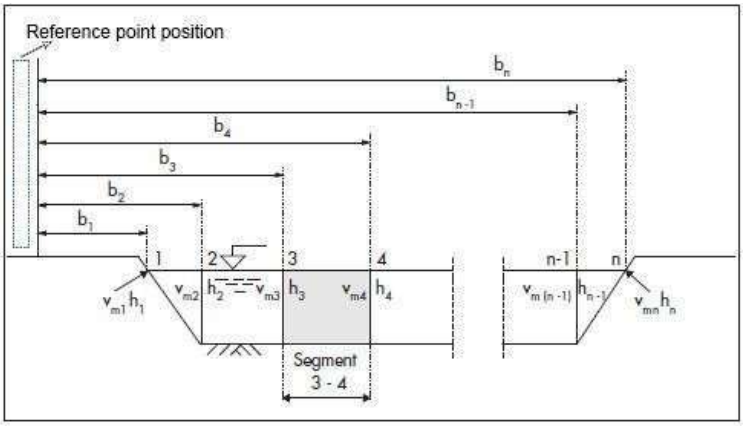
Mode	Measuring point position	Average velocity
1-point	0.6*h	$V_m=V_{0.6}$
2-point	0.2/0.8h	$V_m=(V_{0.2+}V_{0.8})/2$
3-point	0.2/0.6/0.8h	$V_m=0.25(V_{0.2}+2V_{0.6}+V_{0.8})$
4-point	0.2/0.4/0.7/0.9h	$V_m=0.25(V_{0.2}+V_{0.4}+V_{0.7}+V_{0.9})$
5-point	Close to surface/0.2/0.6/0.8h/Riverbed	$V_m=0.1(V_0+3V_{0.2}+3V_{0.4}+2V_{0.8}+V_S)$
6-point	Close to	$V_m=0.1(V_0+2V_{0.2}+2V_{0.4}+2V_{0.7+}2V_{0.9}+V_S)$

	surface/0.2/0.4/0.7/0.9h/Riverbed	

Note: The sensor must be flooded about 10cm when close to surface. Please according to the actual need to choose.

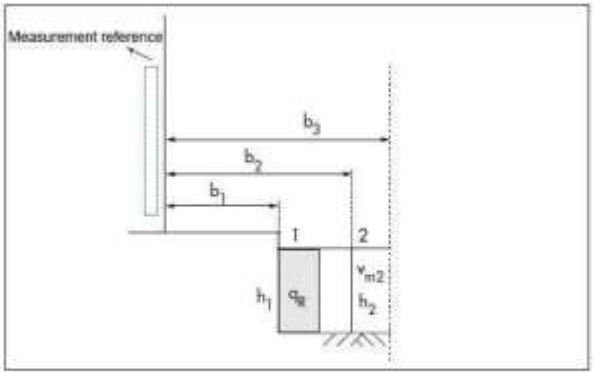
8.2.4 Flow calculation

8.2.4.1 Flow calculation between measuring point line



$$q_{3-4} = (\frac{V_{m3} + V_{m4}}{2}) \times (\frac{h_3 + h_4}{2}) \times (b_4 - b_3)$$

8.2.4.2 Line flow calculation



$$q_3 = v_{m3} \times [\frac{(b_3 - b_2) + (b_4 - b_3)}{2}] \times h_3$$

8.2.4.3 Side wall flow calculation

$$q_R = [h_1 \times \frac{(b_2 - b_1)}{2}] \times k_R \times v_{m2}$$

Note: K_R is side wall factor, Please refer to the table 4:

Side wall type	K_R

Smooth without vegetation (concrete, steel or cement surface)	0.8-0.9
Brick without vegetation	0.7
Rough surface without plenty of vegetation	0.5-0.6

Table 4

8.3 Measurement requirements

①Please try best to select point on flat area of channel or river. Avoid gate, curve, inlet/outlet and ramp. The straight channel section should be long enough (upstream is 10-15 times channel width, downstream is 2-5 times channel width). So the flow distribution will be more stable and uniform. And the data will be more accuracy.

②Velocity sensor position: Please point the measuring head to the upstream and ensure the velocity sensor parallels to the flow direction. Waiting a moment for stable running of sensor then resend the data. Avoid the primary interference signal input and eliminate the electrode oxide film interference.

8.4 Operating mode

There are two operating modes: “Time” select 0 is manual continuity operating mode. When select “Time” and period measuring fit “Interval”, it will be period-interruption mode. Continuous mode is manual interval period measuring design. When the flow display is working, the operating time will stop anytime. Then manually enter the next period measurement. The display backlight will automatically turn off after 60 seconds without any operation. If you want to turn on the display backlight, please press any button on keyboard; The flow display will turn off automatically after 30 minutes without any operation under power-save mode. And it will last work till battery out without power-save mode (auto turn off select 0).

8.5 Zero calibration (automatic zero setting)

Zero calibration: Long press (+) enter the parameter setting mode and find “Zero calibration”, then press “Set” to automatic zero setting. Then there will be white line under the “00”, press “+” and modify “00” to “01” and press “set” again. The automatic zero setting

will be turn on. The automatic zero setting will cost 60 seconds. The screen time digital will display from 60 to 0. The automatic zero setting complete. Zero calibration is necessary when needs and verify. Please make sure the medium statically and surround the electrode. The vessel must be non-conductive material (Picture as following for example)

Note: Operating instruction:

The electrode should be in the center of medium. Metal portion touch the medium.

Please keep static during zero calibration both medium and sensor.

8.6 Historical data record and query

Ⅱ/Ⅲ-Model display can record 1000 items historical data.

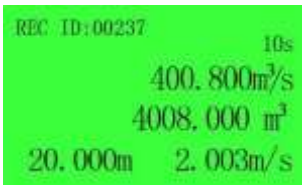
8.6.1 Data record and storage

The instrument will record internal storage number automatically. You can set original value in “Setting”, each measuring will add 1 automatically and cover the current value after 1000 items.

8.6.2 Date query

Please turn on the display and keep normal measuring status, press “+” or “-” to page up and down, find the date query and press “set” select record number, then press “Exit”. The program will enter data query display. You can use “+” or “-” to inquire all the historical data. Each date has number, so you can check the date according to order number. If you want to find some items. Please enter the number in data setting menu then exit the parameter setting status. It will display this item. When you complete, please press “EXIT” to quit data query display and get back to normal measuring working status.

8.6.3 Date query interface introduction



IX. Maintenance (Notice)

9.1 Please wipe the electrodes with clean wet cloth before use after long time place. Then immerse into the water 3-5 hours;

9.2 Please keep the sensor clean, avoid mud and grease;

9.3 Please keep the electromagnetic velocity display clean and dry;

9.4 Please remember to change the battery. (Battery is 1.5V*5, long time place should remove the internal battery).

X. Fault Handling

NO.	Alarming	Information	Treatment
1		Low press alarm	Please replace battery
2		Exciting alarm	1. Excitation line loose; 2. Excitation line fault; 3. Return to factory.
3		Bare electrode	1. Velocity measuring height setting is not current; 2. Water level sensor damage; 3. Return to factory.