Operation manual

HD353-A (50kHz)

HD353-B (100kHz)

Ultrasonic level meter

Read and fully understand the contents of this Operation manual before operating the product.
Keep this manual so that you can check the contents anytime.

Foreword

Thank you for purchasing this product.

■For safe operation, read and fully understand the contents of this Operation Manual before attempting to operate the equipment.

■Follow the procedure written clearly in this manual and do not take any action described as Danger, Warning and/or Precautions. If any of them is ignored, it will result in a serious incident or damage to the property and etc.

■After reading this manual, store it in a safe and convenient place where it will not become lost or damaged and can be referred to easily when needed.

■We assume absolutely no responsibility if any damage, injury, lost profit and/or demand from the third party result from this product being used in a manner not described in this Operation Manual.

■If you sell or transfer the ownership of this equipment, always provide the new owner with this Operation Manual.

■We assume absolutely no responsibility if any damage, injury, lost profit and/or demand from the third party result from the measuring result.

■Under the provisions of product liability laws, we assume absolutely no responsibility if damage and/or injury results from this product being used in a manner not described in this Operation Manual or if used in erroneous manner.

●Due to our policy of ongoing product improvement, there may be some variations between the contents of this manual and the actual equipment.

●We ask that you contact this company if you feel that the contents of this manual are unclear or erroneous, or if you feel that some information has not been included.

Table of contents

1. Safety precautions (Must Read)

The "Safety precautions" explains extremely important precautions that must be taken to prevent injury to the person using the product as well as to others and to prevent damage to property.

The following is an explanation of the symbols used. . .	
⚠Danger	This indicates items that if ignored could lead to serious injury or death.
⚠Warning	This indicates items that if ignored could lead to slight injury or damage to property.

Examples of the Indicators

: This symbol means "Prohibited".

: This symbol means "Must Do".

Disassembly Prohibited

Water Contact Prohibited

Disconnect the power plug

General Information

⚠Danger	
	If abnormity of product such as fog from the product is seen, turn the power off immediately and contact our distributor for repair.
 Water Contact Prohibited	Never allow water to come in contact with the product. Moreover, never place the product in a location where it will come in contact with water. ●This could cause damage, electrical shock or shorting.
 Disassembly Prohibited	Modification or Disassembly Prohibited. ●Never disassemble, repair or modify the equipment. This could cause fire, electrical shock or injury.
 Prohibited	Never place foreign objects, such as pins, wire or other metal objects, it the opening. ●This could cause electrical shock or shorting.
 Prohibited	Never use the product under the following conditions. * Locations that could cause high temperatures, such as a location in direct sunlight. * Locations where dust, particles or corrosive gases are created. * Locations subject to strong shock or vibration. * Locations subject to water leakage or high levels of humidity. ●If these warnings are ignored, damage to the product could occur and in some cases, this could result in a major accident, such as electrical shock.
 Wet Hands Prohibited	Never touch the plug or operating parts with wet hands. Moreover, never allow the product to come in contact with water. ●This could cause electrical shock. Stop operations immediately when the product does come in contact with water.
 Prohibited	Never bend the power cord excessively, pull on it, twist it, bundle it or place heavy objects on it. ●This could damage the cord and cause damage, fire or electrical shock.
 Prohibited	Never use the product if any cord or plug is damaged or broken. ●This could cause electrical shock, shorting or fire.

⚠Warning	
	Do not use the product at a place close to other ultrasonic device to avoid the unwanted operation due to the interrelated influence.
	Do not give any strong shock to the product and drop down the product.

2. Components

Confirm all of followings are supplied.
If any of followings is missed, contact the distributor.

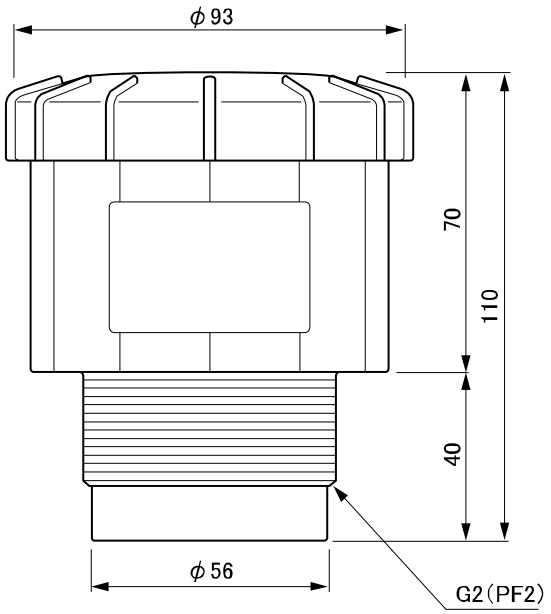
HD353 (Main unit)	1
Distribution cable 10m	1
Operation Manual	1

■Option

30m distribution cable: HD-002

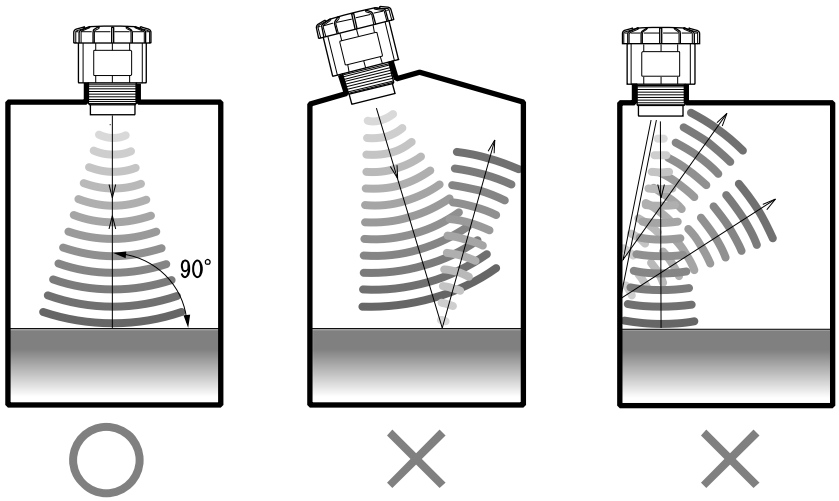
3. Names of parts

4. Dimensional drawing of main unit



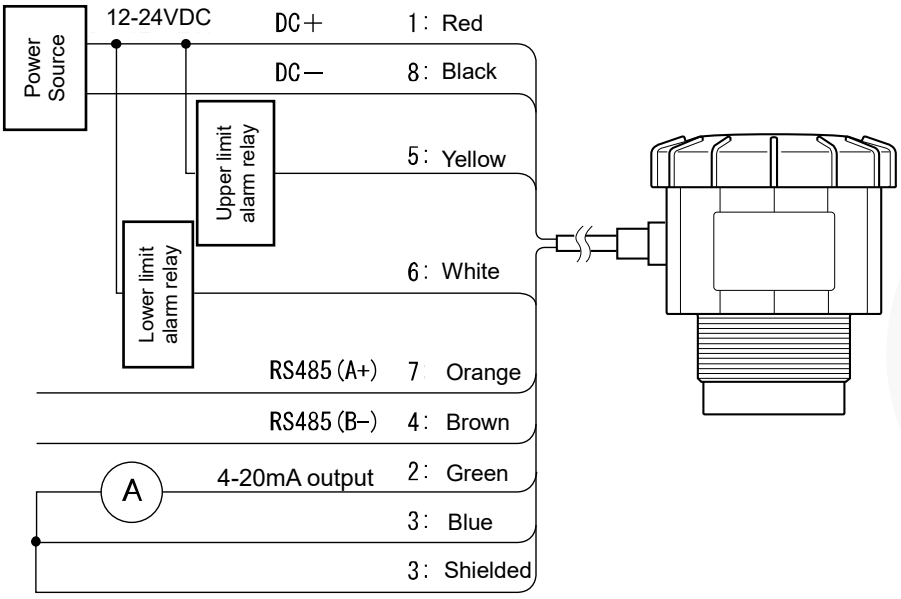
5. Installation and precautions

・Install HD353 on the top of tank horizontally.
・Screw in HD353 into the resin flange with G2(PF2) to the tank.
・Do not use metal nut or flange to install HD353 to the tank to avoid the incorrect measurement. Use the resin nut or flange to install HD353 to the tank.



・Install HD353 so that the ultrasonic transmitting surface becomes parallel to the liquid surface.
・Do not install HD353 close to the sidewall of tank to avoid the incorrect measurement due to the undesired reflections from the sidewall.
・Do not screw in HD353 with too much force.
・Avoid the direct sunlight to HD353.
・Do not install the multiple ultrasonic sensors to the same tank. To avoid the mutual interference of ultrasound.

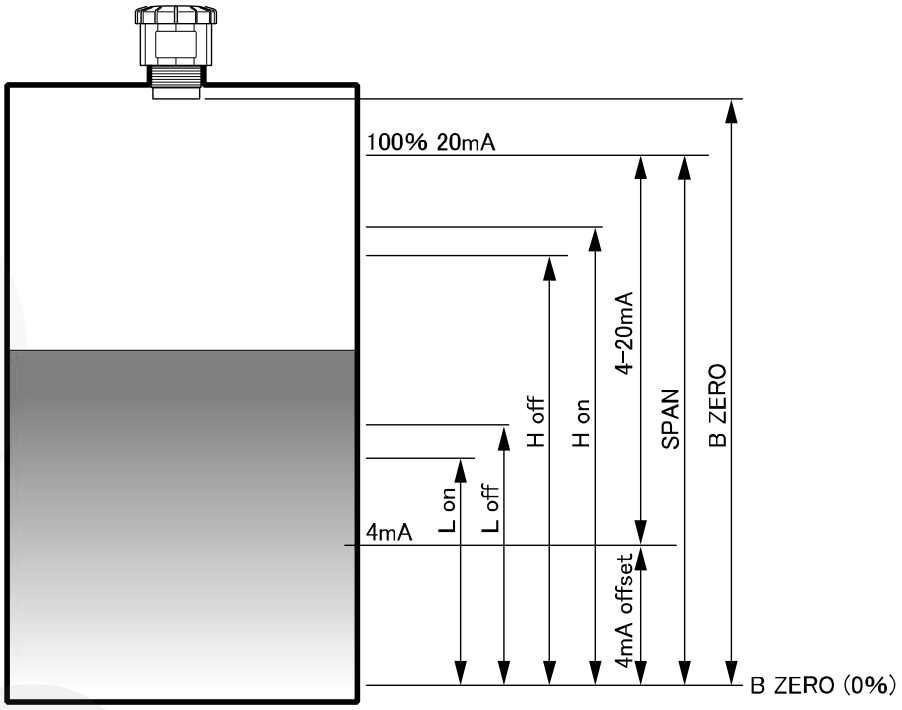
6. Wiring and precautions



Red lead wire:	Power source 12-24 VDC(+)
Black lead wire:	Power source 0V(-)
Yellow lead wire:	Upper limit alarm SW (Open collector output, NPN type)
White lead wire:	Lower limit alarm SW (Open collector output, NPN type)
Orange lead wire:	RS485(A+)
Brown lead wire:	RS485(B-)
Green lead wire:	4-20mA output(+)
Blue lead wire:	GND (Upper/lower limit alarm SW, 4-20mA output)
Shielded wire:	Grounding (Connect Shielded wire to Blue lead wire and to Ground)

[Caution] Output rating of upper/lower limit alarm is 30V/0.1A.
When a relay etc. is connected, the output rating of relay to be used must be within the above voltage and current.

7. Settings according to the tank



1) Press MENU key to indicate MENU.
2) Change the indicated parameter by ◄ ► keys and select the parameter by SET key. Change the setting value by ◄ ► keys.
   Press SET key again to determine the setting value. Press MENU key not to determine the setting value.
3) B ZERO;
   Distance from the ultrasonic transmitting surface to the tank bottom
   B ZERO can be the distance from the ultrasonic transmitting surface to arbitrary 0% level.
4) SPAN;
   Level from 0% to 100%
   Set the level from 0% which is set at B ZERO to 100%.
5) SW H/L;
   Level setting of alarm switch
   Set the level of SW H/L ON/OFF.
   Pay attention to the functions of SW H/L ON/OFF.
6) 4mA OFST;
   Set the offset of 4mA output.

8. Operating instructions

Basic key operation

Press MENU key to indicate MENU.
Change the indicated parameter by ◄ ► keys and select the parameter by SET key. Change the setting value by ◄ ► keys.
Press SET key again to determine the setting value. Press MENU key not to determine the setting value.

Press MENU key again to escape from MENU.

Operating mode

There are 2 operating modes, Level meter mode and Weir flowmeter mode.
Select the operating mode at 20.FLOWmod in MENU.

Display mode

Select the display mode from the following 4 modes.
The selectable display modes depend on Level meter mode and Weir flowmeter mode.

<Level meter mode>

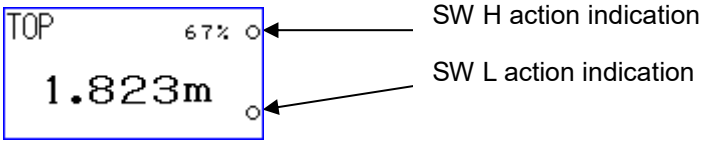
A …… TOP-based distance display
B …… BOTTOM-based level display
C …… % display
D …… Ultrasonic A mode display

<Weir flowmeter mode>

A …… Weir flowmeter display
B …… BOTTOM-based level display
C …… % display
D …… Ultrasonic A mode display

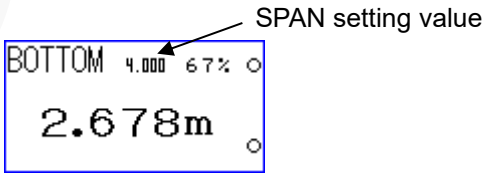
DISPMODE A - C <Level meter mode>

DISPMODE A (TOP-based distance display)

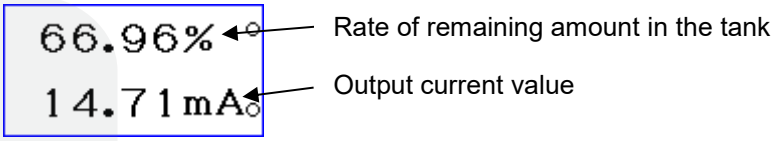


SW action indication;
ON: ● OFF: ○

DISPMODE B (BOTTOM-based level display)

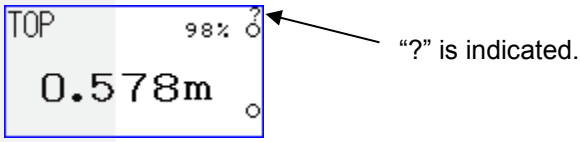


DISPMODE C (% display)



Switch DISPMODE by ◄ ► keys.

<Measurement error indication>



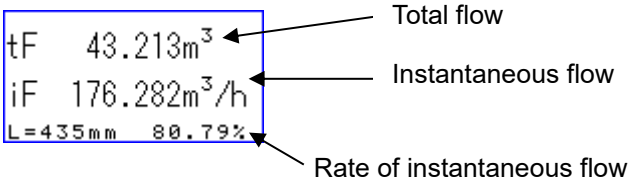
“?” is indicated at the upper right corner when the ultrasonic reflection echo cannot be detected.

DISPMODE A - C <Weir flowmeter mode>

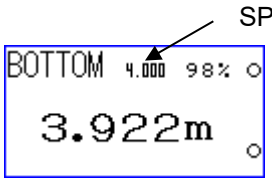
DISPMODE A (Weir flowmeter display)

tF: Total flow

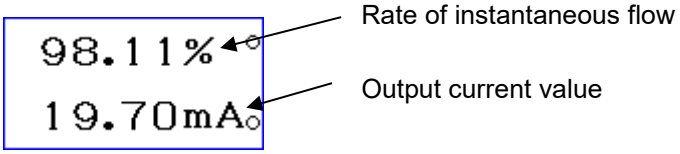
iF: Instantaneous flow



DISPMODE B（BOTTOM-based level display）

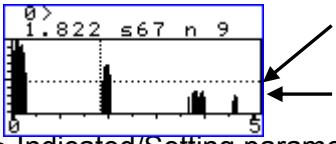


DISPMODE C (% display)



DISPMODE D (Ultrasonic A mode display)

Set the parameters related to the ultrasonic measurement based on the indicated waveform of ultrasonic reflections.
Measured value and setting value are indicated at the bottom of display.
Change the indicated parameter by ◄ ► keys and select the parameter by SET key.
(While selecting, underlined characters are indicated.)
Change the setting value by ◄ ► keys after the parameter is selected and determine the setting value by SET key.



Threshold level line

Indicated/setting parameters of DISPMODE D

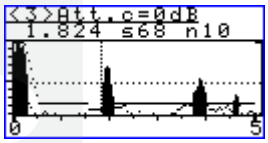
● Indicated/Setting parameter

Indicated parameters: 0>: Measured value s: Signal level n: Noise level

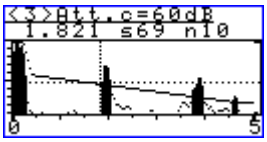
<1> RANGE: Indicated range scale
Setting range: Min. 1m - Max. 10m (1m step)

<2> STC: Sensitivity Time Control
Sensitivity of close range is decreased to lower the undesired reflections from the close range.
Setting range: 0 - 10 (Default: 0)
Larger value: Sensitivity of close range is lower.

<3> Att.c: Mask level for the entire area
Mask level gets lower according to the ultrasonic attenuation based on the distance from the sensor.

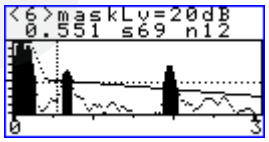


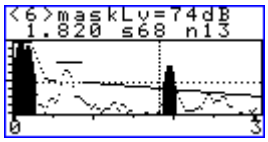
Att.c=0dB



Att.c=60dB

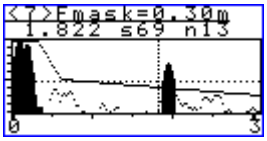
<4> maskP: Start position of rectangular mask
<5> maskW: Rectangular mask width
<6> maskLv: Rectangular mask level
Settings of rectangular mask to avoid the undesired reflections from an obstacle within the measuring range.



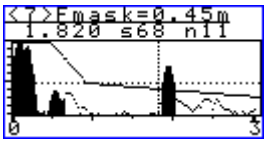


<7> Fmask: Reverb mask width

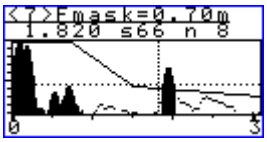
Reverb mask width should be wider to avoid incorrect measurement when the oscillation reverb is too long.



Fmask: 0.30m



Fmask: 0.45m



Fmask: 0.70m

[Caution] Distance within Reverb mask width cannot be measure at all.

<8> THRESH: Threshold level

Setting range: -4bB - -36dB (Default: -20dB)

Signal at the threshold level and lower is not be detected.

Threshold level should be larger when 2 or 3 times that of actual distance is detected caused by the multiple reflections.

<9> FREQ: Ultrasonic frequency

Setting range;

HD353-A: 45 - 55kHz (1kHz step)

HD353-B: 90 - 110kHz (1kHz step)

Set the value so that the signal level can be larger.

<10> NoiseSup: Noise suppression

Setting range: 0 - 3

Select the value so that the noise level can be smaller.

9. Setting in MENU

Press MENU key to indicate MENU.
Press MENU key again to escape from MENU.
After no key operation for 3 min., the display returns to the main display, automatically.

DISPMODE: A - D
Select the appropriate one.

B ZERO: HD353-A: 0.5 - 10m HD353-B: 0.25 - 5m
Set the distance from the ultrasonic transmitting surface to the tank bottom or the channel floor.

SPAN: HD353-A: 0 - 10m HD353-B: 0 - 5m
Set the measuring range from the tank bottom or Max. overflow level.
SPAN is the range of 4-20mA output.
[Caution] If “4mAOFST” is any other than 0, “4mAOFST” to “SPAN” is 4-20mA output range.

RESPONSE: 1000m/min - 0.01m/min
Fast <-> Slow
Set the response speed to the measured distance change.

SW H ON/OFF: HD353-A: 0 – 10m HD353-B: 0 – 5m
Set the level from the tank bottom to turn ON/OFF the upper limit SW.

SW L ON/OFF: HD353-A: 0 – 10m HD353-B: 0 – 5m
Set the level from the tank bottom to turn ON/OFF the upper limit SW.

[Caution] The function of SW ON/OFF depends on the setting value of SW H/L ON/OFF.
[Caution] In case SW H/L ON and OFF are switched frequently, the difference between SW H/L ON and OFF should be larger to give hysteresis characteristics.

4mA OFST: 0 – SPAN or lower

"4mAOFST=0" means that the tank bottom is the distance/level of 4mA output.

[Caution] If "4mAOFST" is any other than 0, "4mAOFST" to "SPAN" is 4-20mA output range.

I4-20: Norm(Normal) or Reve(Reverse)

Set the basis of 4-20mA output.

Normal: 4mA = 0%, 20mA = 100%

Reverse: 20mA = 0%, 4mA = 100%

*If any other than 0 is set to [4mA OFST], OFFSET works at 0% side.

BRIGHT: OFF <-> AUTO <-> ON

Set the back light function.

AUTO: ON for 10 min. after power power-on, OFF after 10 min. passes

1 hour: ON for 1 hour after any key operation, OFF after 1 hour passes

4-20SET: normal <-> i4mA - i20mA

Parameter for the connection test of 4-20mA output.

normal: Current of measured value is output.

i4mA: 4mA is output forcibly.

I20mA: 20mA is output forcibly.

normal <-> i4mA <-> i8mA <-> i12mA <-> i16mA <-> i20mA

Once escape from MENU, setting gets "normal".

Dist Adj: -50 - +50mm

Set the value for the distance correction.

Err Cond: hold <-> i4fix <-> i20fix

Set the current output for the measurement error.

Hold: Current output of measured value before measurement error happens is output.

i4fix: 4mA is output when the measurement error happens.

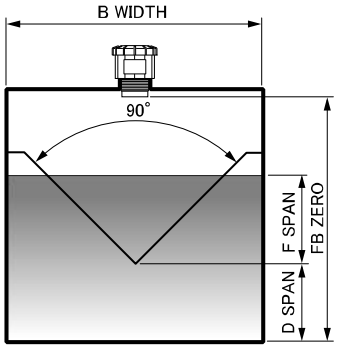
i20fix: 20mA is output when the measurement error happens.

10. Weir flowmeter setting

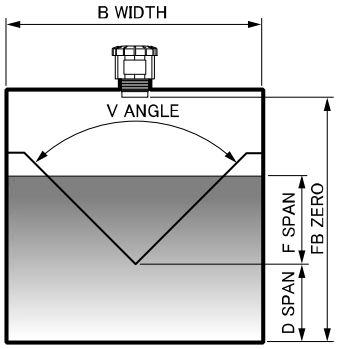
FLOWmod: Selection of Weir flowmeter function
OFF: Level meter mode
Others: Weir flowmeter mode

Level meter mode: OFF

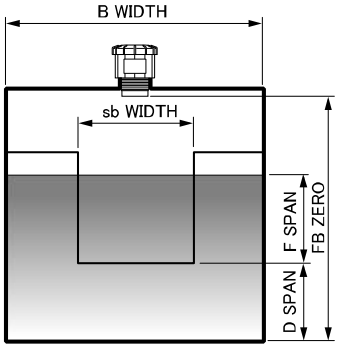
90 deg V-notch weir: 90ang



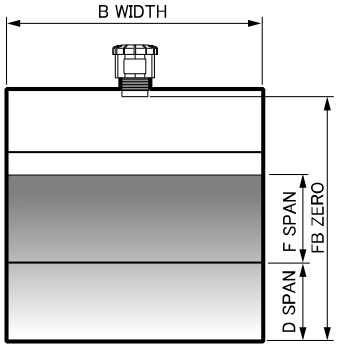
Arbitrary V-notch weir: AngleV



Contracted rectangular weir: Squar1

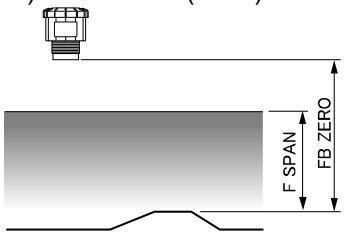


Suppressed rectangular weir: Squar2



Parshall flume flowmeter

<-> PF-1(1inches) <-> PF-2(2inches) <-> PF-3(3inches)
<-> PF-6(6inches) <-> PF-9(9inches) <-> PF-10(1feet)
<-> PF-15(1.5feet) <-> PF-20(2feet) <-> PF-30(3feet)
<-> PF-40(4feet) <-> PF-50(5feet) <-> PF-60(6feet)
<-> PF-70(7feet) <-> PF-80(8feet)



FBZERO: Distance from the ultrasonic transmitting surface to the channel floor
Setting range: 0.3 - 5m

FSPAN: Max. overflow level
Setting range: 0.05 - 3m
Max. measurable flow depends on FSPAN.
While FSPAN is set, Max. measurable flow is showed at the bottom of display as “MaxFlow=XX.XXm^3

B WIDTH: Channel width
Setting range: 0.4 - 32m

D SPAN: Height from the channel floor to the lower edge of weir
Setting range: 0.001 - 3.5m

sbWIDTH: Cutout width of contracted rectangular weir
Setting range: 0.15 - B WIDTH

V ANGLE: Arbitrary angle of V-notch (for AngleV)
Setting range: 45.0 - 100.0 deg

F CUT OF: Low cut OFF of flow
Setting range 0.0 - 10.0% of Max. measurable flow
Flow at F CUT OF or lower is recognized as no flow.
Output current of flow at F CUT OF or lower is 4mA.
While FSPAN is set, Max. measurable flow is showed at the bottom of display as “MaxFlow=XX.XXm^3

Parshall flume setting

FBZERO: Distance for Min. flow
FSPAN: Distance for Max. flow

11. Setting parameters

No	Parameter	Explanation	Setting range Selectable item
0	DISPMODE	Display mode	A TopDis B BotDis C Percen D Echo
1	B ZERO	Distance from the ultrasonic transmitting surface to the tank bottom	HD353-A: 0.5 - 10 HD353-B: 0.25 - 5 Unit [m]
2	SPAN	Level from 0% to 100%	HD353-A: 0 - 10 HD353-B: 0 - 5 Unit [m]
3	RESPONSE	Response speed to the measured distance change	0.01 - 1,000 Unit [m/min]
4	SW H ON	Level from the tank bottom to turn on the upper limit alarm SW	HD353-A: 0 - 10 HD353-B: 0 - 5 Unit [m]
5	SW H OFF	Level from the tank bottom to turn off the upper limit alarm SW	
6	SW L ON	Level from the tank bottom to turn on lower limit alarm SW	
7	SW L OFF	Level from the tank bottom to turn off the lower limit alarm SW	
8	4mA OFST	Offset of 4mA output	0 - SPAN setting value Unit [m]
9	I4-20	Basis of 4-20mA output	Norm, Reve
10	Temp	Sensor temperature	
11	Echo Lv	Signal level	
12	NoiseLv	Noise level	
13	BRIGHT	Back light setting	OFF, Auto, ON
14	4-20SET	Connection test of 4-20mA output	normal, i4mA, i8mA, i12mA, i16mA, i20mA
15	Dist Adj	Distance correction	-50 - +50 Unit [mm]
16	Err Cond	Current output for measurement error	Hold, i4fix, i20fix

No	Parameter	Explanation	Setting range Selectable item
17	RS485 No.	RS485 MODBUS NO.	1-99
18	485BAUD	Baud rate for RS485 communication	2400, 4800, 9600, 19200, 38400, 57600 or 115200
19	PARITY	Parity check for RS485 communication	NONE, ODD, or EVEN
20	FLOWmod	Weir flowmeter function	As “Weir flowmeter setting”
21	FBZERO	Distance from the ultrasonic transmitting surface to the channel floor	0.3 - 5 Unit [m]
22	FSPAN	Max. overflow level	0.3 - 5 Unit [m]
23	B WIDTH	Channel width	0.4 - 32 Unit [m]
24	D SPAN	Height from the channel floor to the lower edge of weir	0.001 - 3.5 Unit [m]
25	sbWIDTH	Cutout width of contracted rectangular weir	0.15 - B WIDTH Unit [m]
26	V ANGLE	Arbitrary angle of V-notch	45 - 100 Unit [deg]
27	F CUT OF	Low cut OFF of flow	0 - 10 Unit [%]
28	Total Flow RST	Total flow reset	
29	SYSTEM RESET	System reset	

12. Connection to the computer (RS485)

Specifications of RS485

Communication protocol	MODBUS(RTU)
Electrical characteristics	Compliant with EIA RS485
Communication method	2 wire and half-duplex (Poling/selecting)
Synchro system	asynchronous method
Baud rate	Selectable from 2400, 4800, 9600, 19200, 38400, 57600 or 115200
Start bit	1 bit
Data length	8 bit
Parity	Selectable from None, ODD or EVEN
Stop bit	1 bit
Delimiter	Silent interval for 3.5 characters
Character code	Binary code
Transmission control procedure	No control sequence
Number of unit which can be concatenated	32 units including host unit
Unit address	Selectable from 1 – 99
Max. length of communication cable	1200m in total
Error check	CRC
Response speed	Within the time for 10 characters

Default of unit address

Default of unit address is 0.

Select the unit address from 1 - 99 when you use RS485 communication.

13. RS485 MODBUS communication format

1: In case of no incoming command for 3.5-character-time, HD1200 recognizes the completion of incoming command and the command processing is done.
2: Unit address can be selected from 1 to 99.

MODBUS RTU command message frame

START	ADDRESS	FUNCTION	DATA	CRC CHECK	END
Time for 3.5 characters	8 bits	8 bits	N * 8 bits	16 bits	Time for 3.5characters

Correspondent command

03	Read Holding Register	Readout of holding register
04	Read Input Register	Readout of input register
06	Preset Single Register	Write of holding register
08	Diagnostics	Loop-back test

Command = 04 Readout of input register

Query

Slave Address	Function	Starting Address Hi Lo	No. of Points Hi Lo	CRC

Response

Slave Address	Function	Byte Count	Data n Hi Lo	Data n+1 Hi Lo	CRC

Register address	Content	Example	Readout value
0	Distance	2000mm	2000
2	Level from the tank bottom	3000mm	3000
4	%	100%	10000
6	Noise level	10	10
8	Signal level	80	80
10	Sensor temperature	25.0 deg C	250
12	Temperature inside of HD353	25.0 deg C	250
13	Max. instantaneous flow	100.0 m^3/h	100
14	Instantaneous flow	20.0 m^3/h	20
15	Total flow	1000.0 m^3	1000
16	Max. overflow level	255mm	255
17	Rate of instantaneous flow	100%	10000
18	Total flow (High 1 6bits)	1000.0 m^3/h	1000
19	Total flow (Low 16 bits)		

Command = 03 Readout of holding register, Command = 06 Write of holding register

Query(03,06)

Slave Address	Function	Starting Address Hi Lo	No. of Points Hi Lo	CRC

Response(03)

Slave Address	Function	Byte Count	Data n Hi Lo	Data n+1 Hi Lo	CRC

Response(06)

Slave Address	Function	Register Address Hi Lo	Preset Data Hi Lo	CRC

Register address	Content	Readout value (Example)	Range of write value
0	RESPONSE	5	0 - 5
1	THRESHOLD	0	0 - 8
2	STC	1	0 - 10
3	AVERAGE	6	1 - 30
4	BOTTOM ZERO	830	30 - 2030
5	SPAN	800	0 - 2000
6	SW H ON	700	0 - 2000
7	SW H OFF	699	0 - 2000
12	SW L ON	100	0 - 2000
13	SW L OFF	101	0 - 2000
14	4-20mA OFFSET	0	0 - 2000
28	B?WIDTH	800	400 - 7000
29	bb_WIDTH	400	150 - 5000
30	D_SPAN	100	1 - 3500
31	V_ANGLE	900	450 - 1000
32	FLOW MODE	6	0 - 22
36	LOW CUT OFF	0	0 - 100
37	FLOW ZERO	2000	300 - 5000
38	FLOW SPAN	200	50 - 3000
39	TOTAL FLOW RESET	0	Write 1 to reset total value.

14. Specifications

Model	HD353-A	HD353-B
Ultrasonic frequency	50kHz	100kHz
External dimensions	Dia. 93 x 110mm	
Rated power source	12 - 24VDC	
Permissible power source range	+/- 10% of Rated power source	
Max. power consumption	3W or lower	
Output current	4-20mA +/- 0.02mA DC	
Output	Upper and lower limit alarm output switches (NPN open collector)	
Interface	RS485 (MODBUS RTU)	
Additional function	Weir flowmeter function	
Measurement range	0.3 - 10m	0.15 - 4m
Measurement object	Liquid / Powder	
Beam angle	14 deg (-6dB) / 10 deg (-3dB)	
Memory backup	FERAM	
Display	Graphic LCD (128x64dot)	
Setting	Key operation	
Resolution	1mm	
Temperature compensation sensor	-20 - +70 deg C, Accuracy: Within +/- 2 deg C	
Measurement accuracy	+/- 0.25% of F.S.	
Installation screw	G2 (PF2)	
Material of main unit	PP (Polypropylene)	
Housing structure	IP65 equivalent (Without lid: IP20 equivalent)	
Weight	350g	
Standard	EN61326-1: 2013	
Ambient temperature	-20 - +70 deg C (No freeze and condensation)	
Ambient humidity	Max. 80% (at 31 deg C)	
Storage temperature	-30 - +80 deg C (No freeze and condensation)	
Distribution cable	Length of distribution cable: 10m Detachable waterproof connector 8 wires x 0.3mm^2	

15. After-the-sale-service

◆When after-the-sale-service is required, please contact the seller of product or the manufacturer with the detailed information about the malfunction.

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MADE IN JAPAN
January, 2018