

KWS-200 Online NH4-N Ammonia Nitrogen Sensor

Introduction

Kacise introduces an online ammonia nitrogen sensor that requires no reagents, is green and non-polluting, and can be monitored online in real time. Integrated ammonium, potassium (optional), pH and reference electrodes automatically compensate for potassium (optional), pH and temperature in water. It can be directly put into installation, which is more economical, environmentally friendly and convenient than traditional ammonia nitrogen analyzer. The sensor adopts RS485 output and supports Modbus for easy integration.



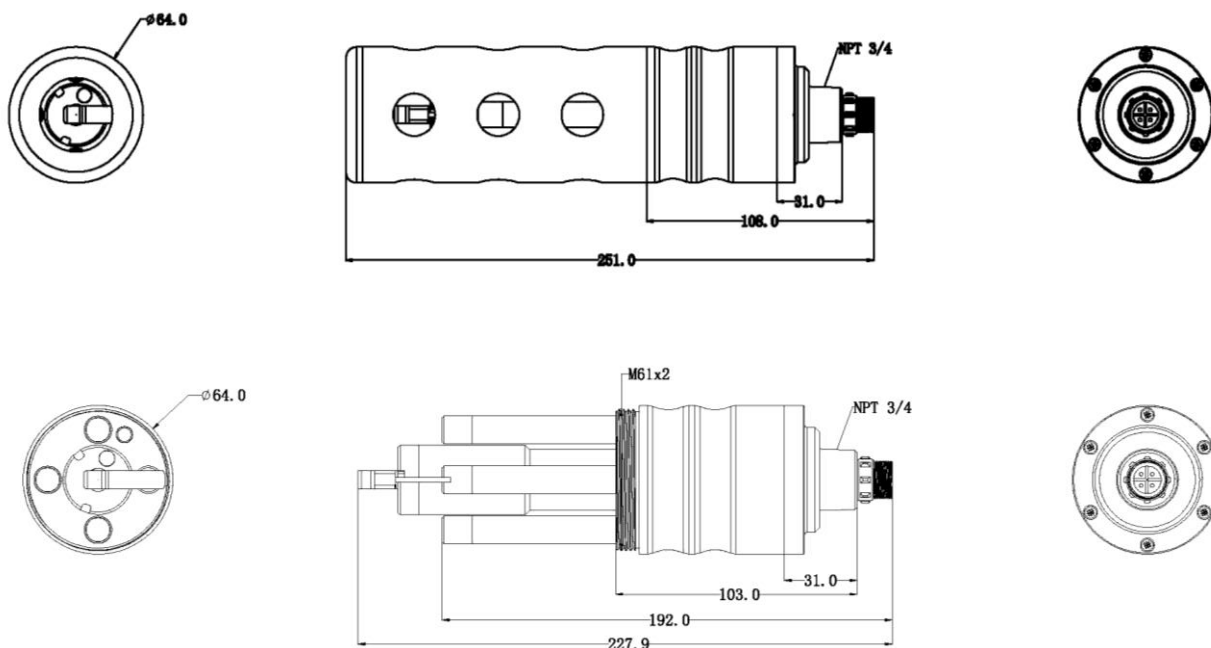
Feature

- Digital sensor, RS-485 output, support MODBUS
- No reagents, no pollution, more economical and environmentally friendly
- Automatically compensates for pH and temperature in water

Technical Specifications

Model	KWS-200
Measuring Range	0-1000mg/L NH4-N
Accuracy	5%
NH4-N Resolution	0.1 mg/L
Ph Range	4-10
Ph Accurate	±0.1
Ph Resolution	0.01
Protection Grade	IP68
Deepest Depth	underwater 10 m
Temperature Range	0 ~ 50°C
Output	RS-485, MODBUS protocol
Power Supply	DC 8~26V, current <50mA
Size	Φ26*177.5 mm
Cable Length	5 m, customizable
Material	POM

Dimension



Maintenance Methods and FAQ

Maintenance Schedule and Method

1. Maintenance Schedule

It is recommended to periodically calibrate or clean the sensor surface according to the actual application scenario.

Maintenance Task	Recommended Maintenance Frequency
Calibrate the sensor (if required by the competent authority)	According to the maintenance schedule required by the competent authority

2. Maintenance Methods

Sensor maintenance

- 1) Sensor outer surface: Clean the outer surface of the sensor with tap water. If there is still debris, wipe it with a soft, damp cloth.
- 2) Check the cable of the sensor: the cable should not be tightened during normal operation, otherwise the cable inside the cable will be broken, causing the sensor to not work properly.
- 3) Sensor storage: When the sensor is not in use, the black plastic cap should be fastened to check whether the sponge inside is wet. If it is not wet enough, please add 3mol/L potassium chloride solution and let the electrode be placed with potassium chloride. Preserved in the solution.

The Matters Needing Attention

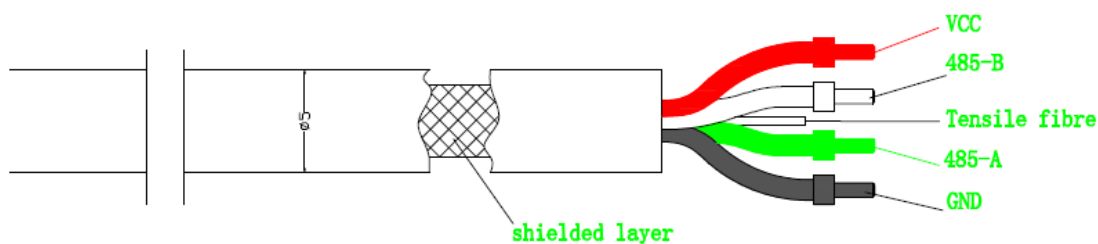
The probe contains sensitive optical and electronic components. Make sure the probe is not subject to severe mechanical shock. Damage to the sensor due to impact or man-made will not be covered by the warranty. The sensor inlet water is not covered by the replacement of the pH electrode.

FAQ

Error	Possible Reason	Solution
The operation interface cannot be connected, or does not display measurement results.	Controller and cable connection error	Reconnect controller and cable
	Cable failure	Please contact us.
The measured value is too high, too low or the value is continuously unstable.	Measurement has shifted	Recalibrate
	Water in the structure	Replace sensor sponge
	The pH electrolyte is exhausted	Replace the pH electrochemical part

Wiring

- ammonia nitrogen probe size
64x251 mm (Φ xL)
- power information
The power supply must be DC 12V +/-5%, current <50mA
- cable information
4 wire AWG-24 or AWG-26 shielding wire. OD=5mm



- Red - power supply (VCC)
 White - 485 data _B (485_B)
 Green --- 485 data _A (485_A)
 Black --- ground line (GND)

Modbus Protocol

1. Data Format

When the device uses RTU (Remote Terminal Unit) mode for MODBUS serial communication, the 8-bit byte of each message contains two 4-bit hexadecimal characters. The main advantage of this mode is that it has a greater character density and better data throughput than the ASCII mode of the same baud rate. Each message must be transmitted in a continuous string.

Coding system: 8-bit binary

Each 8-bit byte in the message contains two 4-bit hexadecimal characters (0-9, A-F)

Bits in each byte: 1 start bit

8 data bits, the least significant bit is sent first

No parity

1 stop bit

Baud rate: 9600bps

Serial transmission of characters:

Every character or byte is sent under this sequence (left to right):

Least Significant Bit (LSB).....Most Significant Bit(MSB)

Start	1	2	3	4	5	6	7	8	Stop
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2. Command Description

2.1 Set Slave Device ID

Purpose: Set MODBUS slave address to a sensor probe. Range of address is 1~247.

Sensor probe slave address can be set via MODBUS register 0x3000:

Start address	Number of registers	Register 1	MODBUS Function code
0x3000	0x01	New Slave address	0x10

Figure 1: Register definition of Set Slave ID Command

Below is an example of request and response frames for setting slave device ID command. Old slave address is 0x01, new address is 0x14.

Definition	Address	Function code	Start address		Number of registers		Number of bytes	Register value		CRC	
Byte	0	1	2	3	4	5	6	7	8	9	10
Value	0x01	0x10	0x30	0x00	0x00	0x01	0x02	0x14	0x00	0x99	0x53

Figure 2: Request frame to Set Slave ID

*Note: byte 8 is reserved

Definition	Addresses	Function code	Start address		Number of registers			CRC
Byte	0	1	2	3	4	5	6	7
Value	0x01	0x10	0x30	0x00	0x00	0x01	0x0E	0xC9

Figure 3: Response frame for Set Slave ID Command

2.2 Get pH and potential Value (ORP)

Purpose: Get current pH and potential value (ORP), the unit is mV.

The pH and potential value can be read from 4 continuous MODBUS registers starting from address 0x2600.

Start address	Number of registers	Register 1-2	Register 3-4	MODBUS Function Code
0x2600	0x04	potential value	pH value	0x03

Figure 4: Request frame to Get pH and potential value(ORP) Command

Below is an example of request and response frames for getting pH and potential value command, assuming slave device address is 0x01, returned pH value is 7 and potential value (ORP) is -6.56mV.

Definition	Device address	Function code	Start address		Number of registers		CRC	
Byte	0	1	2	3	4	5	6	7
Value	0x01	0x03	0x26	0x00	0x00	0x04	0x4F	0x41

Figure 5: Request frame to Get pH and potential value (ORP) Command

Definition	Device address	Function code	Number of bytes	Register value		CRC	
Byte	0	1	2	3~6	7~10	11	12
Value	0x01	0x03	0x08	-6.56	7	0x5C	0xE6

Figure 6: Response frame for Get pH and potential value (ORP) Command

potential value (3-6)				pH value (7-10)			
0x85	0xEB	0xD1	0xC0	0x00	0x00	0xE0	0x40

Figure 7: Registers definition for pH and potential value (ORP).

2.3 Get NH₄⁺ and K⁺ in mV

Purpose: Get current NH₄⁺ and K⁺, the unit is mV.

The NH₄⁺ and K⁺ can be read from 4 continuous MODBUS registers starting from address 0x3700.(For now being, K⁺ value is ignored)

Start address	Number of registers	Register 1-2	Register 3-4	MODBUS Function Code
0x3700	0x04	NH ₄ ⁺	K ⁺	0x03

Figure 8: Request frame to Get NH₄⁺ and K⁺ Command

Below is an example of request and response frames for getting NH₄⁺ and K⁺ command, assuming slave device address is 0x01, returned NH₄⁺ value is -20.1 and K⁺ is -32.2mV.

Definition	Device address	Function code	Start address		Number of registers		CRC	
Byte	0	1	2	3	4	5	6	7
Value	0x01	0x03	0x37	0x00	0x00	0x04	0x4A	0x7D

Figure 9: Request frame to Get NH₄⁺ and K⁺ Command

Definition	Device address	Function code	Number of bytes	Register value		CRC	
Byte	0	1	2	3~6	7~10	11	12
Value	0x01	0x03	0x08	-20.1	-32.2	0x5B	0x61

Figure 10: Response frame for Get NH₄⁺ and K⁺ Command

NH4+ value (3-6)				K+value (7-10)			
0xCD	0xCC	0xA0	0xC1	0xCD	0xCC	0x00	0xC2

Figure 11: Registers definition for NH4+ and K+.

2.4 Get NH3_N NH4+ and K+ in mg/L

Purpose: Get NH3_N NH4+ and K+ value after temperature compensation, the unit is mg/L.

The NH3_N ,NH4+ and K+ can be read from 6 continuous MODBUS registers starting from address 0x2800.

Start address	Number of registers	Register 1-2	Register 3-4	Register 5-6	MODBUS Function Code
0x2800	0x06	NH3_N	K+	NH4+	0x03

Figure 12: Request frame to Get NH3_N ,NH4+ and K+ Command

Below is an example of request and response frames for getting NH3_N ,NH4+ and K+ command, assuming slave device address is 0x01, returned NH3_N value is 7.6,NH4+ value is 5.2 and K+ is 1.0 mg/L.

Definition	Device address	Function code	Start address		Number of registers		CRC	
Byte	0	1	2	3	4	5	6	7
Value	0x01	0x03	0x28	0x00	0x00	0x06	0xCC	0x68

Figure 13: Request frame to Get NH3_N ,NH4+ and K+ Command

Definition	Device address	Function code	Number of bytes	Register value			CRC	
Byte	0	1	2	3~6	7~10	11~14	15	16
Value	0x01	0x03	0x0C	7.6	1.0	5.2	0x6C	0x7D

Figure 14: Response frame for Get NH3_N ,NH4+ and K+ Command

NH4_N value (3~6)				K+ value (7~10)				NH4+ value(11~14)			
0x33	0x33	0xF3	0x40	0x00	0x00	0x80	0x3F	0x66	0x66	0xA6	0x40

Figure 15: Registers definition for NH3_N ,NH4+ and K+.

2.5 Get temperature value

Purpose: Get current temperature value , the unit is C.

Temperature can be read from 2 continuous MODBUS registers starting from address 0x2400.

Start address	Number of registers	Register 1-2	MODBUS function code
0x2400	0x02	temperature value	0x03

Figure 16: Request frame to Get temperature Command

Below is an example of request and response frames for getting temperature command, assuming slave device address is 0x01, returned temperature value is 15.8.

Definition	Device address	Function code	Start address		Number of registers		CRC	
Byte	0	1	2	3	4	5	6	7
Value	0x01	0x03	0x24	0x00	0x00	0x02	0xCE	0xFB

Figure 17: Request frame to Get temperature Command

Definition	Device address	Function code	Number of bytes	Register value	CRC	
Byte	0	1	2	3-6	11	12
Value	0x01	0x03	0x04	15.8	0xE4	0x50

Figure 18: Response frame for Get temperature Command

Temperature value (3~6)			
0xCD	0xCC	0x7C	0x41

Figure 19: Registers definition for temperature.

2.6 Stop Measurement

Purpose: After stable test results is obtained, stop measurement activities.

MODBUS register 0x2E00 is used for this command.

Start address	Number of registers	MODBUS function code
0x2E00	0x01	0x03

Figure 20: Register definition of Stop Measurement Command

Below is an example of request and response frames for a device with slave address 0x01 to stop measurement activities.

Definition	Device address	Function code	Start address		Number of registers		CRC	
Byte	0	1	2	3	4	5	6	7
Value	0x01	0x03	0x2E	0x00	0x00	0x01	0x8D	0x22

Figure 21: Request frame to Stop Measurement Command

Definition	Device address	Function code	Number of bytes	Register value	CRC	
Byte	0	1	2	3~4	5	6
Value	0x01	0x03	0x00	meaningless		

Figure 22: Response frame for Stop Measurement Command

2.7 Set pH Electrode Coefficients

Purpose: Recover pH factory calibration coefficients K1~K6. **K1=6.86, K2=-6.72, K3=0.04, K4=6.86, K5=-6.56, K6=-1.04** by default.

Customer coefficients can be set at 12 continuous MODBUS registers starting from address 0x2900.

Start address	Number of registers	Register 1-12	MODBUS function code
0x2900	0x0C	K1~K6	0x10

Figure 23: Register definition of Set pH Customer Calibration Coefficients Command

Below is an example of request and response frames for setting customer calibration coefficients, assuming slave address is 0x01.

Definition	Device address	Function code	Start address		Number of registers		Number of bytes	Register value	CRC	
Byte	0	1	2	3	4	5	6	7-30	15	16
Value	0x01	0x10	0x29	0x00	0x00	0x0C	0x18	K1~K6	0x94	0x59

Figure 24: Request frame to Set pH Customer Calibration Coefficients Command

Note: Coefficients K1~K6, floating point numbers in little-endian storage mode

K1(7~10)				K2(11~14)				K3(15~18)				K4(19~22)			
0x1f	0x8	0xd	0x4	0x3	0x0	0xd	0xc	0x0	0xd	0x2	0x3	0x1	0x8	0xd	0x4
	5	b	0	d	a	7	0	a	7	3	d	f	5	b	0
K5(23~26)				K6(27~30)											
0x8	0xe	0xd	0xc	0xb	0x1	0x8	0xb								
5	b	1	0	8	e	5	f								

Figure 25: Registers for coefficients K1~K6

Definition	Device address	Function code	Start address		Number of registers		CRC	
Byte	0	1	2	3	4	5	6	7
Value	0x01	0x10	0x2	0x00	0x0	0x0	0xC8	0x50
			9		0	C		

Figure 26: Response frame for Set pH Customer Calibration Coefficients Command

2.8 Get pH Electrode Coefficients

Purpose: Get pH Customer Calibration Coefficients .

The Customer Calibration Coefficients can be read from 12 continuous MODBUS registers starting from address 0x2900.

Start address	Number of registers	Register 1-12	MODBUS function code
0x2900	0x0C	k1~k6	0x03

Figure 27: Request frame to Get Customer Calibration Coefficients Command

Below is an example of request and response frames for getting Customer Calibration Coefficients command, assuming slave device address is 0x01, returned Customer Calibration Coefficients are K1=6.86,K2=-6.72,K3=0.04, K4=6.86,K5=-6.56,K6=-1.04 .

Definition	Device address	Function code	Start address		Number of registers		CRC	
Byte	0	1	2	3	4	5	6	7
Value	0x01	0x03	0x29	0x00	0x00	0x0C	0x4D	0x93

Figure 28: Request frame to Get Customer Calibration Coefficients Command

Definition	Device address	Function code	Number of bytes	Register value		CRC	
Byte	0	1	2	3-14	15-26	27	28
Value	0x01	0x03	0x0C	k1~k3	k4~k6	0xAB	0xF5

Figure 29: Response frame for Get Customer Calibration Coefficients Command

K1(3~6)				K2(7~10)				K3(11~14)				K4(15~18)			
0x1f	0x8	0xd	0x4	0x3	0x0	0xd	0xc	0x0	0xd	0x2	0x3	0x1	0x8	0xd	0x4
	5	b	0	d	a	7	0	a	7	3	d	f	5	b	0
K5(19~22)				K6(23~26)											
0x8	0xe	0xd	0xc	0xb	0x1	0x8	0xbf								
5	b	1	0	8	e	5									

Figure 30: Registers definition for Customer Calibration Coefficients.

2.9 Get pH User Calibration Coefficients

Purpose: Get pH calibration coefficients K and B.

User calibration coefficients (K and B) can be read from 4 continuous MODBUS registers starting from address 0x1100.

Start address	Number of registers	Register 1-2	Register 3-4	MODBUS function code
0x1100	0x04	K	B	0x03

Figure 31: Register definition of Get pH User Calibration Coefficients Command

Below is an example of request and response frames for getting customer calibration coefficients from a device with slave address 0x01, assuming returned values are: K=1.0; B=0.0.

Definition	Device address	Function code	Start address		Number of registers		CRC	
Byte	0	1	2	3	4	5	6	7
Value	0x01	0x03	0x11	0x00	0x00	0x04	0x41	0x35

Figure 32: Request frame to Get pH User Calibration Coefficient Command

Definition	Device address	Function code	Number of bytes	Register value		CRC	
Byte	0	1	2	3-6	7-10	11	12
Value	0x01	0x03	0x08	1.0	0.0	0x9E	0x12

Figure 33: Response frame for Get pH User Calibration Coefficient Command

Note: K and B are floating point numbers in little-endian storage mode

K(3-6)				B(7-10)			
0x00	0x00	0x80	0x3F	0x00	0x00	0x00	0x00

Figure 34: Registers for two coefficients K and B.

2.10 Set pH User Calibration Coefficients

Purpose: Set pH calibration coefficients K and B.

Customer coefficients (K and B) can be set at 4 continuous MODBUS registers starting from address 0x1100.

Start address	Number of registers	Register 1-2	Register 3-4	MODBUS function code
0x1100	0x04	K	B	0x10

Figure 35: Register definition of Set pH User Calibration Command

Below is an example of request and response frames for setting customer calibration coefficients, assuming slave address is 0x01, coefficients are K=1.0 and B=0.0.

Definition	Device address	Function code	Start address		Number of registers		Number of bytes	Register value		CRC	
Byte	0	1	2	3	4	5	6	7-10	11-14	15	16
Value	0x01	0x10	0x1	0x0	0x0	0x04	0x08	1.0	0.0	0x8	0xA

			1	0	0					1	E
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Figure 36: Request frame to Set pH User Calibration Coefficient Command

Note: Coefficients K and B, floating point numbers in little-endian storage mode

K(7-10)				B(11-14)			
0x00	0x00	0x80	0x3F	0x00	0x00	0x00	0x00

Figure 37: Registers for two coefficients K and B

Definition	Device address	Function code	Start address		Number of registers		CRC	
Byte	0	1	2	3	4	5	6	7
Value	0x01	0x10	0x11	0x00	0x00	0x04	0xc4	0xf6

Figure 38: Response frame for Set Customer Calibration Coefficient Command

2.11 Get NH4+ User Calibration Coefficients

Purpose: Get NH4+ calibration coefficients K and B.

User calibration coefficients (K and B) can be read from 4 continuous MODBUS registers starting from address 0x3600.

Start address	Number of registers	Register 1-2	Register 3-4	MODBUS function code
0x3600	0x04	K	B	0x03

Figure 39: Register definition of Get NH4+ User Calibration Coefficients Command

Below is an example of request and response frames for getting customer calibration coefficients from a device with slave address 0x01, assuming returned values are: K=1.0; B=0.0.

Definition	Device address	Function code	Start address		Number of registers		CRC	
Byte	0	1	2	3	4	5	6	7
Value	0x01	0x03	0x36	0x00	0x00	0x04	0x4B	0x81

Figure 40: Request frame to Get NH4+ User Calibration Coefficient Command

Definition	Device address	Function code	Number of bytes	Register value		CRC	
Byte	0	1	2	3-6	7-10	11	12
Value	0x01	0x03	0x08	1.0	0.0	0x9E	0x12

Figure 41: Response frame for Get NH4+ User Calibration Coefficient Command

Note: K and B are floating point numbers in little-endian storage mode

K(3-6)				B(7-10)			
0x00	0x00	0x80	0x3F	0x00	0x00	0x00	0x00

Figure 42: Registers for two coefficients K and B.

2.12 Set NH4+ User Calibration Coefficients

Purpose: Set NH4+ calibration coefficients K and B.

Customer coefficients (K and B) can be set at 4 continuous MODBUS registers starting from address

0x3600.

Start address	Number of registers	Register 1-2	Register 3-4	MODBUS function code
0x3600	0x04	K	B	0x10

Figure 43: Register definition of Set NH4+ User Calibration Command

Below is an example of request and response frames for setting NH4+ customer calibration coefficients, assuming slave address is 0x01, coefficients are K=1.0 and B=0.0.

Definition	Device addresses	Function code	Start address		Number of registers		Number of bytes	Register value		CRC	
Byte	0	1	2	3	4	5	6	7-10	11-14	15	16
Value	0x01	0x10	0x36	0x00	0x00	0x04	0x08	1.0	0.0	0x81	0xAE

Figure 44: Request frame to Set NH4+ User Calibration Coefficient Command

Note: Coefficients K and B, floating point numbers in little-endian storage mode

K(7-10)				B(11-14)			
0x00	0x00	0x80	0x3F	0x00	0x00	0x00	0x00

Figure 45: Registers for two coefficients K and B

Definition	Device address	Function code	Start address		Number of registers		CRC	
Byte	0	1	2	3	4	5	6	7
Value	0x01	0x10	0x36	0x00	0x00	0x04	0xC4	0xF6

Figure 46: Response frame for Set Customer Calibration Coefficient Command

2.13 Get NH3_N User Calibration Coefficients

Purpose: Get NH3_N calibration coefficients K and B.

User calibration coefficients (K and B) can be read from 4 continuous MODBUS registers starting from address 0x3400.

Start address	Number of registers	Register 1-2	Register 3-4	MODBUS function code
0x3400	0x04	K	B	0x03

Figure 47: Register definition of Get NH3_N User Calibration Coefficients Command

Below is an example of request and response frames for getting customer calibration coefficients from a device with slave address 0x01, assuming returned values are: K=1.0; B=0.0.

Definition	Device address	Function code	Start address		Number of registers		CRC	
Byte	0	1	2	3	4	5	6	7
Value	0x01	0x03	0x34	0x00	0x00	0x04	0x4B	0x81

Figure 48: Request frame to Get NH3_N User Calibration Coefficient Command

Definition	Device	Function	Number	Register	CRC
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	addresses	n code	of bytes	value			
Byte	0	1	2	3-6	7-10	11	12
Value	0x01	0x03	0x08	1.0	0.0	0x9E	0x12

Figure 49: Response frame for Get NH3_N User Calibration Coefficient Command

Note: K and B are floating point numbers in little-endian storage mode

K(3-6)				B(7-10)			
0x00	0x00	0x80	0x3F	0x00	0x00	0x00	0x00

Figure 50: Registers for two coefficients K and B.

2.14 Set NH3_N User Calibration Coefficients

Purpose: Set NH3_N calibration coefficients K and B.

Customer coefficients (K and B) can be set at 4 continuous MODBUS registers starting from address 0x3400.

Start address	Number of registers	Register 1-2	Register 3-4	MODBUS function code
0x3400	0x04	K	B	0x10

Figure 51: Register definition of Set NH3_N User Calibration Command

Below is an example of request and response frames for setting NH3_N customer calibration coefficients, assuming slave address is 0x01, coefficients are K=1.0 and B=0.0.

Definition	Device address	Function code	Start address		Number of registers		Number of bytes	Register value		CRC	
Byte	0	1	2	3	4	5	6	7-10	11-14	15	16
Value	0x01	0x10	0x34	0x00	0x00	0x04	0x08	1.0	0.0	0x81	0xAE

Figure 52: Request frame to Set NH3_N User Calibration Coefficient Command

Note: Coefficients K and B, floating point numbers in little-endian storage mode

K(7-10)				B(11-14)			
0x00	0x00	0x80	0x3F	0x00	0x00	0x00	0x00

Figure 53: Registers for two coefficients K and B

Definition	Device address	Function code	Start address		Number of registers		CRC	
Byte	0	1	2	3	4	5	6	7
Value	0x01	0x10	0x34	0x00	0x00	0x04	0xc4	0xf6

Figure 54: Response frame for Set Customer Calibration Coefficient Command

2.15 Get Slave Device ID

Purpose: Get current MODBUS slave address to a sensor probe. Use 0xFF as fixed Device address.

Sensor probe slave address can be read from MODBUS registers 0x3000.

Start address	Number of registers	Register 1	MODBUS Function code
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0x3000	0x01	Current Slave address	0x10
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Figure 55: Get slave ID command

Below is an example of request and response frames for getting slave device id, assuming returned address is 0x03.

Definition	Device address	Function code	Start address		Number of registers		CRC	
Byte	0	1	2	3	4	5	6	7
Value	0xFF	0x03	0x30	0x00	0x00	0x01	0x9E	0xD4

Figure 56: Request frame of get slave device ID comment

Definition	Device address	Function code	Number of bytes	Register value		CRC	
Byte	0	1	2	3	4	5	6
Value	0xFF	0x03	0x02	0x03	0x00(reserve)	0x91	0x60

Figure 57: Response frame of get slave device ID comment

3. Procedure to get NH3_N value

It's highly recommended that customers get an average NH3_N results after 10 consecutive measurements, then perform display or other process.