LWTX-4501 On-Line Abrasive Sensor Communication Protocol (Conventional)

LWTX-4501 online abrasive grain sensor (hereinafter referred to as the sensor) provides a standard RS485 communication interface, using MODBUS RTU communication protocol to communicate with the host. In a complete online monitoring system, the master control device acts as the host and the sensor acts as the slave. Each communication handshake always consists of the host sending an access request and the slave responding.

Use of specification standards: "GB/T19582-2008 Modbus protocol-based industrial automation network specification".

1.Data Frame Formatting

The format of each byte (frame) sent by the sensor completely follows the MODBUS communication protocol of GB/T19582-2008 standard, and the function code supports reading, writing and batch writing. The CRC checksum: (CRC-16/MODBUS x16+x15+x2+1) starts from "address code" and ends with "data". The data frame contains start bit, information bit and stop bit, total 10 bits, as shown in Figure 1.

Frame format (10-bit):

starting position	D0	D1	D2	D3	D4	D5	D6	D7	stop bit

Figure 1 Data frame format

The specific definitions are as follows:

Bit 1: Start bit ("0" is valid);

Bits 2 to 9: Information bits;

Bit 10: stop bit ("1" valid);

Size: The data frame adopts the order of sending and reading from low to high bit, for multi-byte data, the low byte is transmitted first, followed by the high byte. For 16-bit or 32-bit binary data, it is divided into two or four data frames and transmitted serially in the order from low byte to high byte.

2.Message Format

The format of each message received and sent by the sensor is as follows:

--address

--Function code

--Data number

--Data 1

--...

--Data n

--CRC16 checksum

3. Serial Port Setting

parametric	causality
baud	9600
data bit	8
parity check	无
stop bit	1
sensor address	1

Table 1 Sensor serial communication default settings

4. MODBUS Function Code

function code		define
03	0x03	Read Holding Register
04	0x04	Read Input Register
06	0x06	Write Single Register
16	0x10	Write multiple register

Table 2 Sensor modbus function codes

4.1 Holding register (0x03 function code)

register address	causality	Read/Write	16-bit word length	unit
0x100A	direction	Read/Write	1	
0x100B	cumulative time	Read/Write	1	s
0x100C	sensor serial number	Read	10	
0x9000	sensor address	Read/Write	1	

Table 3 modbus holding registers

Note: 1) Direction - refers to the direction of flow of the liquid through the sensor, the default is 0 (from the direction of the M12 electrical interface into the oil), optional 1 (at this time the flow direction is reversed);

4.2 Input register (0x04 function code)

Table 4 modbus input register

register address	causality	Read/Write	16-bit word length	unit	data type
0x000C	Quantity of ferromagnetic particles 1 grade (40-99um)	Read	2	corn	unsigned int
0x000E	Quantity of ferromagnetic particles 2 grade (100-199um)	Read	2	corn	unsigned int
0x0010	Quantity of ferromagnetic particles 3 grade (200-299um)	Read	2	corn	unsigned int
0x0012	Quantity of ferromagnetic particles 4 grade (300-399um)	Read	2	corn	unsigned int
0x0014	Quantity of ferromagnetic particles 5 grade (>400um)	Read	2	corn	unsigned int
0x0016	Total number of ferromagnetic particles	Read	2	corn	unsigned int
0x0018	Quantity of non-ferromagnetic particles 1 grade (150-199um)	Read	2	corn	unsigned int
0x001A	Quantity of non-ferromagnetic particles 2 grade (200-299um)	Read	2	corn	unsigned int
0x001C	Quantity of non-ferromagnetic particles 3 grade (300-399um)	Read	2	corn	unsigned int
0x001E	Quantity of non-ferromagnetic particles 4 grade (400-499um)	Read	2	corn	unsigned int
0x0020	Quantity of non-ferromagnetic particles 5 grade (>500um)	Read	2	corn	unsigned int
0x0022	Total number of non-ferromagnetic particles	Read	2	corn	unsigned int
0x0024	In-shell temperature[The displayed value must be divided by 1000]	Read	2	℃	signed int
0x0026	Estimated flow rate[Minecraft Business Province (Israel) 1000]	Read	2	m/s	unsigned int

5. Example of communication

5.1 Read current address

Sensor Default Address1;

Example of reading the current address of the sensor [sensor current address is 1]:

apply		response	
domain name	(hexadecimal)	domain name	(hexadecimal)
address code	FF	address code	FF
function code	03	function code	03
data home address Hi	90	data byte length	02
data home address Lo	00	current address Hi	00
data item Hi	00	current address Lo	01
data item Lo	01	CRC16 Lo	50
CRC16 Lo	BC	CRC16 Hi	50
CRC16 Hi	D4		

Table 5 Example of reading address

5.2 Change address

Example of changing the sensor address [changing the sensor from the current address 1 to address 5]:

apply		response	
domain name	(hexadecimal)	domain name	(hexadecimal)
current address	01	current address	01
function code	06	function code	06
data home address Hi	90	data home address Hi	90
data home address Lo	00	data home address Lo	00
new address Hi	00	new address Hi	00
new address Lo	05	new address Lo	05
CRC16 Lo	64	CRC16 Lo	64
CRC16 Hi	C9	CRC16 Hi	C9

Table 6 Example of setting address

5.3 Read the number of particles

Example of reading the number of particles in the sensor [2 ferromagnetic particles in 2nd gear, 3 ferromagnetic particles in 3rd gear, 4 ferromagnetic particles in 5th gear, 9 ferromagnetic particles, 4 non-ferromagnetic particles in 2nd gear, 2 non-ferromagnetic particles in 3rd gear, 3 non-ferromagnetic particles in 5th gear, 9 non-ferromagnetic particles, 32.687° C, 0.28m/s flow rate]:: The temperature of the housing is 32.687° C, the flow rate is 0.28m/sec. /s].

apply		response	
domain name	(hexadecimal)	domain name	(hexadecimal)
address	01	address	01
function code	04	function code	04
data home address Hi	00	Number of data bytes	38
data home address Lo	0C	Quantity of ferromagnetic particles 1 grade	00 00 00 00
data item Hi	00	Quantity of ferromagnetic particles 2 grade	02 00 00 00
data item Lo	1C	Quantity of ferromagnetic particles 3 grade	03 00 00 00
CRC16 Lo	31	Quantity of ferromagnetic particles 4 grade	00 00 00 00
CRC16 Hi	C0	Quantity of ferromagnetic particles 5 grade	04 00 00 00
		Total number of ferromagnetic particles	09 00 00 00
		Quantity of non-ferromagnetic particles 1 grade	00 00 00 00
		Quantity of non-ferromagnetic particles 2 grade	04 00 00 00
		Quantity of non-ferromagnetic particles 3 grade	02 00 00 00
		Quantity of non-ferromagnetic particles 4 grade	00 00 00 00
		Quantity of non-ferromagnetic particles 5 grade	03 00 00 00
		Total number of non-ferromagnetic particles	09 00 00 00
		Shell temperature	AF 7F 00 00
		flow rate	18 01 00 00
		CRC16 Lo	24
		CRC16 Hi	C7
Tx:01 04 00 0C 00 1C 31 C0 Rx:01 04 38 00 00 00 00 02 00 00 00 03 00 00 00 00 00 00 00 04 00 00 00 09 00 00 00 00 00 00 04 00 00 00 02 00 00 00 00 00 00 00 03 00 00 00 09 00 00 00 AF 7F 00 00 18 01 00 00 24 C7			

Table 7 Example of reading sensor particle count

5.4 Zeroing of statistical data

Data Zero command [sensor current address is 1]:

01 05 00 00 F0 00 89 CA

5.5 Accumulation function description

Accumulation time [default]: 300 seconds;

Accumulated time setting mode:

1)1 second [data refresh in real time];

2)300...3600 seconds [Particle data is automatically accumulated during the accumulation time, and particle data is automatically cleared when the accumulation time expires];