SGX SENSORTECH

An Amphenol Company



PSD4

Modbus-RTU Communication Protocol

UART Interface

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1. Product Overview and Configuration Parameters

1.1 Product Overview

The PSD4 Smart Gas Sensor utilizes UART (TTL) half-duplex interface communication with the following communication. For detailed configuration, please refer to **[1.2 UART (TTL) Configuration Parameters]**.

The Modbus-RTU communication part used by this product adopts holding registers, and the reading adopts 03H operation code. Writing uses 06H and 10H operation codes.

1.2 UART (TTL) Configuration Parameters

Baud Rate	Data Bits	Start Bit	Stop Bit	Parity Bit	Read/Write Data Interval
9600	8 Bits	1 Bit	1 Bit	None	>= 1 s

1.3 CRC-16/Modbus Calculation

The calculation formula is: x16+x15+x2+1
C Language calculation function:

```
uint16_t get_modbus_crc(uint8_t *buffer, uint16_t len)
{
uint16_t wcrc = 0XFFFF;
uint8_t temp;
uint16_t i = 0, j = 0;
for (i = 0; i < len; i++)
{
temp = *buffer & 0X00FF;
buffer++;
wcrc ^= temp;
for (j = 0; j < 8; j++)
{
if (wcrc & 0X0001)
{
wcrc >>= 1;
wcrc ^= 0XA001;
}
else
{
wcrc >>= 1
}
}
}
return wcrc;
}
```

2. Gas Concentration Unit Table

Value (Hex)	0x02	0x04	0x08
Concentration Unit	ppm	ppb	%vol.

3. Sensor Type Table

Sensor Type	HCHO	VOC	CO	Cl_2	H_2	H_2S	HCl	HCN	HF	NH_3	NO_2	O_2	O_3	SO_2
Value (Hex)	0X17	0X18	0X19	0X1A	0X1B	0X1C	0X1D	0X1E	0X1F	0X20	0X21	0X22	0X23	0X24

Sensor Type	HBr	Br_2	F_2	PH_3	AsH_3	SiH_4	GeH_4	B_2H_6	BF_3	WF_6	SiF_4	XeF_2	TiF_4	SMELL
Value (Hex)	0X25	0X26	0X27	0X28	0X29	0X2A	0X2B	0X2C	0X2D	0X2E	0X2F	0X30	0X31	0X32

Sensor Type	IAQ	AQI	NMHC	SO_X	NO_X	NO	C_4H_8	$C_3H_8O_2$	CH_4S	C_8H_8	C_4H_{10}	C_2H_6	C_6H_{14}	C_2H_4O
Value (Hex)	0X33	0X34	0X35	0X36	0X37	0X38	0X39	0X3A	0X3B	0X3C	0X3D	0X3E	0X3F	0X40

Sensor Type	C_3H_9N	C_3H_7N	C_2H_6O	CS_2	C_2H_6S	$C_2H_6S_2$	C_2H_4	CH_3OH	C_6H_6	C_8H_{10}	C_7H_8	CH_3COOH	ClO_2
Value (Hex)	0X41	0X42	0X43	0X44	0X45	0X46	0X47	0X48	0X49	0X4A	0X4B	0X4C	0X4D

Sensor Type	H_2O_2	N_2H_4	$C_2H_8N_2$	C_2HCl_3	$CHCl_3$	$C_2H_3Cl_3$	H_2Se	LEL	CO_2	PID_VOCS
Value (Hex)	0x4E	0x4F	0x50	0x51	0x52	0x53	0x54	0x55	0x56	0x57

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4. Change the Modbus Address

When you need to modify the product address number, you need to modify the address of each product one by one, and you cannot modify the addresses of multiple products at the same time.
Suggested modification range: 01(0x01)<=addr<=127(0x7F), the default value is 01 (0x01).

Instruction Header										Address	MODBUS-RTU CRC	
0x80	0x72	0x65	0x70	0x6F	0x6C	0x65	0x76	0x65	0x44	X	0x80	0x80

Instruction Header										Address	MODBUS-RTU CRC	
0xFF	0x72	0x65	0x70	0x6F	0x6C	0x65	0x76	0x65	0x44	X	0x80	0x80

5. Holding Register Table, and Read and Write Examples

Note: I. R (Read)/W (Write)
II. Float Type data conversion:
Please refer to http://www.binaryconvert.com/convert_float.html?
C language can be converted by referring to the following combinations

```
typedef union {
float data;
uint32_t uint32_data;
uint8_t uint8_data[4];
}FLOAT_DATA_U;
```

5.1 Product Overview

Register Address (Hex)	Data	Description	Data Type (Big-Endian)	R/W
0x2000	Byte[0]	Gas concentration value (byte[0]<<24)|(byte[1]<<16)|(byte[2]<<8)|byte[3] Then follow 32 Bit float Data type conversion	float	R
	Byte[1]			
0x2001	Byte[2]			
	Byte[3]			
0x2002	Byte[4]	Maximum range (Byte[4]<<8)|Byte[5]	uint16	R
	Byte[5]			
0x2003	Byte[6]	Byte[6] is fixed to 0 Byte[7] Sensor type, please refer to [3. Sensor Type Table]	uint16	R
	Byte[7]			
0x2004	Byte[8]	Byte[8] is fixed to 0 Byte[9] Unit type, please refer to [2. Gas Concentration Unit Table]	uint16	R
	Byte[9]			
0x2005	Byte[10]	Byte[10] is fixed to 0 Byte [11] Device status 0: The device is normal 1: It is recommended to replace the sensor 2: The sensor must be replaced	uint16	R
	Byte[11]			
0x2006	Byte[12]	Gas concentration value (without inhibition) (byte[12]<<24)|(byte[13]<<16)|(byte[14]<<8)|byte[15] Then follow 32 Bit float Data type conversion	float	R
	Byte[13]			
0x2007	Byte[14]			
	Byte[15]			

Read real-time data example:

Send: 0x01 0x03 0x20 0x00 0x00 0x08 0x4F 0xCC

Receive: 0x01 0x03 0x10 0x42 0x47 0x99 0x9A 0x03 0xE8 0x00 0x19 0x00 0x02 0x00 0x00 0x42 0x47 0x98 0xC6 0xA1 0x30

Send explanation:

0x01----------Modbus address
0x03----------Read holding register
0x20 0x00----------Starting register address - 0x2000
0x00 0x08----------Read register length - 8 registers
0x4F 0xCC----------Modbus-RTU CRC

Receive explanation:

0x01----------Modbus address
0x03----------Read holding register
0x10----------Read data length - 16 bytes
0x42 0x47 0x99 0x9A----------Concentration value - 0x4247999A - 49.9 (IEEE754 single precision 32-bit)
0x03 0xE8----------Range - 0x03E8 - 1000
0x00 0x19----------Sensor Type - CO
0x00 0x02----------Unit Type - ppm
0x00 0x00----------Device Status - normal
0x42 0x47 0x98 0xC6----------Concentration value - 0x4247999A - 49.9 (IEEE754 single precision 32-bit)
0xA1 0x30----------Modbus-RTU CRC

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5.2 Software Version Number Register

Register Address (Hex)	Data	Description	Data Type (Big-Endian)	R/W
0x2010	Byte[0]	Software version number "PSD4-V00023"	ASCII	R
	Byte[1]			
0x2011	Byte[2]			
	Byte[3]			
0x2012	Byte[4]			
	Byte[5]			
0x2013	Byte[6]			
	Byte[7]			
0x2014	Byte[8]			
	Byte[9]			

Example of software version number:
Send: 0x01 0x03 0x20 0x10 0x00 0x05 0x8F 0xCC
Receive: 0x01 0x03 0x0A 0x44 0x53 0x34 0x2D 0x56 0x30 0x30 0x30 0x32 0x33 0x66 0xE9
Send explanation:
0x01----------Modbus address
0x03----------Read holding register
0x20 0x10----------Starting register address - 0x2010
0x00 0x05----------Read register length - 5 registers
0x8F 0xCC----------Modbus-RTU CRC
Receive explanation:
0x01----------Modbus address
0x03----------Read holding register
0x0A----------Read length - 10 bytes
0x44 0x53 0x34 0x2D 0x56 0x30 0x30 0x30 0x32 0x33----------Concentration value - 0x4247999A - 49.9 (IEEE754 single precision 32-bit)
0x66 0xE9----------Modbus-RTU CRC

5.3 Manufacturer Identification Code Register

Register Address (Hex)	Data	Description	Data Type (Big-Endian)	R/W
0x2035	Byte[10]	Manufacturer Identification Code "01234567890123456789012345678901 2"	ASCII	R/W
	Byte[11]			
0x2036	Byte[12]			
	Byte[13]			
0x2037	Byte[14]			
	Byte[15]			
0x2038	Byte[16]			
	Byte[17]			
0x2039	Byte[18]			
	Byte[19]			
0x203A	Byte[20]			
	Byte[21]			
0x203B	Byte[22]			
	Byte[23]			
0x203C	Byte[24]			
	Byte[25]			
0x203D	Byte[26]			
	Byte[27]			
0x203E	Byte[28]			
	Byte[29]			
0x203F	Byte[30]			
	Byte[31]			
0x2040	Byte[32]			
	Byte[33]			

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Example of writing manufacturer identification code:

Send: 0x01 0x10 0x20 0x30 0x00 0x11 0x22 0x30 0x31 0x32 0x33 0x34 0x35 0x36 0x37 0x38 0x39 0x30 0x31 0x32 0x33 0x34 0x35 0x36 0x37 0x38 0x39 0x30 0x31 0x32 0x33 0x34 0x35 0x36 0x37 0x38 0x39 0x30 0x31 0x32 0x00 0x9A 0x8D

Receive: 0x01 0x10 0x20 0x30 0x00 0x11 0x0B 0xCA

Send explanation:

0x01----------Modbus address
0x10----------Writing to multiple holding registers
0x20 0x30----------Register address - 0x2030
0x00 0x11----------Register length - 17 registers
0x22----------Write data length - 4 bytes
0x30 0x31 0x32 0x33 0x34 0x35 0x36 0x37 0x38 0x39 0x30 0x31 0x32 0x33 0x34 0x35 0x36 0x37 0x38 0x39 0x30 0x31 0x32 0x33 0x34 0x35 0x36 0x37 0x38 0x39 0x30 0x31 0x32 0x00----------Write data - "01234567890123456789012345678901 2"
0x9A 0x8D----------Modbus-RTU CRC

Receive explanation:

0x01----------Modbus address
0x10----------Writing to multiple holding registers
0x20 0x30----------Register address - 0x2030
0x00 0x11----------Register length - 17 registers
0x0B 0xCA----------Modbus-RTU CRC

Example of reading manufacturer identification code:

Send: 0x01 0x03 0x20 0x30 0x00 0x11 0x8E 0x09

Receive: 0x01 0x03 0x22 0x30 0x31 0x32 0x33 0x34 0x35 0x36 0x37 0x38 0x39 0x30 0x31 0x32 0x33 0x34 0x35 0x36 0x37 0x38 0x39 0x30 0x31 0x32 0x33 0x34 0x35 0x36 0x37 0x38 0x39 0x30 0x31 0x32 0x00 0xE7 0x78

Send explanation:

0x01----------Modbus address
0x03----------Read holding registers
0x20 0x30----------Starting register address - 0x2030
0x00 0x11----------Read register length - 17 registers
0x8E 0x09----------Modbus-RTU CRC

Receive explanation:

0x01----------Modbus address
0x03----------Read holding registers
0x22----------Read length - 34 bytes
0x30 0x31 0x32 0x33 0x34 0x35 0x36 0x37 0x38 0x39 0x30 0x31 0x32 0x33 0x34 0x35 0x36 0x37 0x38 0x39 0x30 0x31 0x32 0x33 0x34 0x35 0x36 0x37 0x38 0x39 0x30 0x31 0x32 0x00----------Software version number (ASCII) - "01234567890123456789012345678901 2"
0xE7 0x78----------Modbus-RTU CRC

5.4 Calibration Register

Register Address (Hex)	Data	Description	Data Type (Big-Endian)	R/W
0x2050	Byte[0] Byte[1]	User calibration enable flag 0: Disable 1: Enable Other: Invalid	uint16	R/W
0x2051	Byte[2] Byte[3]	Calibrate user 0 point 1: Write 0 point Other: Invalid	uint16	W
0x2052	Byte[4] Byte[5]	Write the calibration concentration value, can not be written together with register 0x2051 Concentration>0 (byte[4]<<24)|(byte[5]<<16)|(byte[6]<<8)|byte[7] Then follow 32 Bit float Data type conversion	float	W
0x2053	Byte[6] Byte[7]			
0x2054	Byte[8] Byte[9]	Restore factory settings 1: Restore factory settings Other: Invalid	uint16	W

The initial value of user calibration is the same as the factory calibration. Before the user wants to write the calibration himself, please turn on the "user calibration enable flag" first.

Example of reading the user calibration enable flag:

Send: 0x01 0x03 0x20 0x50 0x00 0x01 0x8F 0xDB

Receive: 0x01 0x03 0x02 0x00 0x00 0xB8 0x44

Send explanation:

0x01----------Modbus address
0x03----------Read holding registers
0x20 0x50----------Starting register address - 0x2050
0x00 0x01----------Read register length - 1 register
0x8F 0xDB----------Modbus-RTU CRC

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Example of restoring factory calibration:
Send: 0x01 0x10 0x20 0x54 0x00 0x01 0x02 0x00 0x01 0x4B 0x86
Receive: 0x01 0x10 0x20 0x54 0x00 0x01 0x4B 0xD9
Send explanation:
0x01----------Modbus address
0x10----------Writing to multiple holding registers
0x20 0x54----------Register address - 0x2054
0x00 0x01----------Register length - 1 register
0x02----------Write data length - 2 bytes
0x00 0x01----------Restore factory settings
0x4B 0x86----------Modbus-RTU CRC
Receive explanation:
0x01----------Modbus address
0x10----------Writing to multiple holding registers
0x20 0x54----------Register address - 0x2054
0x00 0x01----------Register length - 1 register
0x4B 0xD9----------Modbus-RTU CRC

5.5 Product Overview

Register Address (Hex)	Data	Description	Data Type (Big-Endian)	R/W
0x2060	Byte[0]	Entering sleep mode	uint16	W
	Byte[1]	1: Enter sleep mode Others: No operation		

Enter sleep example:
Send: 0x01 0x10 0x20 0x60 0x00 0x01 0x02 0x00 0x01 0x4F 0xF2
Receive: 0x01 0x10 0x20 0x60 0x00 0x01 0x0A 0x17
Send explanation:
0x01----------Modbus address
0x10----------Writing to multiple holding registers
0x20 0x60----------Register address - 0x2060
0x00 0x01----------Register length - 1 register
0x02----------Write data length - 2 bytes
0x00 0x01----------Entering sleep
0x4F 0xF2----------Modbus-RTU CRC
Receive explanation:
0x01----------Modbus address
0x10----------Writing to multiple holding registers
0x20 0x60----------Register address - 0x2060
0x00 0x01----------Register length - 1 register
0x0A 0x17----------Modbus-RTU CRC

5.6 Product Overview

Register Address (Hex)	Data	Description	Data Type (Big-Endian)	R/W
0x2070	Byte[0]	Entering sleep mode	uint16	W
	Byte[1]	1: Enter sleep mode Others: No operation		
0x2071	Byte[2]	Exit sleep mode (must be written together with register 0x2070)	uint16	W
	Byte[3]	1: Exit sleep mode Others: No operation		

Wake-up example:
Send: 0x01 0x10 0x20 0x70 0x00 0x02 0x04 0x00 0x01 0x00 0x01 0xFD 0x4A
Receive: 0x01 0x10 0x20 0x70 0x00 0x02 0x4B 0xD3
Send explanation:
0x01----------Modbus address
0x10----------Writing to multiple holding registers
0x20 0x70----------Register address - 0x2070
0x00 0x02----------Register length - 2 registers
0x04----------Write data length - 4 bytes
0x00 0x01----------Current Modbus address
0x00 0x01----------Wake up the device
0xFD 0x4A----------Modbus-RTU CRC
Receive explanation:
0x01----------Modbus address
0x10----------Writing to multiple holding registers
0x20 0x70----------Register address - 0x2070
0x00 0x02----------Register length - 2 registers
0x4B 0xD3----------Modbus-RTU CRC

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Receive explanation:
0x01----------Modbus address
0x03----------Read holding registers
0x02----------Read length - 2 bytes
0x00 0x00----------User calibration enable flag - 0x0000 - User calibration is not enabled
0xB8 0x44----------Modbus-RTU CRC

Example of writing the user calibration enable flag:
Send: 0x01 0x10 0x20 0x50 0x00 0x01 0x02 0x00 0x01 0x4A 0x02
Receive: 0x01 0x10 0x20 0x50 0x00 0x01 0x0A 0x18
Send explanation:
0x01----------Modbus address
0x10----------Writing to multiple holding registers
0x20 0x50----------Register address - 0x2050
0x00 0x01----------Register length - 1 register
0x02----------Write data length - 2 bytes
0x00 0x01----------User calibration enable flag - 0x0001 - Enable User Calibration
0x4A 0x02----------Modbus-RTU CRC
Receive explanation:
0x01----------Modbus address
0x10----------Writing to multiple holding registers
0x20 0x50----------Register address - 0x2050
0x00 0x01----------Register length - 1 register
0x0A 0x18----------Modbus-RTU CRC

Example of writing 0 point:
Send: 0x01 0x10 0x20 0x51 0x00 0x01 0x02 0x00 0x01 0x4B 0xD3
Receive: 0x01 0x10 0x20 0x51 0x00 0x01 0x5B 0xD8
Send explanation:
0x01----------Modbus address
0x10----------Writing to multiple holding registers
0x20 0x51----------Register address - 0x2051
0x00 0x01----------Register length - 1 register
0x02----------Write data length - 2 bytes
0x00 0x01----------Write data - 0x0001
0x4B 0xD3----------Modbus-RTU CRC
Receive explanation:
0x01----------Modbus address
0x10----------Writing to multiple holding registers
0x20 0x51----------Register address - 0x2051
0x00 0x01----------Register length - 1 register
0x5B 0xD8----------Modbus-RTU CRC

Example of calibration concentration (write 20.0f):
Send: 0x01 0x10 0x20 0x52 0x00 0x02 0x04 0x41 0xA0 0x00 0x00 0xFA 0x95
Receive: 0x01 0x10 0x20 0x52 0x00 0x02 0xEB 0xD9
Send explanation:
0x01----------Modbus address
0x10----------Writing to multiple holding registers
0x20 0x52----------Register address - 0x2052
0x00 0x02----------Register length - 2 registers
0x04----------Write data length - 4 bytes
0x41 0xA0 0x00 0x00----------Concentration value written - 0x41A00000 - 20.0f (IEEE754 single precision 32-bit)
0xFA 0x95----------Modbus-RTU CRC
Receive explanation:
0x01----------Modbus address
0x10----------Writing to multiple holding registers
0x20 0x52----------Register address - 0x2052
0x00 0x02----------Register length - 2 registers
0xEB 0xD9----------Modbus-RTU CRC

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