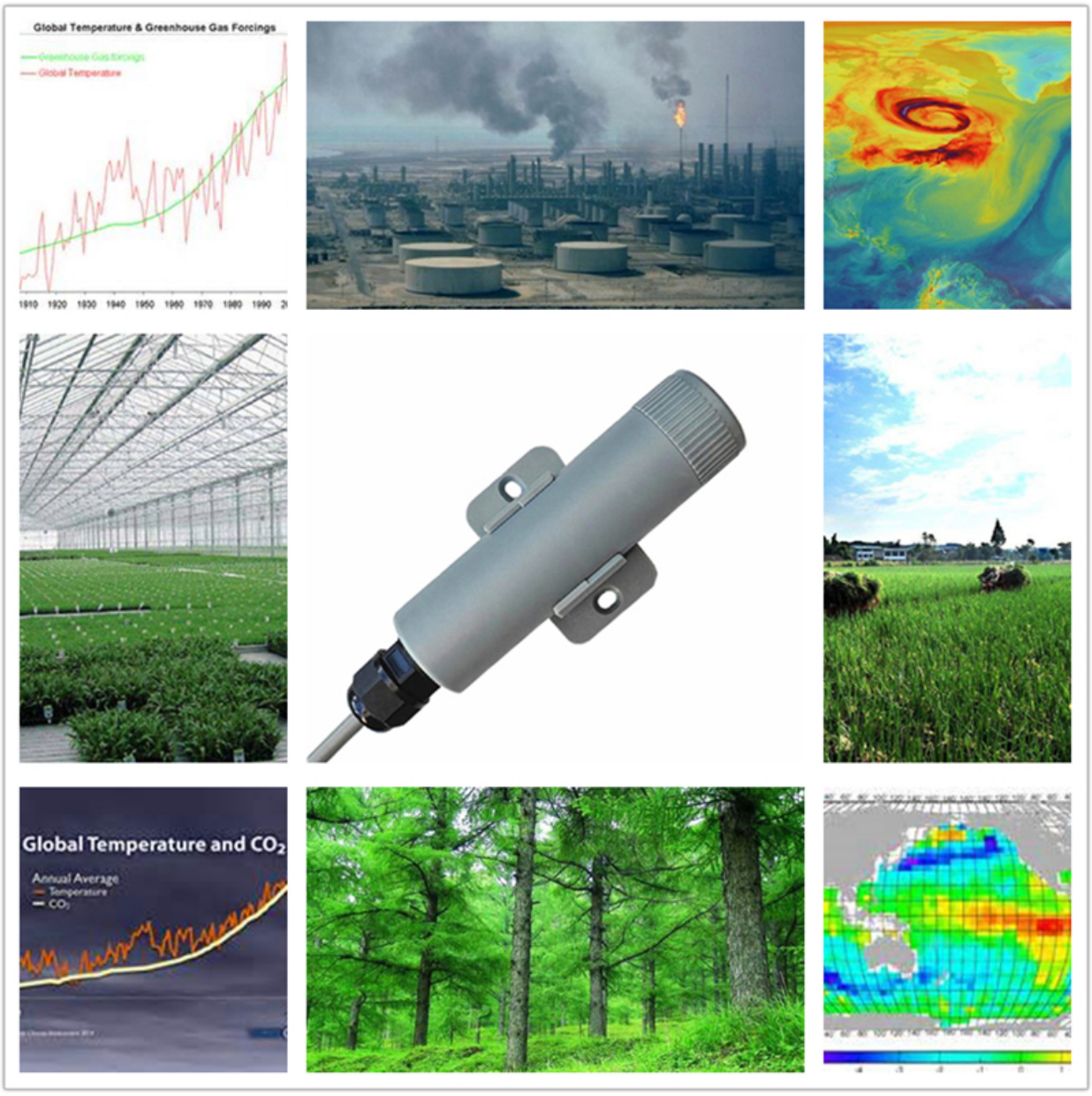
DigiGas-VNI

Air Quality VOC and NOx Index Sensor (SDI-12 Interface)

Air Quality VOC and NOx Index Sensor (RS485 Interface)

User Manual



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2 Introduction

2.1 Brief

DigiGas-VNI is a digital gas concentration sensor designed for easy integration into air purifiers or demand-controlled ventilation system, providing one VOC and one NOx based indoor air quality signal, It's applicable for science research, warehousing and cold chain logistics, laboratory application etc.

The SDI-12 output provides universal compatibility with any SDI-12-enabled data logger and low power applications, or use a RS485 physical interface for applications that require long cable runs or many sensors.

Features

- Integrated with Sensirion SGP41 sensor, VOC and NOx Index output
- Calibrated output with temperature and humidity compensation
- Outstanding long-term stability and lifetime
- Digital Output SDI-12 or RS485 with built-in surge protection
- Small size with high accuracy with excellent stability
- Wall mounting installation
- Reverse power protection and Built-in TVS/ESD protection
- Excellent price-performance ratio

Applications

- Air purifiers
- Ventilation system
- Indoor air quality monitoring
- Laboratory application

Specifications	
Output Interface	Optional: SDI-12, V1.3 Optional: RS485, Modbus-RTU
Power Supply	5-28V DC
Power Consumption	SDI-12 Interface: Quiescent current in continuous measurement mode: <2mA @12V DC Max. current during measurement: <5mA@12VDC RS485 Interface: Quiescent current in continuous measurement mode: <5mA @12V DC Max. current during measurement: <10mA@12VDC
VOC Index	Range: 1-500, Resolution: 1
NOx Index	Range: 1-500, Resolution: 1
Temperature Accuracy	Range: -40～125℃, Resolution: 0.01℃ Typical Accuracy: +/-0.2℃ **Note: The long-term operating temperature range is -40~80 ° C**
Humidity Accuracy	Range: 0-100%, Resolution: 0.01% Typical Accuracy: ±1.8% RH
Operating	Temperature: -40～80℃, Humidity: 0-95% non-condensing
IP Ratings	IP50
Installation	Wall mounting
Cable Length	2 meters or Customize
Dimension	Sensor body: 111*25.5mm (Length*Diameter)

2.2 Limitations on MOX based TVOC sensor

TVOC stands for total volatile organic compounds. It is by definition the sum of all VOCs present in a given environment. Most health-related indoor air quality levels, such as those published by the German Federal Environmental Agency or the WHO, as well as building norms such as RESET or LEED, refer to tVOC. To measure this accurately, an analytical device is needed that can selectively quantify hundreds of VOCs individually at the same time, such as a gas chromatograph. These devices are large and expensive and are not suited for consumer devices such as indoor air quality monitors or air purifiers; however, they are state-of-the-art.

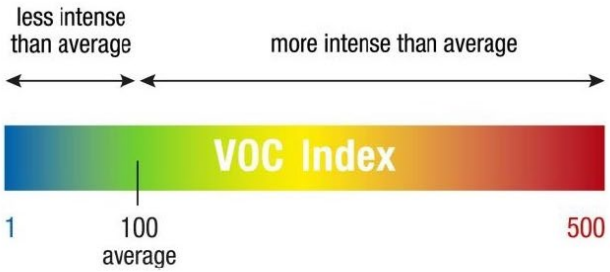
The MOX sensors which are currently available on the market (including Sensirion's SGP4x) can be calibrated for one specific gas or gas mixture in the laboratory. This allows a MOX sensor to accurately measure the concentration of the calibrated gas (mixture) in a controlled environment. However, the gas composition of VOCs in the field constantly and widely varies; therefore, all VOC compounds must be measured individually, as stated above. This means that an etVOC (where "e" stands for "equivalent") output from a MOX sensor may deviate from the true value by a factor of two (corresponding to −50/+100 %) or more. It also can happen that the sensor output moves in the opposite way compared to the true tVOC value. This behavior is called broadband sensitivity because the sensor is reacting to multiple gases at the same time, but cannot distinguish which gas is causing the signal change.

Furthermore, under field conditions it cannot be guaranteed that the reference gas conditions used for calibration (which is called baseline) are also exactly present in the field. This is necessary to compensate for the drift which almost every MOX sensor faces over time. This adds an additional, substantial error to the concentration readings. It is therefore important to understand that current MOX sensors can only work as semiquantitative VOC indicators, not as true tVOC detectors. The same arguments also are valid for the NOx output.

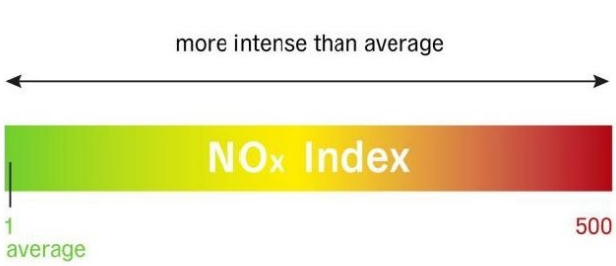
2.3 Features of VOC and NOx Index based sensor

To overcome the shortcomings of MOX technology, The sensor algorithm automatically adapts its outputs to any indoor environment and maps all VOC and NOx events to a VOC and NOx Index scale, respectively, ranging from 1 to 500 index points. In case of the VOC Index, a value of 100 refers to the average indoor gas composition over the past 24 h. While values between 100 and 500 indicate a deterioration, values between 1 and 100 inform about improvement of the VOC based air quality. In case of the NOx Index, the average condition is mapped to a value of 1 and therefore, the

NOx Index displays values between 2 and 500 when NOx events are present.



Explanation of the VOC Index scale.



Explanation of the NO_x Index scale.

2.4 Accuracy

VOC and NOx Sensing Performance

Parameter	Conditions	Min.	Typ.	Max.	Units
Output Signal Range	VOC Index	1	N/A	500	VOC Index points
Output Signal Range	NOx Index	1	N/A	500	NOx Index points
Measurement range	Ethanol in clean air	0	N/A	1,000,000	ppb
Measurement range	NO2 in clean air	0	N/A	10,000	ppb
Specified range	Ethanol in clean air	500	N/A	10,000	ppb
Specified range	NO2 in clean air	50	N/A	650	ppb
Device-to-device variation	VOC Index	N/A	<±15 <±15	N/A	VOC Index points or % m.v. (the larger)
Device-to-device variation	NOx Index	N/A	<±50 <±50	N/A	NOx Index points or % m.v. (the larger)
Repeatability	VOC Index	N/A	<±5 <±5	N/A	VOC Index points or % m.v. (the larger)
Repeatability	NOx Index	N/A	<±5 <±5	N/A	NOx Index points or % m.v. (the larger)
Limit of detection	Ethanol in 500 ppb of ethanol and 0 ppb of NO2 in else clean air	N/A	N/A	<50 or <10	ppb or % of concentration setpoint (the larger)
Limit of detection	NO2 in 500 ppb of ethanol in else clean air	N/A	N/A	<20 or <10	ppb or % of concentration setpoint

					(the larger)
Response time τ63%	changing concentration from 5'000 to 10'000 ppb of ethanol at sampling interval of 1 s	N/A	<10	N/A	s
Response time τ63%	changing concentration from 150 to 300 ppb of NO2 at sampling interval of 1 s	N/A	<250	N/A	s
Switch-on behavior	Time until reliably detecting VOC or NOx events	N/A	<60	N/A	s
Switch-on behavior	VOC Index (Time until specifications in this table are met)	N/A	<1.5	N/A	h
Switch-on behavior	NOx Index (Time until specifications in this table are met)	N/A	<6	N/A	h
Sampling interval	N/A	N/A	1	N/A	s

Temperature Sensing Performance

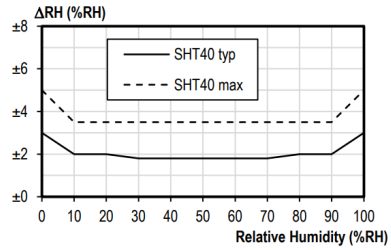
Parameter	Conditions	Value
Temperature measurement range	-	- 40～125 ℃，0.01℃
Accuracy (typ.)	typical	± 0.2 ℃
Repeatability	typical	± 0.07 ℃
Response time	τ63%	2 s
Accuracy drift	typical	< 0.03 ℃ / year

Humidity Sensing Performance

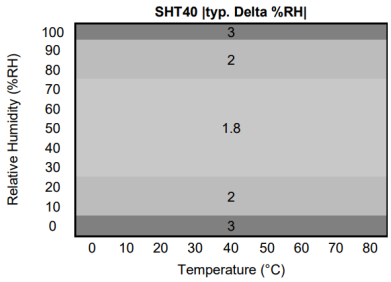
Parameter	Conditions	Value
Humidity measurement range	-	0～100 %RH，0.01%RH
Accuracy (typ.)	typical	±1.8%RH
Repeatability	typical	±0.15 %RH
Response time	τ63%	6 s
Accuracy drift	typical	<0.25 %RH / year

Full range accuracy of temperature and humidity

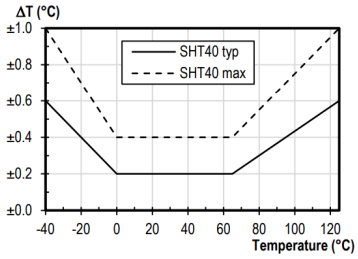
Accuracy



SHT40 typical and maximal relative humidity accuracy at 25 °C.



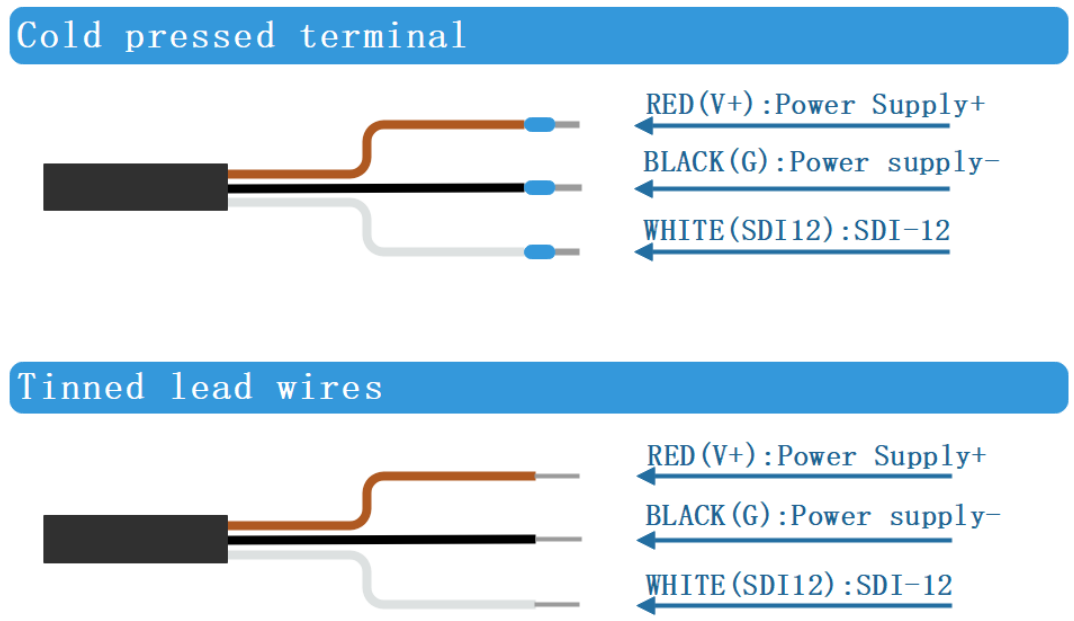
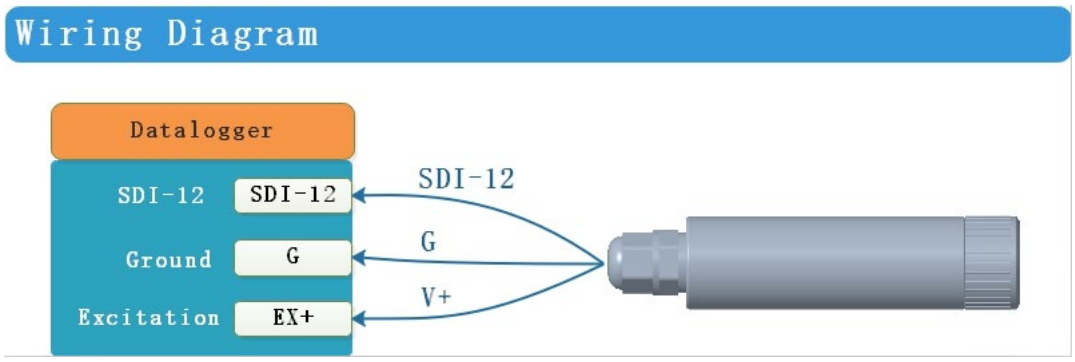
Typical RH accuracy tolerance over humidity and temperature for SHT40.



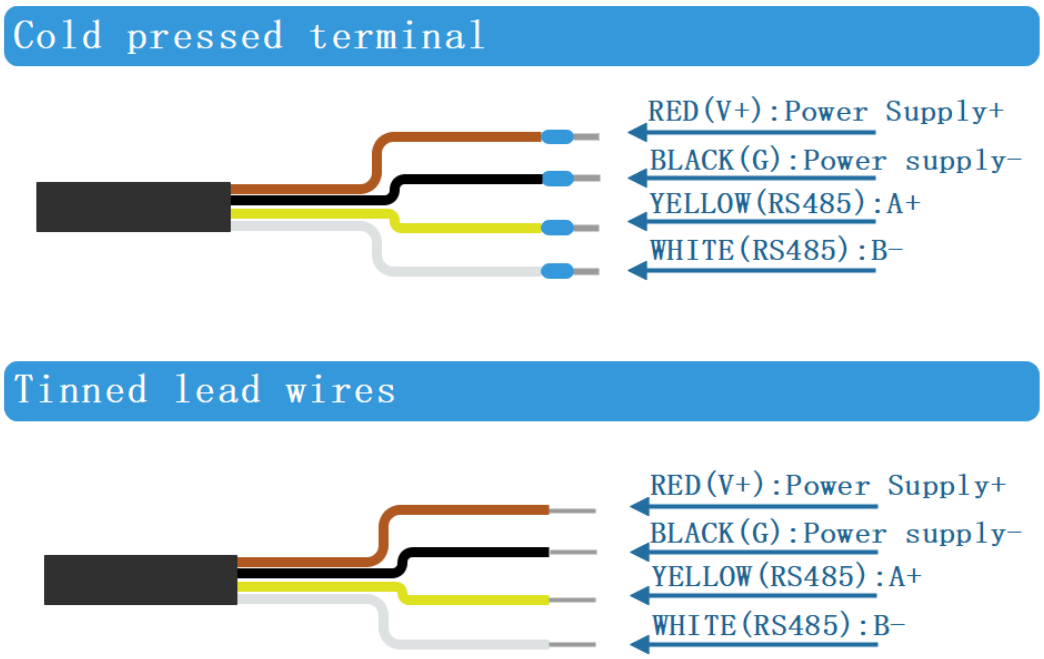
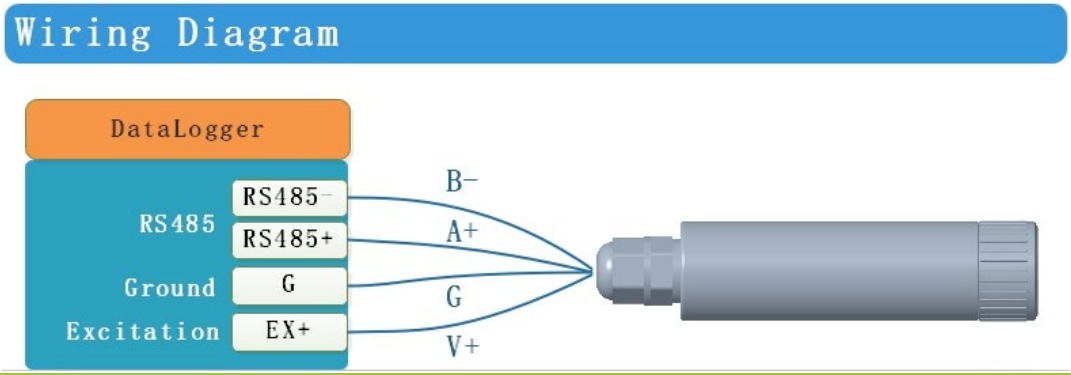
SHT40 typical and maximal temperature accuracy.

3 Wiring diagrams

3.1 SDI-12 Interface

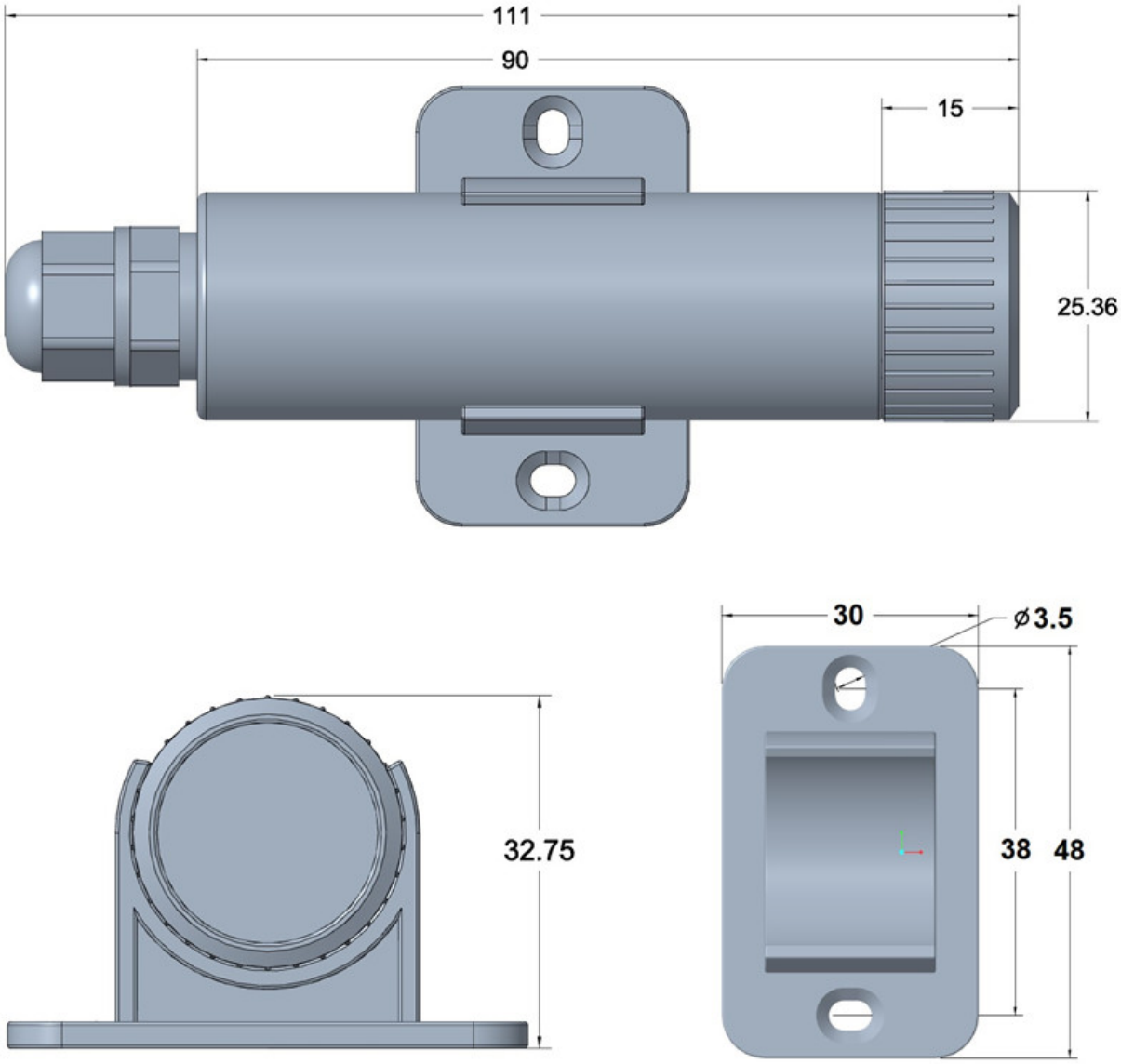
Type	Wiring diagram
SDI-12 Interface	
Connections	

3.2 RS485 Interface

Type	Wiring diagram
RS485 Interface	
Connections	

4 Dimension and Ordering Infomation

4.1 Dimension



Unit: mm

4.2 Ordering Information

Ordering Information		
Parameters	**Code**	**Comments**
Code 1:Product Series	DigiGas-VNI	DigiGas-VNI, VOC and NOx Index, Air temperature, humidity sensor
Code 2: Range and Accuracy	A	Default, Please refer to “Accuracy” chapter
Code 3: Power Supply	A X	5-28V DC Customize
Code 4: Output Interface	A B	RS485(Modbus-RTU) SDI-12
Code 5: Connector	B C	Cold pressed terminal Stripped & tinned lead wires
Code 6: Cable Length	002 XXX	2 Meters Customize, XXX is required cable length (Unit: meter)
Ordering Code Example: DigiGas-VNI-A A A B 002 Product Series: DigiGas-VNI, VOC and NOx Index, Air temperature, humidity sensor; Range and Accuracy: Default; Power Supply: 5-28V DC; Output Interface: RS485(Modbus-RTU); Connector: Cold pressed terminal; Cable Length: 2 Meters		

5 SDI-12 Communication

The sensor has SDI-12 interface and protocol. The description and terms used within this chapter are listed in table below:

Parameters	Unit	Description
±	-	Sign of the value
a	-	SDI-12 address
n	-	Number of measurements (fixed width of 1)
nn	-	Number of measurements with leading zero if necessary (fixed width of 2)
ttt	Seconds	Maximum measurement time (fixed width of 3)
tttt	Seconds	Maximum measurement time (fixed width of 4)
<TAB>	-	Tab character
<SAPCE>	-	Space character
<CR>	-	Carriage return character
<LF>	-	Line feed character
<Checksum>	-	SUM Checksum
<CRC_ADI>		ADI protocol CRC Checksum
<CRC>	-	SDI-12 protocol CRC Checksum
<VERIFY_STATUS>	-	Sensor Verification status
<SENSOR_STATUS>	-	Sensor Operating Status, The meaning of bit: BIT.7: 0 (Idle Status)，1 (Running) BIT.2: 0 (Normally)，1 (Warm up) Reserved for other bits
<+VOCIndex>	-	VOC Index Range: 1-500
<+NOXIndex>	-	NOX Index Range: 1-500
<±Temperature>	℃ ℉	Temperature(Original), The value is output based on the temperature unit setting
<±TemperatureCalibed>	℃ ℉	Temperature(Calibrated), The value is output based on the temperature unit setting
<±TOffset>	℃ ℉	Temperature offset, The value is output based on the temperature unit setting Range: -10.00~10.00 Default: 0.00 <±TemperatureCalibed> = <±Temperature> + <±TOffset>
<+Humidity>	%	Humidity(Original).
<+HumidityCalibed>	%	Humidity(Calibrated).
<+HumiOffset>	%	Humidity offset Range: -10.00~10.00

		Default: 0.00 <+HumidityCalibed> = <+Humidity> + <+ HUMIOFFSET>
<±DewPoint>	℃ ℉	Dew point(Original), The value is output based on the temperature unit setting
<±DewPointCalibed>	℃ ℉	Dew point(Calibrated), The value is output based on the temperature unit setting
<TemperatureUnit>	℃ ℉	Temperature unit C: Degree Celsius(Default) F: Degree Fahrenheit

The following error value will be responded as measurement value when there is error:

Error Value	Description
-9999	Sensor Broken

5.1 SDI-12 Interface and Protocol

5.1.1 SDI-12 Interface

Please refer to SDI-12 standard user manual V1.3.

5.1.2 Protocol

Request	Response	Comment
a!	a<CR><LF> a: Sensor address	**Acknowledge Active** **Example:** Request: 0! Response: 0<CR><LF>
aI!	allccccccccmmmmmmvvvxxxxxxxxxxxx xxxx<CR><LF> a: Sensor address ll:SDI-12 Version Number cccccccc: 8 characters vendor identification mmmmmm: 6 characters specifying the sensor model number vvv: 3 characters specifying the sensor version xxxxxxxxxxxxx: 13 characters serial	**Send Identification** **Example:** Request: 0I! Response: 013INFWIN DGGVOC4.1DigiGas-46004<CR><LF>

	number <CR><LF>: terminates the response	
?!	a<CR><LF> a: Sensor address	**Sensor Address Query** **Example:** Request: ?! Response: 0<CR><LF>
aAb!	b<CR><LF> a:Current Sensor address b:New Sensor address	**Change Sensor address** **Example:** Request: 0A1! Response: 1<CR><LF>
aM!, aMC!	a0015CR><LF> a: Sensor address 001: Measurement data will be ready in 001 seconds, 5 Number of measurement data returned by aD0! <CR><LF>: terminates the response aD0! Response data format: a<+VOCIndex<+NOXIndex><±TemperatureCalibed><+HumidityCalibed><±DewPointCalibed>[<CRC>]<CR><LF>	**VOC Index, NOX Index, Temperature calibrated, Humidity calibrated, Dew Point calibrated Measurement** **Example:** Request: 0M! Response: 00015<CR><LF> Response: 0<CR><LF> Request: 0D0! Response: 0+102+1+22.00+25.89+1.58<CR><LF>
aM1!, aMC1!	a0015CR><LF> a: Sensor address 001: Measurement data will be ready in 001 seconds, 5 Number of measurement data returned by aD0! <CR><LF>: terminates the response aD0! Response data format: a<+VOCIndex<+NOXIndex><±Temperature><+Humidity><±DewPoint>[<CRC>]<CR><LF>	**VOC Index, NOX Index, Temperature, Humidity, Dew Point Measurement** **Example:** Request: 0M1! Response: 00015<CR><LF> Response: 0<CR><LF> Request: 0D0! Response: 0+102+1+22.00+25.89+1.58<CR><LF>
aC!, aCC!	a00105CR><LF> a: Sensor address 001: Measurement data will be ready in 001 seconds,	**VOC Index, NOX Index, Temperature calibrated, Humidity calibrated, Dew Point calibrated Measurement** **Example:**

	05 Number of measurement data returned by aD0! <CR><LF>: terminates the response aD0! Response data format: a<+VOCIndex<+NOXIndex><±TemperatureCalibed><+HumidityCalibed><±DewPointCalibed>[<CRC>]<CR><LF>	Request: 0C! Response: 000105<CR><LF> Response: 0<CR><LF> Request: 0D0! Response: 0+102+1+22.00+25.89+1.58<CR><LF>
aC1!, aCC1!	a00105CR><LF> a: Sensor address 001: Measurement data will be ready in 001 seconds, 05 Number of measurement data returned by aD0! <CR><LF>: terminates the response aD0! Response data format: a<+VOCIndex<+NOXIndex><±Temperature><+Humidity><±DewPoint>[<CRC>]<CR><LF>	**VOC Index, NOX Index, Temperature, Humidity, Dew Point Measurement** **Example:** Request: 0C1! Response: 000105<CR><LF> Response: 0<CR><LF> Request: 0D0! Response: 0+102+1+22.00+25.89+1.58<CR><LF>
aV!	a0012<CR><LF> a: Sensor address 001: Measurement data will be ready in 001 seconds 2: Number of measurement data <CR><LF>: terminates the response aD0! Response data format: a<VERIFY_STATUS><SENSOR_STATUS><CR><LF>	**Sensor Verification Command** **Example:** Request: 0V! Response: 00012<CR><LF> Response: 0<CR><LF> Request: 0D0! Response: 0+0+0<CR><LF>
aD0! aD1! aD2!	[<svvvv><svvvv><svvvv>…][<CRC>]<CR><LF> [<svvvv>]: data value [<CRC>]: Optional 3 characters CRC checksum, <CR><LF>:terminates the response	Send Data since the last aM, aMC, aC, aCC, aV command, The data returned depends on the comm and sent most recently.
aR0!, aRC0!	Response data format: a<+VOCIndex<+NOXIndex><±TemperatureCalibed><+HumidityCalibed><±DewPointCalibed>[<CRC>]<CR><LF>	**VOC Index, NOX Index, Temperature calibrated, Humidity calibrated, Dew Point calibrated Measurement** **Example:** Request: 0R0!

		Response: 0+102+1+22.00+25.89+1.58<CR><LF>
aR1!, aRC1!	Response data format: a<+VOCIndex<+NOXIndex><±Temperature><+Humidity><±DewPoint>[<CRC>]<CR><LF>	**VOC Index, NOX Index, Temperature, Humidity, Dew Point Measurement** **Example:** Request: 0R1! Response: 0+102+1+22.00+25.89+1.58<CR><LF>
aR9!, aRC9!	Response data format: a<+VOCIndex<+NOXIndex><±Temperature><±TemperatureCalibed><+Humidity><+HumidityCalibed><±DewPoint><±DewPointCalibed>[<CRC>]<CR><LF>	**VOC Index, NOX Index, Temperature, Temperature calibrated, Humidity, Humidity calibrated, Dew Point, Dew Point calibrated Measurement** **Example:** Request: 0R9! Response: 0+94+94+1+1+22.28+22.28+26.02+26.02+1.88+1.88<CR><LF>
aXR_TUNIT!	aTUNIT=<TemperatureUnit><CR><LF> <X> is temperature unit: C: degrees Centigrade F: degrees Fahrenheit	**Query temperature unit** **Example:** Request: 0XR_TUNIT! Response: 0TUNIT=C<CR><LF>
aXW_TUNIT_<TemperatureUnit>!	aTUNIT=<TemperatureUnit><CR><LF>	**Configure temperature unit** **Example:** Request: 0XW_TUNIT_C! Response: 0TUNIT=C<CR><LF>
aXR_TOFFSET!	aTOFFSET=<±TOffset><CR><LF> <±TOffset>: Temperature offset value. Range: -10.00~10.00, Default: 0.00, The offset value will be applied from the next measurement command. <±TemperatureCalibed> = <±Temperature> + <±TOffset>	**Query temperature offset value** **Example:** Request: 0XR_TOFFSET! Response: 0TOFFSET=+1.00<CR><LF>
aXW_TOFFSET_<±TOffset>!	aTOFFSET=<±TOffset><CR><LF>	**Configure temperature offset value** **Example:** Request: 0XW_TOFFSET_+1.00! Response: 0TOFFSET=+1.00<CR><LF>
aXR_HUMIOFFSET!	aHUMIOFFSET=<±HUMIOFFSET><CR><LF> <±HUMIOFFSET>: Humidity offset value. Range: -10.00~10.00, Default: 0.00 The offset value will be applied from the next measurement comman	**Query humidity offset value** **Example:** Request: 0XR_HUMIOFFSET! Response: 0HUMIOFFSET=+1.00<CR><LF>

	d. <+HumidityCalibed> = <+Humidity> + <+HUMIOFFSET>	
aXW_HUMIOFFSET_<±HUMIOFFSET>!	aHUMIOFFSET=<±HUMIOFFSET><CR><LF>	**Configure humidity offset value** **Example:** Request: 0XW_HUMIOFFSET_+1.00! Response: 0HUMIOFFSET=+1.00<CR><LF>
aXR_SN!	aSN=<ssssssss><CR><LF> <ssssssss> is 8-digits serial number	**Query serial number** **Example:** Request: 0XR_SN! Response: 0SN=12345678<CR><LF>
aXW_SN_<ssssssss>!	aSN=<ssssssss><CR><LF>	**Configure serial number** **Example:** Request: 0XW_SN_ABCDEFGH! Response: 0SN=ABCDEFGH <CR><LF>

6 RS485 Communication

6.1 Modbus Protocol

Modbus Protocol is widely used to establish master-slave communication between intelligent devices or sensors. A MODBUS message sent from a master to a slave contains the address of the slave, the function code (e.g. 'read register' or 'write register'), the data, and a check sum (LRC or CRC).

The sensor is RS485 interface with Modbus protocol. The default serial communication settings is slave address 1, modbus rtu, 9600bps, 8 databits and 1 stop bit. All communication settings can be changed with modbus command, and take effective after re-power up the sensor.

Following modbus function code are supported by sensor.

Modbus Function Code 0x03 : used for reading holding register.

Modbus Function Code 0x04 : used for reading input register.

Modbus Function Code 0x06 : used for writing single holding register.

Modbus Function Code 0x10: used for writing multiple holding register.

6.2 Modbus Register

Parameters	Register Addr. (HEX/DEC)	Data Type	Modbus Function Code(DEC)	Range and Comments	Default Value
VOC Index(Calibrated by Temp. and Humi.) VOC_INDEX_CALIBED	0x0000 /0	UINT16 RO	3/4	1-500	N/A
NOx Index(Calibrated by Temp. and Humi.) NOX_INDEX_CALIBED	0x0001 /1	UINT16 RO	3/4	1-500	N/A
RESERVED	0x0002 /2	UINT16 RO	3/4	Reserved for future use	N/A
RESERVED	0x0003 /3	UINT16 RO	3/4	Reserved for future use	N/A
Temperature(Calibrated) TEMPRATURE_CAL	0x0004 /4	INT16 RO	3/4	-4000-12500 mapping to -40.00-125.00 (℃); -4000-25700 mapping to	N/A

IBED				-40.00-257.00 (°F)	
Humidity(Calibrated) HUMIDITY_CALIBED	0x0005 /5	INT16 RO	3/4	0-10000 mapping to 0.00-100.00 (%)	N/A
Dew point(Calibrated) DEWPOINT_CALIBED	0x0006 /6	INT16 RO	3/4	-10000-12500 mapping to -100.00-125.00 (℃) -14800-25700 mapping to -148.00-257.00 (°F)	N/A
RESERVED	0x0007 /7	INT16 RO	3/4	Reserved	0
RESERVED	0x0008 /8	INT16 RO	3/4	Reserved	0
RESERVED	0x0009 /9	INT16 RO	3/4	Reserved	0
RESERVED	0x000A /10	INT16 RO	3/4	Reserved	0
RESERVED	0x000B /11	INT16 RO	3/4	Reserved	0
RESERVED	0x000C /12	INT16 RO	3/4	Reserved	0
RESERVED	0x000D /13	INT16 RO	3/4	Reserved	0
RESERVED	0x000E /14	INT16 RO	3/4	Reserved	0
RESERVED	0x000F /15	INT16 RO	3/4	Reserved	0
VOC Index(Original) VOC_INDEX_CALIBED	0x0010 /16	UINT16 RO	3/4	1-500	N/A
NOx Index(Original) NOX_INDEX_CALIBED	0x0011 /17	UINT16 RO	3/4	1-500	N/A
RESERVED	0x0012 /18	UINT16 RO	3/4	Reserved for future use	N/A
RESERVED	0x0013 /19	UINT16 RO	3/4	Reserved for future use	N/A
Temperature(Original) TEMPRATURE	0x0014 /20	INT16 RO	3/4	-4000-12500 mapping to -40.00-125.00 (℃);	N/A

				-4000-25700 mapping to -40.00-257.00 (°F)	
Humidity(Original) HUMIDITY	0x0015 /21	INT16 RO	3/4	0-10000 mapping to 0.00-100.00 (%)	N/A
Dew point(Original) DEWPOINT	0x0016 /22	INT16 RO	3/4	-10000-12500 mapping to -100.00-125.00 (℃) -14800-25700 mapping to -148.00-257.00 (℉)	N/A
RESERVED	0x0017 /23	INT16 RO	3/4	Reserved	0
RESERVED	0x0018 /24	INT16 RO	3/4	Reserved	0
RESERVED	0x0019 /25	INT16 RO	3/4	Reserved	0
RESERVED	0x001A /26	INT16 RO	3/4	Reserved	0
RESERVED	0x001B /27	INT16 RO	3/4	Reserved	0
RESERVED	0x001C /28	INT16 RO	3/4	Reserved	0
RESERVED	0x001D /29	INT16 RO	3/4	Reserved	0
RESERVED	0x001E /30	INT16 RO	3/4	Reserved	0
RESERVED	0x001F /31	INT16 RO	3/4	Reserved	0
Temperature Unit TEMPUNIT	0x0020 /32	UINT16 R/W	3/6/16	0: ℃ 1: ℉	0
Temperature Offset TOFFSET	0x0021 /33	INT16 R/W	3/6/16	-1000～1000 mapping to -10.00～10.00℃	0
Humidity Offset HUMIOFFSET	0x0022 /34	INT16 R/W	3/6/16	-1000～1000 mapping to -10.00～10.00%	0
Floating Point Register Byte Order FLOATBYTEORDER	0x0023 /35	INT16 R/W	3/6/16	Configure floating point register byte order. 0: Big-endian [ABCD] 1: Little-endian[DCBA] 2: Big-endian byte swap [BADC] 3: Little-endian byte	3

				swap[CDAB]	
Modbus Slave Address ADDRESS	0x0200 /512	UINT16 R/W	3/6/16	0-255	1
RS485 baudrate BAUDRATE	0x0201 /513	UINT16 R/W	3/6/16	0-5 0: 1200bps 1: 2400bps 2: 4800bps 3: 9600bps 4: 19200bps 5: 38400bps	3: 9600bps
RS485 Protocol PROTOCOL	0x0202 /514	UINT16 R/W	3/6/16	0 0: Modbus RTU	0: Modbus RTU
RS485 parity PARITY	0x0203 /515	UINT16 R/W	3/6/16	0-2 0: NONE 1: EVEN 2: ODD	0: NONE
RS485 data bits DATABITS	0x0204 /516	UINT16 R/W	3/6/16	1 1: 8 bits	1: 8 bits
RS485 Stopbits STOPBITS	0x0205 /517	UINT16 R/W	3/6/16	0-1 0: 1 stopbit 1: 2 stopbits	0: 1 stopbit
Reserved RESERVED	0x0206 /518	UINT16 R/W	3/6/16	Reserved	0
Reserved RESERVED	0x0207 /519	UINT16 R/W	3/6/16	Reserved	0
User Defined Serial Number USERSN	0x0220 /544 0x0221 /545 0x0222 /546 0x0223 /547	UINT16 R/W	3/16	0x0000000000000000- 0xFFFFFFFFFFFFFFFF Those four registers should be read/write in one command.	N/A
VOC Index(Calibrated by Temp. and Humi.) VOC_INDEX_CALIBED_FLOAT	0x1000 /4096	FLOAT RO	3/4	1-500	N/A

NOx Index(Calibrated by Temp. and Humi.) NOX_INDEX_CALIBED_FLOAT	0x1002 /4098	FLOAT RO	3/4	1-500	N/A
RESERVED_FLOAT	0x1004 /4100	FLOAT RO	3/4	reserved for future use	N/A
RESERVED_FLOAT	0x1006 /4102	FLOAT RO	3/4	reserved for future use	N/A
Temperature(Calibrated) TEMPRATURE_CALIBED_FLOAT	0x1008 /4104	FLOAT RO	3/4	-40.00-125.00 (℃); -40.00-257.00 (℉)	N/A
Humidity(Calibrated) HUMIDITY_CALIBED_FLOAT	0x100A /4106	FLOAT RO	3/4	0.00-100.00 (%)	N/A
Dew point(Calibrated) DEWPOINT_CALIBED_FLOAT	0x100C /4108	FLOAT RO	3/4	-100.00-125.00 (℃) -148.00-257.00 (℉)	N/A
RESERVED_FLOAT	0x100E /4110	FLOAT RO	3/4	Reserved	0
RESERVED_FLOAT	0x1010 /4112	FLOAT RO	3/4	Reserved	0
RESERVED_FLOAT	0x1012 /4114	FLOAT RO	3/4	Reserved	0
RESERVED_FLOAT	0x1014 /4116	FLOAT RO	3/4	Reserved	0
RESERVED_FLOAT	0x1016 /4118	FLOAT RO	3/4	Reserved	0
RESERVED_FLOAT	0x1018 /4120	FLOAT RO	3/4	Reserved	0
RESERVED_FLOAT	0x101A /4122	FLOAT RO	3/4	Reserved	0
RESERVED_FLOAT	0x101C /4124	FLOAT RO	3/4	Reserved	0
RESERVED_FLOAT	0x101E /4126	FLOAT RO	3/4	Reserved	0
VOC Index(Original) VOC_INDEX_CALIBED_FLOAT	0x1020 /4128	FLOAT RO	3/4	1-500	N/A
NOx Index(Original) NOX_INDEX_CALI	0x1022 /4130	FLOAT RO	3/4	1-500	N/A

BED_FLOAT					
RESERVED_FLOAT	0x1024 /4132	FLOAT RO	3/4	reserved for future use	N/A
RESERVED_FLOAT	0x1026 /4134	FLOAT RO	3/4	reserved for future use	N/A
Temperature(Original) TEMPRATURE_FLOAT	0x1028 /4136	FLOAT RO	3/4	-40.00-125.00 (℃); -40.00-257.00 (℉)	N/A
Humidity(Original) HUMIDITY_FLOAT	0x102A /4138	FLOAT RO	3/4	0.00-100.00 (%)	N/A
Dew point(Original) DEWPOINT_FLOAT	0x102C /4140	FLOAT RO	3/4	-100.00-125.00 (℃) -148.00-257.00 (℉)	N/A
RESERVED_FLOAT	0x102E /4142	FLOAT RO	3/4	Reserved	0
RESERVED_FLOAT	0x1030 /4144	FLOAT RO	3/4	Reserved	0
RESERVED_FLOAT	0x1032 /4146	FLOAT RO	3/4	Reserved	0
RESERVED_FLOAT	0x1034 /4148	FLOAT RO	3/4	Reserved	0
RESERVED_FLOAT	0x1036 /4150	FLOAT RO	3/4	Reserved	0
RESERVED_FLOAT	0x1038 /4152	FLOAT RO	3/4	Reserved	0
RESERVED_FLOAT	0x103A /4154	FLOAT RO	3/4	Reserved	0
RESERVED_FLOAT	0x103C /4156	FLOAT RO	3/4	Reserved	0
RESERVED_FLOAT	0x103E /4158	FLOAT RO	3/4	Reserved	0

UINT16:16 bit unsigned integer

INT16:16bit signed integer

RO: Register is Read Only

R/W: Register is Read/Write

HEX: Hexadecimal (data with 0x/0X prefix)

DEC: Decimal

FLOAT: Floating point register, the byte order is configured by “Floating Point Register Byte Order, FLOATBYTEORDER” register. Please refer to “Modbus Register Detail Descripton” for more details.

The register value will be set as following when there is sensor error:

Error Value	Register Address	Error
-32768	VOC Index	sensor broken
-32768	NOx Index	sensor broken
-32768	Temperature value	sensor broken
-32768	Humidity value	sensor broken
-32768	Dew point value	sensor broken

6.3 Modbus Register Detail Descripton

VOC_INDEX_CALIBED: VOC Index(Calibrated by Temp. and Humi.), UINT16 VOC_INDEX: VOC Index (Original), UINT16		
Range	1-500	Default: N/A
Parameter Save	N/A	

Note: VOC index value

VOC_INDEX_CALIBED_FLOAT: VOC Index(Calibrated by Temp. and Humi.), FLOAT VOC_INDEX_FLOAT: VOC Index (Original), FLOAT		
Range	1-500	Default: N/A
Parameter Save	N/A	

Note: VOC index value. The byte order is configured by “Floating Point Register Byte Order, FLOATBYTEORDER” register.

NOX_INDEX_CALIBED: NOX Index(Calibrated by Temp. and Humi.), UINT16 NOX _INDEX: NOX Index (Original), UINT16		
Range	1-500	Default: N/A
Parameter Save	N/A	

Note: NOX index value

NOX_INDEX_CALIBED_FLOAT: NOX Index(Calibrated by Temp. and Humi.), FLOAT NOX_INDEX_FLOAT: NOX Index (Original), FLOAT		
Range	1-500	Default: N/A
Parameter Save	N/A	

Note: NOx index value. The byte order is configured by “Floating Point Register Byte Order, FLOATBYTEORDER” register.

TEMPEATURE_CALIBED: Temperature(Calibrated), INT16 TEMPERATURE: Temperature(Original), INT16		
Range	-4000-12500 mapping to -40.00-125.00 (Temperature Unit set to ℃); -4000-25700 mapping to -40.00-257.00 (Temperature Unit set to ℉)	Default: N/A
Parameter Save	N/A	

Note: Temperature measurement value

TEMPEATURE_CALIBED_FLOAT: Temperature(Calibrated), FLOAT TEMPERATURE_FLOAT: Temperature(Original), FLOAT		
Range	-40.00-125.00 (Temperature Unit set to ℃); -40.00-257.00 (Temperature Unit set to ℉)	Default: N/A
Parameter Save	N/A	

Note: Temperature measurement value. The byte order is configured by “Floating Point Register Byte Order, FLOATBYTEORDER” register.

HUMIDITY_CALIBED: Humidity(Calibrated), INT16 HUMIDITY: Humidity(Original), INT16		
Range	0-10000 mapping to 0.00-100.00 (%)	Default: N/A
Parameter Save	N/A	

Note: Humidity measurement value

HUMIDITY_CALIBED_FLOAT: Humidity(Calibrated), FLOAT HUMIDITY_FLOAT: Humidity(Original), FLOAT		
Range	0.00-100.00 (%)	Default: N/A
Parameter Save	N/A	

Note: Humidity measurement value. The byte order is configured by “Floating Point Register Byte Order, FLOATBYTEORDER” register.

DEWPOINT_CALIBED: Dew point(Calibrated), INT16 DEWPOINT: Dew point(Original), INT16		
Range	-10000-12500 mapping to -100.00-125.00 (Temperature Unit set to ℃) -14800-25700 mapping to -148.00-257.00 (Temperature Unit set to ℉)	Default: N/A
Parameter Save	N/A	

Note: Dew point measurement value

DEWPOINT_CALIBED_FLOAT: Dew point(Calibrated), FLOAT DEWPOINT_FLOAT: Dew point(Original), FLOAT		
Range	-100.00-125.00 (Temperature Unit set to ℃); -148.00-257.00 (Temperature Unit set to ℉)	Default: N/A
Parameter Save	N/A	

Note: Dew point measurement value. The byte order is configured by “Floating Point Register Byte Order, FLOATBYTEORDER” register.

TEMPUNIT: Temperature Unit		
Range	0: ℃ 1: ℉	Default: 0
Parameter Save	YES	

Note: Temperature Unit.

TOFFSET: Temperature Offset, INT16		
Range	-1000～1000 mapping to -10.00～10.00℃	Default: 0
Parameter Save	YES	

Note: Temperature Offset.

TEMPRATURE_CALIBED = TEMPRATURE + TOFFSET;

TEMPRATURE_CALIBED_FLOAT = TEMPRATURE_FLOAT + TOFFSET / 100.00;

HUMIOFFSET: Humidity Offset, INT16		
Range	-1000～1000 mapping to -10.00～10.00%	Default: 0
Parameter Save	YES	

Note: Humidity Offset.

HUMIDITY_CALIBED = HUMIDITY + HUMIOFFSET;

HUMIDITY_CALIBED_FLOAT = HUMIDITY_FLOAT + HUMIOFFSET / 100.00;

FLOATBYTEORDER：Floating Point Register Byte Order, INT16		
Range	0: Big-endian [ABCD] 1: Little-endian[DCBA] 2: Big-endian byte swap [BADC] 3: Little-endian byte swap[CDAB]	Default: 3
Parameter Save	YES	

Note: Configure floating point register byte order.

Example: The 123456.00 in IEC754 is 0x47F12000 (A=47, B=F1, C=20, D=00), then

0: Big-endian [ABCD]

1: Little-endian[DCBA]

2: Big-endian byte swap [BADC]

3: Little-endian byte swap[CDAB]

SLAVEADDRESS: Modbus Slave Address, UINT16		
Data Range	0-255	Default: 1
Parameter Storage	YES	

Note: Please power up the sensor to take effective after set.

BAUDRATE: Serial Comm Baudrate, UINT16		
Data Range	0-5 0:1200bps 1:2400bps 2:4800bps 3:9600bps 4:19200bps 5:38400bps	Default: 3
Parameter Storage	YES	

Note: Please power up the sensor to take effective after set.

PROTOCOL: Serial Comm Protocol, UINT16		
Data Range	0 0:Modbus RTU	Default: 0
Parameter Storage	YES	

Note: Please power up the sensor to take effective after set.

PARITY: Serial Comm Parity, UINT16		
Data Range	0-2 0:NONE 1:EVEN 2:ODD	Default: 0
Parameter Storage	YES	

Note: Please power up the sensor to take effective after set.

DATABITS: Serial Comm Databits, UINT16

Data Range	1 1:8 databits	Default: 1
Parameter Storage	YES	

Note: Please power up the sensor to take effective after set.

STOPBITS: Serial Comm Stopbits, UINT16		
Data Range	0-1 0:1 stopbit 1:2 stopbits	Default: 0
Parameter Storage	YES	

Note: Please power up the sensor to take effective after set.

USER_SN--- User Serial Number		
Data Range	0x0000000000000000-0xFFFFFFFFFFFFFFFF User Serial Number. These four registers should be read and write together from start address 0x0220 with quantity 4.	Default: N/A
Parameter Storage	YES	

Appendix A SDI-12 Sensor Testing and Settings

The user can test the communication or set the parameters with the SDI-12 sensors in the following method.

■ Use any kind of master device that supports the SDI-12 interface (such as data acquisition device, data logger, etc.) to communicate with the sensor or set the parameters.

■ Use a computer to communicate with the sensor through the SDI-12 converter (such as the SDI12ELF20 converter) and to set the parameters.

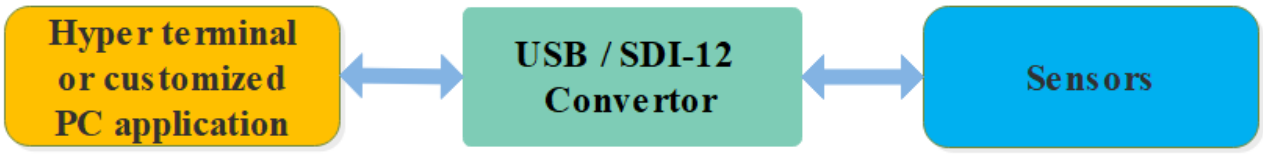
This chapter mainly introduces the communication or parameter setting on a computer for sensor through the SDI-12 converter (SDI12ELF20).

A.1 Testing SDI-12 Sensors with SDI12ELF20 Converter

SDI12ELF20 is a communication converter between USB master device and SDI-12 sensor. It supports bidirectional transparent transmission of SDI-12 communication data and is used to control or test SDI-12 compatible sensors or devices. The USB master device can be a computer, Raspberry PI and other hosts that support USB interface.

SDI12ELF20 Converter User Manual
https://www.infwin.com/sdi12elf20-sdi-12-to-usb-converter/

In this example, a computer is used as a USB host to connect the sensor through the SDI12ELF20 converter for SDI-12 communication test.



Installation steps:

■ Install USB Virtual COM port driver on PC, laptop or other USB master device. The converter uses the CH340C as the USB bridge chip. Download and install the CH340C driver and install it. After the converter is connected to the PC, a COM port is added to the system port. Use this port number in the debugging software to debug the communication with the converter.

Driver Download
https://www.infwin.com/resource-usb-to-serial-port-driver-ch340-series

■ Connect the converter to a PC, laptop or other USB master device through USB port

■ Connect the sensor of the SDI-12 port to the converter

■ The sensor can be powered by the power output that comes with the converter or by an external power supply which has common POWER GROUND with the converter power supply

■ Users can use any serial communication software for SDI-12 communication, such as Terminal or HyperTerminal, The default communication parameters of SDI12ELF20 is 9600bps, none parity, 8 data bits, 1 stop bit. Please use ASCII mode to send and receive data.

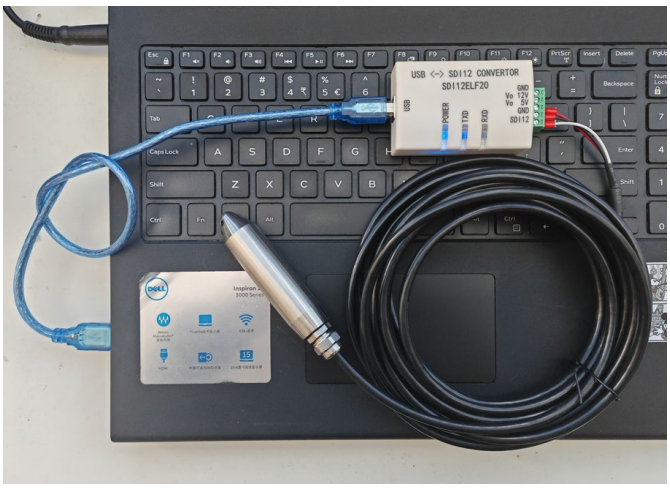
Testing Software Download	
Terminal (universal serial port debugging tool)	https://www.infwin.com/resource-serial-port-com-development-tool/
HyperTerminal (universal serial port debugging tool)	https://www.infwin.com/resource-serial-port-com-development-tool/
SensorOneSetSDI12 (SDI-12 sensor configuration utility)	https://www.infwin.com/resource-sensoronesetsdi12-configuration-utility-for-sdi-12-sensors/

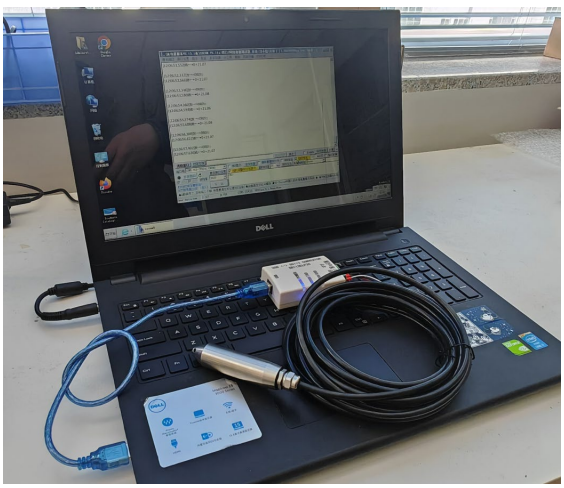
A.2 Testing Example

In this example, we use the SDI12ELF20 converter to communicate between a computer and the rugged temperature sensor DigiTEMP, The power supply of DigiTEMP is also provided by SDI12ELF20.

DigiTEMP Rugged Temperature Sensor User Manual
https://www.infwin.com/digitemp-rugged-digital-temperature-sensor-sdi12-rs485-modbus/

■ **Connections**

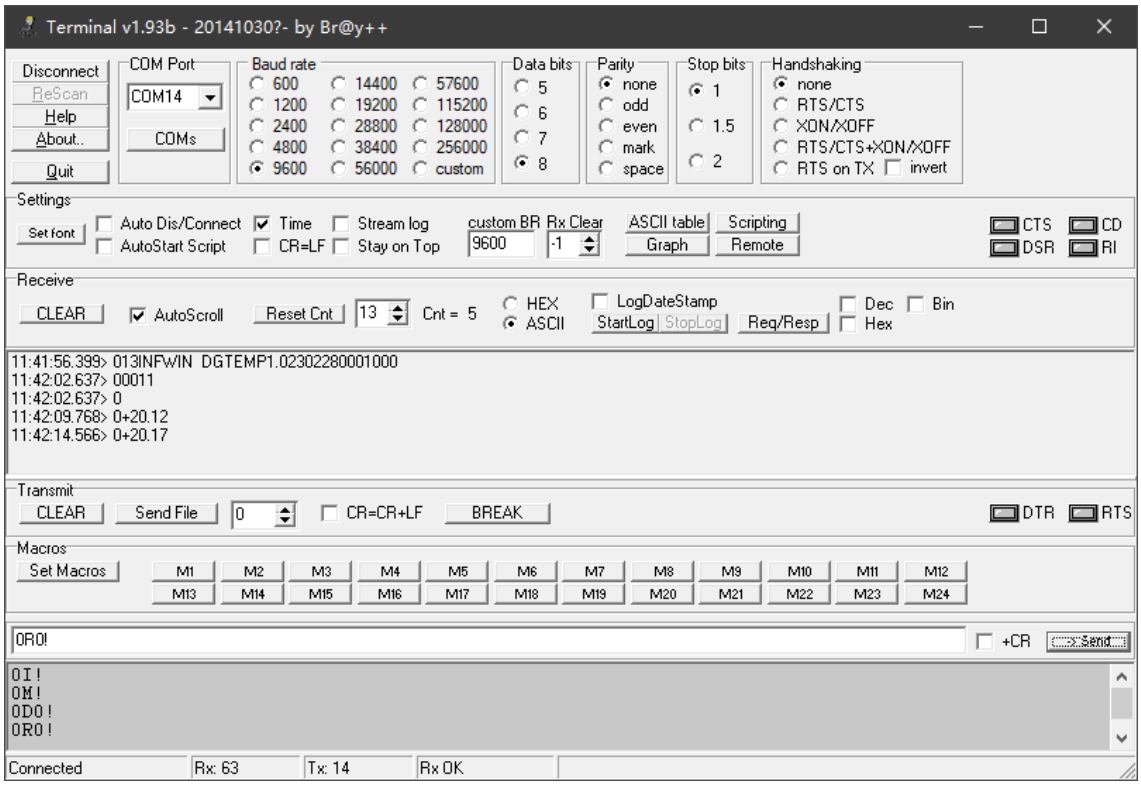




■ **Testing with serial port utility "Terminal"**

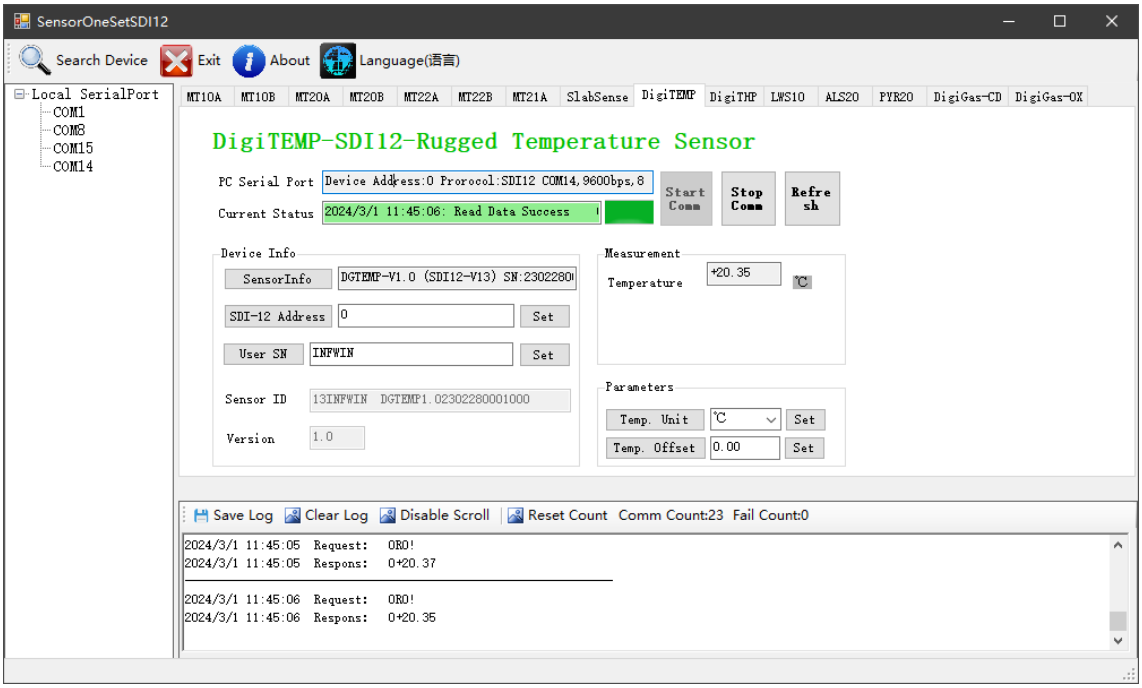
Take "Terminal" as an example, when debugging, please select the corresponding serial port number, baudrate is set to 9600bps, none parity, 8 data bits, 1 stop bit (the default communication Settings of SDI12ELF20), open the serial port and input the SDI-12 command and send. Please note

that the ASCII format should be used for data communication.



■ Testing with SDI-12 sensor configuration utility “SensorOneSetSDI12”

Start up the application, select the corresponding product page DigiTEMP, click "start communication" and choose the proper serial port number, 9600bps, none parity, 8 data bits, 1 stop bit (SDI12ELF20 default communication Settings) and start communication.



Appendix B RS485 Sensor Testing and Settings

The user can test the communication or set the parameters with the SDI-12 sensors in the following method.

■ Use any kind of master device that supports the SDI-12 interface (such as data acquisition device, data logger, etc.) to communicate with the sensor or set the parameters.

■ Use a computer to communicate with the sensor through the SDI-12 converter (such as the SDI12ELF20 converter) and to set the parameters.

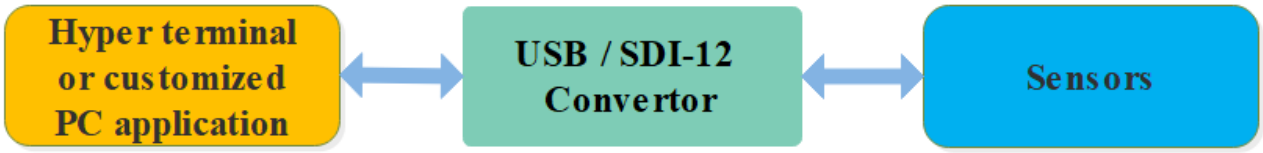
This chapter mainly introduces the communication or parameter setting on a computer for sensor through the SDI-12 converter (SDI12ELF20).

A.1 Testing RS485 Sensors with RS485 Converter

SDI12ELF20 is a communication converter between USB master device and SDI-12 sensor. It supports bidirectional transparent transmission of SDI-12 communication data and is used to control or test SDI-12 compatible sensors or devices. The USB master device can be a computer, Raspberry PI and other hosts that support USB interface.

SDI12ELF20 Converter User Manual
https://www.infwin.com/sdi12elf20-sdi-12-to-usb-converter/

In this example, a computer is used as a USB host to connect the sensor through the SDI12ELF20 converter for SDI-12 communication test.



Installation steps:

■ Install USB Virtual COM port driver on PC, laptop or other USB master device. The converter uses the CH340C as the USB bridge chip. Download and install the CH340C driver and install it. After the converter is connected to the PC, a COM port is added to the system port. Use this port number in the debugging software to debug the communication with the converter.

Driver Download
https://www.infwin.com/resource-usb-to-serial-port-driver-ch340-series

■ Connect the converter to a PC, laptop or other USB master device through USB port

■ Connect the sensor of the SDI-12 port to the converter

■ The sensor can be powered by the power output that comes with the converter or by an external power supply which has common POWER GROUND with the converter power supply

■ Users can use any serial communication software for SDI-12 communication, such as Terminal or HyperTerminal, The default communication parameters of SDI12ELF20 is 9600bps, none parity, 8 data bits, 1 stop bit. Please use ASCII mode to send and receive data.

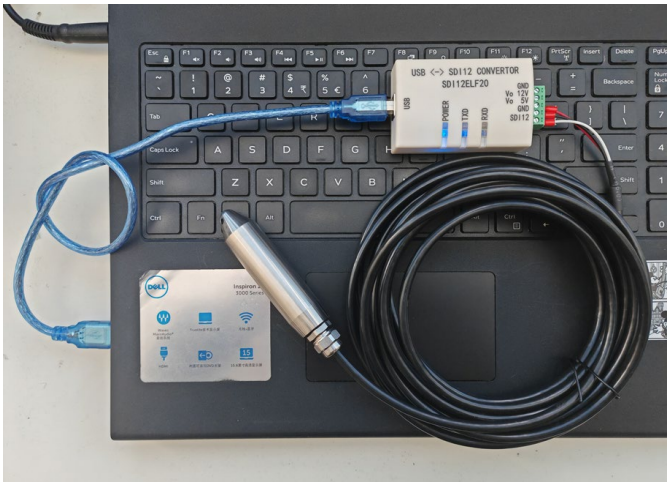
Testing Software Download	
Terminal (universal serial port debugging tool)	https://www.infwin.com/resource-serial-port-com-development-tool/
HyperTerminal (universal serial port debugging tool)	https://www.infwin.com/resource-serial-port-com-development-tool/
SensorOneSetSDI12 (SDI-12 sensor configuration utility)	https://www.infwin.com/resource-sensoronesetsdi12-configuration-utility-for-sdi-12-sensors/

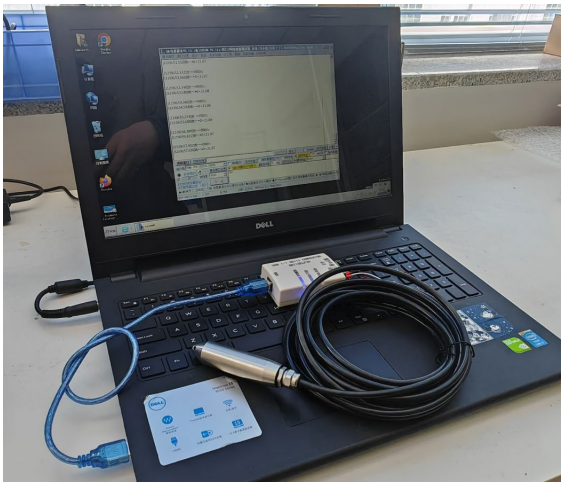
A.2 Testing Example

In this example, we use the SDI12ELF20 converter to communicate between a computer and the rugged temperature sensor DigiTEMP, The power supply of DigiTEMP is also provided by SDI12ELF20.

DigiTEMP Rugged Temperature Sensor User Manual
https://www.infwin.com/digitemp-rugged-digital-temperature-sensor-sdi12-rs485-modbus/

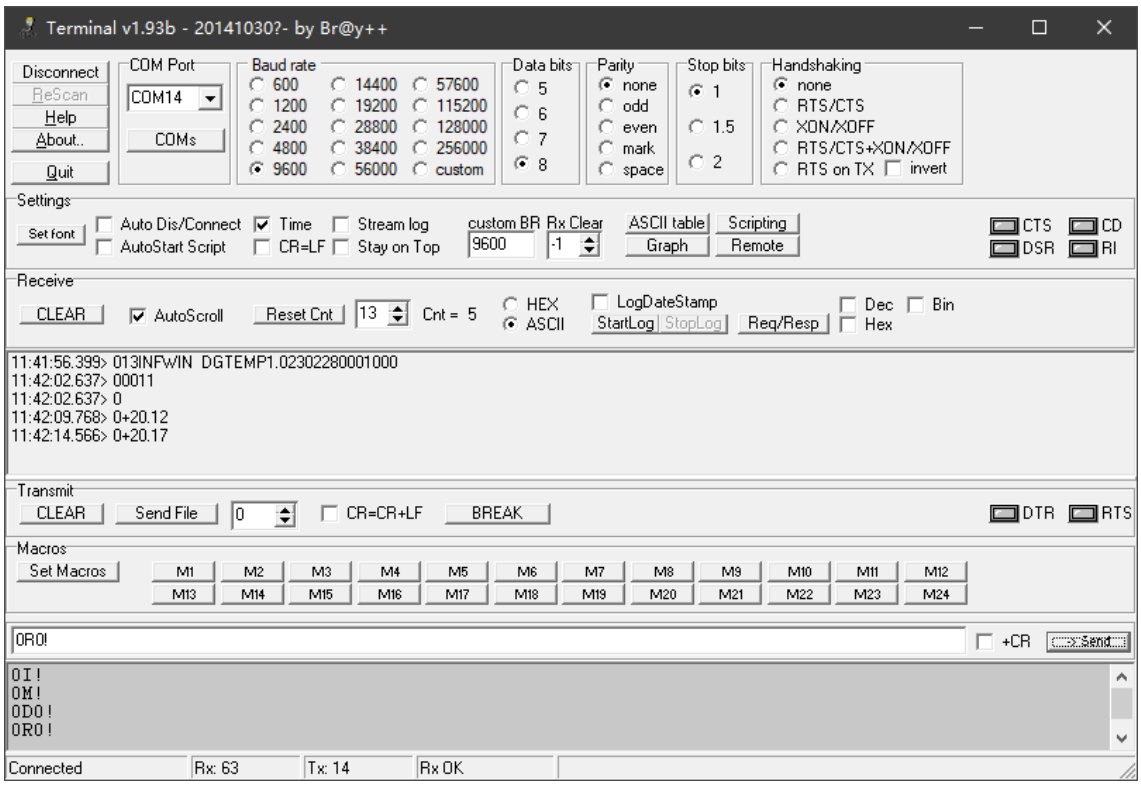
■ **Connections**





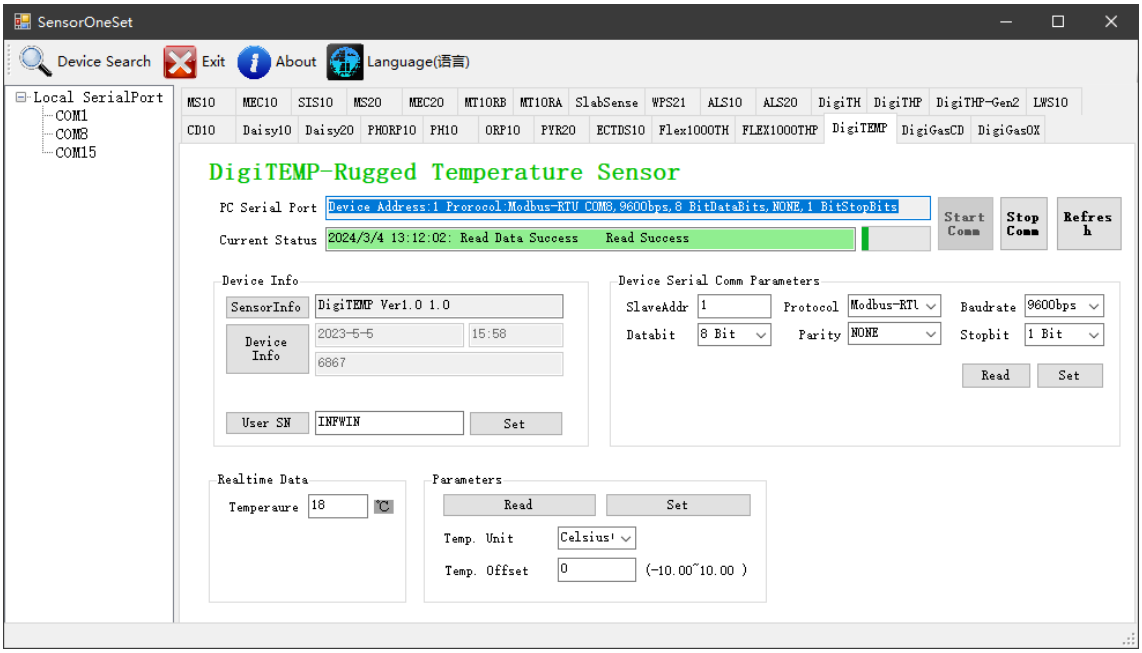
■ **Testing with serial port utility "Terminal"**

Take "Terminal" as an example, when debugging, please select the corresponding serial port number, baudrate is set to 9600bps, none parity, 8 data bits, 1 stop bit (the default communication Settings of SDI12ELF20), open the serial port and input the SDI-12 command and send. Please note that the ASCII format should be used for data communication.



■ Testing with SDI-12 sensor configuration utility “SensorOneSetSDI12”

Start up the application, select the corresponding product page DigiTEMP, click "start communication" and choose the proper serial port number, 9600bps, none parity, 8 data bits, 1 stop bit (SDI12ELF20 default communication Settings) and start communication.



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2025-01-21	V1.0	Initial Creation	sl51930