电应普
BEST SENSOR

DATASHEET

DS1603DA- V2.0 Series Sensor Module

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Product Description

1. General

DA1603DAU-** ultrasonic liquid level sensor series breaks through traditional installation method of open tank contact, and realizes true non-contact measurement of liquid level height in closed containers. The sensor is installed just below (bottom) of the container to detect the liquid level. There is no need to drill a hole of the container, easy to install and online installation can be realized. It can accurately measure the liquid level of various toxic substances, strong acids, strong alkalis and various pure liquids in high temperature and high pressure airtight containers. The sensor has no special requirements for the material of the liquid medium and container which can be widely used.

2. Features

- Non-contact level measurement
- 10～36V operating voltage
- Full-scale real-time tracking, Restart is not required when refill empty container
- Easy to install and debug
- UART serial port automatic output
- RS485 controlled output
- Operating temperature -15℃ to +60℃
- Storage temperature -25℃ to +80℃
- Electrostatic protection design, I/O pins are added with electrostatic protection devices, in accordance with IEC61000-4-2 standard

3. Advantages

High level of protection
Data output is stable and reliable
Fast response time
Wide operating temperature
Small size, easy to install
Strong anti-interference
Low power consumption
Strong anti-static
High measurement accuracy
Automatic output mode

Externally mounted ultrasonic level sensor

The externally mounted liquid level sensor adopts the principle of ultrasonic ranging, uses a special probe attached to the outside of the container wall to collect ultrasonic signals, takes special ultrasonic processing technology as the core of the system, adopts advanced high-speed signal processing technology, and uses Dianyingpu special algorithm. Accurately calculate the container liquid level. The sensor can feed back the measurement results to the control center through the UART serial port or the RS485 output interface.

When measuring the liquid level, the ultrasonic signal is emitted from the probe, and the echo signal is detected by the probe after being reflected back by the liquid surface. The echo signal is processed by a proprietary algorithm to calculate the time, and the system calculates the liquid level or confirms whether there is liquid according to the formula.

Module Specification

Description	DS1603DA-3U V2.0	DS1603DA-3R V2.0	Unit	Note
Operating voltage	10～36	10～36	V	DC
Average operating current	<30	<30	mA	(1)
Blind zone	≤40	≤40	mm	(2)
Measuring level Range	40~2000	40~2000	mm	(2)
Working Period	2	2	S	(3)
Output Interface	UART	RS485		
Resolution	1	1	mm	
Accuracy	±(5+S*1%)	±(5+S*1%)	mm	(4)
Probe frequency	3	3	MHz	
ESD	±4/±8	±4/±8	KV	(5)

Remarks:

(1) 12V power supply, 2S operating cycle test data.

(2) 2mm thickness steel plate container at normal temperature, the container diameter is Φ160mm and the data obtained by testing the water.

(3) The default duty cycle of DS1603DA-3R V2.0 is 2S, which can be set by software.

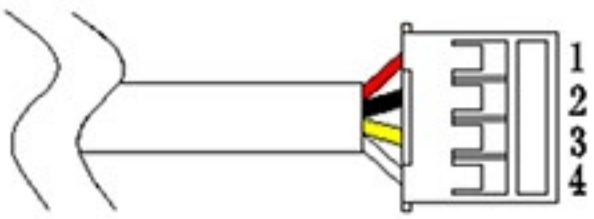
(4) a. S represents the current liquid level height.

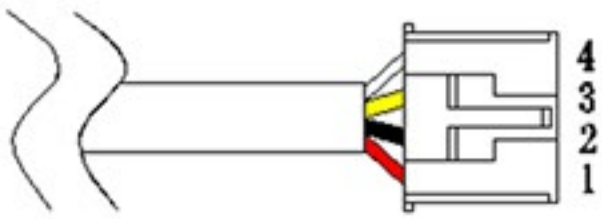
b. The data obtained by testing the water level at a height of 2000mm for a 2mm thick steel plate container at room temperature.

(5) Terminal leads conform to IEC61000-4-2 standard.

DS1603DA-3U V2.0 communication protocol instruction

1. Pin out





Pin	Name	Description	Note
Red wire	VCC	DC 10-36V power input	
Black Wire	GND	GND	
Yellow wire	TX	UART output	
White wire	RX	EMPTY	

2. UART description

The sensor outputs data according to the processed value

UART	Data bit	Stop bit	Parity check	Baud rate
TTL Level	8	1		9600bps

3. UART Output format

Frame data	Description	Byte
Start bit	0XFF OXFF	1byte
Data_H	High8 distance value	1byte
Data_L	Low8 distance value	1byte
SUM	Parity sum	1byte

4. UART Example

Start Bit	Data_H	Data_L	SUM
0XFF	0X07	0XA1	0XA7

Remark:

Checksum only remain low8 value.

SUM =(Start Bit+ Data_H+ Data_L)&0x00FF

=(0XFF + 0X07 + 0XA1)&0x00FF

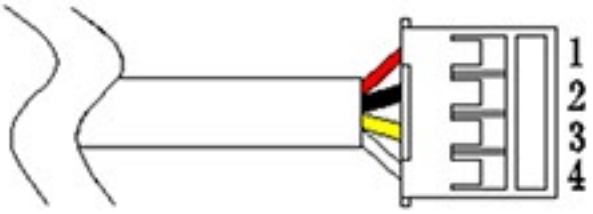
=0XA7

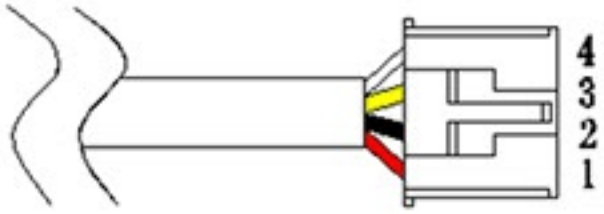
Liquid Level Value= Data_H*256+ Data_L=0X07A1

Converts to decimal is equal to 1953, means current measurement value is 1953mm

DS1603DA-3R V2.0 Communication protocol instruction

1. Pin out





Pin	Name	Description	Note
Red wire	VCC	DC 10-36V power input	
Black Wire	GND	GND	
Yellow wire	B	DATA –	
White wire	A	DATA+	

2. General information

The sensor has built-in two controllable communication protocols, DYP protocol and modbus protocol as a slave device. The two protocols can automatically determine which protocol data frame received data is, and respond with the data frame of the corresponding protocol.

3. Protocol Specification

Default communication format: 9600,n,8,1（Baud Rate 9600， no check bit， 8 data bite， 1 stop bit）

4. Scope of communication protocol

This product can communicate with any host device with RS485 communication interface that supports Modbus protocol (must support 0x03 function code and 0x06 function code) or supports DYP protocol.

5. Modbus Protocol

5.1 Modbus Register address

Modbus RTU

Protocol: Modbus Mode: RTU Liquid level sensor is slave Slave address 0x01 as default

Modbus read function, function code: 0X03			
Status	**Register Address**	**Register Function**	**Description**
Read -only	0x00	Process value	Process value, unit 1mm
Read -only	0x01	Real time value	Real time value, unit 1mm
Reversed	0x02	Reserved	Reserved
Modbus write function, Code:0X06			
Reversed	0x03	Reserved	Reserved
Read-write	0x04	Slave addres	Modbus Slave address, Default is 0X01, ranging 0X01~0XF7, save when powered off.
Read-write	0x05	Setting detected medium	0x01：water 0x02：oil， Other values are invalid， Default 0x01
Read-write	0x06	Setting working period	Set the working speed of the probe to work once in N seconds, the value of N is 0x01~0x3C, the unit is second, the default value is 0x02

Remarks: The processing value is the processed value after the sensor has detected liquid level value multiple times, and the real-time value is each detecting by the sensor.

5.2 Modbus protocol example

(1) Read the value of register at address 0X01 (real-time value), the return value is 0x00D2
Master send：01 03 00 01 00 01 D5 CA
Slave Response：01 03 02 00 D2 38 19

(2) Read two data from address 0X00, the processing value and the real-time value, the returned data processing value is 0x00DC, and the real-time value is 0x00DD
Master Send：01 03 00 00 00 02 C4 0B
Slave Response：01 03 04 00 DC 00 DD FB 90

(3) Write data 0x02 to address 0x05, the measurement medium is oil.
Master Send：01 06 00 05 00 02 18 0A
Slave Response：01 06 00 05 00 02 18 0A

(4) Write data 0x0A to address 0x06 and change the duty cycle to 10 seconds
Master Send：01 06 00 06 00 0A E9 CC
Slave Response：01 06 00 06 00 0A E9 CC

(5) Write data 0X02 to address 0X04 and set the slave address to 0x02
Master Send：01 06 00 04 00 02 49 CA
Slave Response：01 06 00 04 00 02 49 CA

(6) After changing the slave address, read the value of the register at address 0x01 (real time value), 0x0082
Master Send：02 03 00 01 00 01 D5 F9
Slave Response：02 03 02 00 82 7C 25

(7) After changing the slave address, write data 0x01 to address 0x06 and change the duty cycle to 1 second
Master Send：02 06 00 06 00 01 A8 38
Slave Response：02 06 00 06 00 01 A8 38
Note: The above values are all hexadecimal numbers

6. DYP protocol instruction

6.1 DYP Protocol Control Command Feature Code

Control behavior	Read Process value	Read Real time value	Modify sensor address	Medium speed setting	Woring period setting
Code	0x01	0x02	0x03	0x04	0x05

6.2 DYP protocol data frame format

Frame data	Instruction	Byte
Start bit	0x55	1byte
Start bit	0xaa	1byte
Address	Default 0x01	1byte
Command	Feature code	1byte
Data_H	Data high 8 bit	1byte
Data_L	Data low 8 bit	1byte
Checksum	Checksum communication	1byte

6.3 DYP Protocol and checksum

Checksum=(Start bit + Address + Command + data)&0x00ff

6.4 DYP Protocol communication example

6.4.(1) Read Liquid level value

Two command feature codes for reading liquid level values: Command feature code for reading processed value: 0x01 Command feature code for reading real-time value: 0x02

Remarks: The processing value is the value processed after the sensor has detected the liquid level value for many times, and the real-time value is the liquid level value detected by the sensor each time.

The operation method of the two command feature codes is the same. The following takes reading the processing value as an example to introduce the method of reading the liquid level value.

	Start Bit		Address	Command	Data		Checksum
Master Send	0x55	0xaa	0x01	0x01	N/A	N/A	Checksum
Slave response	0x55	0xaa	0x01	0x01	Data_H	Data_L	Checksum

Example: Reading processing value of 0x01 address device.

Sensor Address	0x01
Master Send	0x55 0xaa 0x01 0x01 checksum
Checksum	(0x55+0xaa+0x01+0x01) &0x00ff = 0x01
Sensor return	0x55 0xaa 0x01 0x01 0x02 0x33 checksum
Checksum	(0x55+0xaa+0x01+0x01+0x02+0x33) &0x00ff = 0x36
Instruction	0x02 is high bit value of distance, 0x33 is low bit value of distance. Distance value is 0x0233, transform to decimal is 563 unit is mm

6.4.(2) Modify sensor address

Command code of Modify sensor address: 0x03 (ADD: the address which will be modified)

	Start Bit		Address	Command	Data		Checksum
Master Send	0x55	0xaa	ADD	0x03	N/A	N/A	Checksum
Slave response	0x55	0xaa	ADD	0x03	N/A	N/A	Checksum

Example: Modify 0x01 to 0x05

Original address of sensor	0x01	Modify address to	0x05
Master send	0x55 0xaa 0x05 0x03 checksum		
Checksum	(0x55+0xaa+0x05+0x03) &0x00ff = 0x07		
Sensor response	0x55 0xaa 0x05 0x03 checksum		
Checksum	(0x55+0xaa+0x05+0x03) &0x00ff = 0x07		
Instruction	Setting success when return frame data same with sent, or failed.		

Example of reading processed value after modified address

Sensor Address	0x05
Master Send	0x55 0xaa 0x05 0x01 checksum
Checksum	(0x55+0xaa+0x05+0x01) &0x00ff = 0x05
Sensor Response	0x55 0xaa 0x05 0x01 0x02 0x33 checksum
Checksum	(0x55+0xaa+0x05+0x01+0x02+0x33) &0x00ff = 0x3a
Instruction	0x02 is high bit value of distance, 0x33 is low bit value of distance. Distance value is 0x0233, transform to decimal is 563 unit is mm

Example of modify tested medium after modified address

Sensor Address	0x05
Master Send	0x55 0xaa 0x05 0x04 0x00 0x02 checksum
Checksum	(0x55+0xaa+0x05+0x04+0x00+0x02) &0x00ff = 0x0a
Sensor return	0x55 0xaa 0x05 0x04 0x00 0x02 checksum
Checksum	(0x55+0xaa+0x05+0x04+0x00+0x02) &0x00ff = 0x0a
Instruction	Setting success when return frame data same with sent, or failed.

6.4.(3) Modify testing medium

Command code: 0x04

	Start Bit		Address	Command	Data		Checksum
Master Send	0x55	0xaa	ADD	0x04	Data	Data	Checksum
Slave response	0x55	0xaa	ADD	0x04	Data	Data	Checksum

Example: Modify testing medium to diesel, 0x01 is water, 0x02 is diesel. Default value is 0x01.

Sensor Address	0x01
Master Send	0x55 0xaa 0x01 0x04 0x00 0x02 checksum
Checksum	(0x55+0xaa+0x01+0x04+0x00+0x02) &0x00ff = 0x06
Sensor return	0x55 0xaa 0x01 0x04 0x00 0x02 checksum
Checksum	(0x55+0xaa+0x01+0x04+0x00+0x02) &0x00ff = 0x06
Instruction	Setting success when return frame data same with sent, or failed.

6.4.(4) Setting working period

Command code of modify sensor working period: 0x05

	Start Bit		Address	Command	Data		Checksum
Master Send	0x55	0xaa	ADD	0x05	Data	Data	Checksum
Slave response	0x55	0xaa	ADD	0x05	Data	Data	Checksum

Example: Setting sensor working period of 10 seconds, fill in 0x000a in data bit, value range is 0x01~0x3C. Default value is 0x02

Sensor Address	0x01
Master Send	0x55 0xaa 0x01 0x05 0x00 0x0a checksum
Checksum	(0x55+0xaa+0x01+0x04+0x00+0x0a) &0x00ff = 0x0f
Sensor return	0x55 0xaa 0x01 0x05 0x00 0x0a checksum
Checksum	(0x55+0xaa+0x01+0x05+0x00+0x0a) &0x00ff = 0x0f
Instruction	Setting success when return frame data same with sent, or failed.

6.4.(5) Broadcast address

Broadcast address: 0xFF

	Start Bit		Address	Command	Data		Checksum
Master Send	0x55	0xaa	0xff	0x01	N/A	N/A	Checksum
Slave response	0x55	0xaa	0xff	0x01	Data_H	Data_L	Checksum

Example: Use 0x01 code to read processing value through the 0xFF broadcast address

Sensor Address	0x01
Master Send	0x55 0xaa 0xff 0x01 checksum
Checksum	(0x55+0xaa+0xff+0x01) &0x00ff = 0xff
Sensor return	0x55 0xaa 0x01 0x01 0x02 0x45 checksum

Checksum	0x55+0xaa+0x01+0x01+0x02+0x45) &0x00ff = 0x48
Instruction	0x02 is high bit value of distance, 0x45 is low bit value of distance, Distance value is 0x0245, transform to decimal is 581 unit is mm

Example: Use 0x03 code to read address value through the 0xff broadcast address

Sensor Address	**0x01**
Master Send	0x55 0xaa 0xff 0x03 checksum
Checksum	(0x55+0xaa+0xff+0x03) &0x00ff = 0x01
Sensor return	0x55 0xaa 0x01 0x03 checksum
Checksum	(0x55+0xaa+0x01+0x03) &0x00ff = 0x03
Instruction	Address value is 0x01

Example: Use the 0x04 command to read the currently set measurement medium through the 0xff broadcast address

Sensor Address	**0x01**
Master Send	0x55 0xaa 0xff 0x04 checksum
Checksum	(0x55+0xaa+0xff+0x04) &0x00ff = 0x02
Sensor return	0x55 0xaa 0x01 0x04 0x00 0x02 checksum
Checksum	(0x55+0xaa+0x01+0x04+0x00+0x02) &0x00ff = 0x06
Instruction	Data value is 0x0002, currently set measurement medium is diesel

Example:Use the 0x05 instruction to read the currently set duty cycle through the 0xff broadcast address

Sensor Address	0x01
Master Send	0x55 0xaa 0xff 0x05 checksum
Checksum	(0x55+0xaa+0xff+0x05) &0x00ff = 0x03
Sensor return	0x55 0xaa 0x01 0x05 0x00 0x0a checksum
Checksum	(0x55+0xaa+0x01+0x05+0x00+0x0a) &0x00ff = 0x0f
Instruction	Data value is 0x000a which means 10 seconds duty cycle.

6.4.(6) Attention:

(1) No matter what the address of the sensor is, once the data frame with the address value of 0xff is received, it will respond according to the command feature code of the data frame, and the address value of the response is the local address value instead of 0xff.

(2) When using the 0x03 command when using the broadcast address, 0xff will not be set as the sensor address, but only the current address value of the sensor will be returned.

(3) When the address of the sensor cannot be obtained, the broadcast address can be used, and the address of the current sensor can be obtained according to the address bit of the reply data frame.

(4) The broadcast address cannot be used on a bus loaded with multiple sensors, otherwise multiple modules will respond at the same time and the bus communication will fail. It can only be used in the case of one host to one sensor.

7. LED indicator instruction

(1) LED is always on: the sensor is powered on but no liquid is detected.

(2) LED flashes slowly: When the sensor detects liquid, the LED indicator flashes at a frequency of 1 time per second.

8. Module Selection

The performance of this series of sensors is the same, user selects the corresponding model output method according to the application method.

Model No.	Feature	Note
DS1603DA-3U V2.0	UART output	
DS1603DA-3R V2.0	RS485 output	

9. Module Selection