TOF Sense is a TOF-based (Time of Flight) laser ranging sensor that offers 1cm-5m detection range, 1mm resolution, ± 1.5cm error, and 10Hz data update frequency. The sensor supports 15 ° ~ 27 ° adjustable FOV, UART and CAN communication (selected by setting). Besides, it allows users to actively query the output data, making data acquisition much easier. With a size of 35.58 * 12 * 8.05mm, this small and compact sensor can be used as a distance-measuring tool for distance detection, a robot to avoid obstacles, and can also be used in drones areas such as altitude setting and route planning.

The difference from other ranging sensors is that this sensor reserves two identical communication interfaces. When setting IDs for each sensor and connecting multiple sensors in series, the ranging information of all sensors can be read by just one communication interface.

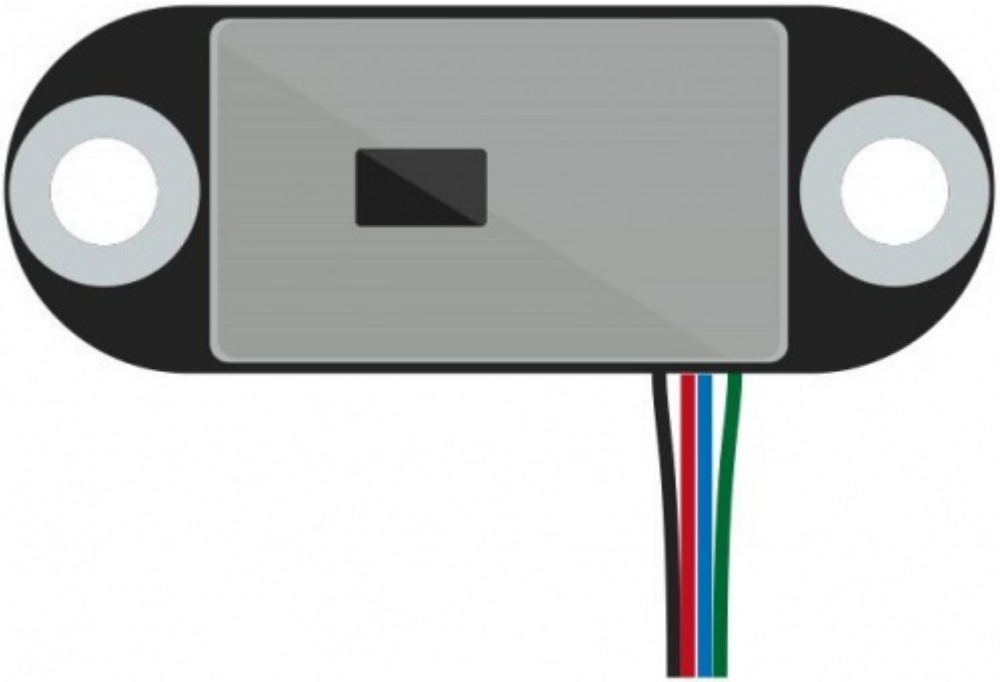
> ⚠ **NOTE**: The UART interface supports a maximum of 8 cascades, and the CAN interface supports 7 cascades at most. Under cascade distance-measuring, it is suitable for UART query, CAN query, and CAN active output.

Specification

- Operating Voltage: 5V
- Operating Current: 0.06A
- Communication Interface: UART, CAN
  - UART (two interfaces can be used as UART simultaneously, 3.3V TTL, 921600 default band rate)
  - CAN (two interfaces can be used as CAN simultaneously, 1Mbps default band rate)
- Maximum Cascading Number: 8 for UART, 7 for CAN
- Blind Zone: 1cm
- Typical Detection Range:
  - Short-range: 0.012m~2.16m
  - Mid-range: 0.012m~3.60m
  - Long-range: 0.01m~5.00m
- Typical Detection Accuracy:
  - Short-range: accuracy±1.0cm, standard deviation<0.3cm
  - Mid-range: accuracy±1.0cm, standard deviation < 1.5cm
  - Long-range: accuracy±1.5cm, standard deviation<0.5cm@[0.01,3]m range

    - Long-range: accuracy±1.5cm, standard deviation<0.5cm@[0.01,3]m range, standard deviation<8cm@[3,5]m range
- Wavelength: 940nm (compliant Class 1 Standard)
- FOV: 15°~27° (adjustable)
- Power Supply: 3.7V~5.2V (the power supplies of all communication interfaces are electrically connected, so any interface can be power supply interface.)
- Power Consumption: 290mW (UART active output, long-range detection, 5.0 power supply, current 58mA)
- Weight: 2.7g
- Dimension: 35.58x12x8.05mm/ 1.40x0.47x0.32"

Board Overview



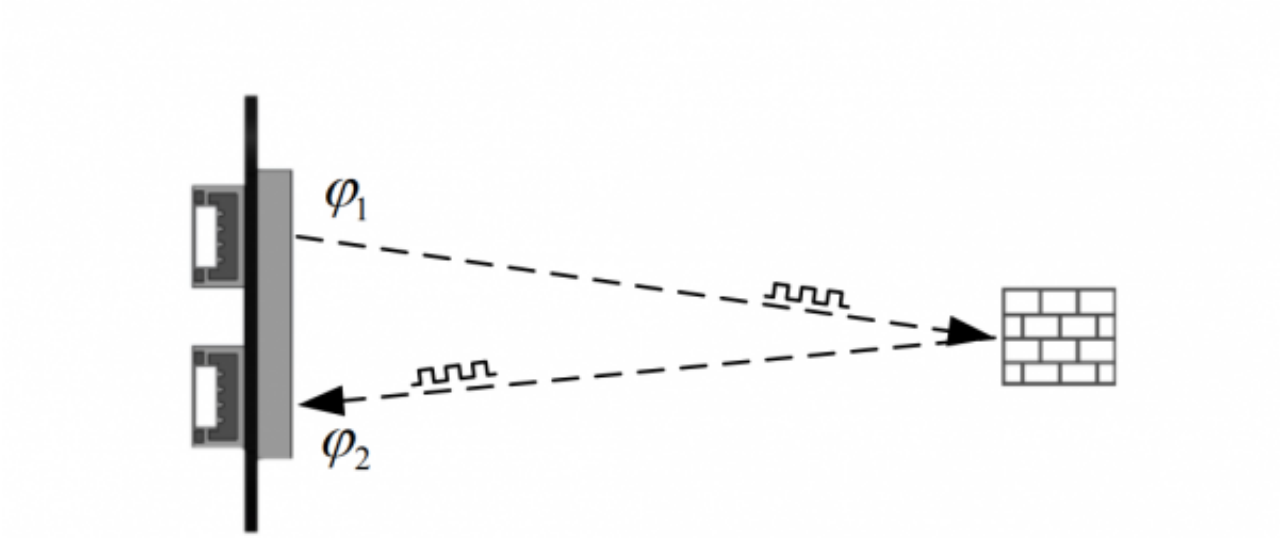
Color	Name	Description
Black	VCC	+
Red	GND	-
Blue	TTL_RXD/CAN_H	Serial port receive/ CAN bus
Green	TTL_TXD/CAN_L	Serial port send/ CAN bus

Button function: restart

Module Description

Principle

TOF is an absolute distance detection technique in which the sensor emits a debugged near-infrared light, which is reflected after an object, and the sensor converts the distance of the subject by calculating the time difference or phase difference of light emission and reflection to generate depth information. Compared with the binocular scheme and the 3D structural light scheme, TOF has the advantages of working distance, wide application scene, and higher accuracy over long distance. Therefore, it is often used in personnel proximity detection, robot barrier avoidance, camera autofocus and other occasions. In the outdoor environment, there is near-infrared light from the sun's light, which affects the measurement of the module.



Function

TOFSense supports short, medium and long distance measurement modes, each of which can output information such as distance measurement *dis*, distance status *dis status*, signal strength *signal strength*, etc.

Outputs: TOFSense supports active output, query output.

- The active output is the module's autonomous continuous transmission of measurement data frames, the send frequency is 10Hz.
- The query output is the module receives the query frame and output measurement data frame.

Connection: TOFSense supports UART and CAN outputs. These two output methods share the same set of physical interfaces. Among them, the UART output supports the active output, the query output, and the query output under multiple cascading connections of a single module. The CAN output supports the active output, query output, and the active output and query output under multiple module cascading connections.

Interfaces and Baut Rate

The TOF Sense standard version supports both UART and CAN communication methods, which share a single interface. The factory default is UART communication, if you need to use CAN communication mode, you can configurate it via the module host computer.

UART Communication

Under serial communication, the Baud rate setting range is shown below.

UART_Baudrate
115200,230400,460800,921600,1000000,1382400,1843200,2000000,2764800,3000000

CAN Communication

Under CAN communication, the Baud rate setting range is shown below.

CAN_Baudrate	Note
100K, 250K, 500K, 1M, 2M, 3M	1M (baud rate in default)

Distance Status

The module can output the current distance state, and the user can process the data in conjunction with the distance state, as shown in the table below.

Value	Note
0	Valid measurement of distance
1	Standard deviation is greater than 15mm
2	Signal strength is below 1Mcps
4	Phase is out of bounds
5	HW error or VCSEL error
7	Mismatch phase
8	Internal algorithm underflow fault
14	Invalid measurement of distance

Signal Strength

Indicates the strength of the current return signal, and a higher value indicates that the returned signal is stronger.

FOV

The size of the field of view angle determines the field of view of TOFSense, and the module can change the X-way field-of-view angle *fov.x*, the Y-direction field angle *fov.y*, the X-directional offset *fov.x_offset*, and the Y-direction offset *fov.y_offset*. X, Y direction field of view angle setting range is 15° to 27°, X, Y direction field of view angle offset setting range is -6° to 6°.

Indicator Light

The indicate lights have two flashing states, flashing 50ms quickly and 100ms flashing slowly. The status and meaning of the LED are shown in the table below.

Status	Note
Flash quickly(interval 0.1s)	Module start-up phase/module firmware update
Flash slowly(interval 1s)	The module is working properly

Module protocol resolution

The protocol consists of Frame Header, Function Mark, Data, sum Check. Among them, Frame Header and Function Mark are fixed values. Data is the data of transfer content. Sum Check is the lowest byte of the sum (that is, all the following bytes added) of Frame Header, Function Mark, and Data. The composition of the agreement: **Frame Header + Function Mark + Data + Sum Check**

1.Example This example takes a single-module continuous ranging with the UART active output mode as the scenario.

Raw data: 57 00 ff 00 9e 8f 00 00 ad 08 00 00 03 00 ff 3a

The instruction format is as follows:

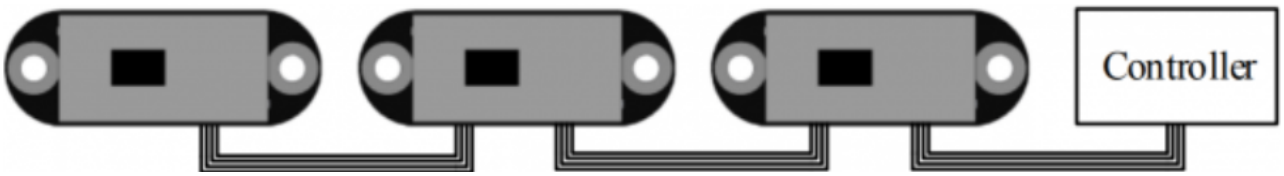
Data	Type	Length（Bytes）	Hex	Result
Frame Header	uint8	1	57	0x57
Function Mark	uint8	1	00	0x00
Reserved	uint8	1	ff	*
ID	uint8	uint8	1	00

System_time	uint32	4	9e 8f 00 00	36766ms
dis * 100	uint24	3	ad 08 00	2.221m
dis_status	uint8	1	00	0
signal_strength	uint16	2	03 00	3
Reserved	*	1	...	*
Sum Check	uint8	1	3a	0x3a

Data | **Type** | **Length（Bytes）** | **Hex** | **Result**

Cascade ranging measurement

The ranging information for all sensors can be read through a single communication interface by configuring multiple sensors with different IDs and in series. The connection diagram is shown in the following image.



Please note that cascade range is only suitable for UART queries, CAN queries, and CAN active output.

Tutorial: Arduino Debugging(PC serial port)

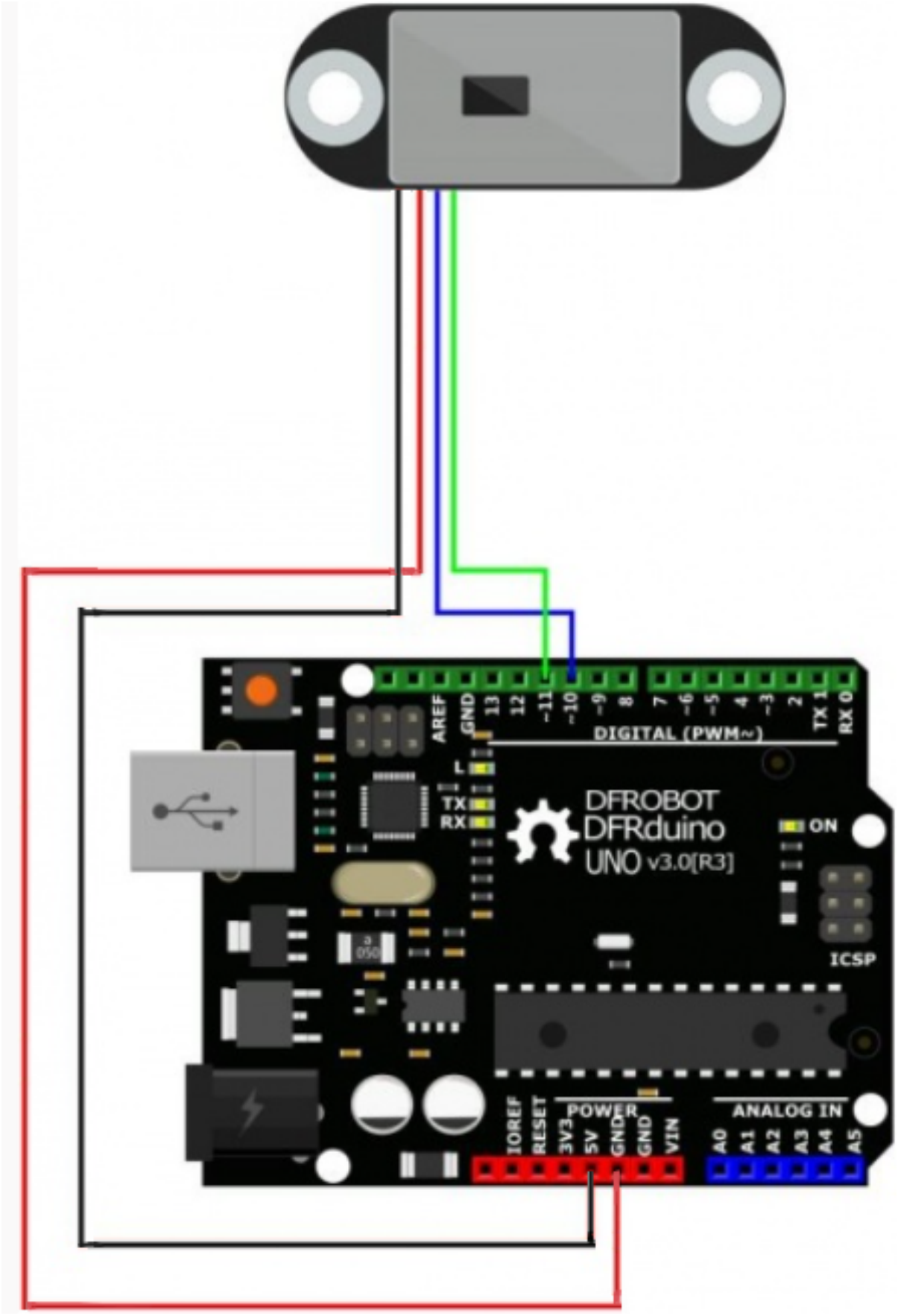
Requirements

- **Hardware**
  - DFRduino UNO R3 (https://www.dfrobot.com/product-838.html) (or similar) x 1
  - TOF Sense Laser Ranging Sensor(5m) x 1
  - M-M/F-M/F-F Jumper wires
- **Software**
  - Arduino IDE (https://www.arduino.cc/en/Main/Software)

Since TOF Sense is a serial port device, while the average Arduino has only one hardware serial port. So, it is recommended to use a soft serial port to work with sensors, and users can also use multiple serial devices, such as Arduino Leonardo, Arduino Mega2560, etc. The most common one--Arduino UNO is used here as a controller, defining D10 and D11 as soft string ports.

Connection Diagram

Use the PC-side serial port software to display the distance detected and to power the entire system.



Sample Code

PC serial tool is required, and the data read will be displayed in the serial tool interface

```
/*
  * @File  : DFRobot_TFmini_test.ino
  * @Brief : This example use TFmini to measure distance
  *         With initialization completed, we can get distance value and signal str
  * @Copyright   [DFRobot](https://www.dfrobot.com), 2016
  *             GNU Lesser General Public License
  *
  * @version  V1.0
  * @date  2018-1-10
*/

#include <SoftwareSerial.h>
SoftwareSerial mySerial(11,10); // RX, TX
int i;
int dat[32]={0};
unsigned long a,p,q,z;
void setup()
{
 Serial.begin(9600);
 mySerial.begin(115200);
}

void loop()
{
    if(mySerial.available()>=32)
    {
      if(millis()-a>500)
      {
        a=millis();
        for(i=0;i<32;i++)
        {
          dat[i]=mySerial.read();
        }
        for(i=0;i<16;i++)
        {
          if(dat[i]==0x57&&dat[i+1]==0&&dat[i+2]==0xff&&dat[i+3]==0)
          {
            if(dat[i+12]+dat[i+13]*255==0)
            {
              Serial.println("Out of range!");
            }
            else
            {
          z=dat[i+11];
          Serial.print("Status = ");
          Serial.print(z);
```

```
            p=dat[i+12]+dat[i+13]*255;
            Serial.print("  Strength = ");
            Serial.print(p);
                q=dat[i+8]+dat[i+9]*255;
                Serial.print("  Distance = ");
                Serial.print(q);
                Serial.println("mm");
              }
               break;
            }
          }
        }
      }
}
```

Expected Results