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information

# The X-D1000 User Manual

X-Dynamics

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# The X-D1000 User Manual

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# The X-D1000 User Manual

## 1. Introduction

### 1.1., The document summary

This document mainly introduces the X-D1000, the iToF series independently developed by X-Dynamics, including the functions, specifications, some design details and operation guide and other parts, mainly for developers to understand and use related products.

### 1.2., The terms for the description

Table 1. Term description standard

term	description
iTOF	The iToF, indirect Time-of-Flight, is an indirect time-of-flight depth sensor that measures the flight time of light by measuring the phase offset. The measurement accuracy of this technology is stable, will not increase the measurement range and reduce, and strong anti-interference ability, is widely used in unmanned driving, AR and other industrial fields.
FOV	Camera field of view, used to describe the angle range of the camera observing a given scene, mainly contains horizontal field of view (H-FoV), vertical field of view (V-FoV) and diagonal field of view (D-FoV)
RGB	RGB mode is one of the most common color patterns, which mainly consists of three color channels, red, green and blue, and generates various faces by

	<p>adjusting the proportion of these three colors</p> <p>colour. The advantage of RGB mode is its high color restoration, which is suitable for digital image processing.</p>
UVC	<p>UVC, fully known as USB Video Class, USB video class, is a kind of USB The protocol standard as defined by the video capture device.</p>

ISP	The ISP is an image signal processor (Image Signal Processor), mainly used for Unit of the output signal processing to the front-end image sensor.
HDR	High dynamic range, High dynamic range imaging, is a improved image brightness and Contrast processing techniques, HDR can provide more than ordinary images trends Scope and image details, to better reflect the visual effect in the real environment.
EV	Exposure Value, The exposure value, is the combination of shutter speed value and diaphragm value, represents a numerical value for the optical ability of the product lens. The sensitivity of the product in the environment matches to the appropriate exposure values.
RAW	Raw data of the phase difference output by the TOF sensor, accessible by calling the SDK Raw data of the camera.
Depth	Depth map, the image is a 2 dimensional image, each pixel value in the image represents the field at the distance between the scene and the camera, the depth data of the camera can be obtained through SDK.
PointCloud	Point cloud map, the image is a three-dimensional image, converted through a depth map.
RGBD	Combination of visible light and depth data.
Calibration algorithm	Relevant algorithm for calibrating the raw sensor output data with the calibration data.
Deep computing algorithm	Algorithm using phase difference according on the time-of-flight principle.
filtering algorithm	An algorithm for processing images with airspace, time domain and confidence.
Point cloud conversion	The 3 D spatial position point cloud was calculated based on the depth image and the camera calibration parameters.
automatic exposure	The technique where the camera automatically adjusts the integration time according to the received amplitude.



### **1.3. Introduction of iToF imaging technology**

X-D1000 is an industrial camera product based on 3D iTOF (indirect Time-of-Flight) technology solution, that is, the sensor emits modulated near-infrared light, reflected by the object, the sensor by calculating the phase difference between the light emission and the reflection, and then converted into the time difference, to calculate the distance of the photographed scene, to produce depth information. Finally, the three-dimensional contour of the object is presented in a topographic map with different colors representing different distances. Products can be widely used in industrial measurement, consumer electronics and other fields that require 3 D images.

## **2. Safety instructions**

### **2.1., Laser safety**

X-D1000 camera has passed CLASS I certification and will not harm the human body during normal use according to the requirements of EN60825. X-D1000 will emit invisible laser during work, it is recommended to avoid direct human eye close contact.

### **2.2., Installation safety**

Before installing the camera, disconnect the external connection of the device and refer to the installation instructions for normal installation.

### **2.3., Electrical connection**

The product is powered by DC power, DC power use range of 18V~25.2V, lower than 18V or higher than 25.2V may cause product damage. Do not pull or insert violently during powering the camera, which may damage the camera power supply interface or power cord.

### **2.4. Unauthorized modification of the device is strictly prohibited**

Do not disassemble the camera or modify the device without authorization. Each camera has been accurately calibrated before leaving the factory, and the accuracy of the camera or damage to the product may be lost during the disassembly or modification, and the safety of the operator may also be threatened.

In case of failure or related questions, please contact the employees of X-dynamics

## 3. Product specifications

### 3.1. TOF Camera

The basic parameters of the TOF camera of the product X-D1000 are shown in the following table:

Table 2. Basic parameters table of the TOF camera

performance index	performance parameter
Resolution and Frame Rate	640 x 480@5fps / 320 x 240@20fps
range	0.2 ~ 10m@10% reflectivity
accuracy	0.5%@1.5m
horizontal FOV	105°
perpendicular FOV	75°
wavelength	940nm

### 3.2. RGB Camera

The basic parameters of the RGB camera for the product X-D1000 are shown in the following table:

Table 3. Basic parameters table of the RGB camera

performance index	performance parameter
Resolution and Frame Rate	1920 x 1080@20fps
horizontal FOV	84°
perpendicular FOV	60°
UVC	support
Shutter mode	Curtain shutter
ISP function	HDR 、 EV

### 3.3. Camera dimensions

The size parameters of product X-D1000 are shown in the following table. Please refer to this article 4. 1 for the specific size diagram.

Table 4. Camera size parameter table

performance index	performance parameter
long	84mm
wide	73mm
tall	35mm
error	±0. 1mm

### 3.4. External interface

The X-D1000 camera can transmit the depth map, point cloud map, original Raw map and RGBD map externally. Customer can select the corresponding image according to your own needs.

Table 5. External interface parameter table

performance index	performance parameter	remarks
network interface	TOF data: Depth, PointCloud, RAW map, RGBD merging data ;	Users can select the configuration based on requirements
USB2.0		
source	24V /5A	External synchronization of the CAN communication

### 3.5. Power supply and power consumption

The parameters in the following table are the power supply demand of the product. Please refer to the following parameters to configure the corresponding power supply accessories, such as super

Out of the following range values, the product may be damaged.

Table 6. Power supply and power consumption parameters table

performance index	performance parameter
Average power consumption	12W
average current	0.5A
Standby current	<0.2A
peak point current	5A
working voltage	24V
The main board is electrical connected to the housing	direct contact

### 3.6. Reliability standards

The parameters in the following table are the absolute parameter values of the working environment of the product, beyond the range value can cause damage to the product, and then it will have a shorter working life.

Table 7. Reliability standard parameter table

performance index	performance parameter
operating ambient temperature	-20°C ~ 60°C
Humidity of working environment	-40°C ~ 80°C
levels of protection	IP 67
security classification	CLASS 1

### 3.7. Functional parameters

Basic function parameters of product X-D1000 are shown in the following table:

Table 8. Functional parameters Table

performance index	performance parameter
operating system	Windows / Linux / ROS
algorithm SDK	Pre-processing: calibration algorithm, depth calculation algorithm, etc.;  Post-processing: filtering algorithm, point-cloud conversion, automatic exposure, etc.;
Parameters can be set	Resolution, frame rate, integration time, confidence, etc

## 4. Structural description

### 4.1. Structural dimension diagram

The structural dimensional diagram of the X-D1000 product is described as follows:

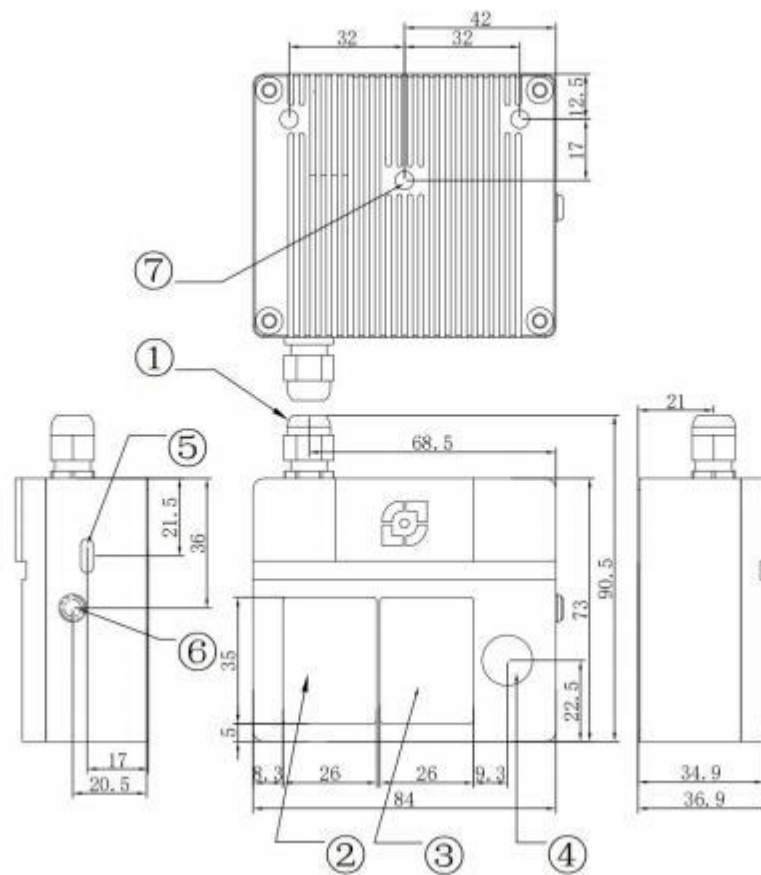


Figure 3. X-D1000 structure diagram in Fig

Note (in mm):

- 1 Power supply and network communication outlet;
- 2 Vcsel TOP protective glass;
- 3 Sensor TOP protective glass;
- 4 RGB module TOP Protective glass ;

5. Type-C interface;

6. Status indicator light;

7 Mounting hole (three in total), thread size 1 / 4-20,4mm deep.

## 4.2. Connection schematic diagram

The product connection diagram is as follows:

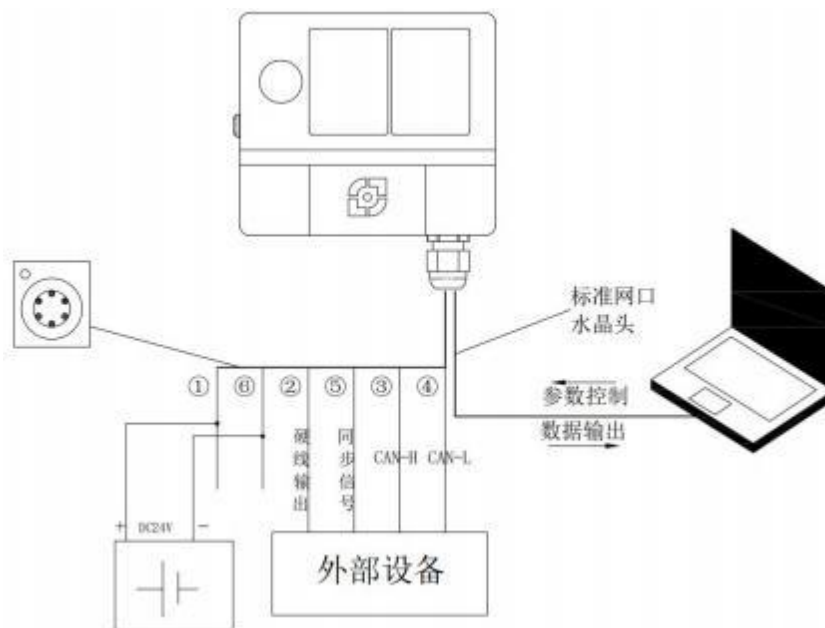
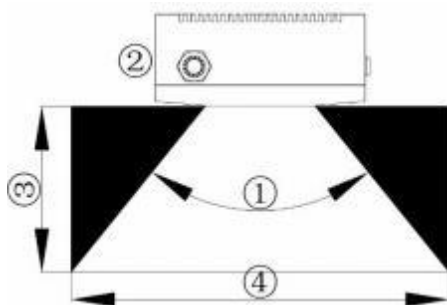


Figure 2. Schematic diagram of the product connection

## 4.3., Installation instructions



1 Field of view angle

2 The camera

3 Distance between the camera and the target

4 The field of view

(1) Installation location, some suggestions on installation location selection are as follows:

1 The target object must be completely within the field of view ④;

2. When installing and positioning, please consider the tolerance;



3 The distance between the camera and the target is the maximum value of the measurement range, please refer to the actual use;

4 The smaller the ③ value, the higher the accuracy;

5 When choosing the installation position, consider to keep the external lens cleanliness of the camera;

6 Do not place test objects that are not meet your expectations, such as mirrors, transparent objects, or other inversions. An object of light, reflecting reflection can cause measurement distortion.

(2) Installation steps are as follows:

1 Install the camera in a fixed position, such as a camera holder;

2 Connect the X-D1000 camera through one end of the Ethernet cable and the other end to the host processor;

3 Insert the DC connector of the 24V power adapter into the transfer connector of X-D1000

4 Plug the adapter into the power supply;

5 Please keep the IP address of the host computer in the same network segment as the camera, and the IP of the camera and the upper computer software need the IP Synchronize at any time;

6 The default IP of 6 X-D1000 is 192.168.31.3, and the default IP in the host software is 192.168.31.3, you can modify the X-D1000 default IP through the host computer. Please note (⑤). after modification

#### **4.4., Heat dissipation suggestions**

The shell of the product itself can meet the cooling requirements, without

adding additional heat dissipation mode. It is recommended to install it where

there is ventilation and convection, and the metal mounting surface contacting with the camera.

## 5. Product interface

### 5.1. X-D1000 interface

The product hardware interface structure diagram is shown as follows:



Figure 4. Product interface diagram

The corresponding interface specification parameters in the product interface diagram are shown in the table below:

Table 2. Interface specifications		
Interface	No.	output
hardware interface	①	One hundred trillion net
	②	DC5521 Power supply input

(Note: Other interfaces, such as external synchronization, input and output interface is optional.)

### 5.2. LED indication

The LED behind the camera, the indicator light, indicating the current state of the camera.

- . After power on, waiting for a while the indicator light is on, that is, the camera is powered on successfully;
- . The indicator light is not on, indicating that the camera is disconnected.

## 6. Working conditions

### 6.1. Hardware requirements

The hardware requirements of the product X-D1000 are as follows:

- . Adapter: 24V / 5A;
- . Adapter interface: DC5521 male;

### 6.2. Software requirements

Operating system: Windows / Linux (PC or ARM) / ROS;

Host computer: XDynamicsRKShell.exe ;

### 6.3. SDK Description

Xdynamics SDK, is a 3D camera for iTOF, providing cross-platform (Windows, ROS, Linux)

Software Development Package, which provides the following functions:

- . Access to and control of hardware devices;
- . Access, control, and data acquisition of the sensors contained in the device;
- . Provide filtering and other algorithm capabilities;
- . Depth, PointCloud, RAW map and RGBD fusion data;
- . Provide example program, help documents and tool software;

If necessary, please contact the relevant sales staff for the latest SDK.

### 6.4. Version upgrade

The version can be upgraded / degraded through the host machine independently developed by X-Dynamics. For the specific operation, refer to the corresponding version of the principal machine;

After the successful upgrade, the camera needs to be restarted before the new version will take effect. Make sure that the communication mode is stable during the upgrade process, otherwise the upgrade will fail. If the upgrade fails, please restart the camera, wait the camera recognizes normally, then repeat the upgrade operation again.