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All-sky imager (project version)

LC-TK Series Manual

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LC-TK 系列天空成像仪

LC-TK series sky imager

一、产品介绍

Product Introduction

全天空成像仪是一款集成了先进光学技术、图像传感器和智能算法的全天候、自动化天空云量观测终端。它通过特殊设计的光学传感系统，自动捕捉清晰的全天空画面，并利用智能云识别算法对云层进行量化分析，为用户提供站点级的“天空实况”，为光伏电站的发电功率预测提供有力的数据保障。



The all-sky imager is an all-weather, automated sky cloud observation terminal that integrates advanced optical technology, image sensors, and intelligent algorithms. Through a specially designed optical sensing system, it automatically captures clear all-sky images and utilizes intelligent cloud recognition algorithms to perform quantitative analysis of cloud layers, providing users with site-level "sky real-time data" and providing powerful data support for power generation forecasting of photovoltaic power stations.

二、产品特点

Product Features

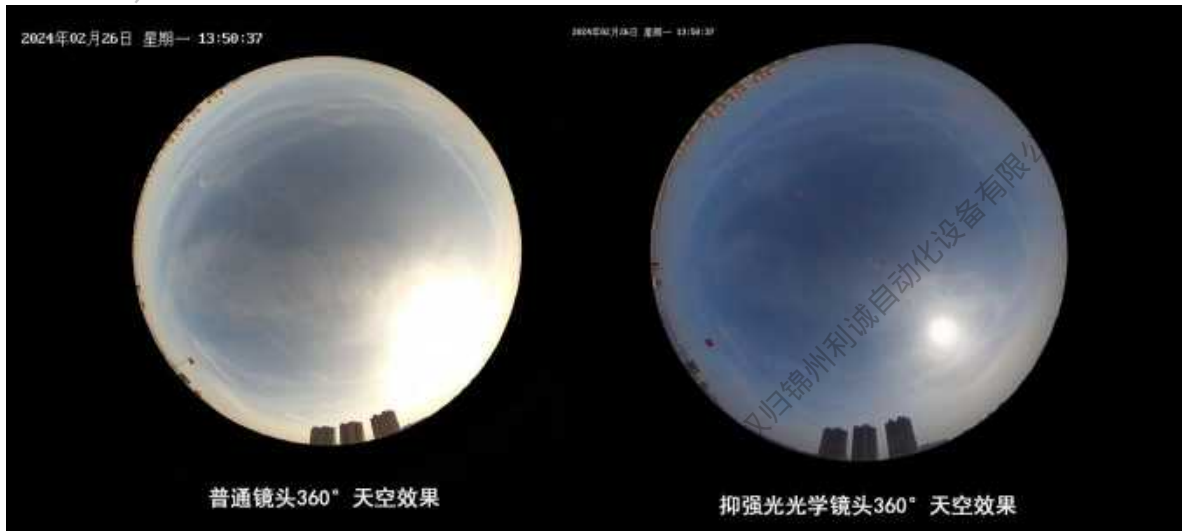
- 高精度 4K 分辨率，拍摄效果更清晰，拍的清才能算的准。
- 全自动深度学习技术，快速识别和删除非天空影像，内置 50 余种全自研天空模型算法，得到的云量分析结果更精确。
- 内置 GPS 定位模块，可全实现全球范围内全自动观测。
- 安装时无需手动修正，更换安装地点自动学习调整无需人工去现场手动修图。
- 设备小巧，功耗低，防护等级 IP66，满足长期室外观测需求。
- 既能输出数据，又能看到实时照片效果，非只有数据无法对比。
- 本地版工控机自动算法分析，支持局域网和 4G 云平台等多种数据传输方式。满足光伏场站的数据传输及保密性要求。
- 支持多地观测，随安随测，随测随走，自带大容量存储卡保证数据不丢失。
- With high-precision 4K resolution, the shooting effect is clearer. Only when the shooting is clear can the calculation be accurate.
- Fully automated deep learning technology quickly identifies and removes non-sky imagery, with over 50 fully self-developed sky model algorithms built-in, resulting in more accurate cloud analysis results.

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- Equipped with a built-in GPS positioning module, it can fully automate observations worldwide.
- No manual correction is required during installation. The system automatically learns and adjusts when changing the installation location, eliminating the need for manual image correction on-site.
- The equipment is compact, with low power consumption and a protection level of IP66, meeting the long-term outdoor observation needs
- It can not only output data but also display real-time photo effects, making comparisons possible beyond just relying on data.
- Local version of industrial control computer automatic algorithm analysis, supporting multiple data transmission methods such as local area network and 4G cloud platform. It meets the data transmission and confidentiality requirements of photovoltaic power stations.
- Supports multi-location observation, allowing for flexible setup and quick deployment, with built-in high-capacity storage cards ensuring data integrity.

实际拍摄效果展示

Actual shooting effect display



云量观测实例

Cloud cover observation example

三、技术参数

Technical Parameters

参数 parameter	LC-TK01 (本地版) LC-TK01 (Local version)	LC-TK02 (4G版) LC-TK02 (4G version)
算法版本 algorithm version	JX1.3	SD1.1
成像传感器分辨率	4K 1200W 4000*3000 pxels	4K 1200W 4000*3000 pxels

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Imaging sensor resolution		
焦距 focal length	1.5mm @F2.0	1.5mm @F2.0
视场角 field of view	水平视场角: 210° 垂直视场角: 210° 对角线视场角: 210° Horizontal field of view angle: 210° Vertical field of view: 210° Diagonal field of view angle: 210°	水平视场角: 210° 垂直视场角: 210° 对角线视场角: 210° Horizontal field of view angle: 210° Vertical field of view angle: 210° Diagonal field of view angle: 210°
光学强光抑制系统 Optical glare suppression system	支持 support	支持 support
需遮挡太阳 Need to block the sun	不需要 No need	不需要 No need
透雾 fog penetration	支持 support	支持 support
图像增强 image enhancement	支持 support	支持 support
背光补偿 backlight compensation	支持 support	支持 support
3D 数字降噪 3D digital noise reduction	支持 support	支持 support
AI 超级降噪 AI super noise reduction	支持 support	支持 support
自动白平衡 Automatic white balance	支持 support	支持 support
自动增益 AGC Automatic Gain Control (AGC)	支持 support	支持 support
动态对比度增强 Dynamic contrast enhancement	支持 support	支持 support
宽动态 Wide Dynamic Range	120 dB	120 dB
信噪比 signal-to-noise ratio	≥50dB	≥50dB
采样频率	60s~86400s	60s~86400s

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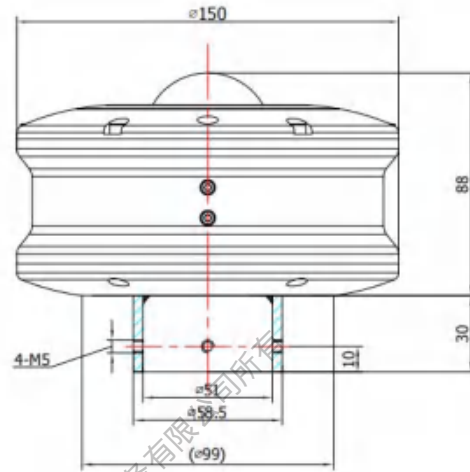
sampling frequency		
存储空间 storage space	256G	100G (可按需扩展) 100G (scalable as needed)
Web 数据平台 Web data platform	支持 support	支持 support
APP APP	不支持 not supported	不支持 not supported
联网需求 Networking requirements	无需联网 No internet connection required	4G 网络 4G network
远程算法升级 Remote algorithm upgrade	不支持 not supported	支持 support
数据输出 data output	当前工作状态 太阳高度角 太阳方位角 日出日落时间 薄云比例 厚云比例 实时总云量 太阳遮挡状态 云速 云向 360° 全天空图像 Current working status solar elevation angle solar azimuth angle Sunrise and sunset time Thin cloud proportion Thick cloud proportion Real-time total cloud cover Sun obscured state Cloud speed cloud direction 360° panoramic image	当前工作状态 太阳高度角 太阳方位角 日出日落时间 薄云比例 厚云比例 实时总云量 太阳遮挡状态 云速 云向 360° 全天空图像 Current working status solar elevation angle solar azimuth angle Sunrise and sunset time Thin cloud proportion Thick cloud proportion Real-time total cloud cover Sun shading state Cloud speed cloud direction 360° panoramic image
数据浏览方式 Data browsing method	本地版平台 Local version platform	云平台 cloud platform
数据输出方式 Data output method	RS485 modbus 格式 (不含图象) RS485 Modbus format (excluding images)	API Json 格式 API JSON format
主机控制箱 Main machine control box	有 have	无 none
算法主机配置	本地边缘计算主机	云服务器

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Algorithm host configuration	CPU: Intel 4 核 内存: 8G 硬盘: 256G Local edge computing host CPU: Intel 4-core Memory: 8G Hard drive: 256GB	CPU: Intel 44 核 88 线程 内存: DDR4 256G 显存: 96G RTX4090, 24G*4 硬盘: 100G/站点 cloud server CPU: Intel 44-core 88-thread Memory: DDR4 256G Video memory: 96G RTX4090 24G*4 Hard disk: 100G per site
工作温湿度 Operating temperature and humidity	-40℃~80℃, 湿度小于 95% (无凝结) -40℃ to 80℃, with humidity less than 95% (no condensation)	-40℃~80℃, 湿度小于 95% (无凝结) -40℃ to 80℃, with humidity less than 95% (no condensation)
防护等级 Protection level	IP66	IP66
供电电压 power supply voltage	DC12V/AC220V	DC12V/AC220V
电流功耗 Current power consumption	最大功耗 20W 正常工作平均功耗 15W Maximum power consumption: 20W The average power consumption during normal operation is 15W	最大功耗 6W 正常工作平均功耗 3.6W Maximum power consumption: 6W The average power consumption during normal operation is 3.6W
数据/供电线 Data/power supply line	10m (标配) 10m (standard configuration)	10m (标配) 10m (standard configuration)
产品清单 Product List	天空成像仪一台 本地版主控机一台 220V 供电线一根 10 米 网线一根 10 米 One sky imager One local master control machine A 10-meter 220V power supply cord A 10-meter network cable	天空成像仪一台 220V 供电线一根 10 米 网线一根 10 米 One sky imager A 10-meter 220V power supply cord A 10-meter network cable

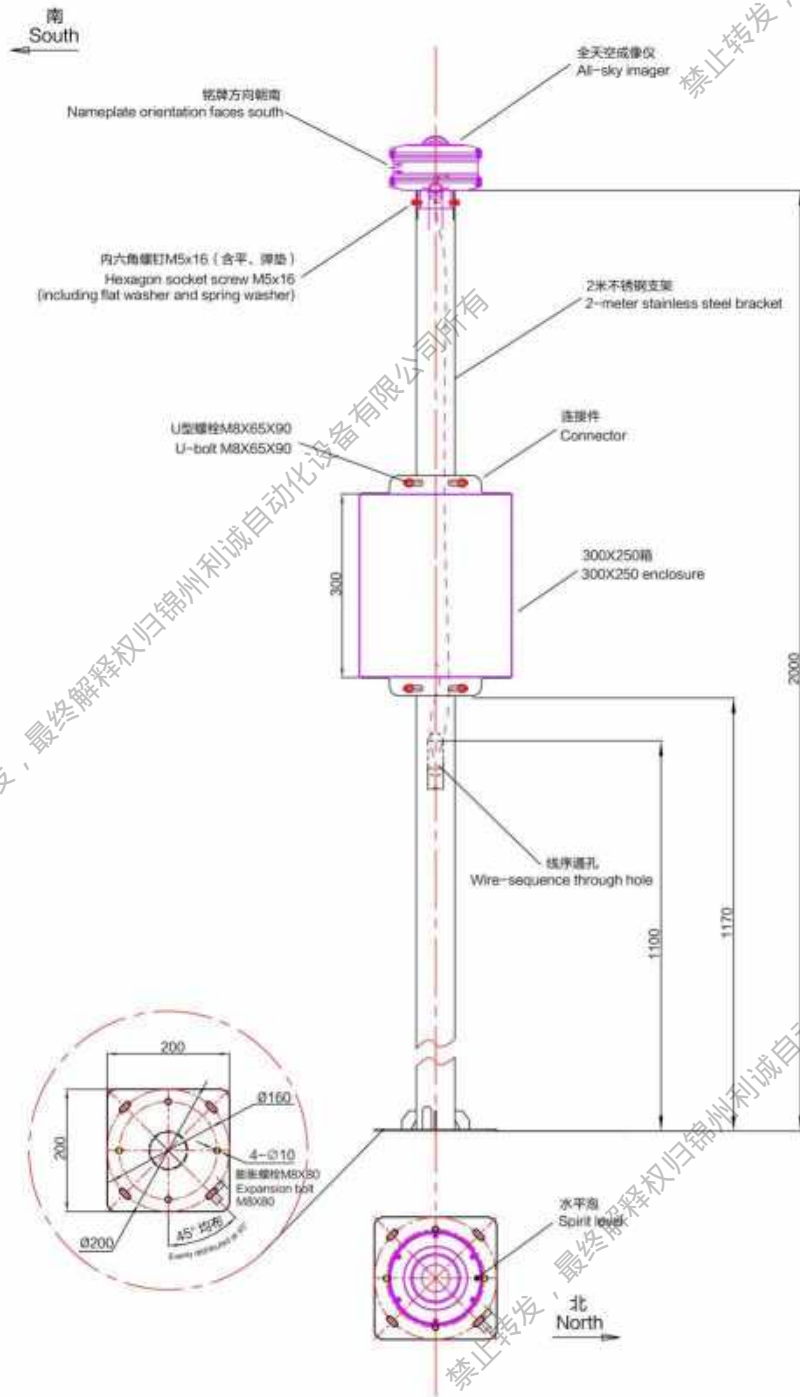
四、产品尺寸图

Product Dimension Drawing



五、产品安装图

Product installation diagram



六、数据读取使用说明

Instructions for data reading

1、通过平台方式查看数据

View data through a platform

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- (1)、本地版：通过局域网固定 IP 访问（默认为 192.168.1.60）
- (2)、4G 版：通过网址访问（tkcxy.qxyd.com）
- (1) Local version: Access via a fixed IP on the local area network (default is 192.168.1.60)
- (2) 4G version: Access through the website (tkcxy.qxyd.com)

a) 2、通过接口获取数据

Obtain data through an interface

- (1)、本地版 TCP 协议，数据点表如下

(1) Local version of TCP protocol, with the data point table as follows

寄存器地址 register address	寄存器名称 register name	读/写 read	详情 Details
0x0000	当前工作状态 Current working status	只读 read-only	输出范围: 0/1 Output range
0x0001	实时云量 Real-time cloud cover	只读 read-only	输出范围: 0-100 Output range
0x0002	薄云比例 Thin cloud proportion	只读 read-only	输出范围: 0-100% Output range
0x0003	重云比例 "Heavy cloud proportion"	只读 read-only	输出范围: 0-100% Output range
0x0004	云向 cloud direction	只读 read-only	输出范围: 1-8 Output range
0x0005	云速 Cloud speed	只读 read-only	输出范围: 0-30 Output range
0x0006	太阳高度角 solar elevation angle	只读 read-only	输出范围: 0-9000 Output range
0x0007	太阳方位角 solar azimuth angle	只读 read-only	输出范围: 0-36000 Output range
0x0008	日出时间 sunrise time	只读 read-only	输出范围: 0000-2359 Output range
0x0009	日落时间 sunset time	只读 read-only	输出范围: 0000-2359 Output range
0x0010	太阳遮挡状态 Sun obscuration state	只读 read-only	输出范围: 0/1 Output range

- (2)、4G 版 HTTP 协议，数据格式如下

```
{  
  "code": 0, //0 表示成功  
  "msg": "实时数据获取成功!", //消息  
  "data": {  
    "device_id": "d01",  
    "is_working": 1,  
    "cloudage": "10.46",  
    "thin_clouds": 30.6,  
    "heavy_clouds": 69.4,  
    "cloud_direction": 6,  
  }  
}
```

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```
"cloud_speed":5.8,  
"solar_altitude":22.73,  
"solar_azimuth":229.07,  
"sunrise":06:47,  
"sunset":17:33,  
"is_cover":0,  
"original_360":"http://ip:9001/upload/2024/2/19/20240219151102/0.jpg",  
}  
}
```

(2) For the 4G version of the HTTP protocol, the data format is as follows:

```
{  
  "code": 0, // 0 indicates success  
  "msg": "Real-time data retrieval successful!", // message  
  "data": {  
    "device_id": "d01",  
    "is_working": 1,  
    "cloudage": "10.46",  
    "thin_clouds": 30.6,  
    "heavy_clouds": 69.4,  
    "cloud_direction": 6,  
    "cloud_speed": 5.8,  
    "solar_altitude": 22.73,  
    "solar_azimuth": 229.07,  
    "sunrise": "06:47",  
    "sunset": "17:33",  
    "is_cover": 0,  
    "original_360": "http://ip:9001/upload/2024/2/19/20240219151102/0.jpg",  
  }  
}
```

Data 数据字段解释:

Data field explanation:

参数 parameter	名称 name
device_id	设备名 device name
is_working	当前工作状态 Current working status
cloudage	实时云量 Real-time cloud cover
thin_clouds	薄云比例 Thin cloud proportion
heavy_clouds	重云比例 Heavy cloud proportion
cloud_direction	云向

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	cloud direction
cloud_speed	云速 Cloud speed
solar_altitude	太阳高度角 solar elevation angle
solar_azimuth	太阳方位角 solar azimuth angle
sunrise	日出时间 sunrise time
sunset	日落时间 sunset time
is_cover	太阳遮挡状态 Sun shading state
original_360	360° 天空全景图像原图 URL 地址 Original URL address of 360° panoramic sky image

七、平台功能介绍

Introduction to platform functions

1. 登录页面

Login page

打开浏览器，输入 IP（我司提供）或者网址，进入平台登录页面，如下图

Open the browser, enter the IP (provided by our company) or the website address, and access the platform login page, as shown below



2. 实时数据页面

Real-time data page

输入我司提供的账号密码登录成功后，进入实时数据页面展示相关数据，如下图

After successfully logging in with the account and password provided by our company, you will enter the real-time data page displaying relevant data, as shown below



1、历史查询界面

Historical query interface

点击进入历史数据页面，默认展示当天的数据信息，可通过设置开始、结束时间查询指定时间范围的数据，点击数据对应的图片标识，可以查看相关图片，点击导出按钮，可以导出该查询时间范围内的数据，如下图

Click to enter the historical data page, which displays the data information of the current day by default. You can query the data within a specified time range by setting the start and end time. Click on the image icon corresponding to the data to view the relevant image. Click the export button to export the data within the queried time range, as shown below

A screenshot of the historical data query interface. It displays a table with multiple columns including '时间' (Time), '状态' (Status), '温度' (Temperature), '湿度' (Humidity), '光照' (Light), '风速' (Wind Speed), '风向' (Wind Direction), 'PM2.5', 'PM10', 'CO2', 'TVOC', '噪声', '甲醛', '苯', '甲苯', '二甲苯', '臭氧', '一氧化碳', '二氧化硫', '氮氧化物', '氨气', '硫化氢', '挥发性有机物', '总挥发性有机物', '总醛类', '总酮类', '总酯类', '总酸类', '总碱类', '总盐类', '总糖类', '总蛋白质', '总脂肪', '总碳水化合物', '总纤维素', '总木质素', '总核酸', '总维生素', '总矿物质', '总微量元素', '总重金属', '总放射性', '总生物活性', '总生物量', '总生物多样性', '总生物生产力', '总生物降解性', '总生物修复性', '总生物可利用性', '总生物可利用性', '总生物可利用性', '总生物可利用性'. A red box highlights an image icon in the '状态' column, and a red arrow points to an '导出' (Export) button in the top right corner of the table area. A watermark '最终解释权归锦州利诚自动化' is visible across the bottom right.