TP Tethered UAV Monitoring System



I. Project Overview

The TethPower tethered UAV monitoring system provides fixed-position aerial observation using external ground power. It combines an industrial UAV, ground station, composite tether, airborne power module, mission payload and monitoring terminal. Visible-light and thermal imaging support day and night observation; lighting, public address and communication relay payloads can be configured for the task. Application scenes illustrate possible uses; they do not document customer deployments or performance tests.

II. System Composition

The system consists of a ground power winch, composite tether, airborne power module, industrial UAV, mission payloads and ground control / monitoring platform. The ground station converts utility or generator AC input into high-voltage DC; the airborne module regulates it for the aircraft and payload. A configured fiber-optic link carries video and telemetry. An onboard backup battery supports emergency landing following tether disconnection or loss of ground power, subject to battery condition and aircraft configuration.

Core Differentiation: Unlike conventional consumer-grade or industry-specific battery-powered drones, the TP tethered monitoring system does not rely on battery endurance as its limiting factor; its core capability lies in prolonged fixed-point aerial surveillance rather than wide-area, long-range flight.

Scenario Applications





Maritime Inspection and Monitoring





Urban Security Surveillance

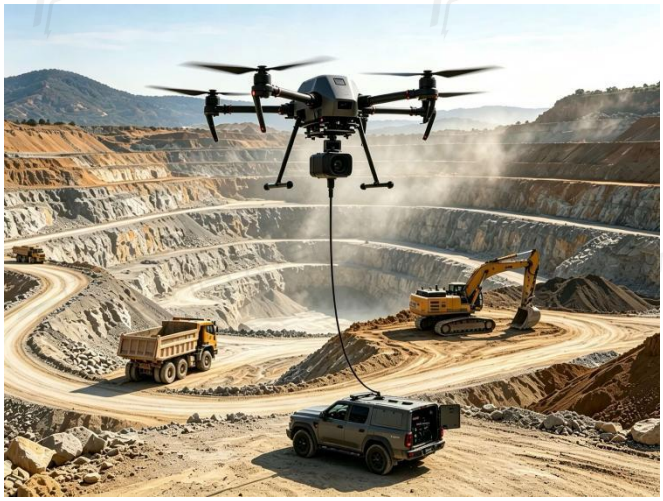




Forest and Grassland Fire Prevention Monitoring

Security for Large-Scale Events





Emergency rescue and disaster response

Large-scale construction sites and mine monitoring

System Selection 1

Equipment Selection – Recommended total takeoff weight <20 kg

	
Ground station TP-T4H	**On-board module TP-P4**

System parameters

Ground station TP-T4H parameters		TP-P4 Onboard Module Parameters	
Main dimensions of the ground station	420mm×345mm×225mm	Aircraft-mounted module dimensions	187mm×95mm×70mm±1mm
Ground station weight	14.5±0.5kg	Onboard module weight	1000g±50g
Cable length	Default: 120 m (customizable extension and fiber optic addition available)	input voltage range	680-800Vdc
input voltage	Single-phase 220 VAC, frequency 50 Hz	output voltage	50Vdc
output voltage	800Vdc	output power	≤4000W
output power	≤4000W	working temperature	-20℃ ~ +40℃
Winding speed	≤2 m/s (adjustable)	Heat dissipation method	Built-in air cooling
Line collection method	Electric/Manual	Input/Output Plugs	Default XT90 (can be changed as needed)

Cable material	Lightweight high-temperature-resistant aviation sheath + alloy high-temperature-resistant aviation wire	output delay	≤5S
Cable tensile strength	≤100kg	Conversion efficiency	≥97%
Cable outer diameter	3.3mm	Mounting	Reserve installation holes and secure with screws
Cable weight	13g/m	Protection rating	IP54 (measured)

System Selection 2

Equipment selection – recommended gross takeoff weight <30 kg

	
Ground station TP-T6	**On-board module TP-P6**

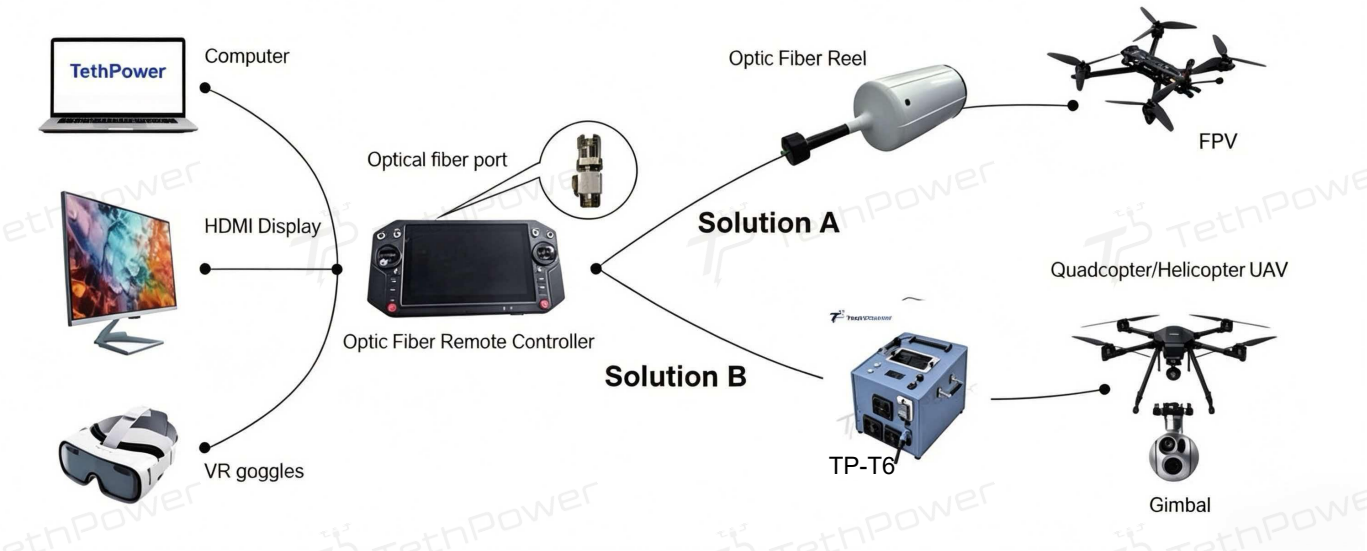
System parameters

Ground station TP-T6 parameters		TP-P6 Onboard Module Parameters	
Main dimensions of the ground station	460mm×355mm×420mm	Aircraft-mounted module dimensions	248mm×107mm×75mm±1mm
Ground station weight	28±0.5kg	Onboard module weight	1400g±50g
Cable length	Default: 120 m (customizable extension and fiber optic addition available)	input voltage range	680-800Vdc
input voltage	Single-phase 200–230 VAC, frequency 50 Hz (nominal 220 VAC)	output voltage	50Vdc

output voltage	750Vdc	output power	≤6000W
output power	5 kW (rated)	working temperature	-20℃ ~ +40℃
Winding speed	≤2 m/s (adjustable)	Heat dissipation method	Built-in air cooling
Line collection method	Electric/Manual	Input/Output Plugs	Default XT90 (can be changed as needed)
Cable material	Lightweight high-temperature-resistant aviation sheath + alloy high-temperature-resistant aviation wire	output delay	≤5S
Cable tensile strength	≤100kg	Conversion efficiency	≥97%
Cable outer diameter	4.2mm	Mounting	Reserve installation holes and secure with screws
Cable weight	19g/m	Protection rating	IP54 (measured)

Select a fiber-optic tether for wired pod video transmission. An optional fiber-optic remote controller carries video and control over the tether. The controller fiber-link range of 0–20 km is not UAV flight range or operating altitude.

	
P-EOP Pod	**Fiber Optic Remote Control (optional)**



Schematic diagram of a fiber-optic tethered UAV fiber-optic remote-control and video transmission system

System parameters

Pod parameters		Fiber Optic Remote Control Parameters	
size	130mm×161mm×202mm	size	265mm×130mm×70mm±1mm
weight	1035g	weight	800g
input voltage	14.8V-25.2V	system	Linux (customizable Android)
dynamic current	1000-1500mA@16V	Flight controllers	PIX、APM、Betaflight
power	Average power: 16 W; peak power: 24 W	Link distance	Fiber optic cable: 0–20 km
Temp.	-20℃ ~ +50℃	Fiber optic interface	FC interface
Video output	Micro HDMI(1080P 30fps/60fps)/IP （RTSP/UDP4K/1080P/720P 30fps H264/H265)	Wavelength	1270 nm / 1310 nm / 1550 nm
memory	TF card (storage capacity up to 256 GB)	Fiber type	monomode optical fiber
control method	PWM/TTL/S.BUS/TCP/UDP	Video interface	RJ45/Network port

Angle constraint range	Pitch angle: -45° to 110°; yaw angle: ±290°/±360° (network transmission version)	Data Orientation	two-way
camera lens	20x optical zoom	working temperature	-20℃ ~ +50℃
Digital zoom	12-fold	Display	7-inch screen, 1080P high-brightness touch display

Comparison between Fiber Optic Transmission and Traditional Wireless Image Transmission

Comparison Item	Fiber optic tethered transmission	Traditional wireless image transmission link
transmission medium	The moored fiber-optic composite cable incorporates built-in optical fibers for wired transmission.	Radio-wave (microwave / OFDM) air transmission
capacity of resisting disturbance	Wired fiber-optic transmission reduces reliance on an over-air RF image link. Confirm the installed equipment, routing and operating environment.	Prone to obstruction and electromagnetic interference; bandwidth may be congested by devices operating on the same frequency; connectivity is likely to experience lag or disconnections in obstructed environments.
Transmission bandwidth	High bandwidth enables stable transmission of 4K / multi-channel HD pod video and supports bidirectional control signals.	Bandwidth is affected by distance, obstructions, and interference; high-bitrate video is therefore prone to bitrate reduction and screen artifacts.
Communication distance	The available link distance depends on the fiber reel, optical equipment and link-loss budget. Confirm the configured link length.	Due to limitations imposed by transmission power and line-of-sight conditions, reliability decreases as the distance increases; therefore, line-of-sight must be maintained.
Control link	Video transmission and remote-control signals are transmitted via fiber optics in an integrated link, supporting direct connection to a fiber-optic remote controller.	Remote control and image transmission typically rely on two independent wireless RF links, creating a risk that both links may become simultaneously unreachable.
applicable scene	Emergency broadcasting, landslide monitoring, long-term fixed-point inspection of bridges, substation inspections, extended airborne standby duty, and operations in areas subject to strong electromagnetic interference	Rapid reconnaissance, large-scale mobile patrols, short-duration missions, and scenarios requiring extensive mobile flight
Signal Safety	Data travel through the physical fiber link. Access control and system configuration remain part of information security.	Radio signals are broadcast over the air, posing a risk of interception and eavesdropping.

III. Core Features and Product Advantages

1. Ultra-long uninterrupted airborne endurance enables day-and-night fixed-point monitoring

External power supports monitoring planned for 24-hour operation, subject to the configured aircraft, power source, weather and operating limits. Operating height can be configured up to 200 m with a corresponding extended tether and suitable aircraft. The two configurations in this manual use a default 120 m cable; confirm the required cable and height before ordering.

2. Multi-load modularization and integrated "observation, surveillance, callout, and communication"

Optical-electric dual-sensor pod: high-definition visible-light zoom + infrared thermal imaging; identifies personnel and vehicles during daylight and detects heat sources at night and in dense smoke, enabling continuous day-and-night detection while supporting target tracking and hotspot identification;

High-power search and illumination: provides wide-area high-altitude lighting at disaster sites and accident locations at night, serving as a replacement for conventional lighting vehicles;

High-frequency public address module: uses airborne broadcasting to direct crowds and issue early warnings, enabling coordinated air–ground command;

Communication relay module: In areas affected by public-network disruptions due to earthquakes, floods, or mountainous terrain, temporary airborne communication nodes are deployed to restore on-site communication links.

3、Multi-layered safety protection enables stable operation in complex environments

The airborne power module regulates the tether input for the aircraft bus. The standby battery provides emergency backup; confirm the aircraft bus, battery interface, charge state and emergency procedure during integration. Battery condition still requires inspection and maintenance during extended operations.

The system is equipped with a dual manual emergency cable-retraction mechanism consisting of a mechanical knob and a detachable hand crank. During normal operation, cable retraction is automatically controlled by the panel's mechanical knob

and electronic control; when outdoor operations encounter power outages or similar conditions at the generator, a hand crank can also be attached for manual cable recovery. The entire manual recovery system employs a purely mechanical transmission and does not rely on a power supply or electronic control unit. Consequently, cable recovery can be completed in field environments without electricity or when electrical components are faulty, addressing the on-site problem where cables cannot be recovered when the purely electronic winch fails. This provides a two-stage emergency backup, significantly enhancing the equipment's fault tolerance and the reliability of field operations, supporting field cable recovery.

4、Rapid deployment and operational flexibility

The complete system supports vehicle-based transport; setup and deployment can be completed on site, eliminating the need for infrastructure construction or the prior installation of tower structures or monitoring poles. Monitoring equipment can be deployed wherever needed and can be mobilized alongside response teams, making it ideal for temporary missions. Ground-based monitoring terminals transmit live footage in real time and support video recording and screenshot storage, enabling retrospective review and evidence collection.

5. Intelligent Situation Assessment

The integrated ground-based monitoring platform enables real-time video decoding, electronic map point annotation, intrusion alerts, and hotspot alerts; it also supports the connection of multiple video outputs to command dashboards, allowing on-site command personnel to directly access a comprehensive high-altitude overview and facilitate rapid decision-making.

IV. Typical Industry Application Scenarios

Public Safety and Security for Large-Scale Events

Suitable for security operations at sporting events, assemblies, temple fairs, and major conferences. Once deployed, the drones provide a high-altitude, panoramic bird's-eye view, enabling real-time monitoring of crowd density and the timely detection of congestion and abnormal gatherings; crowd guidance can be

implemented via a voice-command module; and continuous surveillance can be maintained over key areas, compensating for the limited visibility caused by building obstructions in ground-based cameras and providing the command center with first-hand aerial intelligence.

Emergency rescue and disaster response

At sites affected by floods, earthquakes, and landslides: disasters often cause damage to ground-based communication towers and surveillance facilities. A TP tethered UAV surveillance system can rapidly ascend to the air; on the one hand, it captures panoramic imagery of the affected area to identify trapped individuals and assess the extent of building damage; on the other hand, it can carry a communication relay to rapidly restore on-site communications and be equipped with high-power lighting to support nighttime search and rescue operations.

Forest and Grassland Fire Prevention Monitoring

Forest areas are vast, while the number of traditional lookout tower sites is limited. TP tethered drones can be deployed at fire prevention checkpoints to remain airborne for extended periods and conduct lookout operations; their infrared pods enable day-and-night detection of hotspots in forest fires, allowing smoke plumes and fire points to be identified early; and they can transmit real-time data on the spread of the fire, assisting fire prevention command centers in assessing the fire situation and planning firefighting routes. Additionally, these drones can be equipped with public-address systems to conduct fire-prevention awareness campaigns and issue warnings regarding unauthorized open-fire activities in the wilderness.

Fire Emergency Response

At fire scenes involving high-rise buildings or storage yards, ground-based firefighters are often obscured by dense smoke, making it difficult for them to obtain a comprehensive view of the entire fire scene. A tethered drone hovers over the fire for an extended period, continuously monitoring the fire's development and high-temperature hazard points in the building using visible light and infrared imaging, thereby providing sustained aerial intelligence for firefighting command; at night, it provides high-altitude illumination, supporting rescue operations.

Border defense, maritime defense, and key-area security

Key protected areas—including border lines, coastlines, reservoir areas, large industrial facilities, and oil and gas fields—can be deployed via mobile vehicle-based

systems to conduct prolonged aerial patrols and surveillance, enabling the timely detection of boundary-crossing intrusions, illegal operations, and other such activities; at night, infrared payloads enable day-and-night monitoring, compensating for the distance limitations of ground-based surveillance equipment.

Large-scale construction sites and mine monitoring

Suitable for use at mines and large-scale infrastructure construction sites for on-site safety monitoring and duty, monitoring the operational status of personnel and equipment, and detecting risks such as slope instability and the unauthorized accumulation of construction debris; no tall monitoring towers are required, making the system mobile and flexible. Once the project is completed, the equipment can be withdrawn and relocated, thereby reducing infrastructure investment.

Traffic Incident Response

At the scene of major traffic accidents or highway congestion, the system rapidly ascends to capture aerial traffic conditions, provides real-time insights into traffic flow and the spread of accidents, assists traffic police in directing traffic, and enables prolonged on-site monitoring, thereby preserving complete video evidence for accident response.

V. System Workflow

1. Upon arrival at the mission site, set up the ground winch station and connect it to the utility power supply or a generator;
2. The UAV carries mission payloads such as electro-optical pods and completes equipment self-inspection;
3. Release the tethered cable; the drone ascends to the preset altitude and hovers at the designated position;
4. The ground-based monitoring terminal receives high-definition video and equipment status via fiber-optic backhaul and performs monitoring operations;
5. Depending on the requirements of the task, call functions such as public address systems, lighting, and communication relays;
6. Once the task is complete, the winch automatically retracts the cable, the drone lands smoothly, and the retrieval is finished.

The TP tethered monitoring system supports mobile deployment for fixed-position aerial observation, including planned 24-hour missions when power supply, aircraft configuration, weather and operating limits permit. Select the payload, tether and ground equipment for the actual emergency-response, security, fire-observation or industrial-monitoring task.

Guidelines for Using the TP Tethered System

1. Before each use, inspect the cables of the TP tethered system and confirm that the outer sheath is free of damage or cracking.
2. During transportation, the equipment shall be placed inside an aviation crate for protected transport.
3. During actual operation, ensure that the tethered system provides adequate dust-proof and waterproof protection.
4. In the event of an emergency (e.g., drone loss of control), prioritize cutting off the power supply.
5. Because the tethering equipment has a high output power under front-end load, all tethering-box cables must be fully deployed before operation to facilitate cable current flow and dissipate heat when temperatures are elevated.
6. When operators use the TP tethered system under high-voltage conditions and come into contact with cables, they must wear insulating gloves to support safe handling.
7. After the TP equipment has been installed and completed, when initiating cable collection, do not drag the cables across the ground; avoid stepping on ground stones or sharp objects to prevent the cables from being cut.