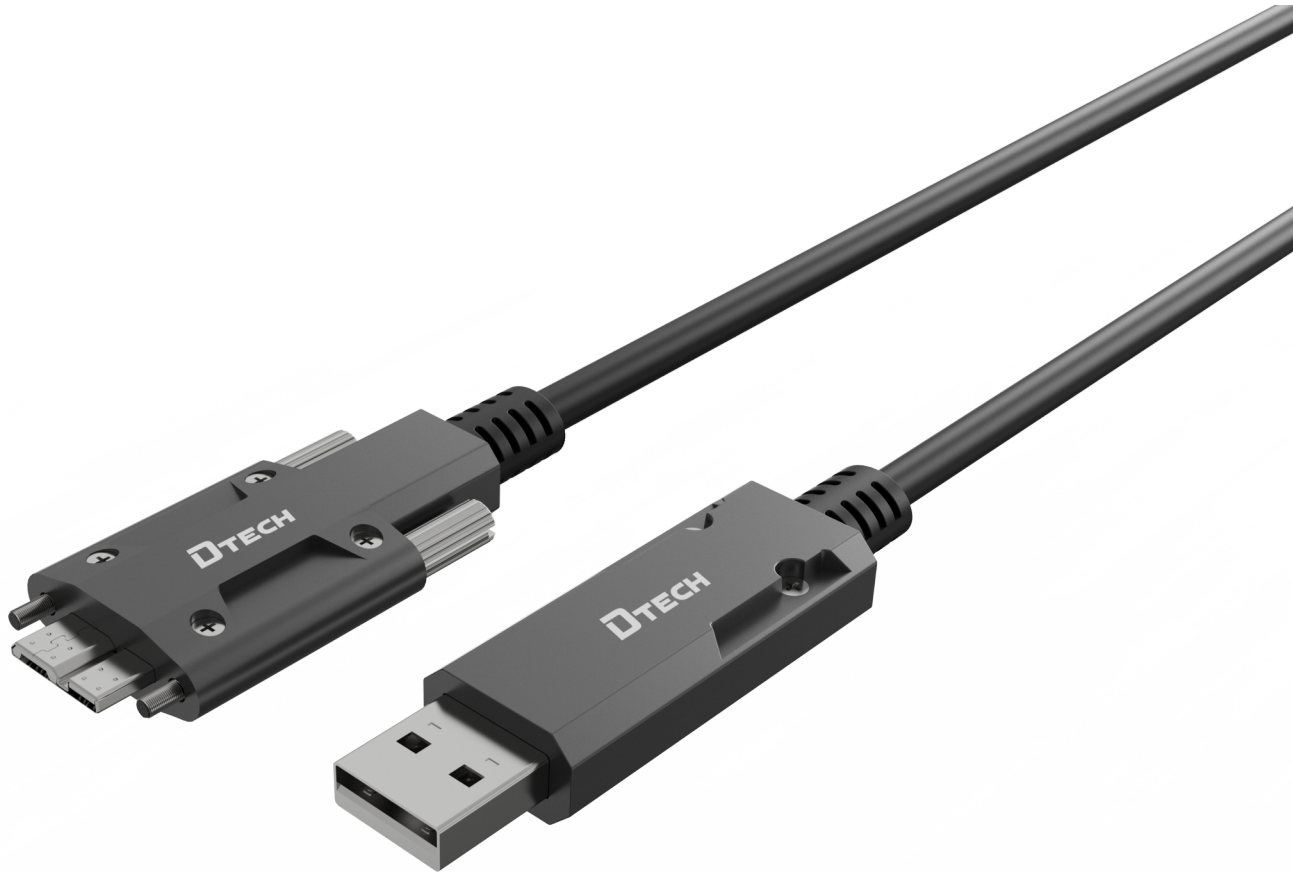




**USB 3.0 Type-A Male to Micro-B Male,
Screw-Locking Industrial Camera Drag
Chain Cable – Product Specification
v1.0.1**

High-Rate Transmission

- Supports USB 3.0 high-speed data transmission at up to 5 Gbps, with backward compatibility with USB 2.0 at 480 Mbps (USB 2.0 supported up to 5 meters).
- Utilizes an 850 nm VCSEL array-based optoelectronic transmission solution, enabling uncompressed and lossless image signal transmission.
- Pure fiber-optic signal transmission supports lossless long-distance transmission over distances of up to 30 meters.
- Built-in signal regeneration and reshaping technology effectively eliminates lag, image artifacts, and frame loss commonly encountered during long-distance transmission.

Industrial-Grade Drag Chain Durability

- Purpose-built structure for industrial drag chain applications, tested to withstand 5 million reciprocating bending cycles.
- Test conditions: 1 m travel distance, 60 cycles/min, bending radius: $R = 8 \times OD$.
- Highly elastic, flex-resistant outer jacket combined with a layered tensile-strength internal structure, designed to withstand continuous dynamic motion of industrial equipment.
- Stable transmission performance after repeated bending, with no connection interruptions or signal attenuation.

High Protection and Interference Resistance

- Optical fiber inherently provides immunity to EMI (electromagnetic interference), effectively resisting interference from variable-frequency drives (VFDs) and servo motors.
- Micro-B connector with a dual-screw locking mechanism provides enhanced vibration resistance and prevents loosening, eliminating connection interruptions caused by equipment vibration.
- Built-in patented micro-diffractive optical module ensures stable operation across a wide industrial temperature range.
- Supports hot-plugging for true plug-and-play operation, enabling seamless integration with industrial equipment for continuous, uninterrupted operation.

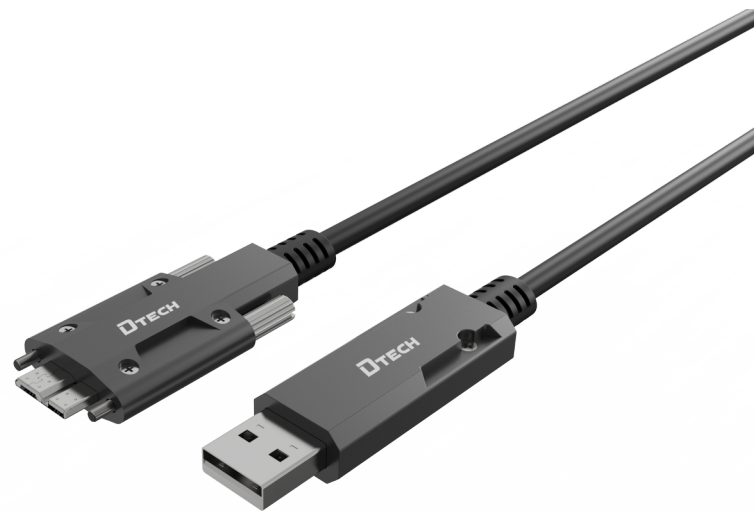
Product Overview

This product is a USB 3.0 electro-optical hybrid fiber drag-chain cable specifically designed for machine vision industrial cameras. It features a USB Type-A male to Micro-B male connector with a screw-locking mechanism, and is purpose-built for industrial automation applications involving continuous drag-chain reciprocating motion, high-electromagnetic-interference (EMI) environments, and long-distance camera cabling.

The cable adopts an electrical-optical separated transmission architecture. High-speed image data is transmitted via multimode optical fiber, while power is delivered through pure copper conductors. This design effectively eliminates common issues associated with conventional copper-core USB cables, including signal attenuation over long distances, electromagnetic interference, cable fatigue and breakage caused by repeated drag-chain bending, and frame loss caused by equipment vibration.

The product features integrated TX/RX optoelectronic conversion modules at both ends, incorporating Alpha Optoelectronics' patented miniature diffractive optical system. No external adjustment or calibration is required, and the system supports automatic adaptation to all baud rates.

The cable assembly adopts an industrial-grade, flex-resistant structural design and has passed a 5-million-cycle drag-chain fatigue test. It is suitable for 24/7 continuous industrial production environments and is widely used in machine vision inspection applications across 3C electronics,



semiconductors, lithium batteries, automotive manufacturing, food and pharmaceuticals, intelligent sorting, and other industries.

The solution effectively enhances the stability of industrial camera image transmission and improves overall system fault tolerance.

Communication Interface Specifications

Parameter Item	Technical Specifications
Interface Standard	Compliant with the USB 3.0 SuperSpeed specification and backward compatible with USB 2.0/1.1.
Interface Configuration	USB 3.0 Type-A Male (Host Side) to Micro-B Male (Device Side, Dual Locking Screws)
Data Transfer Rate	5 Gbps (USB 3.0 SuperSpeed), backward compatible with 480 Mbps (USB 2.0 supported for cable lengths up to 5 m).
Transmission Distance	Uncompressed, lossless transmission with no signal attenuation over the entire 0.5 m to 30 m range.
Transmission Medium	2-Core Multimode Optical Fiber + Multi-Strand Tinned Copper Power Conductors
Operating Wavelength	850 nm VCSEL Array-Based Optical Transmitter
Optical Solution	Patented Miniature Diffractive Optical System with Integrated TX/RX Module
Transmission Characteristics	Signal Conditioning and Regeneration; Zero Latency; Zero Packet Loss; No Image Quality Degradation
Hot-Swapping	Supports USB Standard Hot-Swapping and Plug-and-Play

Energy Chain Durability Performance Parameters

Parameter Item	Technical Specifications
Durability Bending Cycles	≥5 million cycles (certified in accordance with industrial energy chain testing machine standards)
Bending Test Speed	60 cycles/min
Test Reciprocating Stroke	1 m Standard Dynamic Stroke
Bending Radius	8 × Cable Outer Diameter (8 × OD)
Bending Test Results	After 5 million bending cycles, the speed, signal transmission, and power supply functions remained fully operational, with no disconnection observed.

Structural Characteristics	High tensile strength, excellent torsion resistance, and outstanding resistance to repeated bending, designed for dynamic cable routing in energy chains.
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Mechanical and Structural Parameters

Parameter Item	Technical Specifications
Connector Specifications	USB 3.0 Type-A Male to Micro-B Male (with screws on both sides for secure fastening)
Mounting Method	Screw-Locking Mounting Design, Resistant to Vibration, Loosening, and Cable Breakage
Cable Construction	Optoelectronic Hybrid Integrated Construction, Flexible Cable Specifically Designed for Industrial Energy Chains
Cable Routing Method	Fixed Equipment Routing; Dynamic Routing Integrated into Automated Energy Chains

Environmental Adaptability Parameters

Parameter Item	Technical Specifications
Operating Temperature	-20°C to +70°C, Industrial-Grade Wide-Temperature Operation
Storage Temperature	-40°C to +80°C
Operating Humidity	5% RH to 95% RH (non-condensing)
EMI Immunity Level	Optical Fiber Insulated Transmission, Providing Complete Immunity to Industrial EMI and RF Interference
Environmental Protection	Oil and Contamination Resistant, Wear Resistant, and Resistant to Repeated Bending, Designed for Harsh Workshop Environments

Product Functional Features

1. Optical Fiber-Based Optoelectronic Transmission, Providing Complete Isolation from Industrial Interference

Based on an 850 nm VCSEL optoelectronic conversion architecture, high-speed differential image signals are transmitted entirely via optical fiber and physically isolated from the power supply circuitry. The design provides complete immunity to high-frequency harmonics and electromagnetic interference generated by industrial equipment such as variable-frequency drives, servo motors, contactors, and welding equipment. It eliminates common issues associated with conventional copper camera cables, including image distortion, freezing, frame drops, and connection loss, ensuring continuous and stable transmission of high-definition video signals.

2. Lossless Image Transmission over 30 m

Overcoming the conventional 5 m transmission limitation of USB copper cables, the system supports full-speed 5 Gbps lossless transmission over distances of up to 30 m. Image signals are transmitted without compression, attenuation, or latency. An integrated signal regeneration and reshaping circuit ensures clear and stable image quality over long-distance transmission, meeting the cabling requirements of industrial cameras deployed in large-scale automation equipment, across workstations, and on long machine frames.

3. Industrial Screw-Locking Design for Vibration Resistance, Secure Retention, and Reliable Connectivity

The Micro-B device-side connector is equipped with dual-sided locking screws, enabling rigid and secure interface fixation when connected to industrial cameras. Designed to withstand high-frequency vibration in automated equipment and repeated tensile stress from energy chain movement, the locking mechanism effectively prevents connector loosening, intermittent contact, and momentary connection loss. This hardware-level solution eliminates common issues such as random frame drops and unexpected camera disconnections during machine vision system operation.

4. 5 Million Energy Chain Durability Cycles for Dynamic Applications

The cable features an industrial-grade flexible, high-flex formulation combined with a multi-layer tensile-resistant construction, and has undergone rigorous fatigue testing on professional energy chain test equipment. Under standard industrial reciprocating motion conditions, it can withstand more than 5 million bending cycles while maintaining cable jacket integrity, fiber core integrity, and uninterrupted signal transmission. It is ideally suited for long-term dynamic operation in energy chains used with robotic arms, linear modules, and automated production lines.

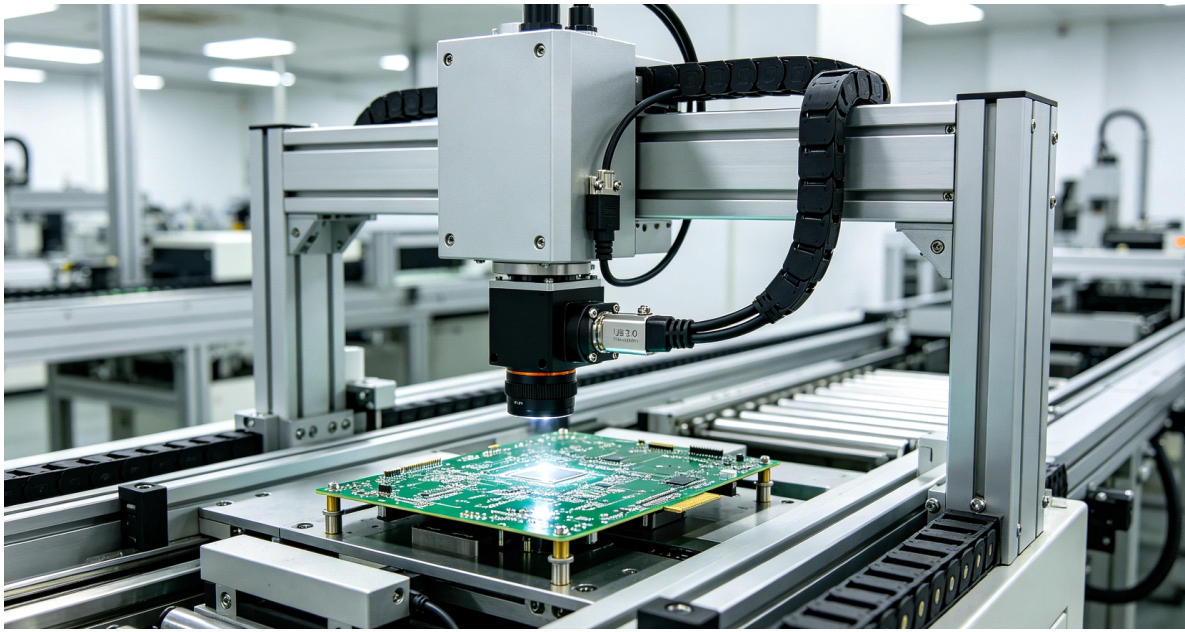
5. Patented Optical Module for High Stability and Scalable Production

Featuring Elpha Optoelectronics' patented miniature diffractive optical system, the integrated TX/RX transceiver module offers a compact design with excellent resistance to temperature variations and mechanical vibration. The simplified assembly process ensures high product consistency and supports standardized, high-volume production, making it well suited for mass-production requirements in industrial equipment applications.

Application Case: Industrial Transmission Solution for Machine Vision

1. Automated Vision Inspection for 3C Electronics

Suitable for equipment used in PCB defect inspection, display dead-pixel detection, electronic component positioning, and precision component surface inspection. During operation, industrial cameras move at high frequency with gantry modules and robotic arms, while the cable is routed dynamically inside energy chains. With excellent flex durability and strong interference immunity, the solution prevents motion-related signal disturbances and cable fatigue failures, ensuring stable, continuous 24/7 inspection on automated production lines.



2. New Energy Battery & Semiconductor Industries

Suitable for high-precision vision applications such as lithium-ion battery cell and electrode surface defect inspection, battery module dimensional verification, semiconductor wafer identification, and precision chip sorting. In densely equipped production environments with complex electromagnetic interference, fiber-optic transmission provides complete electrical isolation from interference, ensuring lossless image acquisition from high-resolution cameras while minimizing false positives, missed detections, and inspection system errors.



3. Industrial Vision Systems for Automotive Manufacturing Lines

Designed for applications including automotive component dimensional measurement, body weld inspection, interior and exterior trim inspection, and automated identification and sorting of automotive parts. Automotive production lines typically involve numerous servo drives and welding equipment, creating harsh electromagnetic environments. This product effectively isolates high-frequency interference while supporting long-distance, cross-station cabling, minimizing signal attenuation over extended cable runs.



4. Food & Pharmaceutical Packaging Inspection Industry

Designed for automated equipment used in pharmaceutical packaging defect inspection, food product visual sorting, packaging integrity verification, and product traceability scanning. Production-line equipment operates continuously with reciprocating motion, subjecting energy chain cables to frequent bending cycles. The product's high durability helps reduce equipment failure rates, ensure continuous production, and minimize downtime and maintenance costs.



5. Machine Vision Systems for Intelligent Logistics Sorting

Suitable for intelligent warehouse sorting equipment, parcel barcode recognition, and package appearance inspection systems. With high-frequency equipment motion and long cable routing distances, the product combines a 5-million-cycle bending life with 30 m lossless transmission capability, meeting the demands of large-scale, high-throughput, continuous machine vision operations in logistics environments.



Core Application Value

Fault Isolation: Fiber-optic transmission provides physical isolation from electromagnetic interference, eliminating camera communication failures caused by interference from industrial equipment.

Durability & Reliability: Industrial energy chain-specific flex-resistant construction is designed for long-term reciprocating motion and provides excellent resistance to cable fatigue and damage.

Stable HD Transmission: Long-distance transmission with minimal signal attenuation ensures the accuracy and stability of machine vision inspection.

Easy Maintenance: Screw-locking connectors prevent loosening and cable disconnection under equipment vibration, significantly reducing maintenance frequency and after-sales service requirements.

Installation and Usage Guidelines

1. **Energy Chain Cable Routing:** The minimum cable bending radius must be ≥ 8 times the cable outer diameter ($8 \times OD$). Sharp bending, excessive bending, and crushing of the cable are strictly prohibited. Maintain adequate slack inside the energy chain to allow free movement. Do not subject the cable to prolonged compression, tension, binding, or friction.
2. **Connector Installation:** After connecting the cable to the industrial camera, tighten the locking screws evenly on both sides. Do not forcibly tighten one side only, as this may deform the Micro-B connector or cause pin misalignment and damage.
3. **Plugging and Unplugging:** Always hold the connector housing when inserting or removing the connector. Never pull or drag the cable itself, as this may cause the internal optical fibers or copper conductors to break.
4. **Data Operation:** Hot-plugging or unplugging the cable is strictly prohibited while the equipment is capturing images at high speed or transmitting data, as this may result in image data loss, equipment errors, or camera disconnection.
5. **Environmental Conditions:** Avoid prolonged exposure of the cable to oil, contaminants, or corrosive liquids, as well as prolonged exposure to high temperatures or direct sunlight. In harsh industrial environments, provide appropriate external protection to extend the service life of the product.
6. **No Unauthorized Modification:** Do not cut or modify the cable, strip the outer jacket, or disassemble the optoelectronic conversion modules at either end. Damage caused by unauthorized modification is not covered under the warranty.

Basic Troubleshooting

Fault Symptoms	Troubleshooting Method
The industrial PC cannot detect the industrial camera.	Check whether the connectors at both ends are properly seated and the screws are securely tightened. Reconnect the cable and ensure that the industrial PC is connected to a native USB 3.0 port. Restart the equipment and try again.
Intermittent image frame loss and momentary disconnection	Check the cable routing in the drag chain for any tension, compression, or sharp bends. Verify that the bend radius meets the 8×OD requirement. Check whether equipment vibration has caused the connectors to become loose.
Insufficient Transmission Rate and Image Stuttering	Ensure that the total cable length does not exceed the maximum limit of 30 meters. Ensure that the cable is connected to a high-speed USB 3.0 port and avoid connecting it to a low-speed USB 2.0 port.

Standard Accessories

1. USB 3.0 Type-A Male to Micro-B Male Screw-Lock Fiber-Optic Drag Chain Cable (Host) × 1

Ordering Model

Model	Specifications	Interface Configuration
DT-CF500-10M	10 m USB 3.0 Type-A Male to Micro-B Male Screw-Lock Fiber-Optic Drag Chain Cable for Industrial Cameras	USB Type-A Male → Micro-B Male
DT-CF500-15M	15 m USB 3.0 Type-A Male to Micro-B Male Screw-Lock Fiber-Optic Drag Chain Cable for Industrial Cameras	USB Type-A Male → Micro-B Male
DT-CF500-20M	20 m USB 3.0 Type-A Male to Micro-B Male Screw-Lock Fiber-Optic Drag Chain Cable for Industrial Cameras	USB Type-A Male → Micro-B Male
DT-CF500-25M	25 m USB 3.0 Type-A Male to Micro-B Male Screw-Lock Fiber-Optic Drag Chain Cable for Industrial Cameras	USB Type-A Male → Micro-B Male