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Technical Information

Raman fiber-optic cables KFOC1 and KFOC1B

Innovative Raman fiber-optics designed for enhanced optical performance, maximum laser safety, and easy installation

Application

Our Raman embedded analyzers and probes are connected by electro-optical (EO) fiber optic cables with integrated low-voltage electrical interlock and optical fiber cable components bundled into one CSA-rated assembly. Rated for indoor/outdoor use, the EO connector is designed to protect the connection from external influences, avoid breakage, and ensure a secure connection. EO fiber cables are available in several size lengths with extension cables to simplify installation and remote analysis.

- Used in all Raman Rxn embedded analyzer installations
- Supports remote analysis of both lab and process measurements
- Used in a variety of industries: Life Sciences, Chemical, Oil & Gas, Food and Beverage

Your benefits

- Simple plug and lock design
- Integrated safety interlock to prevent laser exposure
- Certified for hazardous area environments
- Indoor/outdoor rated cable - flame retardant, fungus resistant, internal strength member
- Available in different fiber lengths to meet your installation requirements

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Function and system design

Introduction

Fiber-optic cables revolutionized Raman spectroscopy by allowing Raman sampling probes to be located remotely from a base unit. This enabled Raman spectra to be acquired in hazardous environments from samples that cannot be easily transported to a sampling chamber. Consequently, Raman spectroscopy entered several new arenas including the industrial process line, where the base unit is placed in a control room or other protected environment while the Raman probe is placed in the process line for real-time, *in situ* process monitoring and control.

In the majority of state-of-the-art remote dispersive Raman systems, the excitation radiation is delivered from the laser to the Raman probe through a single excitation fiber. The scattered radiation that is collected from the sample is delivered to the spectrograph through a single collection fiber.

Optical fibers are constructed of a low-hydroxyl silica core surrounded by a fluorine-doped silica cladding and a protective acrylate buffer coating. This 3-layer fiber is typically formed in a single “draw” manufacturing operation. The outer packaging of the cable may vary depending on the application. Fibers intended for industrial and laboratory applications often place a tight polymer buffer on the fiber or run through a loose polymer tube. Such fiber subassemblies can then be packaged into a composite industrial grade cable with a robust polymer outer jacket containing other such optical fiber subassemblies, electrical wires, and a rigid strength member.

Raman fiber-optic cables

All Endress+Hauser Raman probes use standard cables comprised of an integrated fiber cable assembly containing an excitation fiber and a collection fiber packaged in a robust polyvinyl chloride (PVC) jacket to prevent breakage. Endress+Hauser Raman fiber-optic probes also integrate the laser interlock into the probe termination for improved laser safety. If the cable is severed, the laser switches off within milliseconds, preventing laser light from dispersal into the environment.

Endress+Hauser's Raman fiber-optic cables are rated for indoor/outdoor use, flame/UV resistance, and pull strength, maximizing their safety in the process environment. The cables are suitable for use in a variety of environments including direct burial, underground ducts, aerial installations, steam tunnels, building risers, cable trays, and harsh industrial settings. Consult your local laws and regulations to ensure compliance with cable installation requirements for your specific environment.

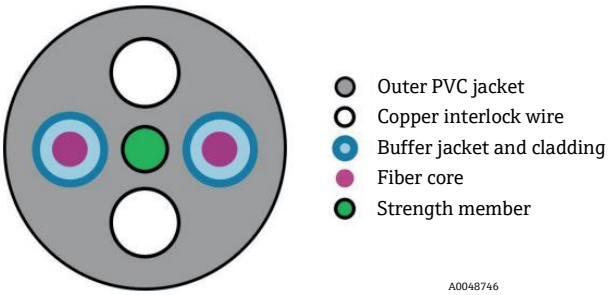

Figure 1. Cross section representation of a Raman fiber-optic cable

Endress+Hauser offers the strength member in both fiber-reinforced plastic (FRP) and aramid yarn (Kevlar). Aramid yarn is a strong plastic made from tightly bonded organic molecules, while fiber reinforced polymer consists of fiberglass made from thin glass strands combined with plastic resin.

Component	KFOC1 Raman fiber-optic cable	KFOC1B Raman fiber-optic cable
Outer PVC jacket	Rigid PVC	Flexible PVC
Copper interlock wire	✔	✔
Buffer jacket and cladding	✔	✔
Fiber core	✔	✔
Strength member	Aramid yarn	Fiber reinforced polymer

Specifications

General

The specifications for Raman fiber-optic cables are listed below.

KFOC1 Raman fiber-optic cable	
Item	**Description**
General features	Integrated copper conductor wire for interlock capability Aramid (Kevlar) internal strength members Flame retardant Fungus resistant
Cable rating (cable only)	Operating temperature: –40 °C to 70 °C (–40 °F to 158 °F) Storage temperature: –55 °C to 70 °C (–67 °F to 158 °F) Certified: CSA-C/US AWM I/II, A/B, 80C, 30V, FTI, FT2, VW-1, FT4 Rated: AWM I/II A/B 80C 30V FT4
Bend radius	152.4 mm (6 in)
Termination	Electro-optic (EO) with connectors

The KFOC1B Raman fiber-optic cable features an improved rating, CMR-certification, ensuring easier compliance with local laws and regulations. This certification supports smoother implementation in process environments. Independently tested and certified by a third party, these cables offer enhanced protection against the spread of fire.

With the CMR rating, the KFOC1B Raman fiber-optic cable is ready for immediate installation in cable trays, risers, and all conduit types with no additional assessments required.

KFOC1B fiber-optic cable	
Item	**Description**
General features	Integrated copper conductor wire for interlock capability Fiber-reinforced plastic (FRP) strength members Flame retardant Fungus resistant
Cable rating (cable only)	Operating temperature: –40 °C to 70 °C (–40 °F to 158 °F) Storage temperature: –55 °C to 70 °C (–67 °F to 158 °F) Certified: cULus AWM I/II, A/B, 80C, 30V, FTI, FT2, VW-1, FT4 Rated: CMR-FO, AWM I/II A/B 80C 30V FT4
Bend radius	152.4 mm (6 in)
Termination	Electro-optic (EO) connectors

Cable types

Fiber-optic cables with different connectors are available to connect various Raman probes and Raman Rxn analyzers. A list of commonly used cables is provided below.

KFOC1B-AAC? (KFOC1B) and KFOC1-BD? (KFOC1)

The question mark in KFOC1B-AAC? and KFOC1-BD**?** represents the configuration length that is customizable in 5 m (16.4 ft) increments.

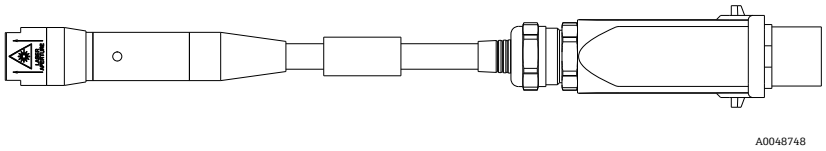

Figure 2. KFOC1-BD?

Analyzer	Probe	Description	Standard Length
Raman Rxn2, Raman Rxn4, Raman Rxn5	Raman Rxn-10, Raman Rxn-30, Raman Rxn-40	Base unit: EO (M) Probe connection: stainless steel connector shell Length: specify in meters	No standard length (limited by application)

NOTICE

- This fiber-optic cable is compatible with some legacy Rxn products.

KFOC1B-AAB? (KFOC1B) and KFOC1-BC? (KFOC1)

The question mark in KFOC1B-AAB? and KFOC1-BC? represents the configuration length that is customizable in 5 m (16.4 ft) increments.

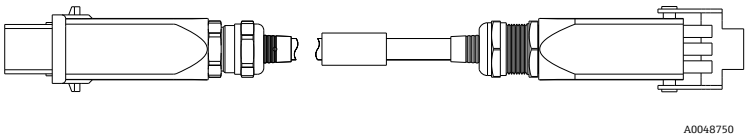

Figure 3. KFOC1-BC?

Analyzer	Probe	Description	Standard Length
Raman Rxn2, Raman Rxn4, Raman Rxn5	Probes that accept EO connectors	Base unit: EO (M) Probe connection: EO (F) Length: specify in meters	5 to 200 m (16.4 to 656.2 ft) in 5 m increments (limited by application)

KFOC1B-AAA? (KFOC1B) and KFOC1-BB? (KFOC1)

The question mark in KFOC1B-AAA? and KFOC1-BB**?** represents the configuration length that is customizable in 5 m (16.4 ft) increments.

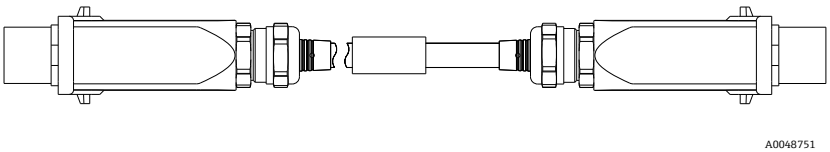

Figure 4. KFOC1-BB?

Analyzer	Probe	Description	Standard Length
Raman Rxn2, Raman Rxn4, Raman Rxn5	Probes that accept EO connectors	Base unit: EO (M) Probe connection: EO (M) Length: specify in meters	5 to 200 m (16.4 to 656.2 ft) in 5 m increments (limited by application)

NOTICE

- This fiber-optic cable is compatible with some legacy Rxn products.

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