CAMO CABLE MONITOR

Productsheet
CAMO Cable Monitor

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The risk of intercepting optical data transmitted through a single mode fiber is now a notable concern. With optimal coupling efficiency, it's possible to tap into gigabit-per-second capacity information without triggering detection from OTDR surveillance systems.

To address this issue, the National Security Agency (NSA) document NSTISSI 7003 suggests physical protection, carrier alerting, or continuous monitoring of the optical cable. However, these precautions are costly and require significant resources.

The CAMO solution involves monitoring the physical effects experienced by optical fibers due to external factors such as pressure variations, mechanical strain, vibrations, and temperature changes. CAMO can be programmed to detect any external phenomena to which optical cables are exposed.

Operating at either 1310 nm or 780 nm for WDM systems, CAMO facilitates multiplexing into transmission systems operating at 1310 nm or 1550 nm.

Applications

- Preventing information wire-tapping.
- Vibration monitoring e.g. pipline and general constructions.

Key Features

- Fiber Type: Single-mode (SM) or Multi-mode (MM)
- Wavelength: 1310 nm or 780 nm
- Transmission length: 30 km @1310 nm, 4 km @780 nm
- Number of channels: 1-4
- Alarm interface: Two individual on/off relays per channel.
- Monitoring software: PC over IP interface
- Power interface: 110VAC or 230VAC

What can CAMO detect?

- Detects a certain specific vibrations of the cable.
- Prevents unintended cutting of the cable by digging.
- Detect certain increase in cable attenuation.
- Record and recognize vibrations caused by normal movements on the cable.

How does the CAMO Cable Monitor work?

The CAMO Cable Monitor is designed to spot alterations in the optical characteristics due to mechanical movements affecting the fiber. The protective outer layer of the optical cable, typically made of soft materials like polyurethane, allows vibrations from the surroundings to transmit to the optical fiber since these materials are somewhat transparent to external disturbances.

These vibrations affect the optical properties of the transmitted light within the fiber, with the extent depending on their intensity. Traditional methods, like Optical Time Domain Reflectometry (OTDR), measure changes in optical power within the fiber, which requires significant bending of the cable to detect attenuation changes accurately. Therefore, CAMO employs a more precise approach by monitoring alterations in phase, wavelength, and polarization dispersion, which are highly sensitive to even the smallest disturbances in the optical cable.

CAMO identifies both attenuation in the fiber and changes in dispersion parameters. Users can set specific times for detecting attenuation, triggering an alarm if it drops below a defined limit. Moreover, changes in dispersion produce vibration signals analyzed across frequency and time, allowing users to set parameters for triggering alarms accordingly.

Different modes for different detections

Attenaution mode

After installation, a reference power level (P ref) in dBm is set. The user chooses the time interval between two measurements (Ta), ranging from 1 second to 10 hours. Additionally, the user specifies an alarm level (P alarm) in dB. An alarm triggers when the received power level falls below (P ref - P alarm) dBm. This alarm mode aims to identify gradual changes in attenuation over an extended period. For instance, it can detect cable material degradation leading to increased attenuation.

Vibration mode

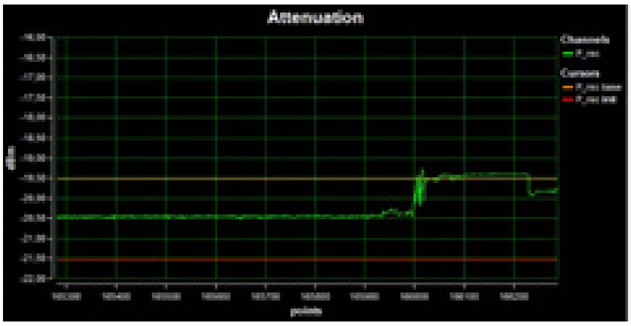
The user can set a sampling frequency ranging from 1 Hz to 10 kHz. The CAMO system analyzes both the magnitude and frequency of the sampled signal. Users can define five frequency bands (A, B, C, D, and E) and program them accordingly. Each band is treated as a logical variable that can be combined with other variables to create a vibration trigger.

For each band, the user specifies the start and stop frequencies along with the signal level. A band is considered ”true” if the signal exceeds this level. Alternatively, users can set a logical alternative to consider the band ”true” if the signal is below the specified level.

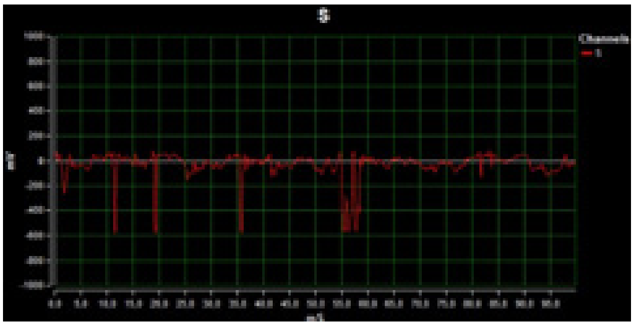
Triggers are generated based on logical combinations of these bands. When a trigger occurs, the user sets a recording duration during which all signal variations are recorded.

An alarm is raised if there are a certain number of triggers within a specified time frame. The CAMO system counts the triggers during the user-defined recording period. Users also define an alarm threshold percentage, and if the number of triggers surpasses this percentage, a vibration alarm is activated. When an alarm is triggered, a physical relay on the CAMO's back panel is closed.

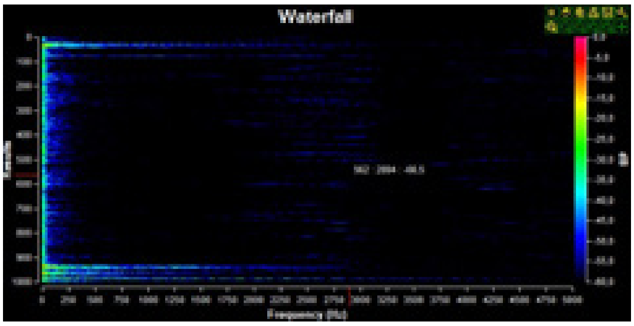
See examples of triggers on page 3.



Example of received power level in dBm with the alarm level in red.



Example of sensor signal showing the signal from a small perturbation of the cable.



Example of FFT analyze of the sensor signal with levels in frequency bands up to 500 Hz.

Trigger examples

Example 1

A trigger shall be generated if the signal between 15-25 Hz is above -40 dB and if the level between 450-650 Hz is blow -30dB.

Band A: f1 = 15 Hz, f2 = 25 Hz, level = -40dB logic = true

Band B: f1 = 450 Hz, f2 = 650 Hz, level = -30dB logic = false

Alarm combination: A * B (A and B)

Example 2

A trigger shall be generated if the signal between 15-25 Hz is above -40 dB or if the level between 450-650 Hz is above -30dB.

Band A: f1 = 15 Hz, f2 = 25 Hz, level = -40dB logic = true

Band B: f1 = 450 Hz, f2 = 650 Hz, level = -30dB logic = true

Alarm combination: A + B. (A or B)

Example 3

A trigger shall be generated if the signal between 15-25 Hz is above -40 dB or if the level between 450-650 Hz are above -30 dB and the signal from 700 to 900 Hz are above -60dB.

Band A: f1 = 15 Hz, f2 = 25 Hz, level = -40dB logic = true

Band B: f1 = 450 Hz, f2 = 650 Hz, level = -30dB logic = true

Band C: f1 = 700 Hz, f2 = 900 Hz, level = -60dB logic = true

Alarm combination: (A + B) * C. (A or B) and C.