Materials Magic
Hitachi Metals

Integrated Power Monitor (IPM)
senses optical signal power level in fiber optical communication networks

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Introduction

Hitachi Metals Ltd.(HML), teamed up with Pactonix Inc., has successfully designed, qualified and mass produced a miniature inline Integrated Power Monitor (IPM) for the existing and next generation fiber optic communication networks. The changing economics of the telecommunication industry demand the networks to be more flexible, reliable, cost effective and easy to operate and maintain. This requires optical signal status to be sensed and monitored at various locations over the entire transmission systems. The monitored signal status is then sent to central control unit as an active feedback for the unit to oversee the entire operation of the systems.

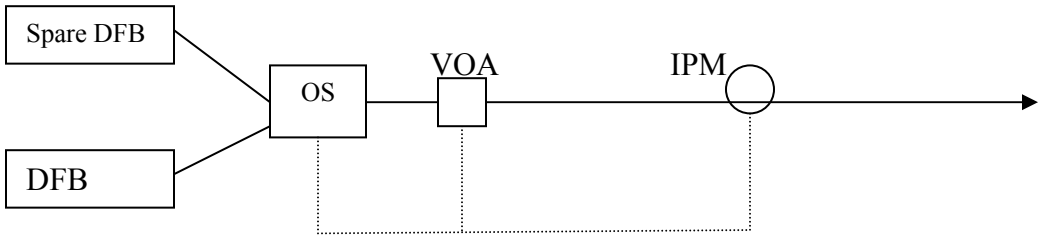
Among all signal parameters, the optical signal power is one of the most important parameters to be monitored. Whether to monitor transmitter output power level, the input and output signal level to an optical amplifier, or to sense the signal absence in protection network schemes, or any other numerous applications, power monitoring is an essential feature in fiber optic networks.

Accurate signal power sensing is essential in communication networks

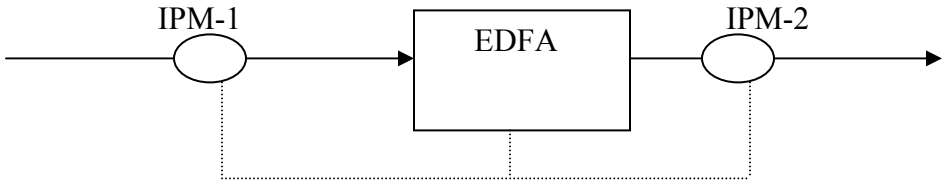
With all the new development and deployment in recent years, the fiber optic communication networks are becoming more and more complex. Accurate signal power sensing has become essential for the system design, management, protection and maintenance. Whether for long haul, metro or access networks, power monitors are required at various locations within the networks. Several examples listed below can illustrate the importance of the IPM in the fiber optical transmission networks.

(1) Signal Transmission

At signal launch site where laser based transmitters are deployed, the light power sent into fiber must be adjustable and maintained at certain level in order to maximize the performance of the whole system. An inline power monitor is placed after an inline Variable Optical Attenuator (VOA). The power level detected by IPM will be used as feedback signal to VOA to actively adjust and maintain the power level for the output. IPM signal detection can also serve as fault detection and warning feedback for the system if the primary laser failed to supply sufficient power level. In such case, an optical switch and a spare DFB laser can be used as a back up or protection.



(2) Signal Amplification
At both input and output of erbium doped fiber amplifier (EDFA), it is necessary to monitor the power, and the amplifier can dynamically adjust its gain accordingly.

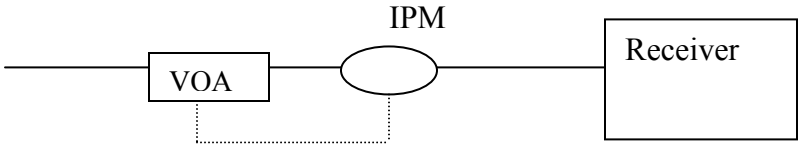


(3) Signal MUX/DEMUX

(4) Signal Protection
Protection switch: to sense the absence of light

In order to sense the absence of light in the fiber, the in-line power monitor is required in the protection scheme.

(5) Signal Receiving
Saturation testing and Alarm threshold testing



Hitachi Metals IPM is based on partial -reflector

Until recently the preferred power monitoring art was an optical tap coupler with a pigtailed photodiode. The optical tap coupler can be fused fiber tap coupler or a thin film filter based three-port tapper. The indium gallium arsenide (InGaAs) is commonly used for pigtailed photodiode for 1200nm to 1750nm wavelength windows. A complete power monitor requires manual fiber fusion splicing and fiber routing. This drove the development of a compact, reliable and cost effective solutions.

Integrated Power Monitors (IPMs) are being manufactured and marketed with a variety of different technologies, each having its own advantages and tradeoffs. There are four currently available: evanescent coupling, fiber micro-bends, integrated wave-guides and partial transmission thin film filters. HML is the first to introduce the high performance and low cost miniaturized IPM based thin film filter.

HML's proprietary IPM design is based on an integrated tapped dual-fiber collimator and a photodiode. The input and output fibers are mated to a dual collimator with a partially

reflecting thin film on. The thin-film filter could be designed to meet various wavelength dependent signal sampling requirements. This compact design provides HML's IPM with high thermal stability, long term reliability together with superior optical/electrical performance and low manufacturing cost.

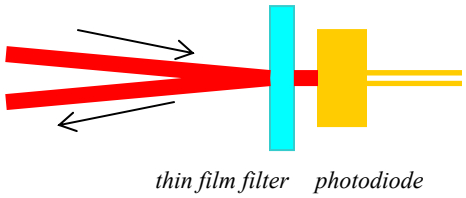


FIGURE 1.HLM's IPM, input and output fibers are mated to a dual collimator focused on a partially reflecting thin film in front of the photodiode.

IPM demonstrates high performance

For optical power monitor, parameters such as insertion loss (IL), polarization dependent loss (PDL), polarization dependent responsivity (PDR) and wavelength dependent responsivity (WDR) represent the performance of the device. Meanwhile, geometric compactness and detecting wavelength range flexibility could make the device more versatile in field deployment.

Compare to the conventional optical power tap/monitor, IPM has advantages in many aspects.

1. Size:

   For a single channel power monitoring, conventional tap/monitor with fused coupler takes a space around 80mm x 50mm x 5mm, while IPM needs only ϕ3mm x 15mm. The compactness of IPM greatly reduced the facility cost and made it more versatile especially as an add-on device for existing equipment.

2. PDR and PDL:

   Unlike conventional tap/monitor, both PDR and PDL for IPM have been minimized based on the cylindrical structure design. Therefore, IPM provided with more accurate power measurement especially at low tap ratio such as under 1%.

3. Wavelength dependent loss (WDL) and wavelength dependent responsivity (WDR):

Since WDL and WDR are related to the contributions from each element in IPM, a desired parameter could be obtained by tuning the property of the thin film coatings. Some special wavelength dependent performance such as band power detector could be achieved with band pass tapping film. Those characters are hard for fused coupler based tap/monitor to perform.

Conclusion

HML's cost effective compact IPM provided a versatile and reliable device for optical power monitoring in fiber networks. It meets or exceeds the industrial standard such as GR-1221-CORE and GR-468-CORE.

About Hitachi Metals, Ltd.

Hitachi Metals, Ltd. is one of the major members of the Hitachi group companies, endeavoring through the medium of its materials to create new components and devices in all the industrial and telecommunication fields. The company's growth is a reflection of its strong marketplace acceptance. These results from a combination of advanced technology, superior customer service, and the ability to provide custom-designed products that meet the exact needs and specifications of customers.

Our Corporate Value

We seek to preserve and enhance:

… Our customer's trust in us by fulfilling our responsibilities.

… The unleashing of our imaginations and energies, coupled with tenacious execution.

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