VCM Quality Monitor for DWDM Optical Fiber Communication

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Summary

This VQM application note document describes the operational procedure of the VQM.

Background

It is well known that increase of communication information capability is alway the target of communication system development. Optical fiber communication features very large information capability and very high speed, but perple expect more. following this expactation, Dense Wavelength Division Multiplexing (DWDM) came and is getting more and more popular.

The conventional optical fiber communication system uses one or two optical wavelength(s) in one fiber such as 1310 nm and/or 1550nm. A DWDM system allows 25 wavelengths from 1520 nm to 1570 nm with the interval of 2 nm to carry the signal in one fiber so that the communication capability increases 25 times. Further more, the theoretical limit of the wavelength interval can be reduced to 0.2 nm, that means the information capability will increase 250 times!!!.

In a DWDM system, the communication quality parameter concerned is not only the optical intensity or power, but also the wavelength accuracy. It is very easy to understand that if a smal wavelength shift will cause very serious cross talk because the optical sensor has very wide spectrum. Therefore a wavelength monitor is necessary to be used in a DWDM system.

A wavelength meter is a very expensive measurement instrument with the price more than 10k US dollars, it is impossible to add a wavelength meter in each optical fiber communication channel.

Introduction

IKM's new invention of a Voltage Channel Monitor (VCM) is good solution.

A VCM has one optical input, one optical output, two

electrical outputs. The sum of the two electrical output voltages is proportional to the input optical intensity or power and the ratio of the two outout voltages indicates the optical wavelength.

The price of a VCM is as low as several hundred US dollars so that it is feasible to use a VCM in each channel of a DWDM system.

The insertion loss of a VCM can be as low as 0.044 dB depending on the user selection.

Table 1 shows the output voltage ratio against the input optical wavelength of a typical VCM

VCM should be used in both side of a DWDM channel. On the transmitter side, it is inserted between the transmitter output and the input of DWDM, on the receiver side, it is inserted between the output of the DWDM and the input of the receiver. The optical and electrical circuit block diagram is shown in Fig. 1.

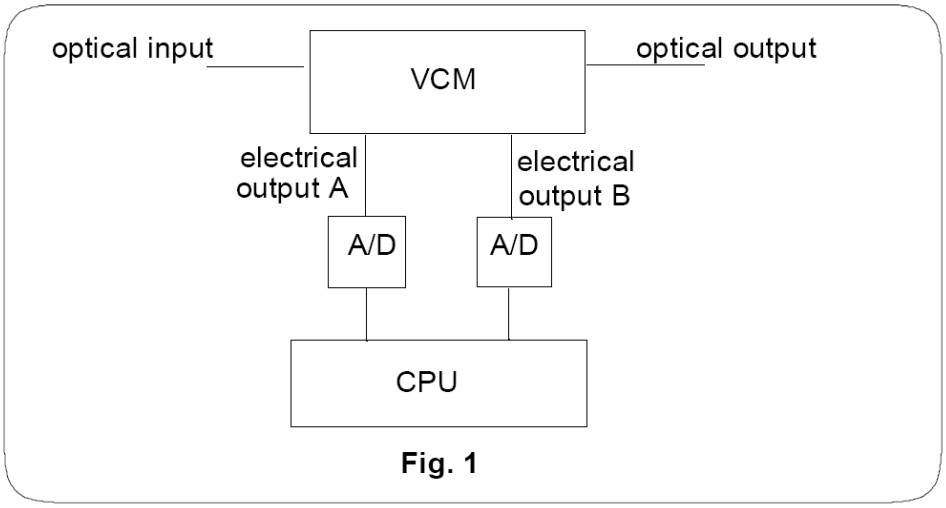

Fig. 1

Operation

The operation of a VCM is very similar to PQM. Two A/Ds are connected to the two electrical output terminal A and B respectively. The A/Ds sample the output voltages and transfer the data to CPU which calculate the ratio of the two voltages and determines the optical wavelength according to the pre calibration look up table or formula.

Before a VCM is put into the operation in a DWDM system, a calibration procedure must be implemented. A wavelength tunable light source and a variable optical attenuator are connected to the optical input of a VCM in series. Measure the optical power, the output voltage ratio at different wavelength and different optical power by the two A/Ds. Based on the data, a set of lookup tables or coefficients can be installed in the computer for the on-line measurement.

The resolution of the A/D recommended is 16 bits to 24 bits.

wavelength (nm)	voltage ratio
1,520	13.48’
1,525	10.67’
1,530	8.545’
1,540	6.636’
1,545	5.000’
1,550	3.566’
1,550	2.414’
1,555	1.515’
1,560	0.8584’
1,565	0.3907’
1,570	0.111’

Table 1