IKM Technology

High-sensitivity Quality Monitor for optical fiber communication

INTRODUCTION

HQM is an optical-electrical converter which features passive in optics, high sensitivity and wide input dynamic range. The input of HQM is optical signal and the output is the analog electrical voltage that is proportional to the logarithm of the input optical power.

As a passive optical device, HQM never generates any optical signal to interfere the normal operation of the optical fiber communication system under monitor. Optically HQM can operation high Baud rate, up to 2.5Gb/s and higher。

The sensitivity of HQM is very high, when the input optical power is as low as -80dBm(10^{-11} W) , the output voltage increment is about 4mV/dBm. When the input optical power is greater than –60 dBm, the output voltage increment is not less than 40 mV/dBm.

The logarithm output makes HQM doesn't require any gain setting and the input dynamic range can reach 7 orders. HQM has a pin of dark voltage compensation by which the affect of dark voltage can be eliminated.

When HQM is combined with the optical coupler of 99:1 or 90:10, it can operate in any optical fiber communication systems without saturation.

Based on the advantages, HQM is an idea device for the quality monitor of long distance backbone optical fiber communication system.

MODULE

The package of HQM is a 12 pin plastic module. The optical interface can be FC type receptacle or ST type receptacle or pigtail.

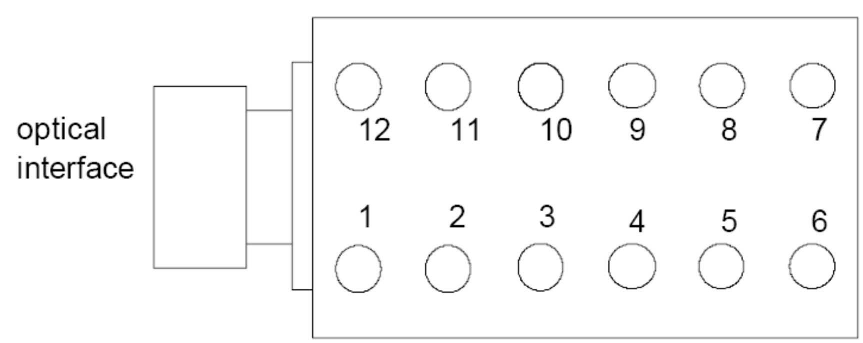

Fig. 1 HQM pin over view

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The twelve electrical pin layout is shown in Fig. 1

PIN OUT

The pin out of HQM is listed as follows

Pin Number	Description
1	+5V
2	0V
3	NC
4	NC
5	NC
6	Output
7	0V
8	NC
9	NC
10	-5V
11	Dark voltage compensation
12	0V

The output voltage range of pin 6 is from +3.0V to –0.5V, the corresponding input optical power range is –80 dBm to 0 dBm.

The definition of dark voltage is the HQM output voltage when it is in a complete dark environment without input optical power.

The operation of the dark voltage compensation is to apply a DC voltage to pin 11, tune the voltage until the output voltage of pin6 reaches +3.0V±1mV, which is called the dark voltage is compensated. The voltage value at pin 11 for the output voltage of +3.0V is called dark voltage compensation voltage. The range of the compensation voltage is about –1mV to +1mV. For the capability of changing the output voltage with the resolution of 0.1mV, the compensation voltage resolution should be 0.05uV. Since the dark voltage depends on the temperature, the dark voltage compensation voltages should be obtained under different environment temperatures.

WAVELENGTH

HQM can operate the optical wavelength from 1310 nm to 1550 nm.

SENSITIVITIES

For the input optical power 0f –80 dBm , the sensitivity is not less than 4mV/dBm
For the input optical power 0f –70 dBm, the sensitivity is not less than 20 mV/dBm.

For the input optical power of –60 dBm and above, the sensitivity is not less than 40 mV/dBm

POWER CONSUMPTIONS

The currents of +5V and –5V are less than 5 mA.

REQUIREMENTS OF POWER SUPPLY

Since HQM is a high sensitivity device, the power supplies of +5V and –5V must be from independent voltage regulators without sharing with any digital circuits.

DIMENSION

The dimension of HQM is shown in Fig. 2

	Metric	Inch
a	13 mm	0.5”
b	43 mm	1.7”
c	10 mm	0.4”
d	2.54 mm	0.1”
e	5.5 mm	0.22”
f	25 mm	1”
g	37 mm	1.45”
h	0.25 mm	0.01”
i	0.5 mm	0.02”
j	17.18 mm	0.7”

CALIBRATION AND CALCULATION OF THE INPUT OPTICAL POWER

The purpose of the calibration is to establish the numerical relationship between the input optical power and the HQM output voltage. The relationship depends on not only the HQM, but also the wavelength and power contribution ratio of the optical power coupler in series with the HQM.

The calibration procedure should be implemented before the system is connected to the optical fiber to be measured.

The calibration circuit is shown in Fig. 3

In Fig. 3 L is a light source with adjustable output optical power or a light

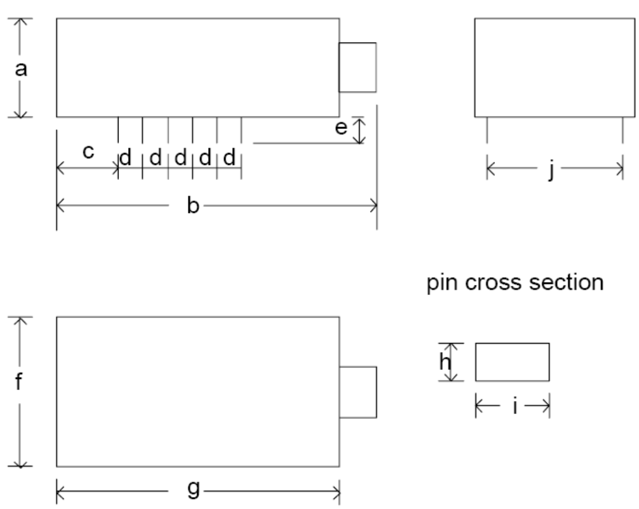

Fig. 2

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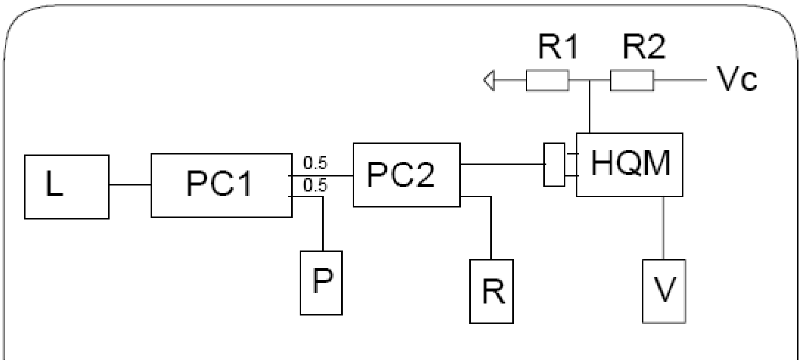

Fig.3

source with a fixed output optical power and an adjustable optical attenuator in series. The wavelength of the light source must be the same to that of the real system. If the HQM may operate for different wavelengths, L should generate all of wavelengths.

PC1 is an optical power coupler with the ratio of 0.5:0.5, P is an optical power meter. Since the output power ratio of PC1 is 0.5:0.5, the reading of the power meter indicates the optical power of PC2 input.

PC2 is an optical power coupler that is combined with the HQM in the real system. The output terminal of PC2 with small ratio is connected to the optical interface of HQM and the terminal with large ratio is connected to receiver R or a matching terminal.

R1 of 1K ohms, R2 of 1M ohms and the control voltage, Vc with the adjustable range from –1V to +1V form a dark voltage compensation voltage generator circuit. Vc can be from a multi turn potential meter or a digital to analog converter of 16 bit resolution. The joint point of R1 and R2 is connected to the dark voltage compensation pin 11 of HQM.

V is a voltage meter connecting to the output pin 6 of HQM.

The calibration procedure consists of two steps:

1. Dark voltage compensation: turn off the light source L, put the HQM in a complete dark environment, adjust Vc until the output voltage of HQM is 3.0V±1mV. Record the value of Vc and the environment temperature. A table of Vc values and the corresponding temperatures should be created. The table should be saved in a non volatilized memory such as hard disk or EPROM or flash memory.

2. Set several output optical power values of the light source L. For each

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setting, read the optical power from the optical power meter P and the output voltage of HQM from the voltage meter V. Record each pair of data of the optical power with the unit of dBm and the HQM output voltage Vout for each wavelength if multi wavelengths are required. The table of the input optical powers and the corresponding HQM output voltages for each wavelength should created and saved in a non volatilized memory such as hard disk or EPROM or flash memory.

The accurate formula of the optical power , P(dBm)and the HQM output voltage Vout(V) is shown in (1)

$$P(dBm) = K + 10*\log[10^{2(Vd - Vout)} - 1] \quad (1)$$

Where Vd is the HQM dark voltage, 3.0V. The unit of the HQM output Vout is volts.

According to the measurement data from 2. and the formula, the best estimation of K value can be obtained.

The K value depends on the wavelength, the power distribute ratio of the optical power coupler in series with HQM.
When $10^{2(Vd - Vout)} - 1 >> 1$, (1) can be simplified to (2)

$$P(dBm) = K + 20\,(Vd - Vout) \quad (2)$$

The accuracy is considered as follows:

When the required error is less than 10%, only if Vout is lower than 2.5 V, (2) can be used in stead of (1)

When the required error is less than 1%, only if Vout is lower than 2.0 V, (2) can be used in stead of (1)

ASSEMBLE NOTES

HQM is very sensitive to the light, no sun light or other strong optical light is allowed to hit on HQM. Any optical luminous device such as LED must be far from HQM.

ENVIRONMENT

Temperature: operation: 0 to +70 C
storage: -20 to +85 C
Humidity: up to 85%, no condense

ORDERING

HQM –XX
XX = FC : FC type receptacle
XX = ST: ST type receptacle
XX = SP: Pigtail with the diameter of 0.9 mm*

If pigtail is selected, the length must be specified.

The data sheets are subjected to modification without notification.