# The Optical Filters in Power Systems

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## Abstract

In this study, the optical filters in power systems are evaluated. To measure the power plants and transmission lines, can be used as the optical filters. The converters are based on the principles and physical laws act and have been proposed as an alternative to conventional CT. In this paper, the performance of converters that operate according to Faraday's law, is studied. A new approach for the design of an optical filter based on two-dimensional photonic crystals is presented. Depending on the desired electronic devices, and high-pass filters are available in three types Payyngzr, bandpass, or a combination of them are classified. But each of the filters in the frequency range of the expected performance of the show.

**Key words:** the optical filters, fiber optic Faraday effect, measuring the electrical installation

## I. INTRODUCTION

In the last few years have been remarkable advances in optical technology, so that technology in various fields of science and engineering has been entered. In different applications, can be measured using this technology [1, 2], to determine the errors in electrical systems [3, 7] and the creation of communications and power networks [8, 9] cited. This paper examines the different ways to measure how the light in high pressure systems and the performance of each method deals with the above principles.

## II. GOALS HAIR

**The overall objectives** :
The optical filters in power systems
**Detailed objectives :**
Optical filter based on photonic crystals
Optical filters and frequency selective surfaces
Different types of optical transducer
Optical filters on the conductor
Control sensor
Principles and guidelines for the evaluation of optical filters
Methods for measuring the deflection angle of polarization in optical filters OCT functional requirements are

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**Methodology**

The magnetic field Maxwell equations with boundary conditions at the interface between the layers, and finally solve the matrix method to calculate the reflectance and transmittance of the filter is proposed. Using software TFcalc, anti-reflection filters optimized by changing the parameters of design.

For this purpose, the optical properties of single Layhayha, Chndlayhayha and their applications were reviewed. The important parameters in the design and construction methods were investigated. Secondly, according to the materials available and accessible using Multisim software Zdbaztaby some kind of filter in the visible and infrared region between 1 to 3 micron design.

## III. OPTICAL FILTER BASED ON PHOTONIC CRYSTALS

A new approach for the design of an optical filter based on two-dimensional photonic crystals are presented. Fvtvnbky forbidden to extract the crystal base band filter design method used for expansion waves were flat. Range, high output, low bandwidth and high quality factor is one of the advantages of this filter. The paper has also investigated the structure in which a crooked rectangular dielectric rod, which was used as the wavelength selective.

## IV. OPTICAL FILTERS AND FREQUENCY SELECTIVE SURFACES

All telecommunications and electronic devices that are used in a particular frequency range, the removal of other frequencies available, the filter circuit within the building use. Depending on the desired electronic devices, and high-pass filters are available in three types Payyngzr, bandpass, or a combination of them are classified. But each of the filters in the frequency range of the expected performance of the show. To solve the problem of high frequency filtering, frequency selective surfaces FSS) have been known since 1960. In this paper we introduce and study a variety of FSS are discussed.

Optical technology for high voltage current measurement systems,for the first time in the late 1960s has been used [10, 11], and since then has elapsed after the research has practical applications [10]. the optical instruments – electri vary. Figures (a) and (b) illustrates the major OCT systems. as can be seen, Changes in each component of the system leads to a new system. For example, optical or electronic sensor can be associated with the high voltage can be active or inactive, insulators and insulating ceramic or polymer can be selected and OCT can be hung or mounted on insulators,however, in most cases, and the quantity measured using optical fibers transferred. variation in signal transduction and how they are encoded. Measured signal can be a relay, stability and apply.

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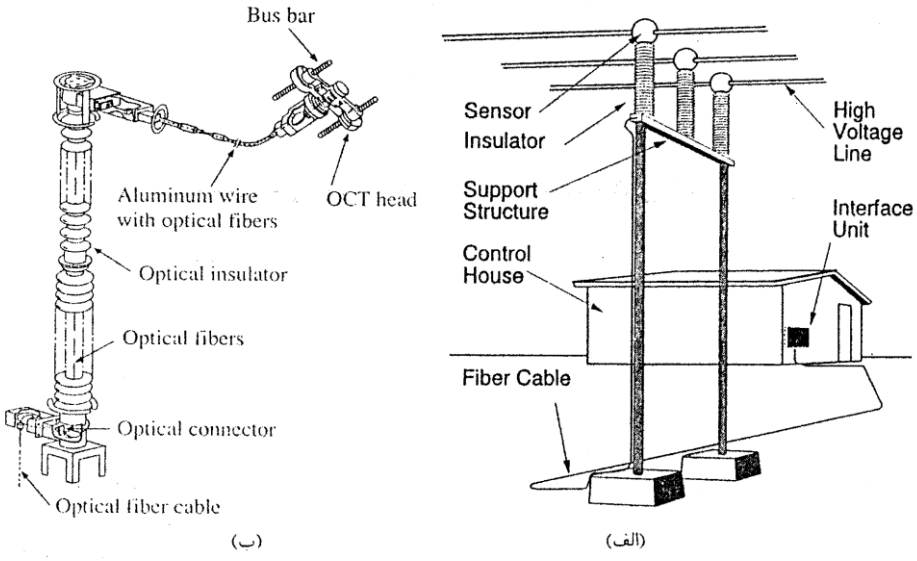


Figure 1: The main components of the optical measurement system, a system of measurement is connected to the HV on insulator [10]; (b) Schematic of the measurement system components [5]

The optical measurement system has many advantages. Among them are the OCT light weight compared to conventional CT cited. The low weight is due to savings in operation and installation materials. For example, Figure 2 shows an example of an OCT without the need for special insulators mounted on an isolator Sksyvnrya observed. Another advantage of OCT is stability against disturbances. On the other hand, instead of replacing the relay digital and conventional electrostatic relays, OCT can be used properly in the system.

## V. DIFFERENT TYPES OF OPTICAL CONVERTERS

Methods used to measure the optical flow are discussed in this paper, based on the similarity measured by the method mentioned above is aimed at conventional CT.

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**TYPE 1; CT CONVENTIONAL LIGHT OUTPUT:**

In this method, as shown in Figure 3, the output of the transformer is connected to a transducer electrical signal into an optical signal. Thus, the optical technology can be used in conjunction with traditional methods of flow measurement. because the output of the CT requires high voltage insulation as conventional CT does not exist, you can save the volume of conductors and insulators. in addition to the CT connection to an electronic transformer, the power consumption is low and constant output, leading to a reduction in core size is CT. for this reason, we can design calculations core CT performed with greater freedom in such cases, the core of ferrite cores with air gap or used to improve the performance of the frequency response of the transformer.

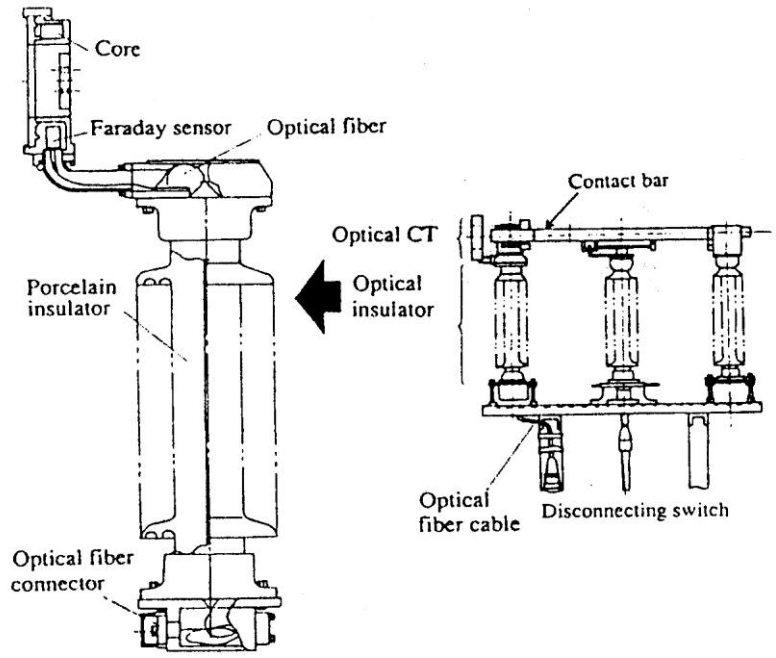


FIGURE 2: AN EXAMPLE OF AN OCT CONNECTED TO THE DISCONNECT SWITCH [7]

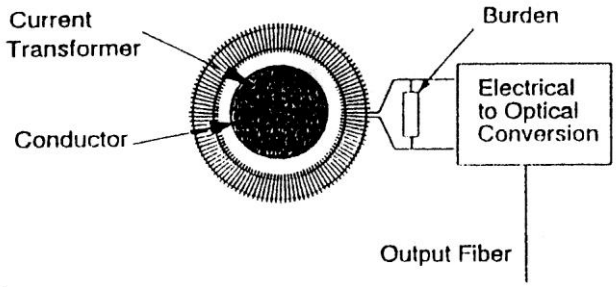


FIGURE 3: CT CONVENTIONAL LIGHT OUTPUT [10]

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## VI. TYPE 2, NUCLEAR MAGNETIC AND OPTICAL MEASUREMENT:

In this method, a magnetic core with an air gap that surrounds the conductor is used (Figure 4). Thus, the magnetic field around the conductor is measured and converted and transferred to the quantity of light. How to convert magnetic fields to the quantity of light on the Faraday effect is done will be explained in the following sections.

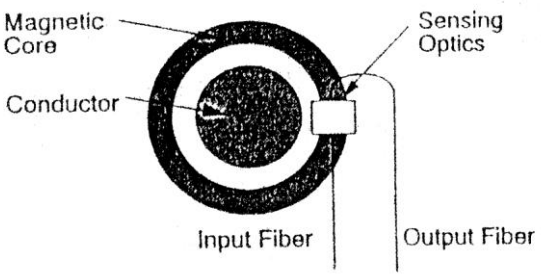


FIGURE 4: USING THE OPTICAL TRANSDUCER MAGNETIC CORE [10]

## VII. TYPE 3: THE ACTIVE MASS OF LIGHT AROUND THE CONDUCTOR:

In this way, according to Figure 5, a material that converts light to energy, the magnetic field has to be put on the conductor inside it, like a normal CT windings, optical fibers are complex. In this method, a closed optical path, surrounds the conductor.

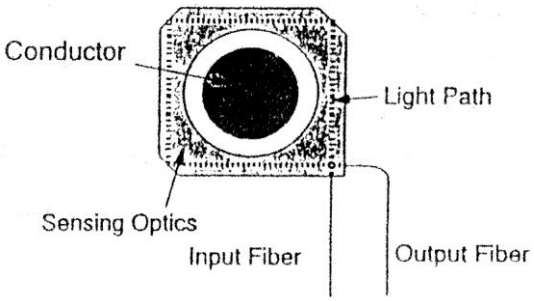


Figure 5: The process of converting light to optically active mass [10]

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## VIII. TYPE 4, OPTICAL FILTERS ON THE CONDUCTOR:

The method is similar to the previous method of filtering an optical path difference in how the twist occurs on the conductive fibers (Fig. 6). The method of direct optical filters are wrapped around the conductor. Number of optical fibers based on the expected sensitivity of OCT determined.

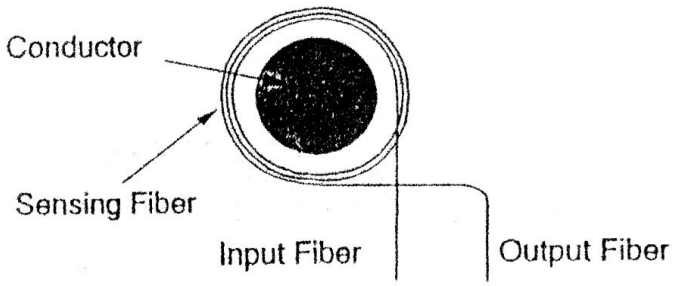


Figure 6: the optical converter with optical filters [10]

## IX. SENSOR CONTROL

In this method, to measure the flow of all the conductors can not be used on the Space. Therefore, in Figure 7, a magnetic field sensor is placed at a point near the conductor. Because of the way the package can not be used in this way, the sensor is a transducer is not real and only weighs right at one point, But the assumption of a uniform field around the conductor, the sensor could be calibrated to determine the flow rate of the conductor.

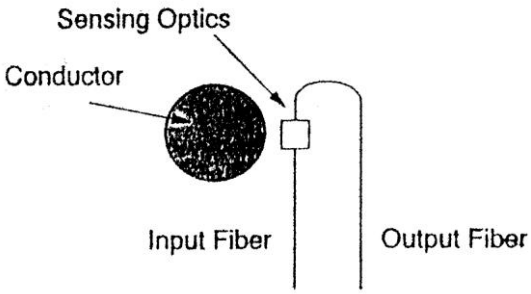


Figure 7: control sensor is used to measure flow [10]

## X. PRINCIPLES AND GUIDELINES FOR THE EVALUATION OF OPTICAL FILTERS

Measurement of optical filters by measuring the magnetic field around it goes back to about a century ago [10]. Accordingly, the sum of the magnetic field intensity on a route depending on the current-carrying conductor is calculated. Spatial distribution of the magnetic field depends on the position of the current-carrying conductors. But if action is necessary to calculate the total field on a closed course. Independent of the flow path of integration is achieved. Flow rate can be calculated according to Ampere's law [12]:

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$$I = \int H.dI \qquad (1)$$

In the above equation, I flow, H magnetic field strength and direction d1 components are integrated. TYPE-1 assay, flow, current transformers, as usual, is the current law. 2 to 4 types of converters usually Faraday effect or the effect of magnetic - optical.
Light polarization vector of the electric field E is determined by characterization. Each light-polarization can be considered the sum of two components perpendicular to each other [12]. If these two components are the same size as the phase of the light with linear polarization plane will be perceived if the components are the same size as the phase difference of 90 degrees, the circular polarization of light. The concept of spin polarization and analysis of the positive and negative components with the same concept of positive and negative sequence components of the power system.
In general, the optical refractive index of the material relative to the direction of polarization of light transmission or it is variable. This property is called Two defeats. The in vitro activity of CH pressure with ambient temperature changes occur, while the origin of the internal structure of their crystals.

The maximum and minimum optical refractive index corresponding to the minimum and maximum transfer speed of light in the material used. The difference in speed causes a phase difference of polarized light component is. If polarized light to pass through the material in this transition phase, but it did exist between the components of the energy exchange, after passing a little spin polarization of the page. This property is read by the optical activity. Faraday effect a modulated optical activity, such that rotation of the light polarization plate in the presence of a magnetic field and accordingly done. This effect was first observed in 1845 by Michael Faraday [12]. The rotation of the polarization plate, in the presence of a magnetic field H, along dI the following equation:

$$\theta = \mu V \int H.dI \qquad (2)$$

Where V is calculated Vrdt fixed. This fixed amount is very small. Vrdt prove citizenship to the wavelength and temperature must be considered in making OCT. An example of a Faraday sensor in the following figure:

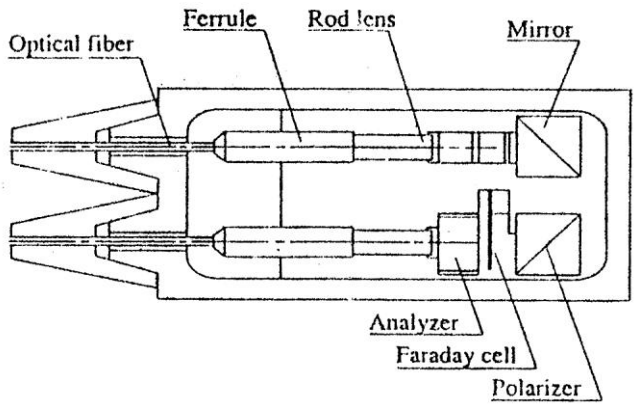


Figure 8: An example of a Faraday sensor and its internal components [5]

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The incoming light is polarized in the OCT. This will put a filter in the light path and select the appropriate polarization occurs. After passing through the magnetic field deviation in polarization angle to be measured. This deviation is not directly measurable, because photodiode sensitive to light intensity, for measuring the deviation of different methods used in this paper is to point out some of them.

## XI. METHODS FOR MEASURING THE DEFLECTION ANGLE OF POLARIZATION IN OPTICAL FILTERS:

### BY AC / DC:

OCT in the light output of a polarization filter passes to the other required information to be extracted from it. Rotation angle of the output light intensity of the polarizing filter over time, $\frac{\pi}{4}$ ,depends. In this practical reasons, this angle is usually considered equal. Be considered. Intensity output, assuming no losses in the OCT, in accordance with the following equation is related to the intensity of the input power:

$$P_{\det} = P_{in}(COS\alpha)^2 = \frac{1}{2}P_{in}(1+\cos(2\alpha)) \qquad (3)$$

Figures 9 (a) and (b) can be helpful in better understanding the issue. Usually, because there is a constant light output optical fiber polarization. For $\alpha = \frac{\pi}{4}$ and the absence of a magnetic field, the output would be half of the input power. Thus, the presence of a magnetic field and the incidence angle of deviation of the polarization plate, according to equation (3) can be output:

$$P_{\det} = \frac{1}{2}P_{in}(1-\sin(2\theta(t)) \qquad (4)$$

Abdel. The relationship among represents both AC and DC current to be considered:

$$P_{DC} = \frac{1}{2}P_{in} \qquad (6)$$

Information about the flow of AC lies, but because of the relation (5) is independent of the energy of the light source, the value of the relationship:

$$\frac{P_{AC}}{P_{DC}} = 2\theta(t) = AI(t) \qquad (7)$$

Is calculated. Recent relationship with the assumption of small deflection angles written where I (t) is going to follow it are measured and A is a constant that depends on the design of the OCT.

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## XII. ADDITION AND SUBTRACTION METHOD:

In this method, the output of the filter OCT angles $\pm\frac{\pi}{4}$ is used. PA1 and PA2 be called if the outputs of these filters:

$$P_{A1}=\frac{1}{2}P_{in}(1+\sin(2\theta(t)))\quad (8)$$

$$P_{A2}=\frac{1}{2}P_{in}(1-\sin(2\theta(t)))\quad (9)$$

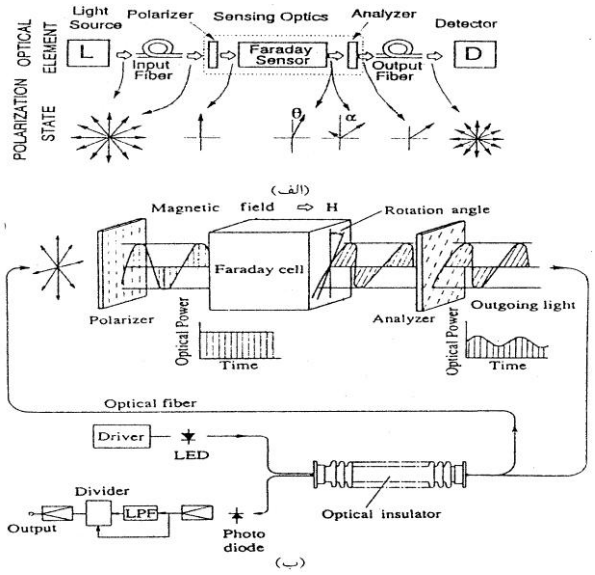


Figure 9: How to change the angle of polarization in the presence of a magnetic field [10, 7]
Thus, the ratio of the difference between the total output flow rate can be calculated. In this method, the sensitivity of output as the previous method. Although this method requires more complicated hardware stability than the more common mode noise.

## XIII. OCT FUNCTIONAL REQUIREMENTS ARE:

**Standards:**

To determine the functional requirements of conventional current transformers CT certain criteria were developed and are available. Many of these requirements in the form of standards, such as 1987: 185 IEC and 13-1978 .ANSI / IEEE C57 are considered. View implementing the requirements indicated by the user, CT. Unfortunately, standard CT can be used for OCT. The basic characteristics of an OCT can be frequency response, signal to noise ratio, harmonic distortion, stable and dynamic range named. However, efforts to establish standards for the optical transducer in the IEEE Technical Committee has started [10]. But before the relevant standards, specifications OCT based on existing needs and the agreement between the manufacturer and the user are determined.

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## XIV. CIRCUITS BY:

In most applications, the output of a conventional CT is one of the values 1 or 5 amps. The current value of a century ago, based on considerations such as stability against noise and electromagnetic relay having enough energy to stimulate selected [10]. Since in some OCT are active electronic devices are used, there is a large flow due to excess consumption and DC battery system will be posts. On the other hand there is a large flow of OCT output is not justified, because these devices due to the nature of light in the presence of noise and disturbances are the stable. To stimulate new tools developed to measure quantities and Rlh¬Hay not require much energy. The amount of current or voltage output of a few mA or mV will OCT. OCT Select the output current or voltage is not accepted as standard and can be of any use-OCT needed to provide the desired output characteristics. In addition to the converter output OCT, an optical signal power is an example of a micro-volts [10], which represents the quantity of high pressure, the need for the intermediate circuit. These circuits are designed and manufactured in a state-models are based on OCT.

## XV. CALIBRATION:

According to the standard IEC 185: 1987, the most stringent accuracy class of a CT ratio equal to a maximum error of 1% / 0 is [10]. This condition can be used for calibration and CT devices are used for calibrating OCT. In these cases, using an amplifier, the output signal OCT to improve the flow rate of CT. Exist to allow calibration. Other methods for OCT calibration with low output current (mA range) exists [13 and 14]. When OCT calibration properties such as frequency response, dynamic range and stability are also considered.
One characteristic of OCT is that the device is made of different parts. Thus, unlike conventional CT with errors in the OCT, only need to replace the faulty part replaced and the system can not be measured. Considering these circumstances, the OCT calibration methods that are applicable at the power plant, would be very useful.

## CONCLUSIONS

Although the function of these devices is based on physical principles and is very simple, but requires special attention in the design and manufacture. the use of these devices in different parts of the power system has been successful. However, the design of better systems in order to increase the accuracy and stability, has created a proper background research. the standards for these devices is very important. Using these tools, in addition to conventional CT can provide the opportunity to evaluate their performance in the system. and work with the Proliferation use these tools in order to improve the economy and the use of technology.

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