HOLMARC

Instruction Manual

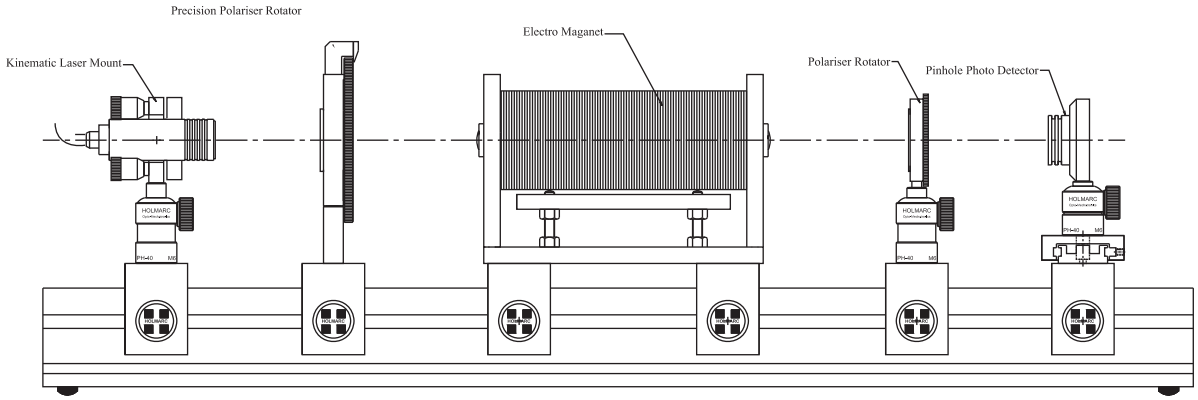
Faraday Effect Apparatus

Model: HO-ED-P-04

CONTENTS Page

Product Features

Holmarc's Faraday Effect Apparatus Model: HO-ED-P-04 is designed for the determination of Verdet's constant of a material for a given wavelength of light. With its new and integrated design, this device is easier to setup and operate so that students can easily understand its principles and theories.



A glass rod with high refractive index is located inside a variable current electromagnet. Red and green diode lasers (650nm, 532nm, respectively) are used for this experiment. The sample is placed between two linear polarizer's. A photo detector is placed at the end of the unit to measure the light intensity as a function of the analyzer angle θ for a full rotation.

Optical isolators based on Faraday's effect have important applications in telecommunication, preventing reflected signals on fiber optic cables from producing unwanted signals. Isolators are important when laser source is used because reflected light can cause havoc at the time of its operation.

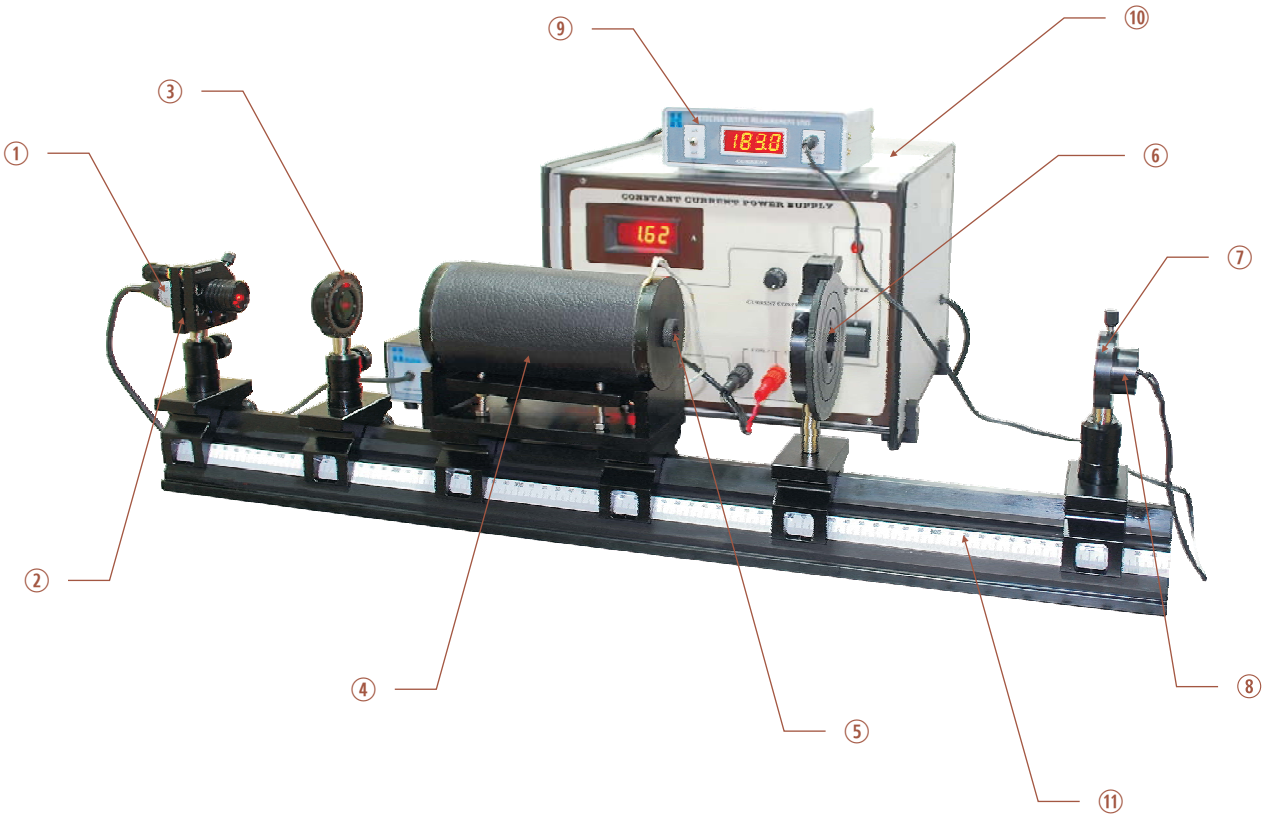
Getting Started

a) Installation & safety Instructions

- It is recommended that students work in pairs - one to take readings from the analyzer and other person to vary the magnetic field.
- Detector can operate in two different modes. mA mode is used for high intensity and A mode is used for low intensity.
- **Do Not** touch the polished faces of the glass specimen inside the electromagnet.

Caution : **Do NOT** sustain a high Magnetic field for more than 3min.for taking readings. It will lead to damage of both coil and Power supply.

b) Part Listing



1. Diode Laser with Power supply
2. Kinematic Laser mount
3. Polarizer
4. Electromagnet
5. Glass rod specimen
6. Analyzer with precision adjustment
7. Detector Mount
8. Pinhole Photo Detector
9. Output Measurement Unit
10. Constant Current Power supply
11. Optical Rail

1. Diode Laser with Power Supply

Specifications:

Colour ..... Red
Output Power 5mW
Wavelength 650nm

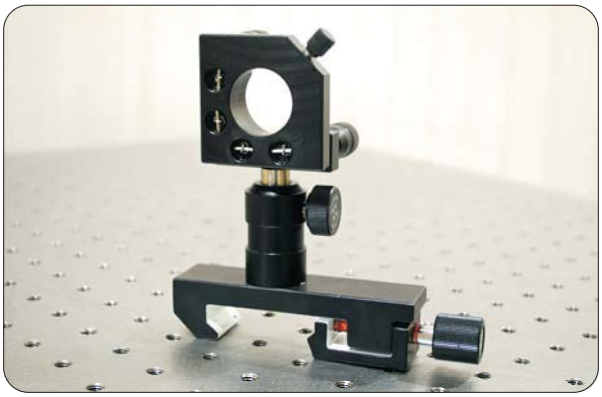
2. Diode Laser with Power Supply

Specifications:

Colour ..... Green
Output power 5mW
Wavelength 532nm

3. Kinematic Laser mount

Degrees of freedom ..... 2 degrees

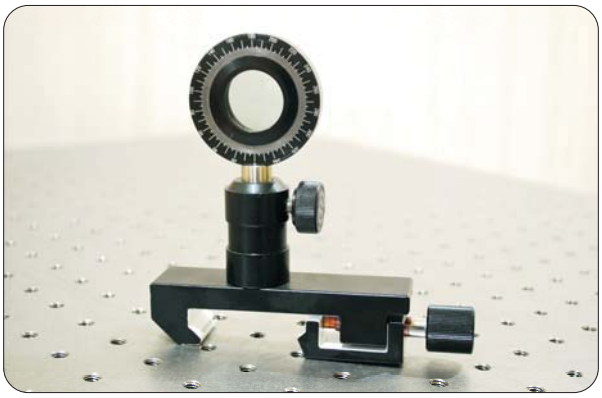


4. Polarizer

Specifications:

Type ..... Sheet polarizer

Accuracy ..... 2 degrees / division

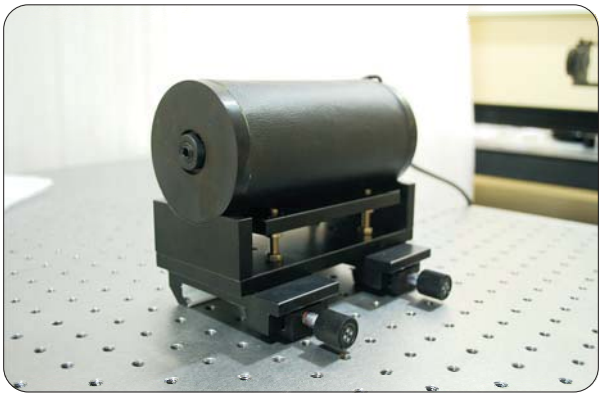


5. Electromagnet

Specifications:

Total number of turns ..... 2508 nos

Length of the coil ..... 15 cm

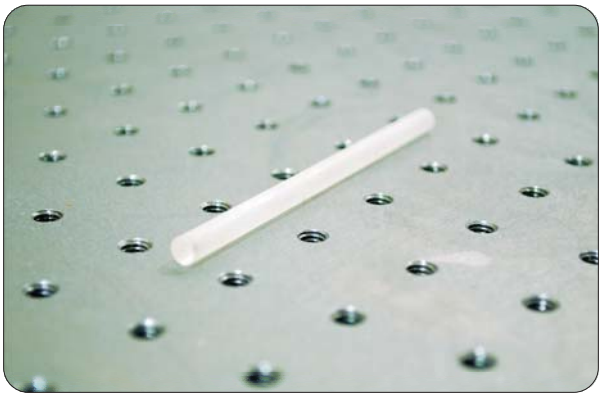


6. Glass rod specimen

Material ..... SF 10

Length ..... 10 cm

Diameter 6mm

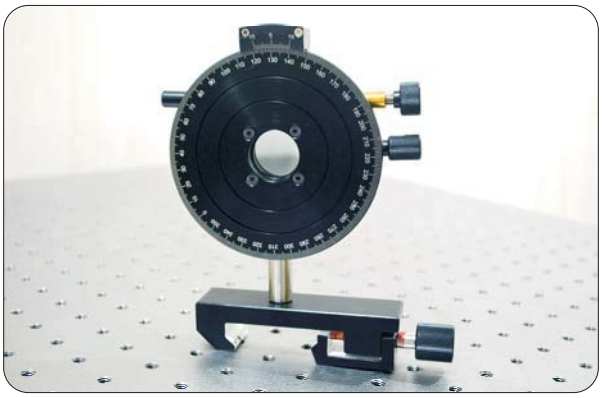


7. Analyzer with Precision Adjustment

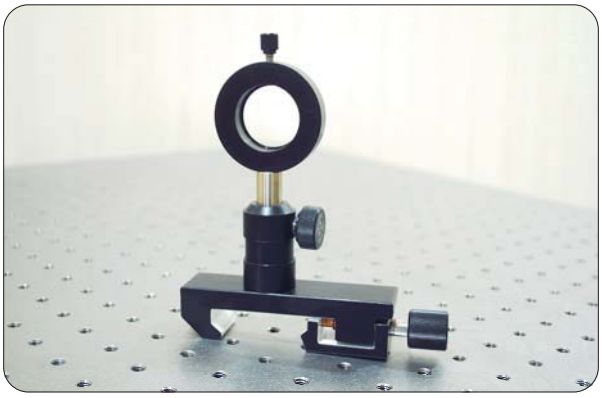
Specifications:

Type ..... Sheet polarizer

Accuracy ..... 1 degree / division



8. Detector Mount



9. Pinhole Photo Detector & Output Measurement Unit

10. Constant Current Power supply

11. Connecting Cable

12. Optical Rail

c) Installation instructions

Following procedure should be followed before starting the experiment. Figures are provided in order to understand the arrangements that are to be made for the experiment.

Placing of specimen and power supply connections

1. Inserting the specimen.

Fig (1)

Fig (2)

Fig (3)

Fig (4)

2. Connecting the cable to Electromagnet.

Fig (5)

3. Connecting the cable to Constant Power supply source.

Fig (7)

Fig (8)

4. Place all the mounts over the rail as shown in the figure. Insert Laser module in the laser mount. Insert pinhole photo detector in to the detector mount.

Fig (9)

Fig (10)

Fig (11)

Fig (12)

Fig (13)

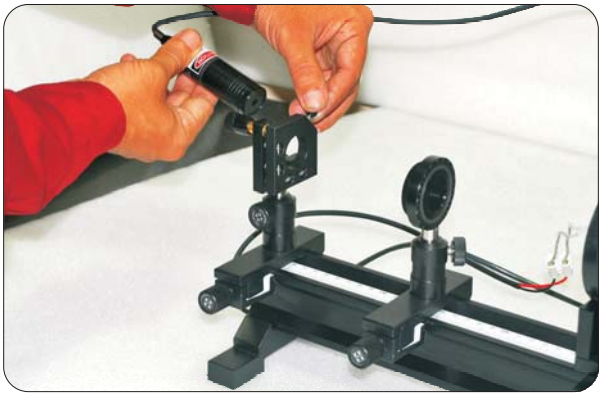


Fig (14)

Fig (15)

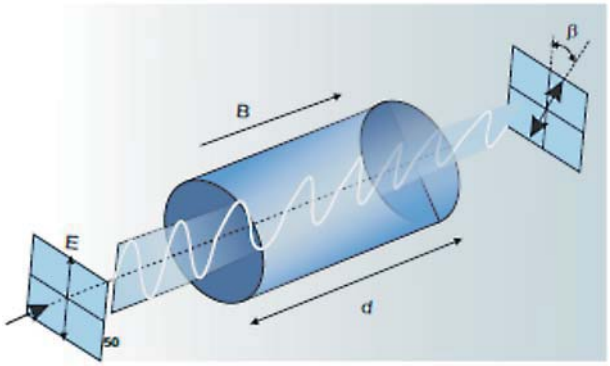
Fig (16)

Switch on the Diode laser. Remove both polarizer and Analyzer from the arrangement. Allow the laser beam to pass through the specimen and to fall exactly at the center of pinhole photo detector.

Now insert the polarizer. Rotate the polarizer in order to get maximum intensity at the pinhole photo detector. Then insert the Analyzer and rotate it for minimum intensity. Now both the analyzer and polarizer are in crossed positions. Lock the analyzer dial with the locking knob provided with the Analyzer.

Theory

Faraday Effect is a magneto optical effect in which the plane of polarized light is rotated as it passes through a medium that is placed in a magnetic field. The amount of rotation is dependent on the amount of sample through which the light passes, strength of the magnetic field and a proportionality constant called the Verdet's Constant.



$$\theta = V\, l\, B$$

Strength of the magnetic field, $B = \pi N I$

where,

N - number of turns per unit length of the coil
I - current through the coil

Experimental Procedure

Fig (17)

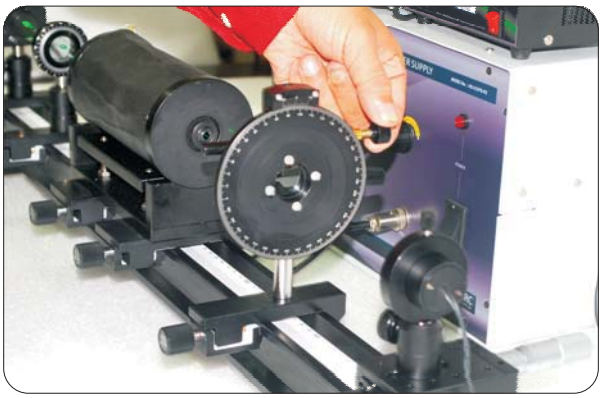


Fig (18)

Note the initial reading of the analyzer. Now, increase the current passing through the Electromagnet by varying the potentiometer provided at the constant power supply box in regular intervals (say 0.4A). Rotate the Analyzer precision adjustment knob in order to sustain the intensity at minimum for each interval. Repeat the procedure till current reaches 4A.

Observations: -

Number of turns in the coil	= 2508 nos.
Length of the coil	= 15 cm
Number of turns per unit length N	= 2508 / 15 = 167.2 /cm
Length of the glass rod	l = 10 cm

Mean Verdet constant = …… min / oersted / cm

Sl No:	Current I (Amp)	θ (min)	Magnetic Field B = πN I	Verdet Constant $V = \theta / l B$
1	0.4			
2	0.8			
3	1.2			
4	1.6			
5	2.0			
6	2.4			
7	2.8			
8	3.2			
9	3.6			
10	4.0			

Mean Verdet constant = …… min / oersted / cm

Experiment Example

Wavelength n = 530 nm

Sl No:	Current I (Amp)	θ (min)	Magnetic Field B = πN I	Verdet Constant $V = \theta / l B \times 10^{-3}$
1	0.4	60	210.0032	28.5709
2	0.8	120	420.0064	28.5709
3	1.2	180	630.0096	28.5709
4	1.6	240	840.0124	28.5709
5	2.0	285	1050.0160	27.1424
6	2.4	330	1312.5200	25.1424
7	2.8	375	1470.0224	25.5098
8	3.2	435	1680.0256	25.8924
9	3.6	495	1890.0288	26.1900
10	4.0	555	2100.0320	26.4281

Mean Verdet's constant = 27.0589 $\times 10^{-3}$ min / oersted / cm

Wavelength n = 650 nm

Sl No:	Current I (Amp)	θ (min)	Magnetic Field B = πN I	Verdet Constant $V = \theta / l B \times 10^{-3}$
1	0.4	42	210.0032	19.9999
2	0.8	78	420.0064	18.5711
3	1.2	120	630.0096	19.0473
4	1.6	165	840.0124	19.6250
5	2.0	195	1050.0160	18.5711
6	2.4	225	1312.5200	17.1425
7	2.8	255	1470.0224	17.3466
8	3.2	285	1680.0256	16.9640
9	3.6	315	1890.0288	16.6666
10	4.0	360	2100.0320	17.1426

Mean Verdet's constant = 18.1077 $\times 10^{-3}$ min / oersted / cm

Maintenance Notes

1. Always keep the equipment in a moisture and dust free atmosphere.
2. Do not touch the active region of polarizer & Analyzer with bare hands
3. 'Switch on' all the electronic devices used in this experiment at least once in a week.

Troubleshooting

If there is no variation in magnetic field,

- Check whether the coil is connected properly with the power supply.

If there is no variation in intensity of the detector,

- Push the connector pin of pinhole photo detector to the power supply.
- Check if the intensity range selector is in correct position.

Technical Support

Contacting Technical Support

Before you call the HOLMARC Technical Support staff, kindly gather the following information:

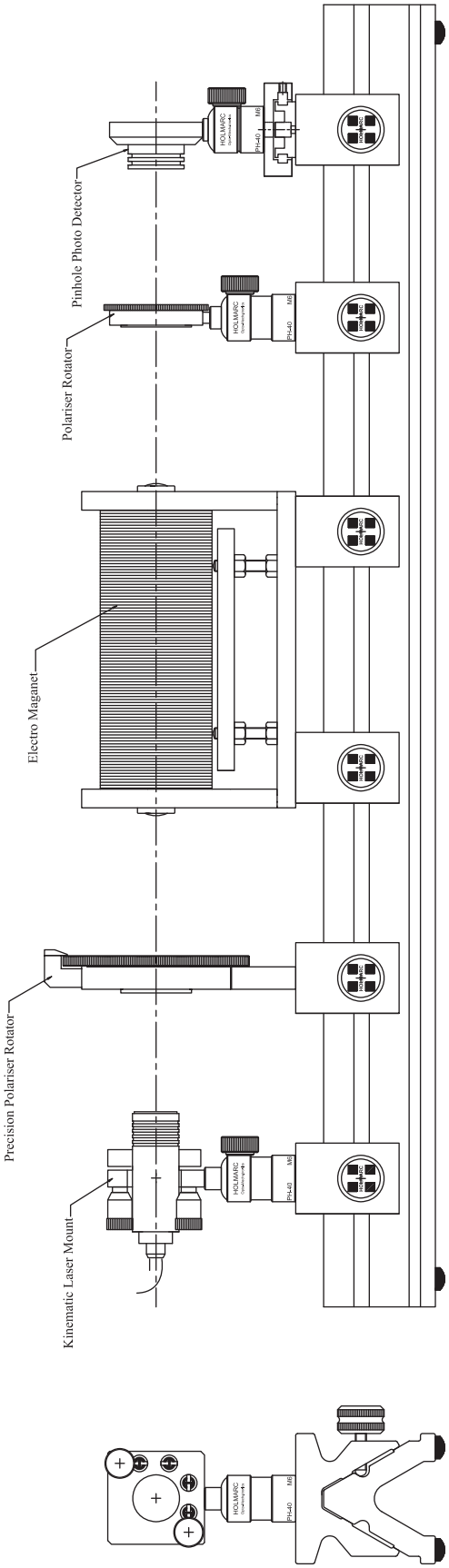
- Title and model number (usually listed on the label);
- Approximate age of apparatus;
- A detailed description of the problem/sequence of events.
- Have the manual in hand to discuss your questions

Feedback

If you have any comments regarding our product or manual, please let us know. If you have any suggestions on alternate experiments or find a problem in the manual, kindly inform us. HOLMARC appreciates any customer feedback. Your inputs help us evaluate and improve our product.

For technical support, call us at
91-484-254-0075 or fax: 91-484-254-3755
E-mail: mail@holmarc.com
Web: www.holmarc.com

Mechanical Drawing



Holmarc Limited Warranty

Every Holmarc Instruments and its accessories are warranted by HOLMARC OPTO-MECHATRONICS P LTD for a period of ONE YEAR from the date of original purchase.

Holmarc will repair or replace a product, or part thereof, found by Holmarc to be defective, provided the defective part is returned to Holmarc, with proof of purchase.

This warranty applies to the original purchaser and our distributors and is non-transferable.

Each returned part or product must include a written statement detailing the nature of the claimed defect, as well as the end user's name, address, and phone number.

This warranty is not valid in cases where the product has been abused or mishandled, where unauthorized repairs have been attempted or performed, or where depreciation of the product is due to normal wear-and-tear.

Holmarc specifically disclaims special, indirect, or consequential damages or lost profit which may result from a breach of this warranty. Any implied warranties which cannot be disclaimed are hereby limited to a term of one year from the date of original retail purchase.

Holmarc reserves the right to change product specifications or to discontinue products without notice.

Please refer our commercial invoice for warranty claim.

(Authorized Signatory)