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Electro-Optic
Modulator
Alignment
DATA SHEET 736

ELECTRO-OPTIC MODULATOR ALIGNMENT

All Quantum Technology, Inc. electro-optic laser light modulators are designed to be aligned in the same way. Linearly polarized light must be passed through the modulator so that the plane of polarity bisects the crystal ordinary (n_o) and extraordinary (n_e) axis at 45 degrees. The two axes of the crystals lie in a plane with the crystal sides. (See Fig. 1)

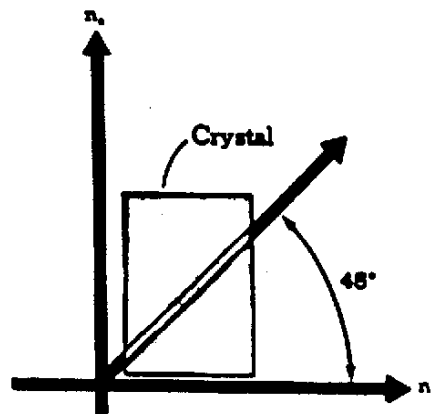


Figure 1

To perform the electro-optic modulator alignment, the optical setup must contain a polarized laser (an input polarizer (P_1) if the laser used is unpolarized) and the output polarizer (P_2) positioned so that its pass direction is orthogonal to the input. (See Fig. 2)

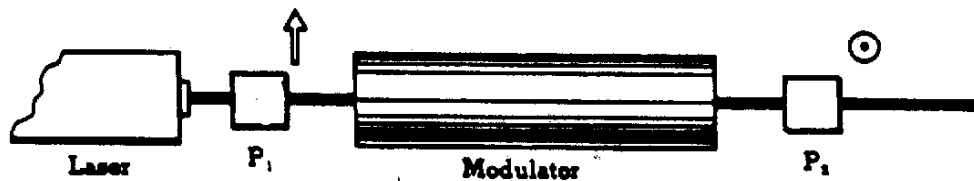


Figure 2

A suitable modulator support must be provided so that adjustments of the modulator can be made in roll, pitch and yaw. (See Fig. 3)

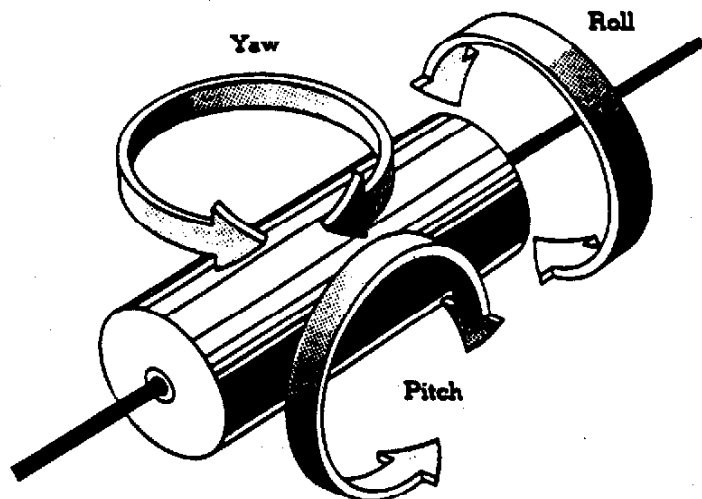


Figure 3

The modulator support used should be capable of securing the modulator in place once it is adjusted.

Proper alignment requires that a DC power supply be used to provide the necessary bias voltage required for the modulator used (see Factory Test Data sheet for voltage requirements). If the modulator was purchased with a Quantum Technology amplifier, the amplifier will supply the necessary voltage. The alignment of the modulator at this point requires that there be no signal present at the signal input to the amplifier. (See Fig. 4)

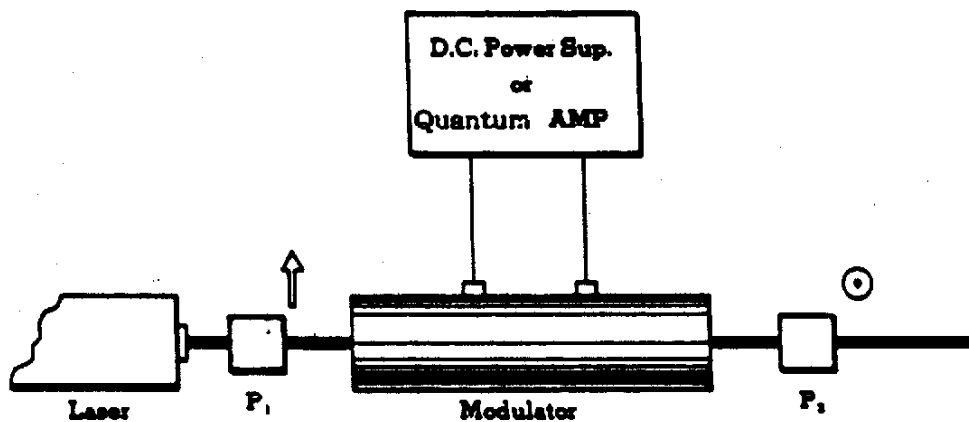


Figure 4

Once the modulator is positioned with the necessary components, and the laser beam is seen to be entering and exiting the modulator without beam distortion, bias voltage can be applied and the results viewed. A suitable photodetector should be used at the output to measure the results. (See Fig. 5)

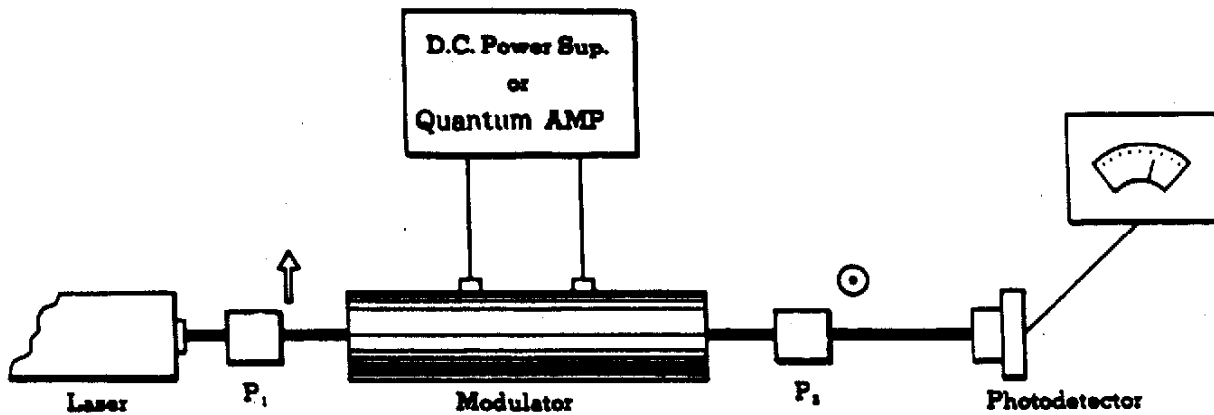


Figure 5

Simultaneous adjustment of power supply voltage and rotation of the modulator about the beam axis will result in a modulated laser output as measured with the photodetector. Voltage changes and rotations should be made until a maximum power level is read at the photodetector. Once a maximum level is found, only the voltage should be changed and a minimum value should be found. Comparison of these readings will indicate the Extinction Ratio (Contrast Ratio) of the modulation system. (See Modulator Test Data Sheet.)

Should the readings obtained indicate values lower than that specified, further adjustments in pitch, yaw, and roll may be required. These adjustments should be slight and should be done while monitoring the minimum light level (null) as measured with the photodetector.

The output and/or input polarizers can be re-attached to the modulator making careful note of the rotational position of the various elements and then rechecking the contrast ratio and transmission. No input polarizer is employed. Then for best extinction, the complete modulator and output polarizer assembly may be rotated slightly about the roll axis while the DC bias voltage is set for an optical minimum.

It should be noted that the modulator performance will be affected by the quality of the input laser beam linearity and mode structure, the output polarizer (analyzer), the proximity of the detector to the modulator/polarizer, and the laser wavelength.

Many Quantum Technology Modulator systems are purchased with options which include:(1) an input polarizer (2) an output polarizer (analyzer) (3) photodetector sampling devices.

All Quantum Technology Modulator Options are designed so that they attach directly to the modulator housing and are properly aligned prior to shipment. Depending upon the options supplied with the modulator, one or more components indicated in the electro-optical modulator alignment procedure may be eliminated.

Appendix A outlines more detailed setup procedures.

Appendix A

Electro-Optic Modulator Adjustment with Pre-mounted Polarizer. The alignment should be done with all cables attached and no electrical signal applied to the driver or modulator.

A. For Output Polarization Parallel to the Input Polarization:

1. Adjust the modulator roll axis so output polarization is roughly parallel to input. The rejected beam should be parallel to the input and point to a safe direction. If the beam is not visible, then view the polarizer output face and set the polarizer exit hole (on Model 19GLE polarizer only) pointing down.
2. Set the DC voltage bias for an optical maximum.
3. Rotate the modulator Roll axis for a more optimum optical maximum.
4. Repeat steps 2 and 3 for best maximum.
5. Now set the DC bias to optical minimum.
6. Rotate modulator Roll finely for best minimum.
7. Repeat steps 5 and 6 for best minimum.
8. Set DC bias voltage for an optical maximum. Check if the level is the same as measured in step 3.
9. Perform steps 5 and 6 and adjust the pitch, yaw and translation for best optical minimum.
10. The alignment is now done. When the alignment is done correctly a dark band or fringe may be seen crossing over the beam area when the bias is varied through the optical minimum. The width, darkness and even the number of fringes depend on the optical alignment, beam parameters such as mode, degree of collimation, wavelength, spectral width, beam diameter, etc.
11. The modulator is now ready for an electrical signal.

B. For Output Polarization Orthogonal (crossed) to the Input:

1. Adjust the modulator Roll axis so that the output polarization is roughly crossed to the input.
2. If the beam is not visible, then view the polarizer output face and set the polarizer exit port orthogonal to the input polarization.
3. Perform steps 5 through 11 of A.

C. For aligning the polarizer to the modulator:

1. Remove the polarizer from the modulator if already attached and set it down stream in the beam path making sure the mounting recess (for the EOM) bias on the input side of the beam.
2. Set the polarizer crossed to the input polarization so that the transmitted light is perfectly minimized.

3. Insert the modulator in the beam path in front of the polarizer making sure the beam.
4. Set the DC voltage bias for an optical maximum.
5. Rotate the modulator Roll axis for a more optimum optical maximum.
6. Repeat steps 2 and 3 again for best maximum due to modulator drift.
7. Now set the DC bias to an optical minimum.
8. Rotate modulator Roll finely for best minimum (not more than ± 2 degrees).
9. Repeat steps 5 and 6 for best minimum.
10. Set DC bias voltage for an optical maximum. Check if the level is the same as measured in step 3. If not perform step 3.
11. The alignment is now done. When the alignment is done correctly a dark band or fringe may be seen crossing over the beam area when the bias is varied through the optical minimum. The width, darkness and even the number of fringes depend on the optical alignment, beam parameters such as mode, degree of collimation, wavelength, spectral width, beam diameter, etc.
12. The modulator is now ready for an electrical signal.

Additional Installation Instructions

If additional optics such as photodiode pickoffs are installed on the modulator as received, generally they may be removed for testing. The Model 38C pickoff alignment instructions may be followed. The Model 19GLE polarizer is not to be removed and does not need to be adjusted. The adjustment procedure for the modulator alignment and/or polarizer realignment may now be followed.

EO Modulator and Polarizer Removal

The laser beam may be inputted on either end of the modulator itself relative to the connectors at each end. The operation is not sensitive as to which end of the laser beam is inputted only that the polarizer be attached to the output end of the modulator end. The difference in modulator performance is almost indistinguishable. Changing the polarizer to the opposite end of the modulator may give less interference of the connectors to the mount in some cases. The direction may be changed by interchanging the removable polarizer mount plate with the removable aperture end plate and keeping the polarizer on the output end of the modulator.

The polarizer may be removed by loosening 3 setscrews located on its circumference. Then the polarizer mount plate may be removed by loosening its screws. The aperture end plate, on the opposite end of the EOM, and its 4 screws can be removed and interchanged with the polarizer mount plate. Now the connector position is opposite relative to the beam input end.

The polarizer and modulator now needs to be oriented per the alignment procedure in the EO modulator instructions.