



**NEOS TECHNOLOGIES**

A Gooch & Housego Company

OPERATING MANUAL

**FOUR NANOSECOND AO MODULATOR  
WITH FOCUSING OPTICS**

MODEL NUMBER:

**17440-FOA WITH 71003**

**DOCUMENT NUMBER: 51A00500D**

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## **SECTION I**

### **INSPECTION PROCEDURE**

Examine the shipping carton for damage. If the shipping carton or packing material is damaged it should be kept for the carrier's inspection. Check the contents of the shipment for completeness, mechanical damage, and then test the equipment electronically. Operating procedures are contained in Section VI. Notify the carrier and NEOS Technologies. If the contents are incomplete, or the equipment does not pass the electrical testing please notify NEOS Technologies.

If there is any problem with the use of this equipment, or if the equipment fails to function as expected contact NEOS Technologies, do not try to trouble shoot or repair this equipment. Consult with a NEOS service engineer. If the equipment needs repair or replacement, contact NEOS Technologies, Inc for a Return Authorization Number.

**SECTION II**  
**DESCRIPTION**  
**ACOUSTO-OPTIC MODULATOR**  
**17440-FOA WITH 71003 FOCUSING OPTICS**

The 17440-FOA modulator consists of a Tellurium Dioxide crystal with a Lithium Niobate transducer. Optimum diffraction efficiency will be provided with a rise time of 4 ns correlating to a waist diameter in the TeO<sub>2</sub> crystal of 19  $\mu\text{m}$ . The modulator is furnished with the 71003 mount with 25 mm input and output lenses. The input laser beam at the lens must be approximately one (1) mm in diameter. Since the laser beam is divergent, the beam reaching the acousto-optic modulator may have expanded to larger than one (1) mm. If this occurs, either shorten the distance between the laser and the acousto-optic modulator assembly or change the input lens so that the F number (25) remains the same. See section V for rise time calculations.

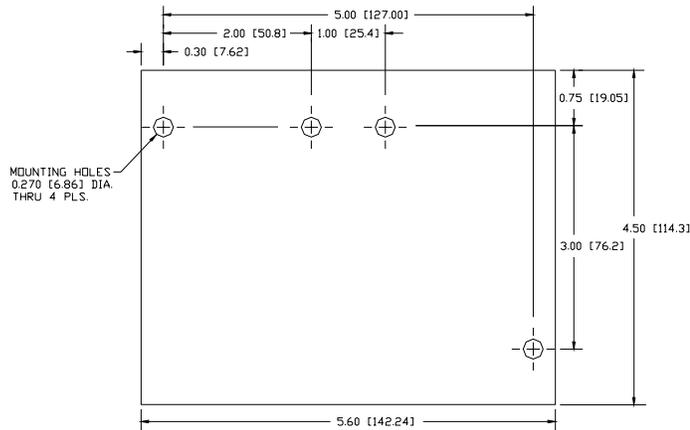
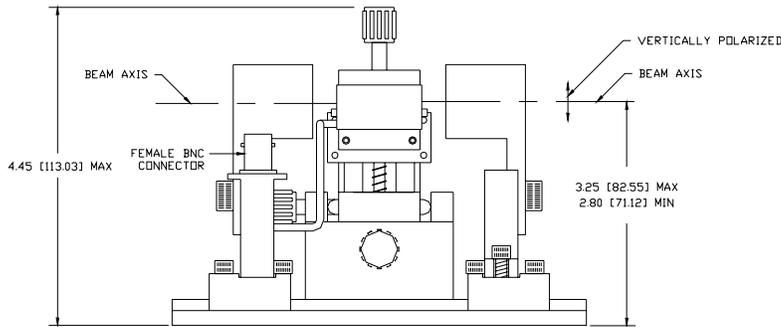
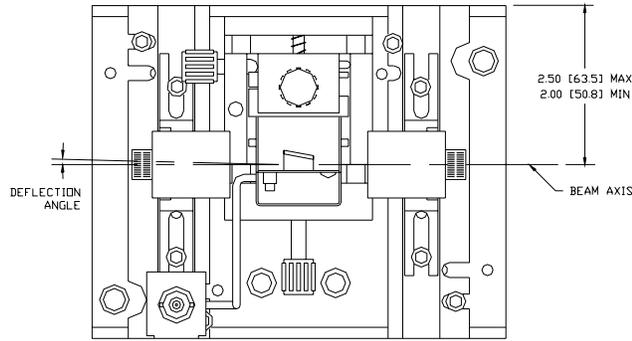
The modulator can be driven with any good driver with a nominal 50  $\Omega$  output of 440 MHz, however, it is recommended that a NEOS driver be used to drive this modulator to achieve optimum performance. The RF input to the modulator should not exceed 1 watt CW. NEOS will not warranty any such damage resulting from too much RF power. Be extremely careful not to focus the laser beam on the gold bond wires on the acoustic transducer, which may vaporize the bond wires. NEOS will not warranty any such damage. The modulator has been designed and verified to satisfy the specifications.

**SECTION III**  
**SPECIFICATIONS**

**17440-FOA WITH 71003 FOCUSING OPTICS**

| <u>PARAMETER</u>                        | <u>SPECIFICATION</u>   |
|---|--|
| Interactive Material                    | TeO <sub>2</sub>   |
| Acoustic Mode                           | Longitudinal   |
| Operating Wavelength                    | 440 – 850 nm   |
| Window Configuration                    | AR Coated  |
| Transmission                            | >95%   |
| Operating Frequency                     | 440 MHz  |
| Diffraction Efficiency                  | >60 % @ 633 nm with Linear, Polarization<br>Perpendicular to Acoustic Propagation.<br>>50 % @ 633 nm with Random Polarization. |
| Acoustic Aperture Size                  | 90 μm  |
| Rise Time                               | <4 ns  |
| Optical Waist Size to achieve Rise Time | 19 μm  |
| Deflection Angle                        | 65 mrad @ 633 nm   |
| RF Power Level                          | 800 mW   |
| Impedance                               | 50 Ω nominal   |
| VSWR                                    | <1.5:1 @ 440 MHz   |
| Assembly N17440-FOA / N71003:           | 53D00327   |
| Acceptance Test Procedure:              | 42A15349   |
| Acceptance Test Results Form:           | 52A15350   |
| Recommended Drivers:                    |  |
| Analog Driver System:                   | 11440-.8AS   |
| Analog Driver Module:                   | 11440-.8AM   |

### SECTION IV OUTLINE DRAWINGS



### 1744-FOA WITH 71003 FOCUSING OPTICS

53D00327

Dimensions are in inches

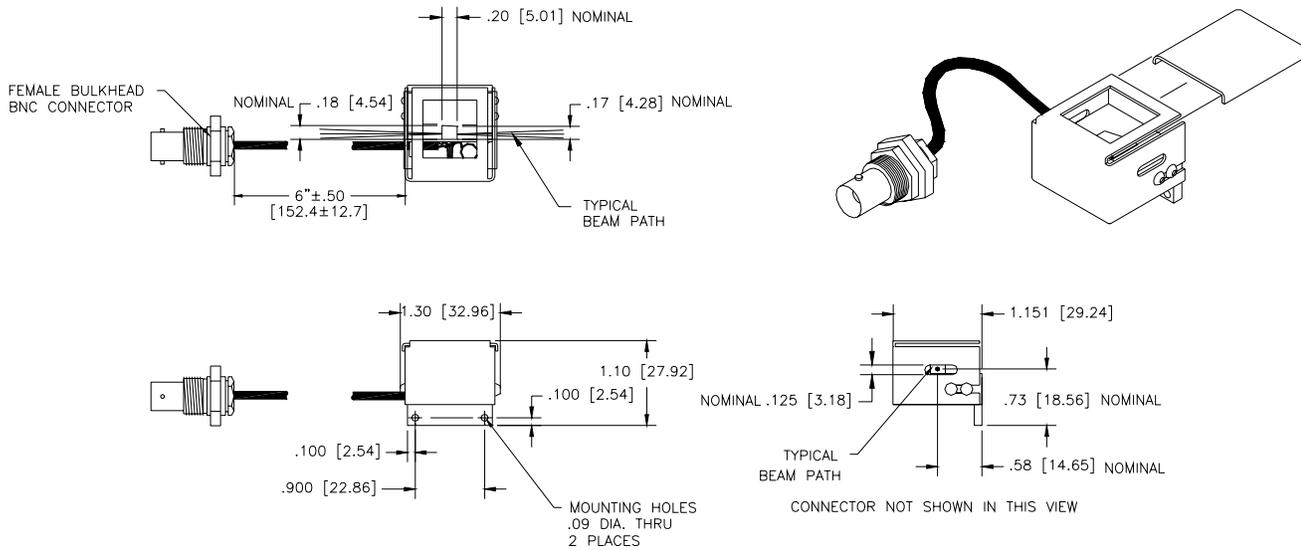
Tolerances:

Decimal: .xx = .01     .xxx = .005

Dimensions in [ ] are in mm.

Millimeter: .xx = .25mm     .xxx = .127mm

Angle: =  $\pm 30^\circ$



**17440-FOA AO MODULATOR**

53B0957

Dimensions are in inches

Dimensions in [ ] are in mm.

Tolerances:

Decimal: .xx = .01 .xxx = .005

Millimeter: .xx = .25mm .xxx = .127mm

Angle: = ± 30'

## SECTION V

### CALCULATIONS:

- The equations to determine the AOM rise time " $t_r$ " are as follows:

First determine the waist size by the equation, 
$$d_0 = \frac{4f\lambda}{\pi d_1}$$

Where:  $f$  = lens focal length in mm

$\lambda$  = the optical wavelength in  $10^{-6}$ m

$d_1$  = the input optical beam diameter in mm

$d_0$  = the waist diameter inside the modulator in  $10^{-6}$ m

Knowing the waist size inside the modulator, then the modulator rise time can be calculated from the relationship:

$$t_r = \frac{1.3d_0}{2V}$$

Where:  $V$  = the acoustic velocity of the modulator material which is 4260 m/s

- The focal length of the lens is the F# of the lens times the input spot diameter:

$$F\# d_1 = f_{\text{lens}}$$

- The deflection angle " $\theta_d$ " is defined as the acoustic drive frequency in megahertz times the wavelength, divided by the acoustic velocity of the material:

$$\theta_d = 2\theta_{\text{Bragg}} = \frac{f_a \lambda}{V} = \frac{440 \times 10^6 \lambda}{4260 \text{ m/s}}$$

Where:  $\theta_{\text{Bragg}}$  = Bragg angle of the modulator.

## SECTION VI

### OPERATION PROCEDURES

Remove the input and output lens from the 71003 mount.

Mount the modulator in the optical path with the laser beam passing through the device window centered on the window vertically and close to the transducer (connector end). The modulator is polarization sensitive and performs best with light linear polarized, oriented perpendicular to the acoustic propagation axis. Random polarization can be used but the diffraction efficiency will be reduced by 10 %. The modulator mount assembly must have sufficient adjustments to peak the modulator efficiency (Bragg angle, horizontal, and vertical position). Be extremely careful not to focus the laser beam on the gold bond wires on the acoustic transducer, which may vaporize the bond wires. NEOS will not warranty any such damage.

Using a 50  $\Omega$  coaxial cable, connect the "RF out" of the driver to the modulator. Turn on the RF power. Be sure the mode switch is in the CW position if using a NEOS driver. Make sure that the RF power does not exceed 1 watt average power. NEOS will not warranty any failure resulting from the application of too much RF power.

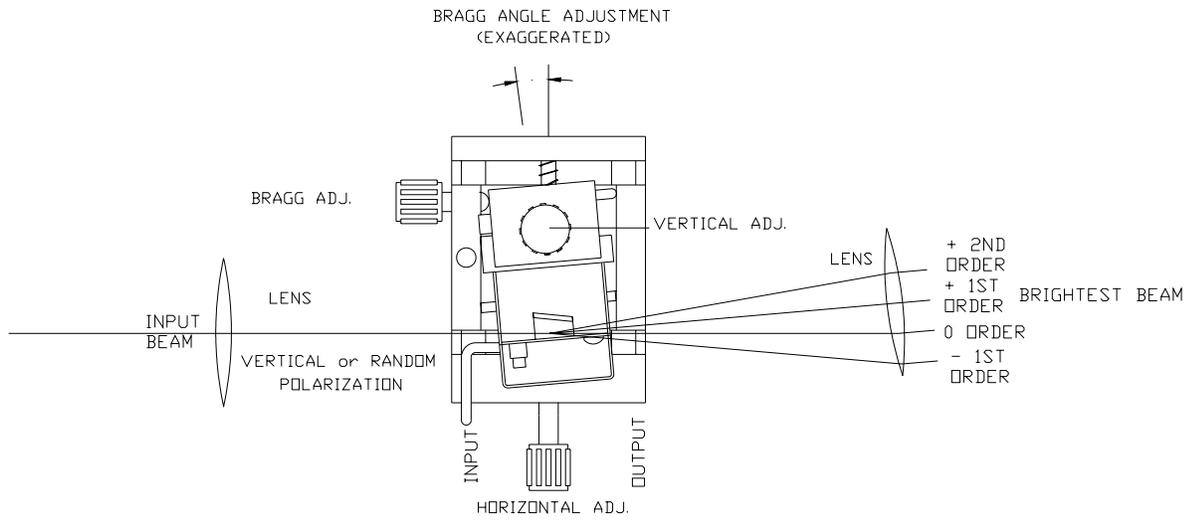
With the laser beam going through the optical crystal, and close to the transducer, adjust the Bragg angle, by rotating the AOM, to allow the diffracted first order beam away from the transducer (connector end) to be the most intense. See figure 4.

Install the lens supplied or a lens as calculated above, into the laser beam on the input side of the modulator to achieve the desired rise time. Position the lens 1 "f" away from the modulator and adjust the height of the modulator to achieve diffraction. Make changes in the Bragg adjustment screw to obtain optimum efficiency. Install a second lens 1 "f" away from the modulator on the output side to re-collimate the output beam. Make changes in the Bragg adjustment and height to obtain optimum efficiency. Adjust the RF driver for power level to obtain maximum diffraction efficiency.

For optimum results, the Bragg angle must be precisely adjusted. The angle between the diffracted and the zero order beam is approximately equal to 0.053 radians with a wavelength of 514 nm. The modulator has been designed and verified to satisfy the specifications before shipment.

To operate the modulator use the first order diffracted beam with the driver mode switch set to normal. See the driver manual for other information.

**FIGURE 4**



**AOM Bragg adjustment**

## SECTION VI

### OPTICAL CLEANING

Periodic cleaning of the AO device is a normal part of maintaining an optical system. When the device is installed in an optical system, make sure that there is access to allow removal of the protective cover and room to clean the device. If removal from the system is necessary, then follow the alignment procedure in this manual to reinstall, realign and, adjust the AO device.

To clean the AO device, remove the screws that hold the cover to the mount. Caution must be used when placing a screw driver near the window opening in the cover, as it is best to protect the opening with tape or cover the opening with your finger (without touching the crystal) to protect it. NEOS will not warrant any damage or scratches caused by inserting the screwdriver into the window opening.

- Remove the protective cover.
- Blow off any visible dust with canned air. Do not use an air gun unless it is filtered and water and oil free!
- Fold (4 times) a new lens tissue into a triangle to make a cleaning tool.
- Dip the tip of the lens tissue into fresh acetone or spray fresh acetone from a squeeze bottle onto it. Then shake excess fluid out of the lens tissue. Do not handle the wet area of the tissue, as your finger oil will be absorbed and contaminate the optical surface of the crystal.
- Wipe (only once) across the crystal in an even motion, starting near the transducer and drawing the tissue across the optical surface toward the other end. Do not damage the bond wires! Do not reuse the tissue as the mounting silver epoxy may be spread onto the window of the crystal.
- Repeat with a new tissue each time and for each surface that needs cleaning.
- Replace the protective cover and screws.
- Realign the device in your system and adjust the Bragg angle for maximum diffraction efficiency.

#### Notes:

- The lens tissue must be lint free and the best grade available.
- Only use each tissue once, for only one surface. Do not reuse the tissue, as it will redistribute the removed dust or mounting silver epoxy.
- The acetone must be electronic grade. The acetone must be fresh from a new bottle, as the acetone will absorb water from the air and cause streaks. Discard any acetone, which has been exposed to the air for more than 4 hours. If the bottle is half- empty, do not use.