NEOS TECHNOLOGIES
A Gooch & Housego Company

OPERATING MANUAL

70 MHz CENTER FREQUENCY OFF AXIS
ACOUSTO-OPTIC BEAM DEFLECTOR

MODEL NUMBER:

45070-5-6.5DEG-.63-XY
WITH 72003 MOUNT

DOCUMENT NUMBER: 51A16077

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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. Notify the carrier and NEOS Technologies. Check the contents of the shipment for completeness, mechanical damage, and then test the equipment electronically. Operating procedures are contained in Section VI. 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

. The off axis 45070-5-6.5DEG-.63 acousto-optic beam deflector (AOBD) is fabricated from $Te0_2$ crystals with $LiNb0_3$ slow shear wave transducers. The off axis deflector differs from the normal on axis deflector in that the acoustic beam is launched into the $Te0_2$ 6.5 degrees off of the 110 propagating axis. This design eliminates a mid-band degeneracy that results in a loss of diffraction efficiency over a narrow frequency range in the operating band of 50 MHz and 90 MHz.

45070-5-6.5DEG-.63 XY with 72003 consist of two AOBD's mounted at right angle to form a X-Y scanning system with the necessary mount to allow for adjustment. The input polarization is such that the polarization is parallel to the acoustic direction for the first device and is indicated on the mount. The devices are uni-directional and will not have the same diffraction efficiency or bandwidth in the reverse direction.

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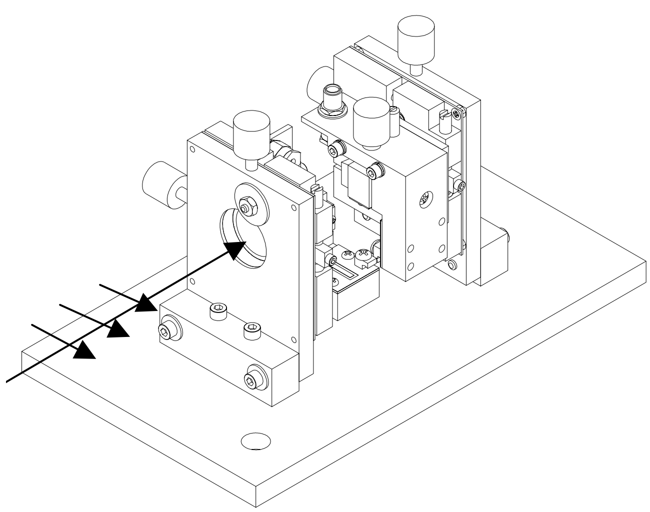
The RF input power should not exceed 2 Watts CW as NEOS Technologies will not warranty damage from RF power applied exceeding 2 Watts. The AOBD can be driven by any good driver with a 50-ohm nominal output; however, it is recommended that a NEOS Technologies driver be used to drive this deflector to achieve optimum performance.



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SECTION III

SPECIFICATIONS

MODEL NUMBER: 45070-5-6.5DEG-.63-XY

PARAMETER	SPECIFICATION
Interactive Material	TeO_2
Acoustic Mode	Shear Wave
Operating Wavelength	633 nm
Window Configuration	AR Coated
Static Transmission	>98 %
Operating Frequency	50 to 90 MHz.
Intensity Variation	2 dB
Diffraction Efficiency	>55 % Midband per Device
Light Polarization	Linear, parallel to acoustic propagation
Acoustic Aperture Size	5 mm
Process Time	7.5 μs
Resolution (T.BW product)	300 spots with no less than 60 μs scan time and full illumination of the aperture
Δ Deflection Angle	38 mrad @ 633 nm
Deflection Angle	67 mrad @ 633 nm
RF Power Level	2 Watt maximum per Device
Impedance	50 Ohms
VSWR	<2:1 across band
Package:	53A2024
Operating Manual: Use Latest Revision.	51A16077
Acceptance Test Procedure:	42A14797
Acceptance Test Results form:	52A12608

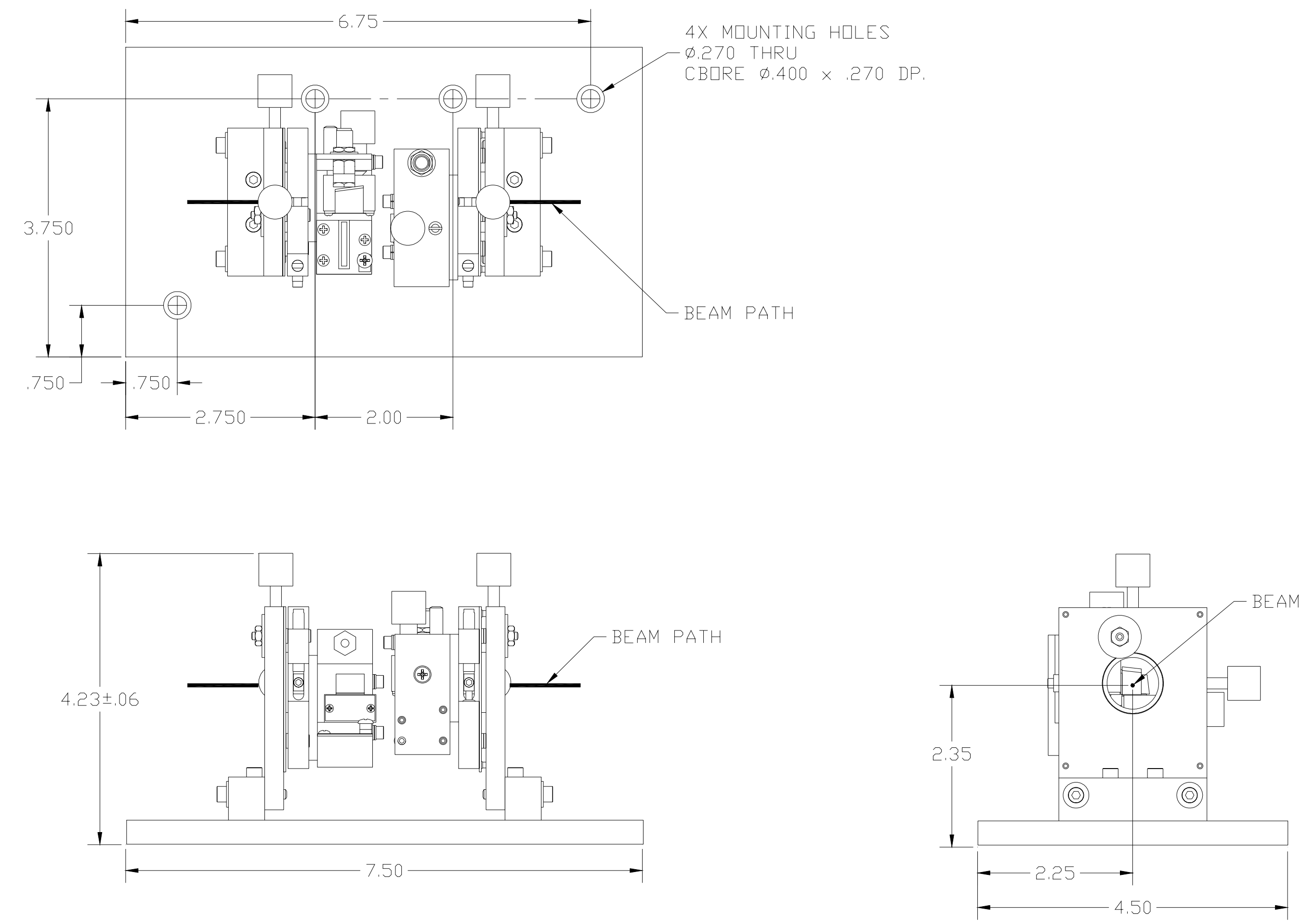
Recommended Driver:

Analog System Digital Frequency Synthesizer: 64010-200-2ASDFS
Analog Module Digital Frequency Synthesizer: 64010-200-2AMDFS

Analog System Voltage Controlled Oscillator: 64040-100-2ASVCO-1
Analog Module Voltage Controlled Oscillator: 64040-100-2AMVCO

SECTION IV

OUTLINE DRAWINGS



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45070-5-6.5DEG-.63-XY with 72003 Mount

SECTION V.
CALCULATIONS

The maximum aperture of each device is 5 millimeters by 5 millimeters. The input laser beam diameter should fully illuminate the aperture in order to achieve the proper number of resolvable spots. The access time (ΔT) can be determined from the following:

- The access time (ΔT) is equal to the Beam diameter (d_0) in the acoustic direction divide by the velocity of sound (V) in the material.

Where: $d_0 = 5$ mm
$V = 0.66$ mm/µs

$$\Delta T = \frac{d_0}{V} = \frac{5}{0.66} = 7.5\ \mu s$$

- The number of resolvable spots (TBW) for Acousto-Optic Beam Deflector is the product of Δf and ΔT

Where: the RF bandwidth (Δf) of the device is 40 MHz.

$$TBW = \Delta f\, \Delta T = 40\text{ MHz X } 7.5\ \mu s = 300$$

300 resolvable spots with uniform illumination of the aperture and no less than 60 µs chirp time to avoid lensing effects.

- The actual number of resolvable spots (N) are dependent on the uniformity of the illumination of the aperture (truncation of the laser beam) and scan chirp time.

$$N = (1 - \frac{\Delta T}{T + \Delta T})\,(\frac{\Delta T\, \Delta f}{a})$$

Where: T = Chirp time
ΔT = access time
a = A parameter for uniformity of illumination.

Where: a = 1 for uniform illumination.

a = 1.34 for gaussian illumination clipped at the $\frac{1}{e^2}$ intensity points.

- A fast RF chirp applied to the AOBD causes a lensing effect due to the presence of more than one frequency in the AOBD with in the access time window. The focal length (FL_a) of the acoustic cylinder lens, lensing effect is:

$$FL_a = V_a^{\ 2} / (\frac{dfa}{dt} \bullet \lambda)$$

Where: $\frac{dfa}{dt}$ is the slope of the frequency change vs time.

The chirp time should not be less than 60 µs to minimize loss in number of resolvable spots.

- The angle between the diffracted and the zero order beam, the deflection angle, $\varnothing_d$, is defined by:

$$\varnothing_d = 2\theta_{Bragg} = \frac{\lambda f}{V} = .\frac{\lambda f}{0.66 mm/\mu sec}$$

Where: f = RF frequency in MHz
λ = optical wavelength
θ = Bragg angle of the Acousto-Optic Beam Deflector

The frequencies "f "are from 50 to 90 MHz with the center frequency = 70 MHz.

SECTION VI.

OPERATING PROCEDURE

Connect to the first AOBD, a RF source that will provide nominally one (1) Watt of CW power between 50 and 90 MHz with a 50 Ohm cable. Project the collimated, horizontal linear polarized light beam into the center of the aperture of the first AOBD on the input side. It's important that the light enter this aperture since this device is unidirectional. Apply the RF power at 70 MHz to the first AOBD. Adjust the Bragg angle and view the output light at a distance of about 1 meter from the output side of the AOBD's, as an array of light spots will result when approaching the Bragg angle. When this array of spots becomes evident, maximize the intensity of the diffracted (-) first order beam (away from the connector), by varying Bragg angle, the vertical and horizontal position of the AOBD.

Connect to the second AOBD, a RF source that will provide nominally one (1) Watt of CW power between 50 and 90 MHz with a 50 Ohm cable. Apply the RF power at 70 MHz to the second AOBD. Adjust the Bragg angle and view the output light, as an array of light spots will result when approaching the Bragg angle. When this array of spots becomes evident, maximize the intensity of the diffracted (-) first order beam (away from the connector of the second device), by varying Bragg angle, the vertical and horizontal position of the second AOBD. Four spots will be seen in this array of spots: the first order beam from each of the AOBD's, the residual un-diffracted beam, and the resultant output beam. Maximize the intensity of the resultant output beam. In most AOBD's you may also see some diffracted light in the positive first order and negative second order, however the intensity of these orders are very low. Note: The output beam's optical path will be deflected from the original path by 67 mrad down and 67 mrad to the left when the AOBD's are at 70 MHz and 633nm λ. This should be taken into the optical design of the user.

The orthogonality of the axis of the output beam scan plane may be adjusted if needed. See figure 1. Loosen the rotation locks on each of the AOBD's mount. The AOBD’s are rotated by hand to the required scan plane. The rotation locks are tightened lightly to hold the position the AOBD's. The rotation is then adjusted for fine rotation with the rotation adjusters on the AOBD's mounts. The locks are then tighten to lock the position of the AOBD’s. The Bragg angle of the AOBD’s must be adjusted when the AOBD’s are rotated. If the AOBD are rotated more than 15 degrees angle then the input polarization must be adjusted to match the axis of the first AOBD acoustic direction.

Check the diffraction efficiency at 50 MHz and 90 MHz RF drive frequencies or sweep the RF over the 40 MHz bandwidth. By sweeping one AOBD fast and the other AOBD slowly a falling raster scan is created. Measure the intensity of the scanning beam and adjust the Bragg angle of each AOBD to obtain the best flatness in intensity across the band for the output of each AOBD.

The RF power should be adjusted to achieve the maximum required diffraction efficiency. However, in no case should the RF power exceed two (2) Watts.

Figure 1

45070-5-6.5DEG-.63-X and Y AOBDs with Mounts

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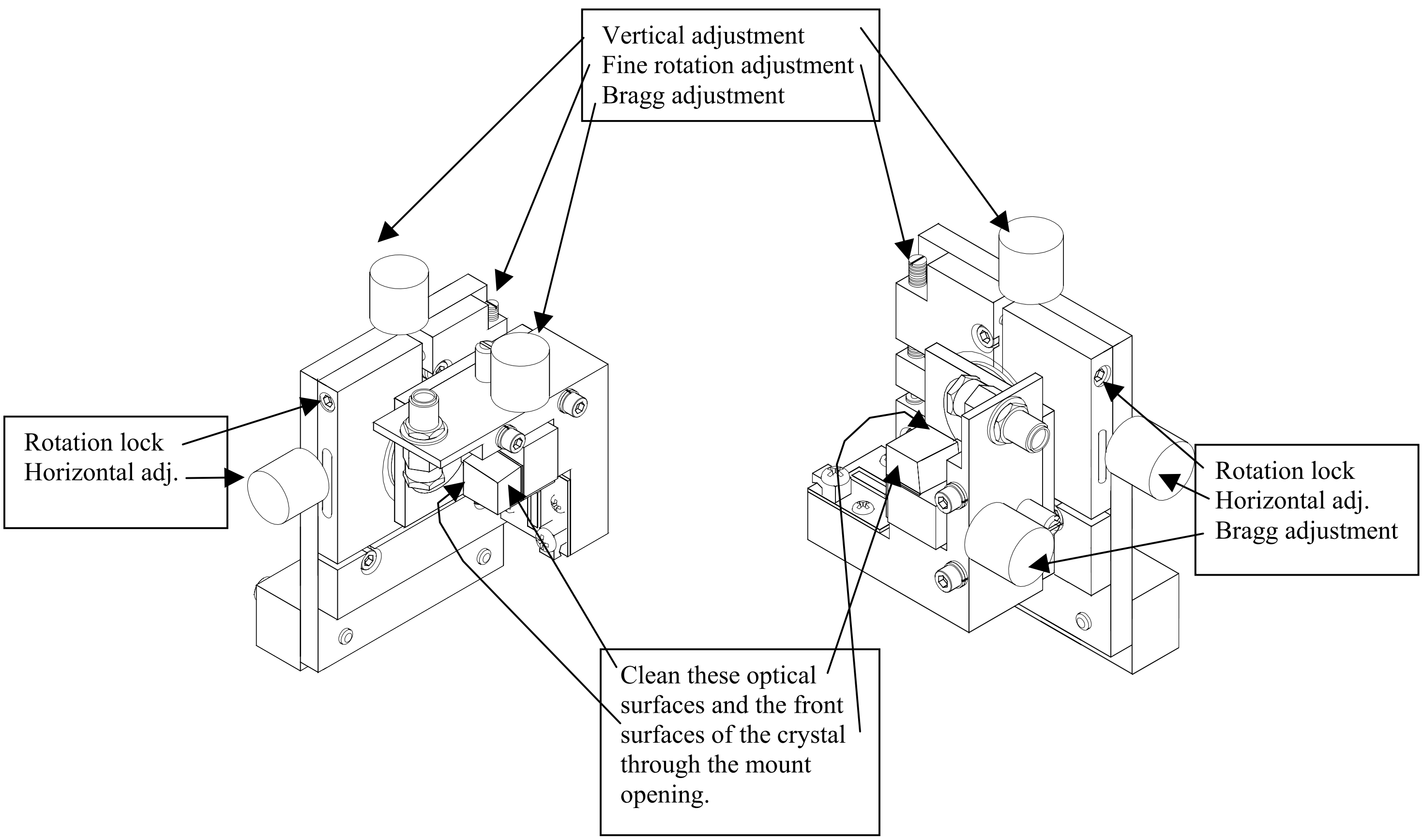

SECTION VII.

OPTICAL CLEANING

Periodic cleaning of the AOBD's optical windows is a normal part of maintaining an optical system. When the AOBDs are installed in an optical system, make sure that there is access to allow removal of the AOBDs and mounts from the system. When removed from the system, follow the alignment procedure in this manual to reinstall, realign and, adjust the AOBDs. Make sure that the AOBDs are reinstalled in the correct position as the devices are unidirectional.

To clean the AOBD windows, remove the screws that hold the AOBD mount to the base plate and remove the mounts with the AOBDs. Clean the AOBDs without removing the AOBD from the mount.

- 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 window 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 AOBD mount and screws.
- Realign the AOBDs 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.