# ACOUSTO-OPTIC
# DEFLECTOR AMPLIFIER
**(including basic alignment for the LS110 & LS110XY)**

# Instruction Manual
# DA134-p-xxx

**Precautions**

**NEVER OPERATE THE DRIVER WITHOUT PROPER COOLING.**
**THE MOUNTING FACE TEMPERATURE MUST NOT EXCEED 60*C.**

**NEVER OPERATE THE DRIVER INTO AN OPEN OR SHORT CIRCUIT LOAD**

**THE VIDEO INPUT LEVEL MUST NOT EXCEED 4V PEAK TO PEAK**
**(*2V WITH RESPECT TO GROUND).**

*PLEASE READ BEFORE ATTEMPTING OPERATION*
*( I know, who needs manuals but make an exception !!)*

ISOMET CORP, 5263 Port Royal Rd, Springfield, VA 22151, USA.
Tel: (703) 321 8301, Fax: (703) 321 8546, e-mail: isomet@isomet.com
***www.ISOMET.com***
ISOMET (UK) Ltd, 18 Llantarnam Park, Cwmbran, Torfaen, NP44 3AX, UK.
Tel: +44 1633-872721, Fax: +44 1633 874678, e-mail: isomet@isomet.co.uk

1. GENERAL

The DA134-p-xxx Modulator/Deflector Driver, figure 1, is a modular, dual output RF power amplifier specifically designed to operate with Isomet acousto-optic devices such as the LS110A. The driver accepts a frequency input in the order of -6dBm (e.g. from the Isomet iDDS frequency synthesizer) and provides phase delayed RF outputs suitable for beam steered acousto-optic deflectors. The driver also accepts an analogue modulating signal at baseband video frequency and provides a double-sideband amplitude modulated RF output to the acousto-optic deflector. A summary of the DA134 driver specification is shown in the following table:

| Model | Use with | Frequency Range | Output Power |
|---|---|---|---|
| D134-p-50 | LS110A NIR | 37.5-62.5MHz (Nominal) | > 1.0 Watt / channel |
| D134-p-100 | LS110A VIS | 75-125MHz (Nominal) | > 1.0 Watt / channel |
| D134-p-125 | LS110A Blue | 100-150MHz (Nominal) | > 1.0 Watt / channel |

Figure 2 is a block diagram of the D134 Driver. The phase delay between the outputs is defined by an internal delay line. This value is specified at time of order and differs with the specification of the particular beam steered deflector. A low level output signal at the operating frequency is provided for monitoring or feedback purposes.

The high frequency, diode ring modulator is used to amplitude-modulate the RF carrier. The baseband video input, from an external 50* drive source, is the modulating input to the ring modulator. A video input swing of 1-volt peak to peak (positive or negative with respect to ground) will result in 100% depth of modulation. The video input level must not exceed 4 volts peak to peak (± 2V with respect to ground).

The amplitude-modulated RF is divided into two channels, one of which includes a coaxial delay line. The signals are subsequently amplified to a preset level in the power amplifier stages. The output hybrid amplifiers are designed to operate at full rated power into a 50* load with 100% duty cycle. The output power level is set by the power adjust potentiometer at the output of the diode ring modulator.

Figure 3 illustrates the principal waveforms of the D134 Driver.

Conduction cooling of the driver from the mounting face to a heatsink or forced-air convection cooling is mandatory. The mounting face temperature must not exceed 60°C. Serious damage to the amplifier may also result if the RF output connector is operated open-circuited or short-circuited.

A low impedance source of d-c power is required for operation of the D134 Driver. The required voltage is +24VDC at a current drain of 800 mA. The external power source should be regulated to ± 2% and the power supply ripple voltage should be less than 25mV for best results.

## 2. SPECIFICATIONS

| | |
|---|---|
| Amplifier Type: | Broadband Class A |
| Output RF Power: | > 1.6Watt per channel |
| Channel to channel phase delay | Deflector dependant |
| Output Impedance: | 50* nominal |
| Load VSWR: | < 2.5:1 for best results |
| Output RF Power Variation vs. Frequency | < 1 dB |
| Spurious Outputs: | Harmonics > 25dB below fundamental |
| Frequency Input Level | -6dBm Specified<br>0 dBm Maximum |
| Frequency Range: | 30 to 250 MHz Maximum<br>75 to 125MHz Specified |
| Video Input Voltage: | 1V peak-to-peak for 100% depth of modulation, DC coupled |
| Input Impedance: | 50* source |
| RF ON-OFF Ratio: | > 40 dB |
| DC Power Input: | +24VDC at 800 mA regulated to * 0.25% |
| Temperature Range: | 0*C to 60*C ambient, temperature at mounting face must not exceed 70*C |
| Mounting Orientation: | Any |

3. THEORY OF OPERATION

Figures 4 and 5 illustrate the key operating parameters. Further explanation is given in the accompanying application notes 'Acousto Optic Deflectors'.

4. INSTALLATION AND ADJUSTMENT

a. Install the D134 Driver on a heat sink as shown in Figure 1. Use heat conducting compound between the Driver mounting face and the heat sink.

b. With no d-c power applied, connect the + 24Vdc line to the 2-pin DC connector as shown in Figure 1. DO NOT APPLY POWER UNTIL THE LOAD IS CONNECTED.

c. Align the deflector head to insure that the incident light beam is centred in the active aperture of the deflector. The light beam polarization should be linear (perpendicular w.r.t. the LS110A base) The input aperture includes a quarter wave plate. This generates the circularly polarized light required by the orientation of the interaction material. The following explanation assumes the light beam is directed slightly toward the transducer (connector end) of the deflector.

d. Connect the two SMA connectors of the deflector to the RF outputs of the D134 beam steered driver X1 and X2. The delayed output ('DLY') should be connected to the SMA nearest the input aperture of the LS110A (J2).

e. Connect a low impedance source to the modulation input 'MOD' and adjust to give a constant dc input level of 0.8V to 1.0V.

f. Connect a suitable frequency source to the frequency 'Input'( e.g. from the Isomet VCO200A)

g. Start by adjusting the Power adjust potentiometer on the D134 to a fully anti-clockwise direction, (Minimum output). The RF power increases with clockwise rotation of the pot.

h. Tune the input frequency source to the mid-frequency point of the AO deflector bandwidth (100MHz for the LS110A Vis).

i. Apply approximately half the required RF power (say 0.2 - 0.4W) at the centre frequency. For the Isomet D134 this is achieved by adjusting the pot 1/4 to 1/3 clockwise from the fully anti-clockwise position. Turn on DC power.

Rotate the deflector slightly until deflection of the light beam occurs. The deflection will occur in the horizontal plane. Select the diffraction spot next to the undiffracted beam and monitor the light intensity by using either a photodetector or a light power meter. Re-adjust the Bragg angle for maximum deflected light intensity. As the deflector is rotated, the correct position is the "second" maximum to occur at the first order angle. Fine tuning of the incident light beam position may be necessary for optimum results.

j. Adjust RF power level carefully for the desired efficiency at the minimum RF power necessary. Do NOT exceed the RF power level at which maximum efficiency is achieved (Psat). Over driving the AO deflector will reduce efficiency and may result in serious damage to the AO crystal.

k. To equalise deflection efficiency at the extremes of the scan, alternate between the minimum and maximum desired frequencies and adjust Bragg angle to give the same efficiency for both. (Note: the photo detector or light power meter will require repositioning for the two angles.) Sweeping the freq' input should result in a continuous deflected line output. If significant peaks and troughs are noted across the sweep, it is probable that the phase delayed output of the DA134 is connected to the incorrect input of the AO deflector.

m. The lead lengths between the two outputs of the DA134 and the beam steered deflector should be equal unless otherwise instructed. Unequal lengths of more than a 1cm would introduce a phase error.
Within limits, small changes in the relative lead lengths can be used to fine tune the deflector sweep response, although this is not usually required. The Bragg angle would need re-adjustment.

n. For dual axis deflectors such as model LS110A-XY , follow the above procedure initially for the X deflector only. Once adjusted set the deflection of the X axis to mid scan (mid frequency) and adjust the Y axis as above.

**Note: For the LS110A-XY, the Y-axis adjuster is locked by 2 Allan head screws either side of the Y-axis pivot point (opposite face to the RF inputs). Slacken before making adjustments with the fine screw adjuster.**

**Optimizing Efficiency**.

- RF Power

Do not apply excessive RF power. This can reduce scan efficiency and degrade flatness

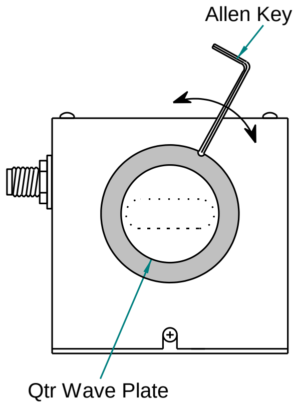
- Start Frequency.

Adjust the frequency start +/-15% about the nominal value
This can help to improve the flatness over the desired scan bandwidth.

- Polarization. See AO deflector requirements.

e.g. the LS110 series AO deflectors require circular polarized input.
A quarter waveplate is factory fitted to the LS110 to transform linear into the circular polarization. To align and adjust this polarizer, locate the hole(s) around the quarter wave ring holder. Place a small Allen key or screw driver into the hole and use a lever to rotate the ring clockwise or counter clockwise. See illustration below. (The ring is a friction fit in the AOD cover secured by a circlip)

Carefully rotate to maximize the diffraction efficiency



## 5. THERMAL EFFECTS

We must consider the thermal effects of this device - both due to optical and acoustic absorption. The majority of heat is generated by RF drive power. As the temperature of the material increases beyond the recommended level, undesired refractive index changes will occur in the material. This results in beam distortion. Ultimately, the crystal will crack due to thermal stresses, if excessive RF power is applied. (>3.0W for a typical visible AO deflector).

## 6. MAINTENANCE

### 6.1 Cleaning

It is of utmost importance that the optical apertures of the deflector optical head be kept clean and free of contamination. When the device is not in use, the apertures may be protected by a covering of masking tape. When in use, frequently clean the apertures with a pressurized jet of filtered, dry air.

It will probably be necessary in time to wipe the coated window surfaces of atmospherically deposited films. Although the coatings are hard and durable, care must be taken to avoid gouging of the surface and residue of the cleaning solution. It is suggested that the coatings be wiped with a soft ball of brushed (short fibres removed) cotton, slightly moistened with clean alcohol. Before the alcohol has had time to dry on the surface, wipe again with dry cotton in a smooth, continuous stroke. Examine the surface for residue and, if necessary, repeat the cleaning.

### 6.2 Troubleshooting

No troubleshooting procedures are proposed other than a check of alignment and operating procedure. If difficulties arise, take note of the symptoms and contact the manufacturer.

### 6.3 Repairs

In the event of deflector malfunction, discontinue operation and immediately contact the manufacturer or his representative. Due to the high sensitive of tuning procedures and the possible damage, which may result, no user repairs are allowed. Evidence that an attempt has been made to open the optical head will void the manufacturer's warranty.

Dim'n: mm

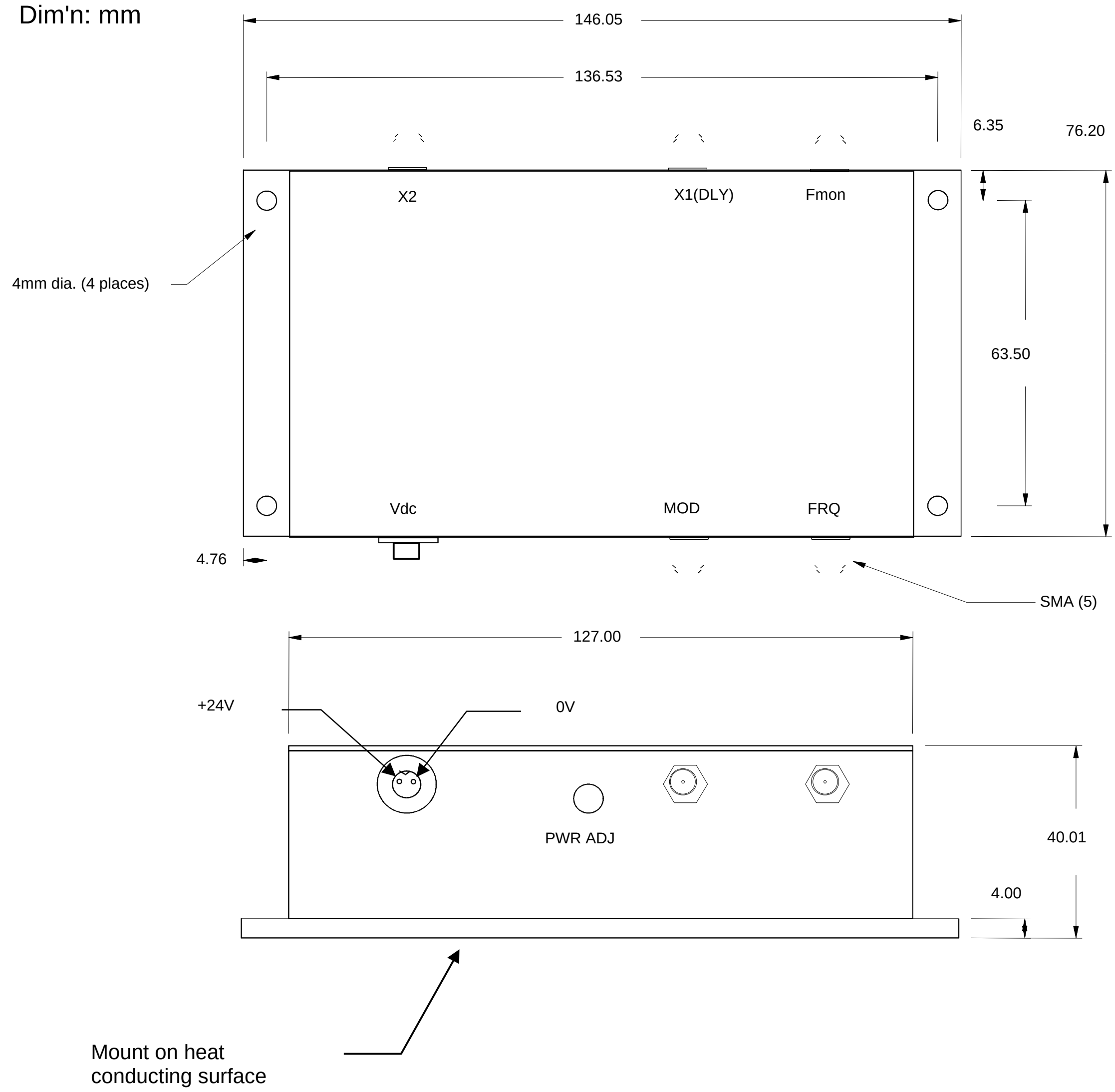



Figure 1, DA134 driver

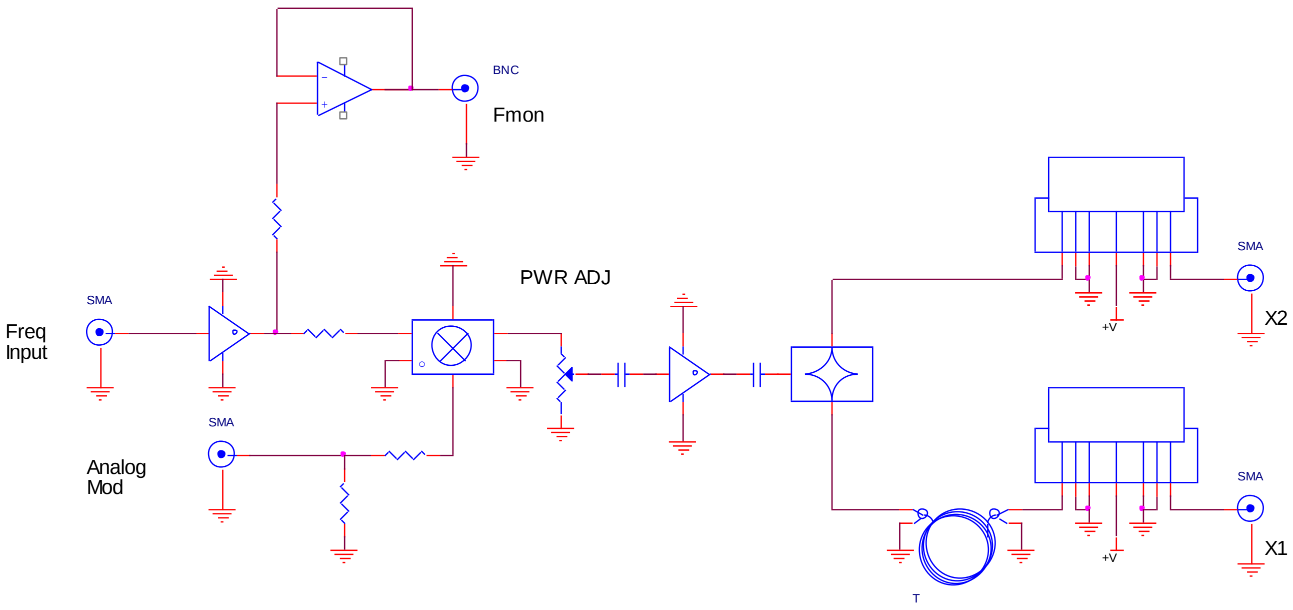



Figure 2,  Driver Block Diagram for DA134 driver

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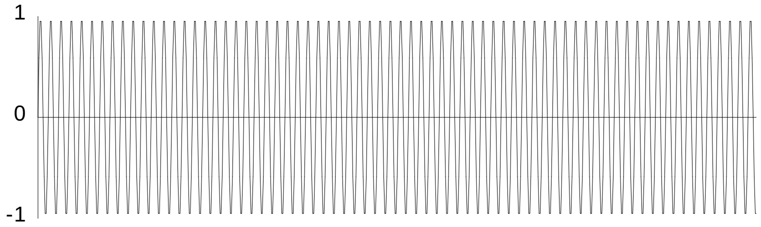
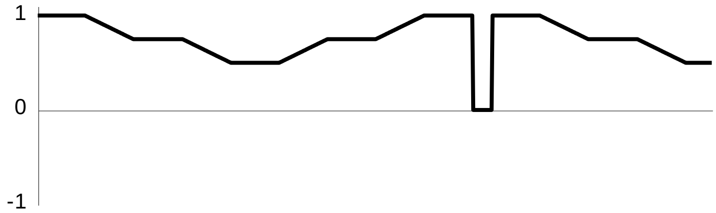
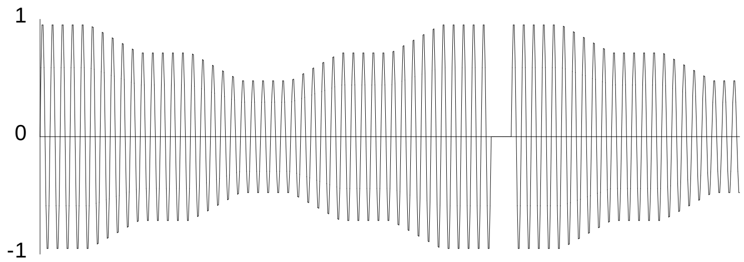



RF Carrier (FRQ input)




Video Input




Modulated RF

Figure 3, Typical Amplitude Modulation Waveforms

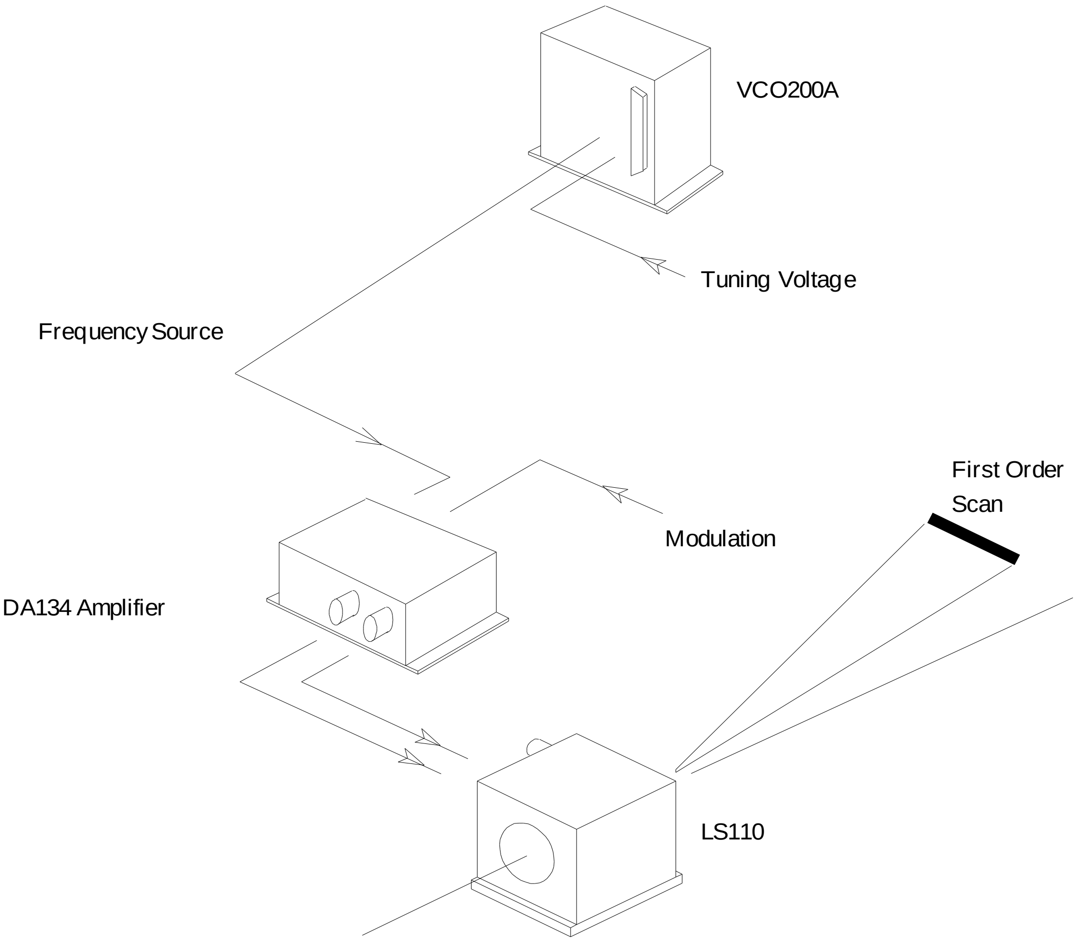
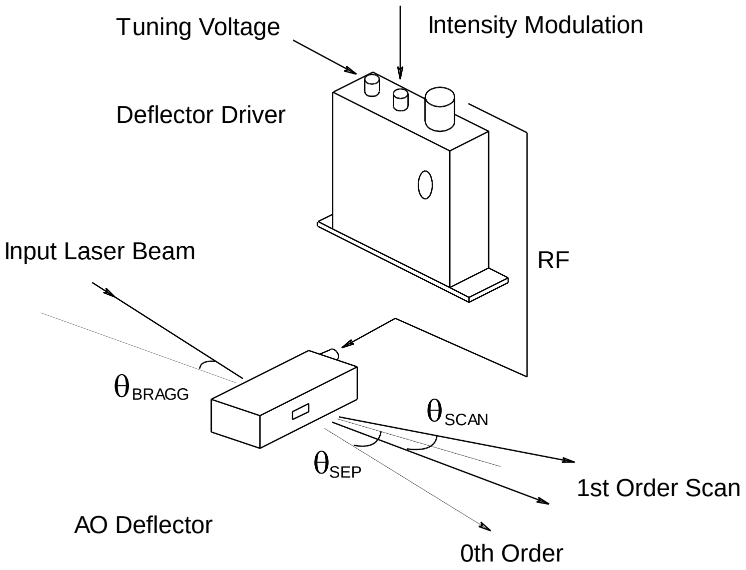



Figure 4,  LS110 AO deflector configuration

**Schematic of a single electrode acousto optic deflector and tunable driver**




The input bragg angle, relative to a normal to the optical surface and in the plane of deflection is given by:

$$\theta_{BRAGG} = \frac{\lambda . fc}{2.v}$$

The separation angle between the zeroth order and mid scan point of the first order is given by:

$$\theta_{SEP} = \frac{\lambda . fc}{v}$$

The first order scan angle is given by:

$$\theta_{SCAN} = \frac{\lambda . \delta f}{v}$$

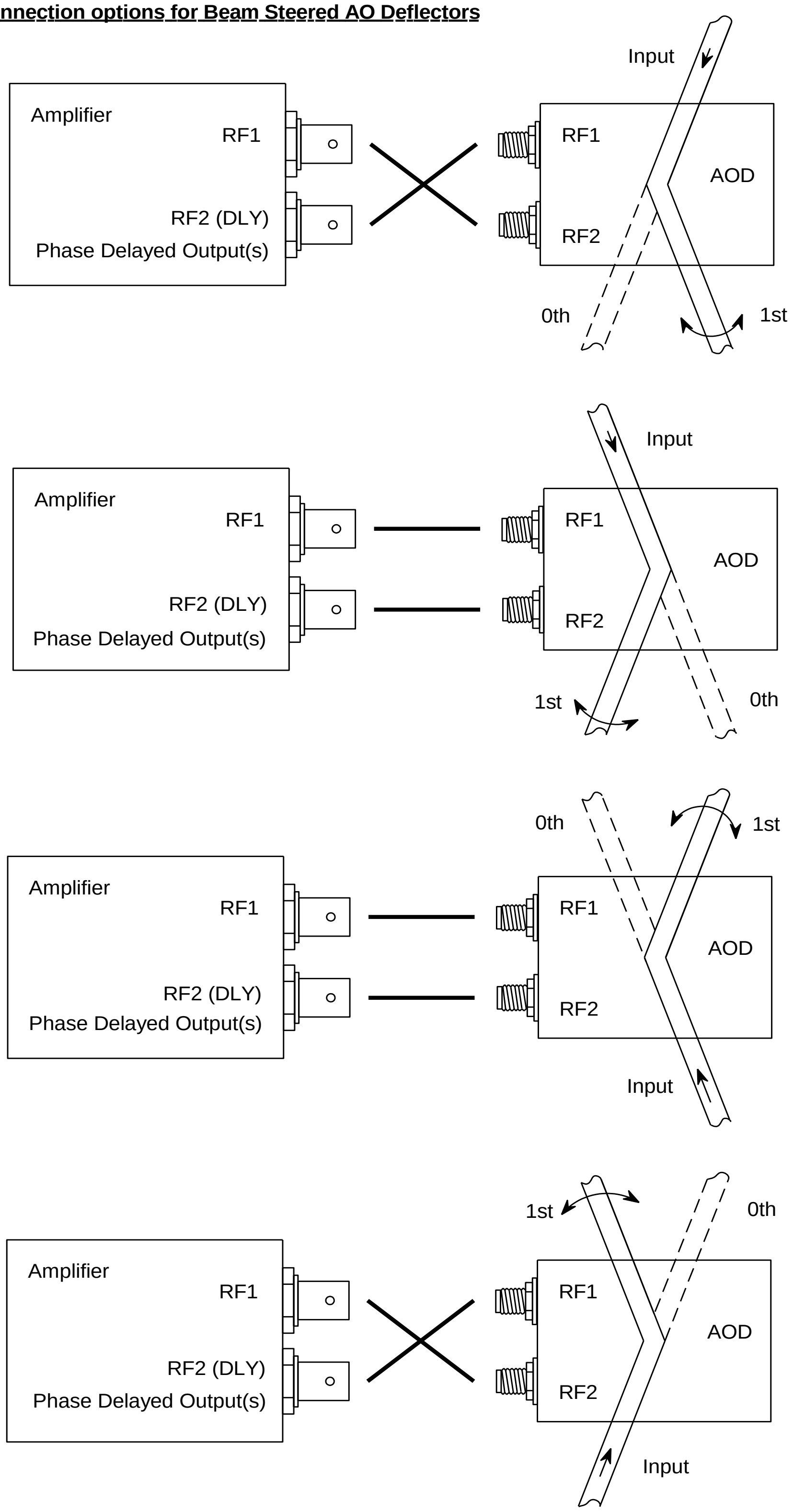
The access time or time aperture is given by:

$$T_{acc} = d/v$$

where : $\lambda$ = wavelength
$\delta f$ = scan frequency bandwidth
fc = centre frequency
v = acoustic velocity of the crystal material
d = beam diameter

Figure 5, Deflector Parameters

## Connection options for Beam Steered AO Deflectors




Correct orientation as viewed from top of AOD
(Connector identification may differ)