ISOMET

Acousto-Optic Deflector Driver
Including: Basic Deflector Alignment

Instruction Manual
D3x3-BS Series

Models -

D323-BS   : 10V Tuning Input, TTL Digital Modulation Input

D333-BS   : 10V Tuning Input, 1.0V Analog Modulation Input

1.   GENERAL

The D3x3-BS Deflector Driver, figure 1, is a modular, swept-frequency RF power source specifically designed to operate with acousto-optic deflectors. The driver accepts a tuning voltage, typically between approximately +0 volts and +10 volts and provides an RF output to the acousto-optic deflector at the tuned frequency. A modulation input is also provided to control the RF amplitude applied to the acousto-optic deflector. A summary of the D3x3-BS driver specification is shown in the following table:

Model	Tuning Range	Modulation	Output Power (total)
D323-BS	75-125MHz (Nominal)	TTL	> 2.7 Watt
D333-BS	75-125MHz (Nominal)	Analog	> 2.7 Watt

Figure 2 is a block diagram of the D3x3-BS driver.   The output frequency is controlled by a hybridized VCO circuit. The output frequency is proportional to the input tuning voltage with a scale factor of approximately 5.0 MHz/volt. . The start frequency corresponding to a tuning voltage of 0.0 volts is defined by the frequency offset potentiometer (FOS). This permits adjustment of the start frequency by approximately -10% / +20%   A table of output frequency versus input tuning voltage is supplied with each driver. The frequency linearity is typically ±1.5%, and frequency stability is typically ±0.25%.

The oscillator output connects to an RF mixer and the frequency monitor output (Fmon).   The frequency monitor output provides a low level (approx. 300mVpp) output signal at the tuned operating frequency. This can be used for measurement or feedback purposes.

The mixer is used to amplitude-modulate the RF carrier. For the D333-BS, a modulation input swing of 1 volt peak to peak (positive or negative with respect to ground) will result in 100% depth of modulation.   For the D323-BS, a TTL High (>2.7V, 20mA) will turn the RF ON. The modulation input level must not exceed 5 volts peak to peak (± 2.5V with respect to ground).

The amplitude-modulated RF is applied to a matched splitter and two power amplifier stages. The output hybrid amplifiers are designed to operate at full rated power into a 50Ω load with 100% duty cycle.   The output power level is set by the power adjust potentiometer.

The phase delay in output X2 is defined by an internal delay line. This value is specific to the beam steered deflector model.

Figure 3 illustrates the principal waveforms of the D3x3-BS Driver.

Conduction cooling of the driver from the mounting face to a heat sink or forced-air convection cooling is mandatory.   The mounting face temperature must not exceed 70°C. Serious damage to the amplifier may also result if the RF output connector is operated open-circuited or short-circuited.

A dual output d-c power supply is required for operation of the D3x3-BS Driver. The required voltages are +24Vdc (or +28Vdc) at a current drain of 900 mA and -12Vdc (or -15Vdc) at a current drain of < 100 mA   The external power source should be regulated to ± 1% and the power supply ripple voltage should be less than 200mV for best results.

2.   SPECIFICATIONS

Oscillator Type:	Varactor-tuned thin film hybrid
Amplifier Type:	Broadband Class A
Output RF Power:	> 1.4 Watt / output
Output Impedance:	50Ω nominal
Load VSWR:	< 2.5:1 for best results
Output RF Power Variation vs. Frequency	< 1 dB
Spurious Outputs:	Harmonics > 20dB below fundamental
Tuning Range:	65 to 135 MHz Maximum
	75 to 125 MHz Typical (or as specified)
Tuning Voltage:	0 to 10V Typical
Tuning Linearity:	<1.5% over specified tuning range

DO NOT APPLY NEGATIVE TUNING VOLTAGE
DO NOT EXCEED + 20V INPUT
DAMAGE MAY RESULT

Tuning Voltage Impedance:	Drive from low impedance source, 50Ω or less
Tuning Slew Rate	> 10 MHz/μs
Residual FM:	< 10 KHz peak-to-peak
Frequency Stability:	±0.25%
Video Input Voltage:	1V peak-to-peak for 100% depth of modulation, DC coupled
Input Impedance:	50Ω source
RF ON-OFF Ratio:	> 37 dB
DC Power Input:	+24Vdc(or +28Vdc) at 900 mA regulated to ± 1%
	-12Vdc (or -15Vdc) at 100 mA regulated to ± 1%
Temperature Range:	0°C to 60°C ambient, temperature at mounting face must not exceed 70°C
Mounting Orientation:	Any

3.   THEORY OF OPERATION

Figure 5 illustrates the key operating parameters.   Further explanation is given in the application note 'Acousto-Optic Deflectors'. See www.isomet.com

4.   INSTALLATION AND ADJUSTMENT

a.   Install the D3x3-BS 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 and –15Vdc lines to the 3-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.

d.   Connect the two SMA connectors of the deflector to the RF outputs of the D3x3-BS beam steered driver. The driver delayed output ('DLY') must be connected to the correct SMA input of the AO deflector. This depends on the Bragg orientation. Figure 4 illustrates the options.

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 the tuning voltage source to the SMA tuning voltage input 'Vt'. To begin, apply a constant voltage of 5V equivalent to the centre frequency of 100MHz nominal.

The output frequency can be measured by connecting a frequency counter to the 'Fmon' output SMA connector

g.   Start by adjusting the Power adjust potentiometer on the D3x3-BS to a fully anti-clockwise direction, (Minimum output).   The RF power increases with clockwise rotation of the pot.

h.   Apply approximately half the required RF power (say 0.7W / output) at the centre frequency. For the Isomet D3x3-BS this is achieved by adjusting the pot 1/3 to 1/2 clockwise from the fully anti-clockwise position. Turn on DC power.

i.   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. 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 D3x3-BS is connected to the incorrect input of the AO deflector.

l.   The lead lengths between the two outputs of the D3x3-BS 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.

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
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

Allen Key

Qtr Wave Plate
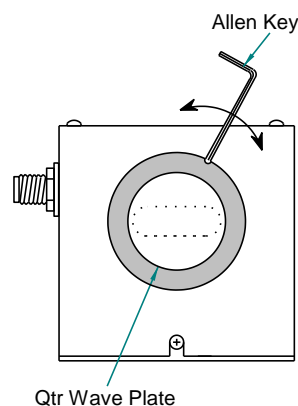
5. THERMAL EFFECTS

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.
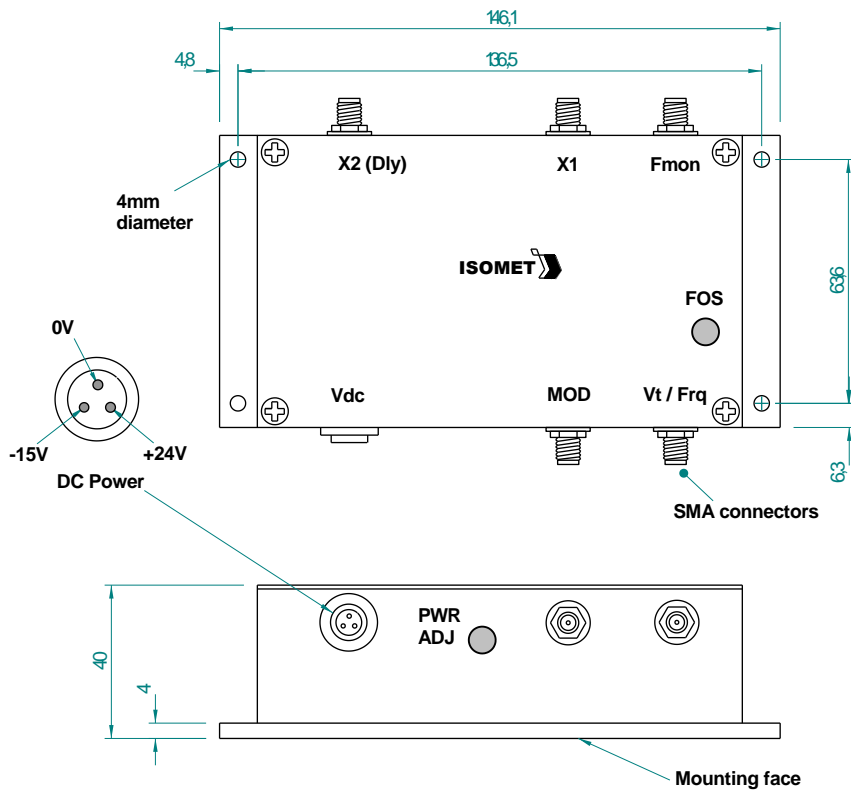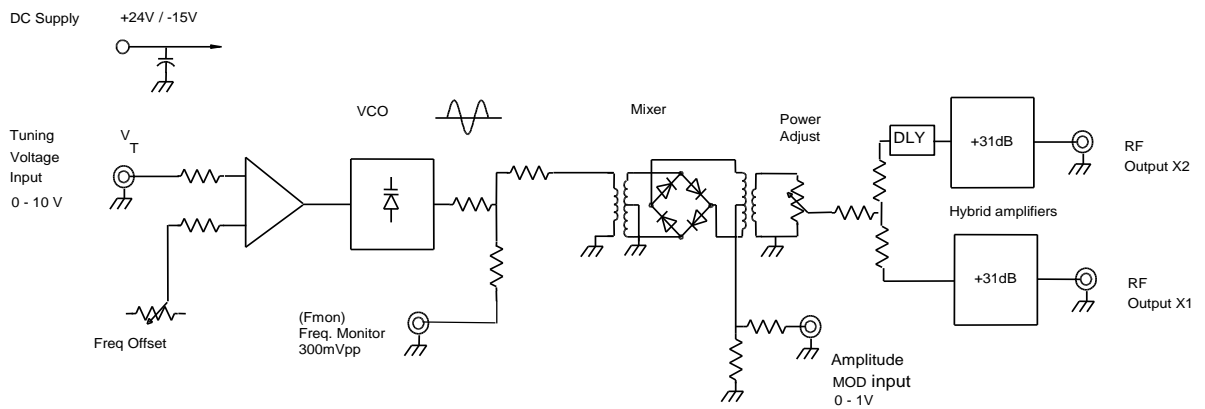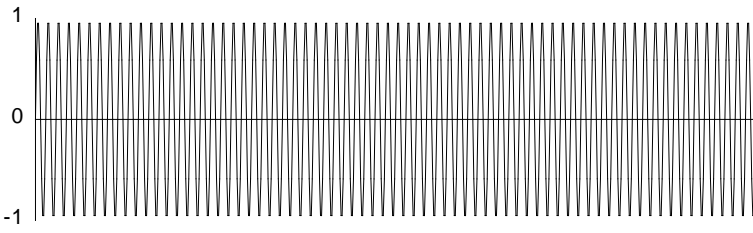
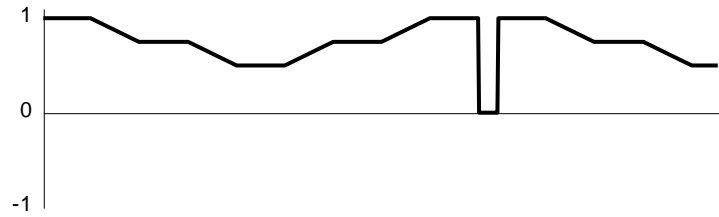Figure 1, D3x3-BS driver
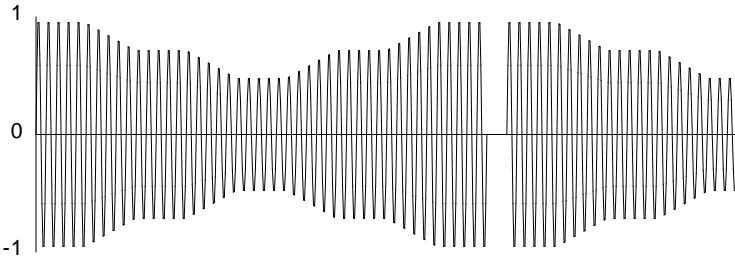

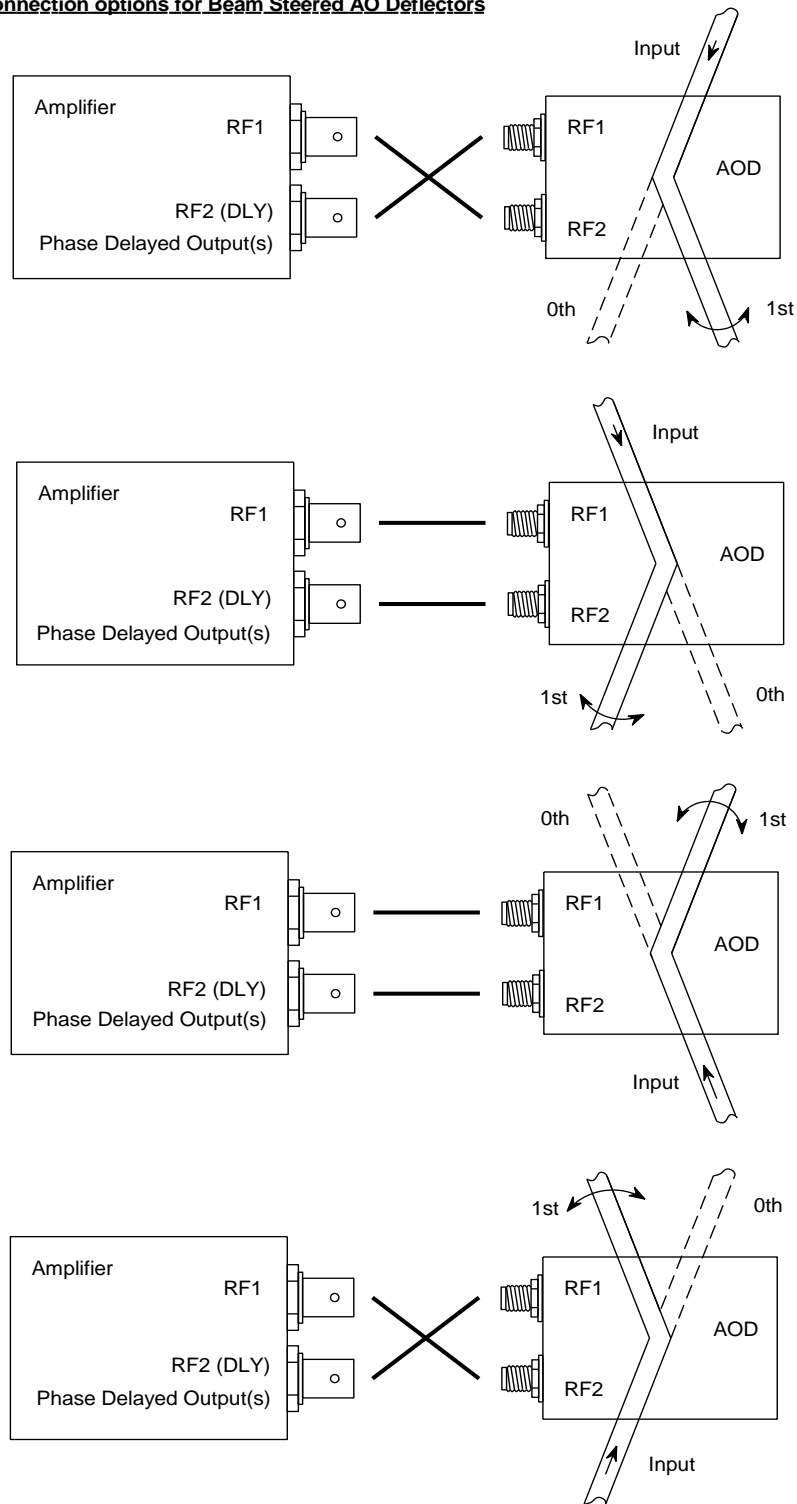Figure 2, Driver Block Diagram for D3x3-BS driver

RF Carrier (FRQ input)

Modulation Input

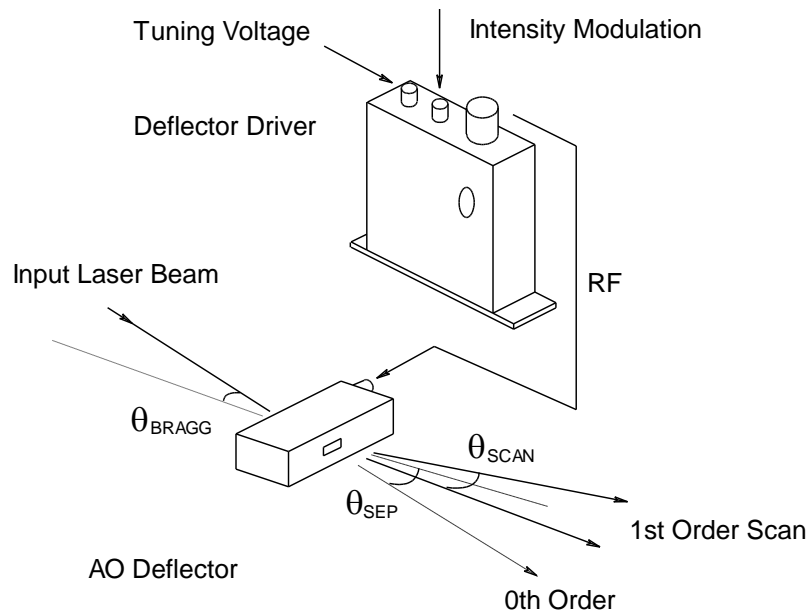RF output

Figure 3, Typical Amplitude Modulation Waveforms

Connection options for Beam Steered AO Deflectors

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

Figure 4

Schematic for a basic 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:

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

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

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

The first order scan angle is given by:

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

The access time or time aperture is given by:

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

where :
λ	=	wavelength
δf	=	scan frequency bandwidth
f_c	=	centre frequency
v	=	acoustic velocity of the crystal material
d	=	beam diameter

Figure 5, Deflector Parameters