

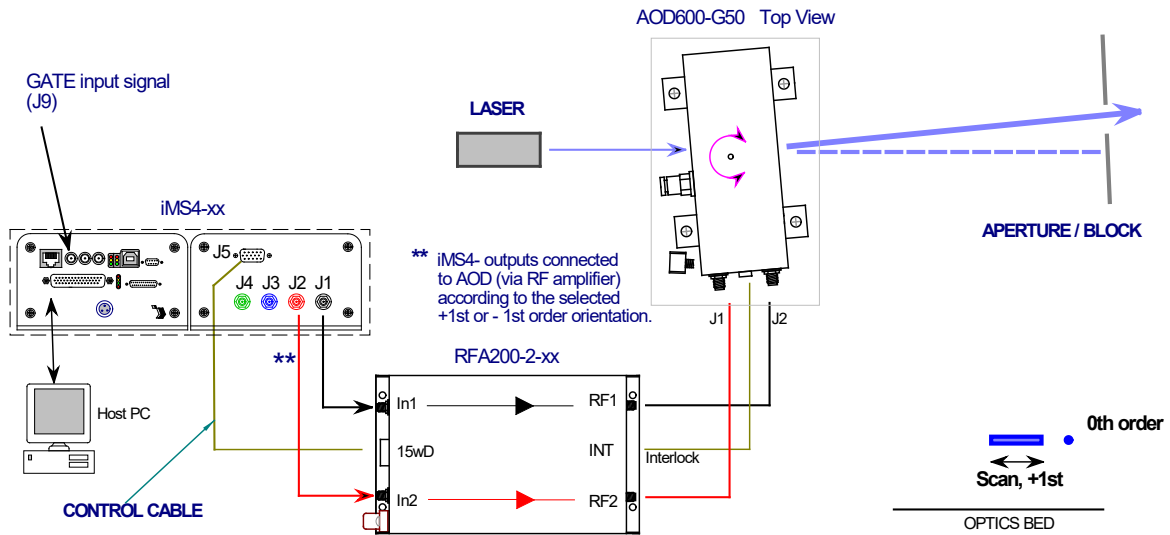
Basic Set-up Guide

IMS4 driving a single axis beam steered Acousto-Optic Deflector (AOD)

The RF connection order is important . It will define the preferred diffraction order; **+1** first order (= away from the RF connector end) or **-1** first order (= towards the RF connector end).

The following description will use the AOD600-Gxx and RFA200-2 series amplifier to illustrate the procedure.

Connections for +1 order



Connections for -1 order

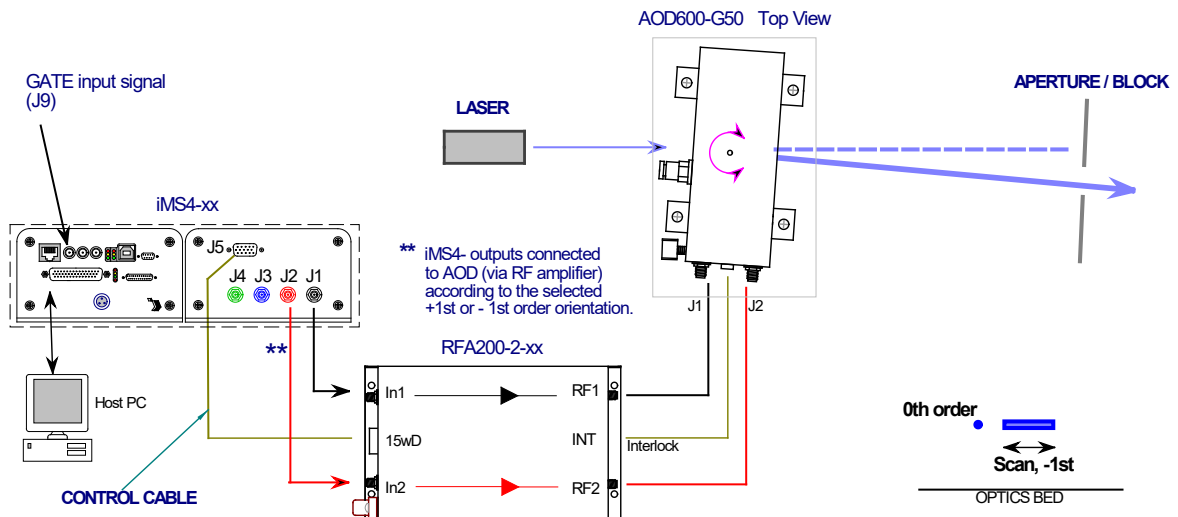


Figure 1: Typical configuration.

Procedure

- Step 1: Coolant connections
- Step 2: Electrical connections
- Step 3: Beam alignment
- Step 4: Configuring iMS4-xx
- Step 5: Set maximum RF power
- Step 6: AOD Bragg angle alignment at centre frequency
- Step 7: Test Scan

Step 1 Coolant connection

Always connect coolant water to both the AOD and RF amplifiers. Operate the recirculating chiller at constant temperature between 18 and 23 deg C, with a stability better than +/- 0.2 deg C. Flow rate of > 2 litres per minute.

Step 2 Electrical connections & LEDs

Connect the iMS4-xx synthesizer and RFA200-2-xx amplifier as shown in Figure 1

RF signal order for -1st diffraction:

iMS4-xx			RFA200-2-xx			AOD650 / D1315
Phase = 0	J1	⇒	IN1	RF1	⇒	J1
Phase Controlled	J2	⇒	IN2	RF2	⇒	J2
				INT	⇐	INT

Input control signals

J9 Gate input

Required to enable RF amplifier, active high 5V logic.
 ALWAYS connect the 15way D-type J5 of the iMS4- to the CTRL input of the RF amplifier.

J10 Trigger input

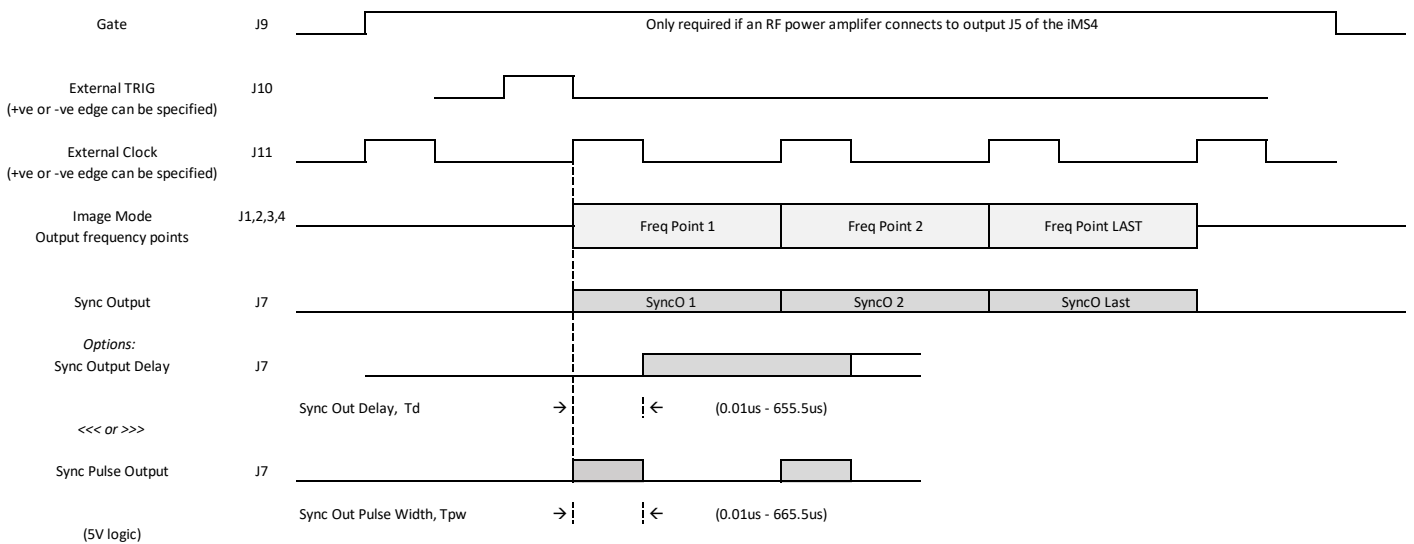
Required if 'External Trigger' is selected in the software.
 Default is a single internal trigger, no repeats.
 This signal initiates the start of an image playback.

J10 Clock input

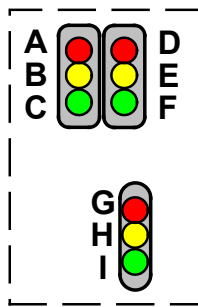
Required if 'External Clock' is selected in the software.
 Default is Internal clock, 100KHz.
 This signal defines the output rate of the Image points (= rate of change of the AO deflector scan angle)

Signal Timing Diagram

Image mode (latency delays not shown for clarity)



iMS4-PT LED Indicators.



Top Stack, Controller PCB

Ident	LED	Mode	iMS4-P
A	RED (top left)	If illuminated	Not Downloading File
B	Yellow	If illuminated	Downloading File
C	Green	Pulsing	Controller OK
D	RED (top right)	If illuminated	Image output stopped
E	Yellow	If illuminated	Waiting on Trigger
F	Green	If illuminated	Image playing / output active

Lower stack. Synthesizer PCB

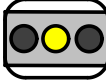
Ident	LED	Mode	Stand Alone iMS4-	In combination with PA J5 connected
G	RED (top)	Constant on	DC power On	Thermal Interlock Open (= fault) or GATE input J9 = low/OFF
H	Yellow	Constant on	NA	PA is enabled. Thermal Interlock OK
I	Green	Pulsing	Synthesizer OK	Synthesizer OK

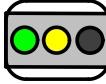
DC power applied, USB communication problem

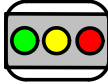
If the 6x LED's (A,B,C,D,E,F) are constantly illuminated, then USB communication has not been established. In this case:

- a: Ensure USB driver is loaded (see section 10)
 - b: Cycle DC power
- and /or
- c: Disconnect then reconnect USB

RFA200-2-xx, LED Indicators

- ✓ 24V connected and DC power on
 - ✗ Interlocks not connected
 - ✗ Over temperature fault / Coolant failure
- 

- ✓ 24V connected and DC power on
 - ✓ Interlocks OK
 - ✗ GATE Low, J9 (= RF amp disabled)
- 

- ✓ 24V connected and DC power on
 - ✓ Interlocks OK
 - ✓ GATE High, J9 (RF enabled)
- 

RFA2000-2-xx, 15-way D-type connector

Connection is required to J5, (15way-D) to allow the GATE signal function correctly. It requires a software command to enable **AND** a logic high signal on the SMA input J9 of the iMS4.

The control cable connection allows remote enable – disable function, as well as temperature and VSWR diagnostics.

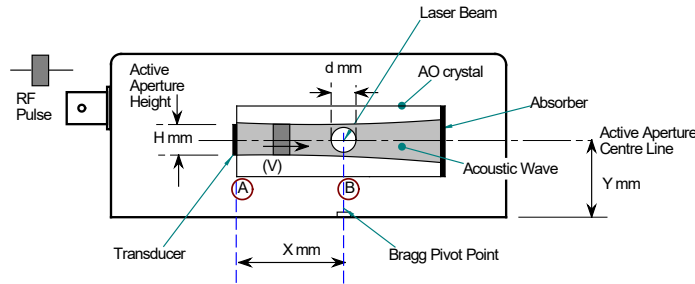
Note:

The RF outputs can also be temporarily disabled by disconnecting the INT connection at the AOD

Step 3: Beam Alignment

Initial alignment without RF power.

Ensure the laser beam is aligned centrally in the AO active aperture.
 This alignment is especially important if the beam diameter approaches the active aperture height dimension H



If in doubt, please refer to app note: Optimizing Efficiency.pdf

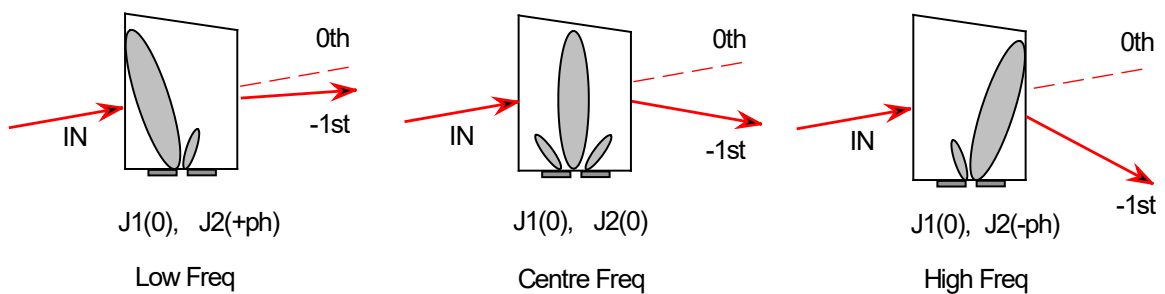
Step 4: Configuring iMS4-xx

AO Scanning Theory

The AOD600 / D1315 series use acoustic beam steering to improve the diffraction efficiency as the frequency is changed to scan the laser beam. To achieve this, the RF drive frequency applied at the two AOD inputs (J1, J2) is controlled in phase and amplitude value.

At the centre frequency, the phase difference between the two AOD inputs is zero. At all other frequencies, there is a positive (+ph) or negative phase (-ph) difference.

At any given moment, the frequency and amplitude applied to each AOD has the same value. Only the phase is different between the two inputs of each AOD



Theoretical phase values are supplied in the default LUT files for the specific AOD and wavelength

Step 5: Setting the Power Level Wipers

The maximum output power level is set by a combination of the **DDS** and channel **Amplitude** Wipers. We will assume Channel-1 and Channel-2 of the iMS4 are used.

- 1: Set the maximum RF power limit *

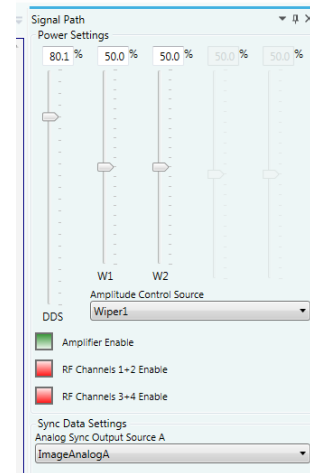
Rev-B (inc' iMS4-L)

Select **Signal Path** panel and set the power control wiper values.

DDS Power: 95% **

Amplitude Control Source: **Wiper 1**

W1 Power: 80% **



Rev-C

Select **Signal Path** panel and set the power control wiper values.

DDS Power: 80% **

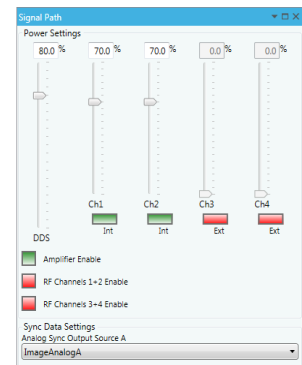
For AOD connected to Ch1 and Ch2

CH1 Wiper Power: 95% **

CH2 Wiper Power: 95% (must be same as CH1)

CH3 Wiper Power: 0% or OFF (red =EXT)

CH4 Wiper Power: 0% or OFF (red=EXT)



- 2: Enable the RF power amplifier ***.

Click on **Amplifier Enable** button **Green** (On)

RF power will be applied to the AOD, when the **Amplifier Enable** button is active

*** CAUTION: THERE IS A RISK OF SERIOUS DAMAGE TO THE AO DEVICES IF OPERATED AT EXCESSIVE (CW) RF POWERS.**

** These values will depend on connected power amplifier (PA) and AO device.

Recommended values are provided on the test data sheet

*** Depends on the amplifier model.

Step 6: Setting BRAGG angle

- 1: Place a detector at first order beam position. See Figure 1
- 2: Select **Calibration panel** tab

Rev-B

Slider values apply to all channels simultaneously

Rev-C

Slider values apply to all channels simultaneously UNLESS channel **HOLD** button(s) is active.

There is one HOLD button for each channel

If HOLD the button is active, the channel output is frozen and the output is set to the FAP value at the time the HOLD button was initiated.

Select Bragg Frequency

Using model AOD600-G50 (AOD650) as an example, this AOD has a maximum frequency tuning ranges of 40 – 60MHz . Set Frequency slider to:

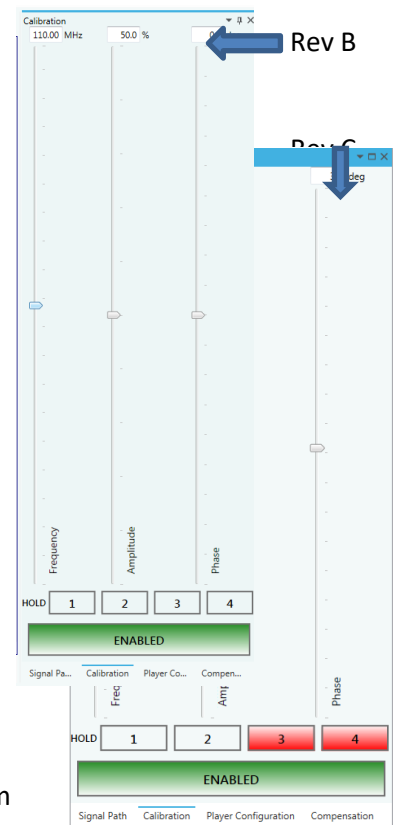
Centre frequency $f_c = 50\text{MHz}$.

Adjust Calibration panel sliders for the Bragg Adjustment

- 1: Set **Frequency** to f_c . (in this example 50MHz).
- 2: Set **Phase** to Zero. The Phase is always Zero at the Bragg angle.
- 3: Set **Amplitude** to a starting value of 50%.

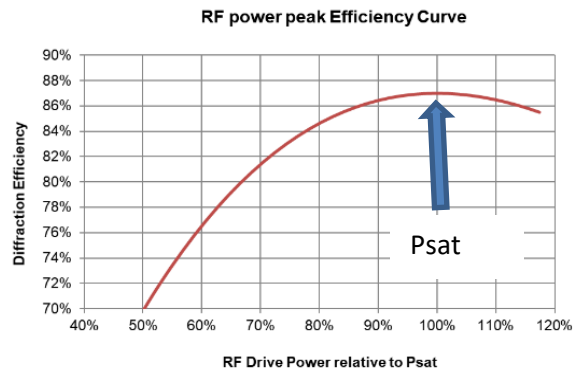
Tip: Drag the wiper position using a mouse or enter the value directly in the window and click on the wiper button to activate. Wiper position will then update to the frequency value.

- 4: Adjust the AOD Bragg angle to find the peak efficiency.
- 5: Re-adjust the **Amplitude** slider, (Calibration panel) to maximize efficiency (DE). The peak efficiency is typically in the range of 85-90% and will be recorded on the test data sheet.



6: Record the peak **DE**, **Amplitude** and **Frequency** values.

7: Secure mechanical Bragg angle adjusters.



Tip: DO NOT overdrive and exceed Psat @ 100%.

Better to operate at < 95% and NOT > 100%.

As noted from the curve above, a small sacrifice in diffraction efficiency of ~2%. will reduce the RF drive power by 10%. This will help to minimize thermal dissipation in the AOD.

Step 7: Test Scan

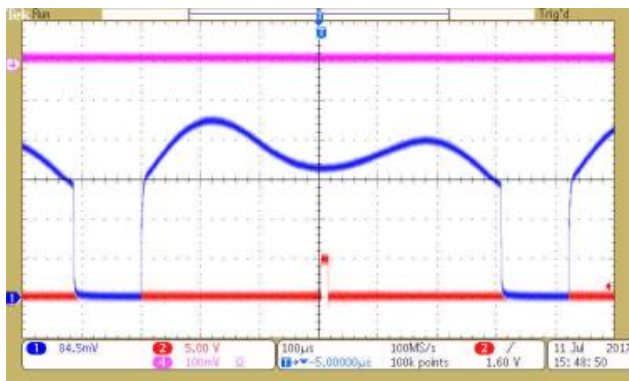
Create an Image file that generates a line scan over the frequency of interest.

To check general alignment and gauge the "health" of the AOD, it is sufficient to operate with a the default LUT file. This will contain theoretical Phase values and a constant Amplitude value (typically 50% to 70%).

Typically, the diffraction efficiency sweep will take a "humped" profile, depending on factors such as cable length and RF power. The average efficiency of this test will be indicative of performance.

In situations where very low efficiencies are recorded, this technique may help to narrow down any issues.

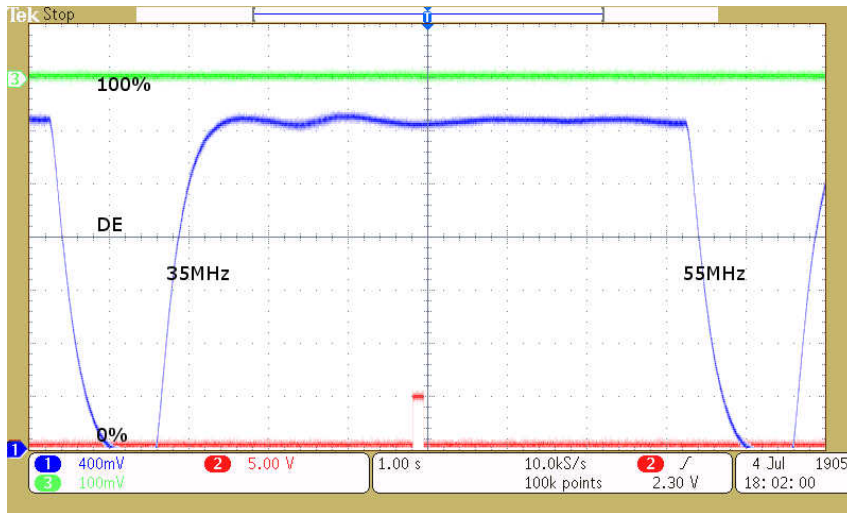
Non-optimized single axis, theoretical phase, 50% Amplitude



(Basic default LUT)

With full calibration and careful adjustment of the RF power, the efficiency is improved.
(refer to iMS4 Compensation LUT Guide)

Typical single axis sweep response with an optimized LUT file:

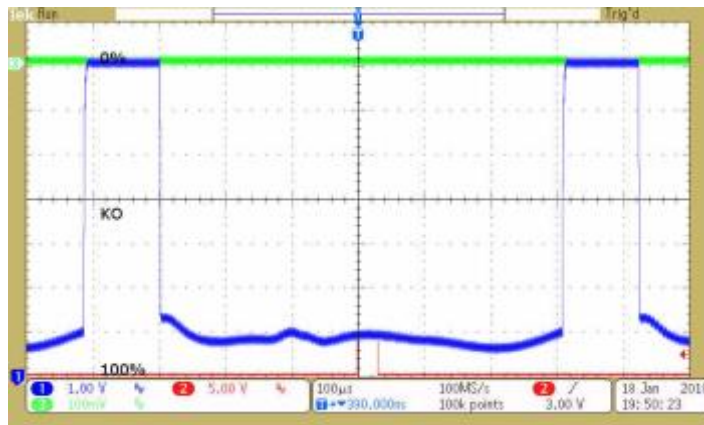


(In this instance, improved sweep efficiency across a full 20MHz bandwidth was obtained operating this AOD at a centre reduced frequency. The slow response of the thermal pile detector is seen in the rise and fall times of the plot).

Zero order Measurement

An alternative to using a detector on the scanned deflected beam is to place the detector on the static Zero order beam and measure the power reduction

Typical Zero order kick-out. 0% = no diffraction



A word of caution:

Low power in the zero order does not always mean high power in the desired first order.
e.g. Excess RF power will cause diffraction into unwanted orders.