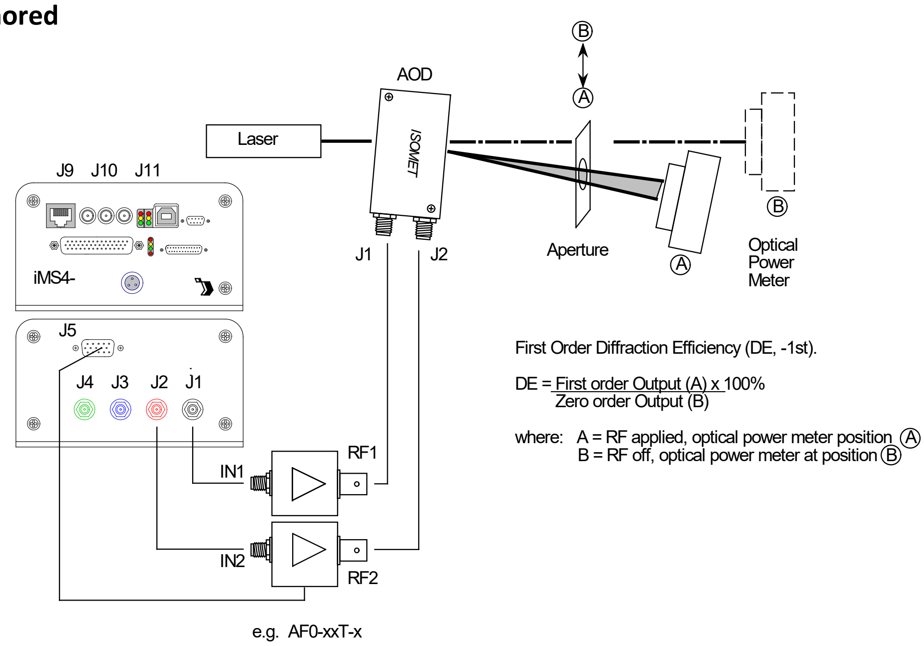
Functional test of the D1312 AO deflector using the iMS4 Isomet Studio.

The method uses the iMS4 in Tone Buffer mode with LUT files supplied by Isomet.
It is a convenient means to set the AOD Bragg angle and check for scan uniformity.

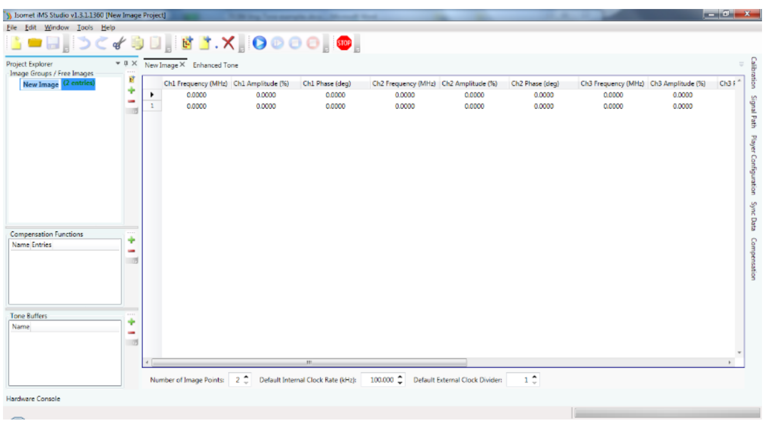
- For X-Y AO deflectors, each AO deflector is tested in turn starting with the X-axis.
- The D1312 is a TeO2 deflector. The input polarization is not critical although vertical with respect to the scan (diffraction) axis is preferred.
- Always ensure cooling water is flowing through AOD. (This does NOT depend on the input laser power).
- To install the software, please refer to *Quick Start Guide.pdf*
- For further reading on Compensation LUT files, please refer to *iMS4 Compensation LUT Guide.pdf*

This app note describes set-up using the D1312-T80L-6 at 1064nm. We will assume the AOD is connected to Ch1 and Ch2 of the iMS4 through two amplifiers e.g. models AF0-80T-4

NOTE: The thermal interlock on the D1312 is not used with the standard AF0 series amplifiers and can be ignored



Start the Isomet Studio

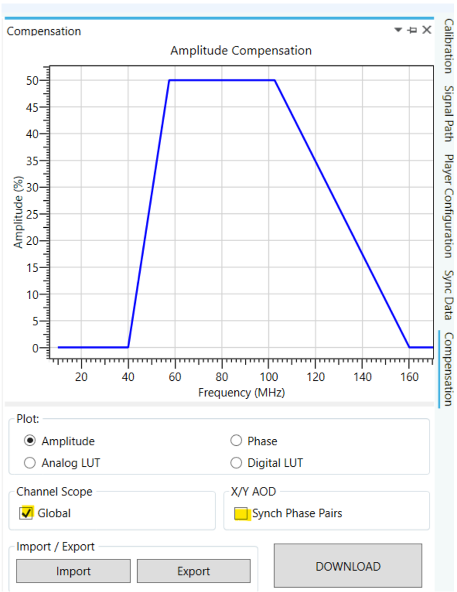


Isomet: 2022-07-05

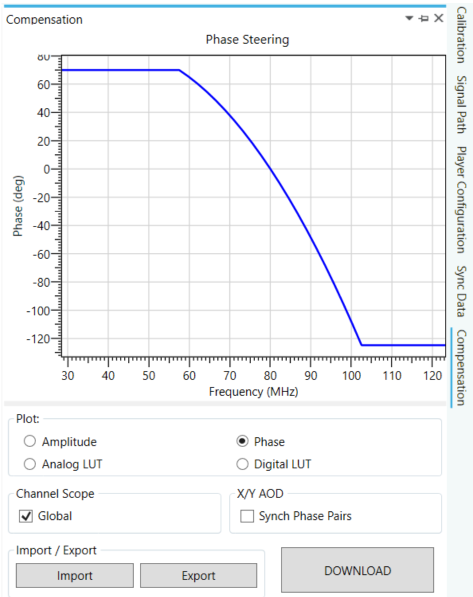
1: Navigate to the location of your iMS4 files.
File > Open > ..\..*D1312-1um-30MHzSweep.iip*

Select ***Compensation*** menu
2: Select ***Global***
3: Deselect ***Sync Phase Pairs***
Navigate to file location
4: ***Import*** ..\..\ *Default-A50%-PCalc-1um(-Gbl).LUT*
This LUT file uses theoretical calculated phase values and constant 50% amplitude.
(For reference, this LUT can also be generated from within the GUI. See: Tools > AO chooser)
Compensation curves will be displayed:

<u>Amplitude vs. frequency</u>



<u>Phase vs. frequency</u>



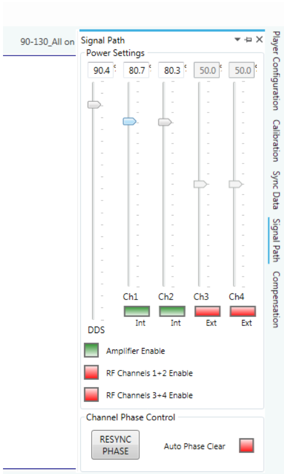
5: ***Download***

6: Select ***Signal Path*** menu

7: Set ***DDS*** wiper to **90%** (applies to all outputs)

8: Set ***Ch1*** wiper to **80%** <u>AND</u> set ***Ch2*** wiper to **80%.**
MUST BE SAME

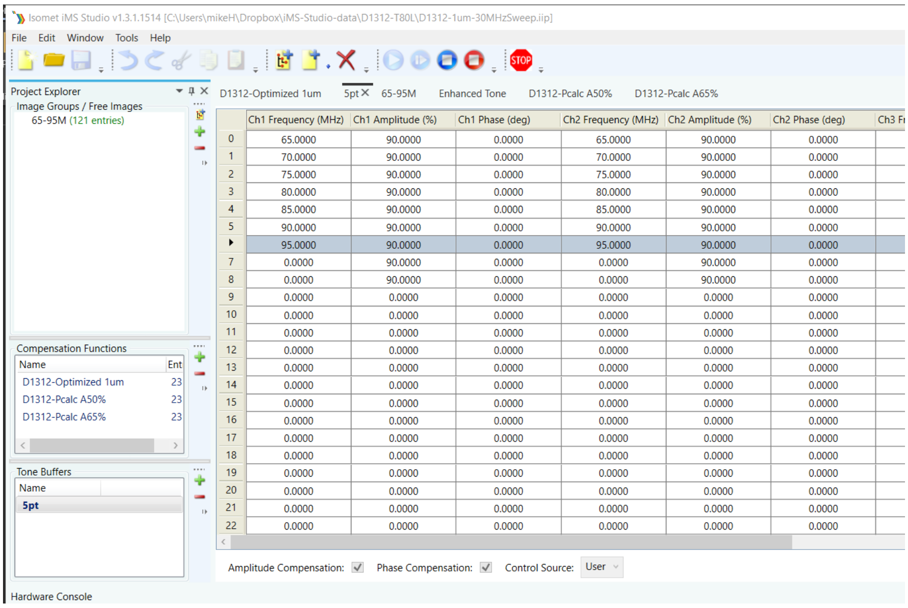
9: To be safe, disable Ch3 and Ch4 .
Hit buttons below "Ch3" , "Ch4" wipers
Will change from Green (INT) > Red (Ext))



10: Note: ***Amplifier Enable*** (Red > Green) serves <u>no</u> function with AF0 series amplifiers.

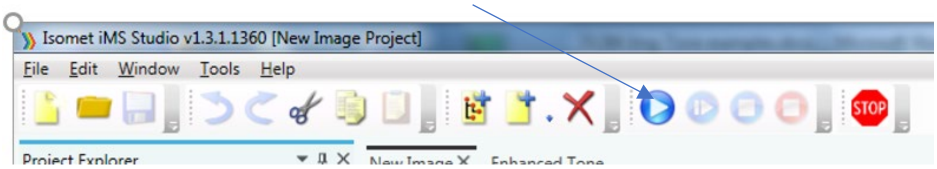
11: GATE input on SMA J9 of the iMS4- <u>is not required</u> when used with the AF0- series amplifiers.

12: In the ***Tone Buffers*** window, select table ***5pt***



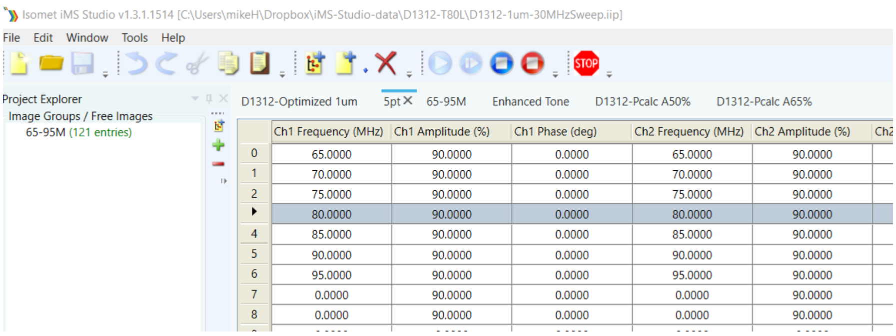
This table comprises 7 frequency points equally spaced across the maximum diffraction bandwith of the AOD.

13: Hit ***Play*** button to enable Tone Output



14: Select row-3 containing the AOD centre frequency. In this case 80MHz.
The active row will be highlighted when selected.

To ensure the single tone output has been initated, navigate to a blank (all zeros) row e.g. row-8 and then back to row-3 (80MHz)



17: **Adjust Bragg angle** for maximum diffraction efficiency. At this stage it should be between 70% and 80%. (See page Appendicies)

18: Step though all 9 frequencies. Measure the efficiency at each frequency.
Centre the power meter on the diffracted beam at each scan angle.
Do not readjust Bragg until all 5 measurement are taken.

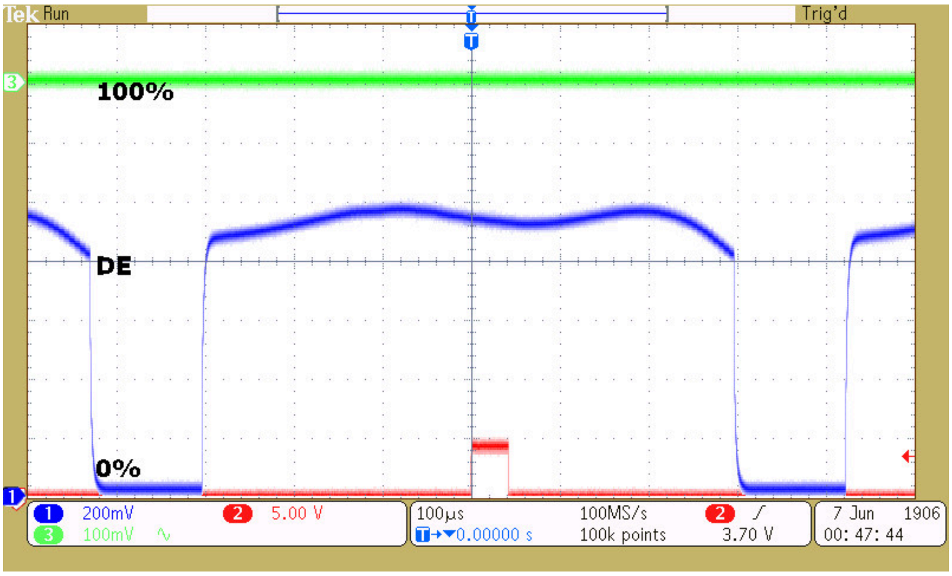
<u>THE FOLLOWING DATA & PLOTS ARE INDICATIVE</u>

19: If all is correct for the selected first order, the results will be similar to the table values below.

Table Row	Freq MHz	Diffraction Efficiency	RF drive power per input (nominal)
0	65	57%	1.5W
1	70	60%	1.6W
2	75	64%	1.6W
3	80	61%	1.6W
4	85	60%	1.6W
5	90	63%	1.7W
6	95	52%	1.7W

The diffraction efficiency variation is less than <+/- 10%

The equivalent sweep response, from 65-95MHz,100steps



Comment

This is a typical response for the default LUT table and confirms that the RF connections and optical alignment are broadly correct. At this stage, it is not optimized but it is approximately flat across the scan. See 21: Improving Scan Efficiency

20: **Error Conditions**

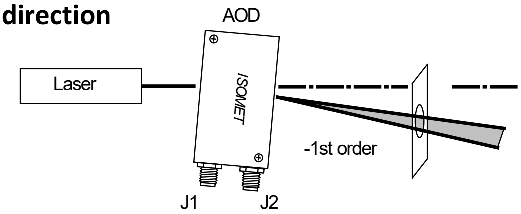
These will occur if :

- RF connection order is incorrect
- Opposite diffraction order has been selected

Note: the efficiency at the centre frequency will still be good but the uniformity will be poor .

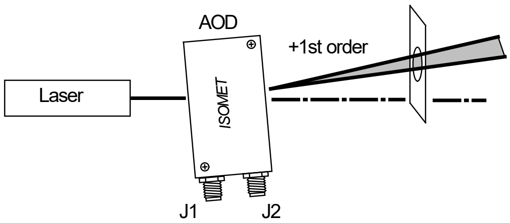
RF Connection v. Scan direction

Minus Bragg requires iMS4 output **J1** to connect (via the amplifer) to AOD input **J1**, and iMS4 **J2** to AOD input **J2**



Conversly :

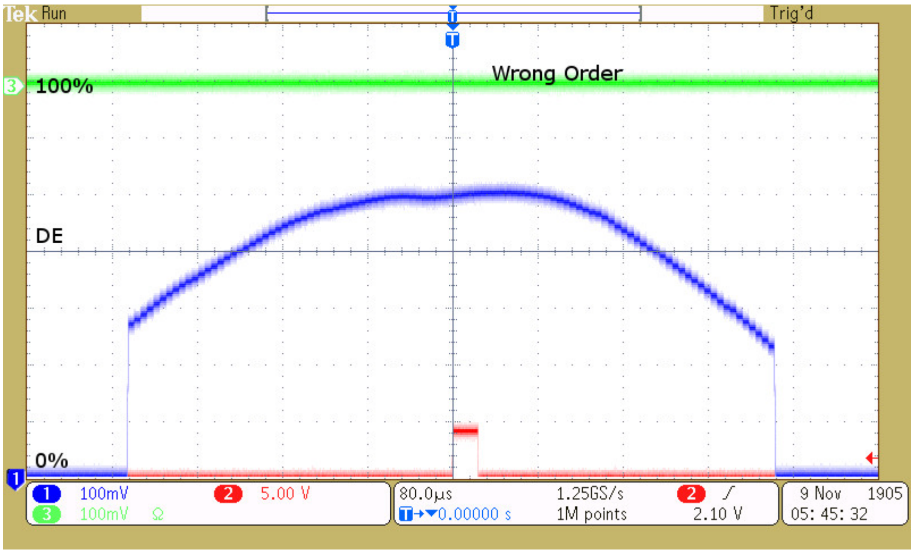
Plus Bragg requires iMS4 output **J1** to connect (via the amplifer) to AOD input **J2**, and iMS4 **J2** to AOD input **J1**



Example:

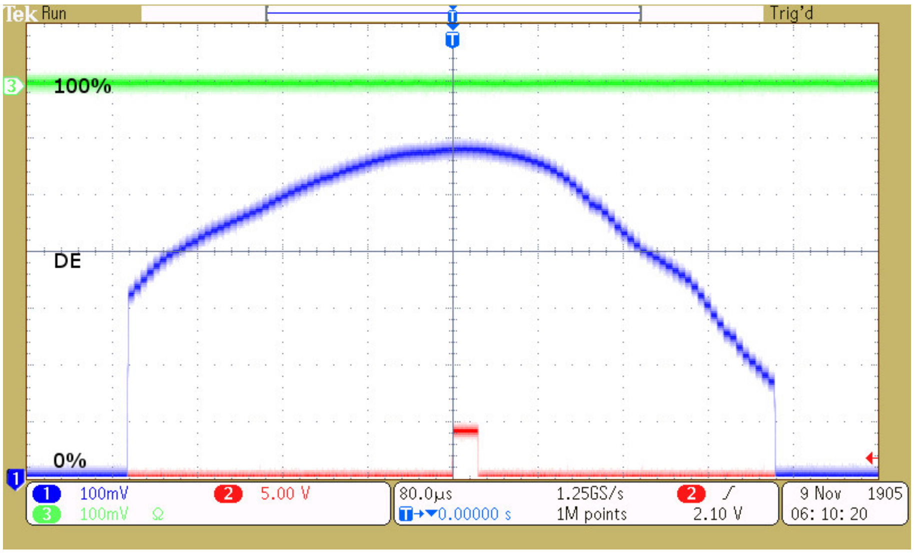
Using the same set-up but aligning the power meter on the opposite first order beam,
Note the large variatation in diffraction effiency . Almost +/- 20%

The equivalent sweep response, from 65-95MHz in 100 steps

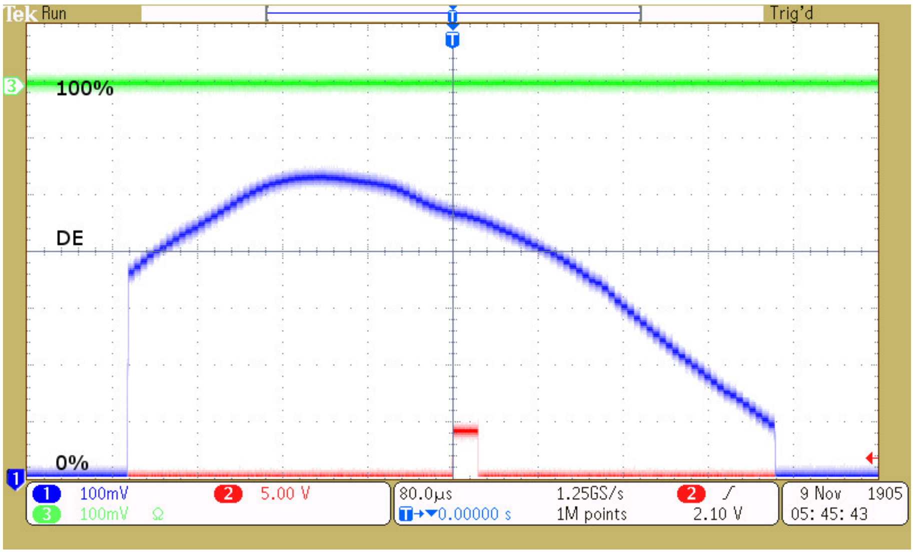


IMPORTANT. It is not possible to improve the efficiency with drive power or Bragg adjustment.

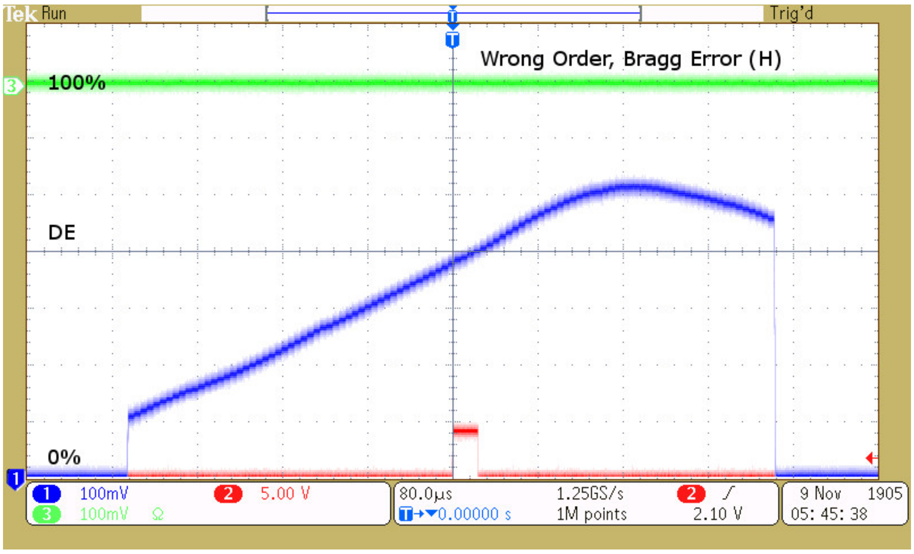
e.g. Error Condition. Increasing RF power = no benefit



Bragg adjusted for low of centre frequency = no benefit



Bragg adjusted for high of centre frequency = no benefit



21: **Improving scan efficiency**.

If your initial results are similar to section 19, continue to 22:

If your initial results are similar to section 20, swap the RF connections at the AOD input and repeat steps 17,18,19.

22: A simple increase in LUT amplitude will provide reasonable flatness and efficiency

This can illustrated by loading a new LUT file as follows.

First, stop the running Tone Buffer in order to upload a new compensation LUT file.

To fully end the Tone Buffer mode, follow steps below A: and B: in order.

A: Select a row containing zero values to stop the RF output e.g. row-8

	Ch1 Frequency (MHz)	Ch1 Amplitude (%)	Ch1 Phase (deg)	Ch2 Frequency (MHz)	Ch2 Amplitude (%)	Ch2 Phase (deg)
0	65.0000	90.0000	0.0000	65.0000	90.0000	0.0000
1	70.0000	90.0000	0.0000	70.0000	90.0000	0.0000
2	75.0000	90.0000	0.0000	75.0000	90.0000	0.0000
3	80.0000	90.0000	0.0000	80.0000	90.0000	0.0000
4	85.0000	90.0000	0.0000	85.0000	90.0000	0.0000
5	90.0000	90.0000	0.0000	90.0000	90.0000	0.0000
6	95.0000	90.0000	0.0000	95.0000	90.0000	0.0000
7	0.0000	90.0000	0.0000	0.0000	90.0000	0.0000
►	0.0000	90.0000	0.0000	0.0000	90.0000	0.0000
9	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

B: Hit ***STOP*** to disable the current Tone Mode

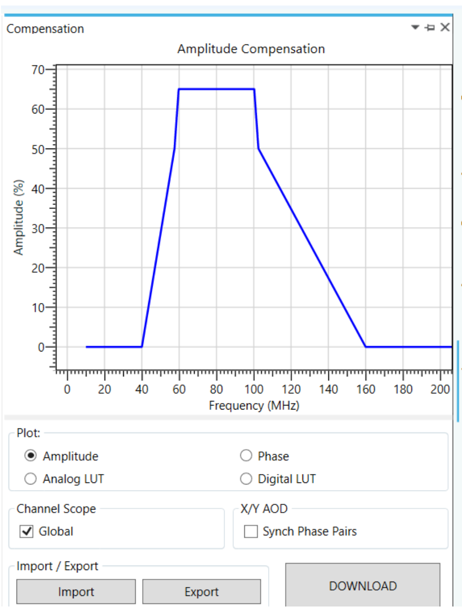
22: Select ***Compensation*** tab

Navigate to your IMS4 files location.

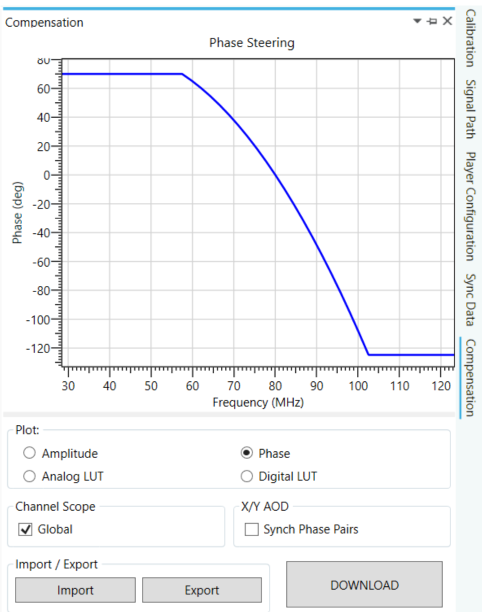
Import *..\..\ Simple-A70%-PCalc-1um(-Gbl).LUT*

This LUT files also uses the theoretical phase values but with increased amplitudes.

Amplitude vs. frequency



Phase vs. frequency



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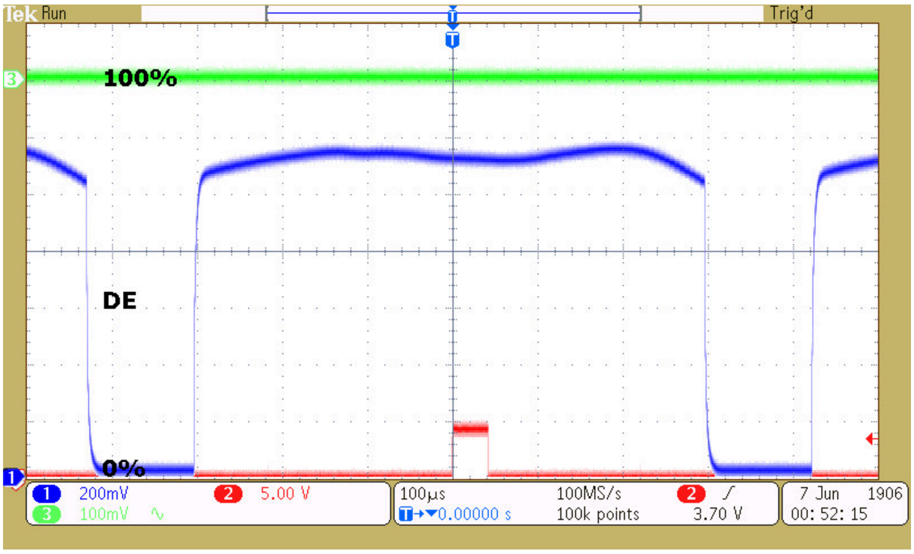
Result:

Table Row	Freq MHz	Diffraction Efficiency	RF drive power per input (Nominal)
0	65	71%	2.9W
1	70	74%	2.8W
2	75	77%	2.8W
3	80	76%	2.8W
4	85	74%	2.9W
5	90	76%	2.9W
6	95	67%	2.9W

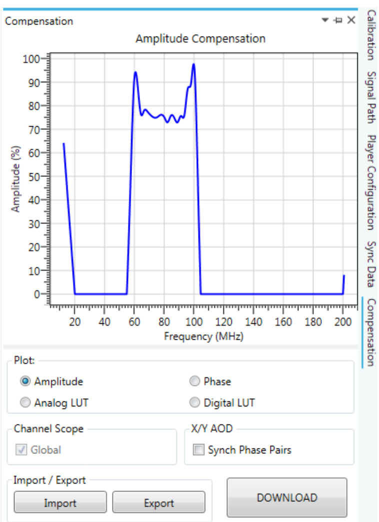
The equivalent sweep response, from 65-95MHz ,100steps



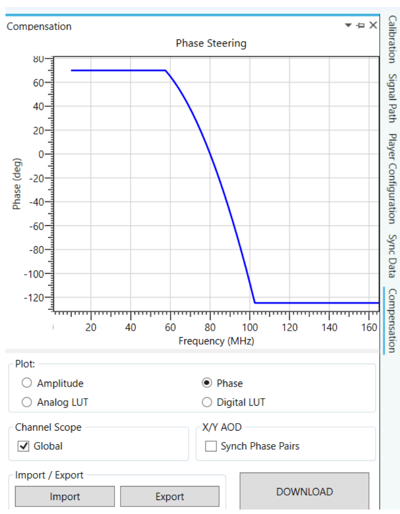
Comment : Depending on the application, this may be acceptable.

23: **Optimization.** For further improvement use the Calibration routine.
This allows precise adjustment of both amplitude and phase at each test frequency.
(For more detail see *iMS4 Compensation LUT Guide.pdf*)
For example: the LUT file: *Optz-A%-PCalc-1um-D90-Ch80(-Gbl).LUT*

Amplitude vs. frequency



Phase vs. frequency



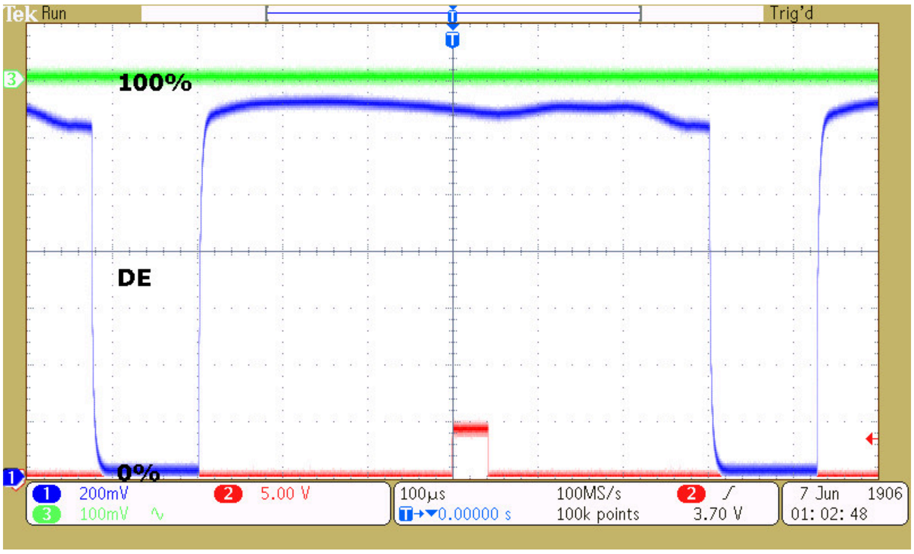
Little to be gained with phase adjustment in this case. Theoretical values are fine.

Result:

Table Row	Freq MHz	Diffraction Efficiency	RF drive power per input (Nominal)
0	65	86%	3.4W
1	70	91%	3.4W
2	75	91%	3.3W
3	80	89%	3.3W
4	85	89%	3.3W
5	90	89%	3.3W
6	95	82%	3.9W

This optimization achieves a variation of +/- 1% across the specifed 20MHz scan (30MHz sweep tested)

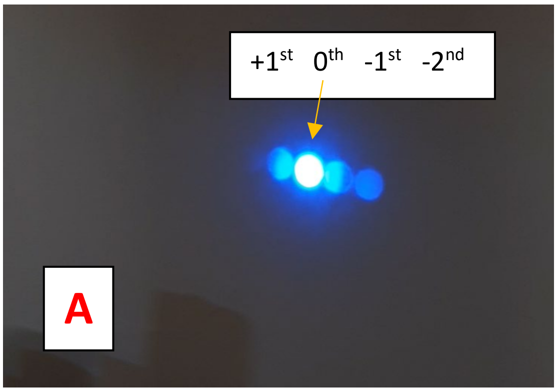
A 65-95MHz first order sweep efficency, with the optimized LUT file



Appendix 1:
<u>Typical Output Beams, Bragg Angle Adjustment, Single Axis</u>

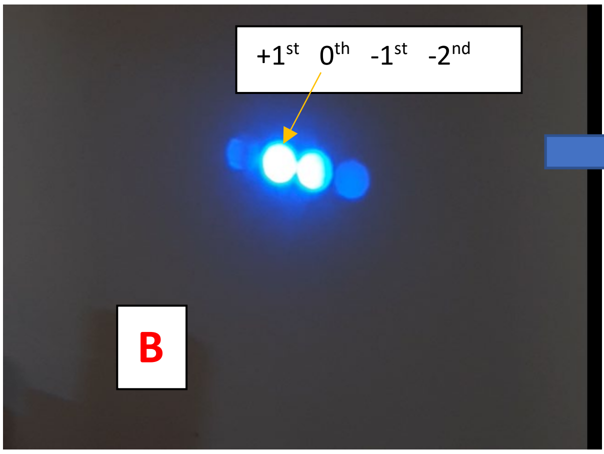
Adjusting Bragg angle for -1st Order Beam

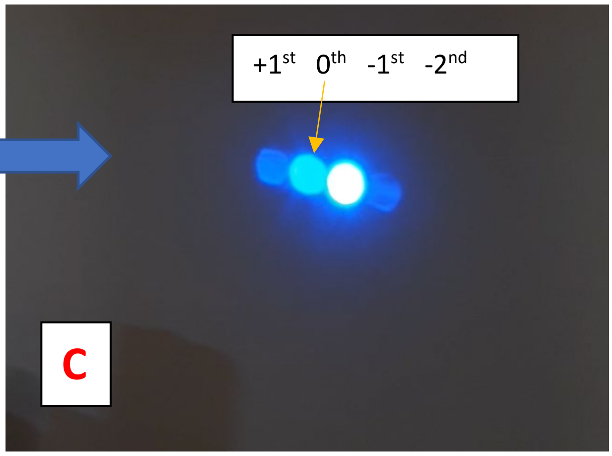
A: AOD normal to input laser Beam



B: Incorrect adjustment

C: Optimized adjustment



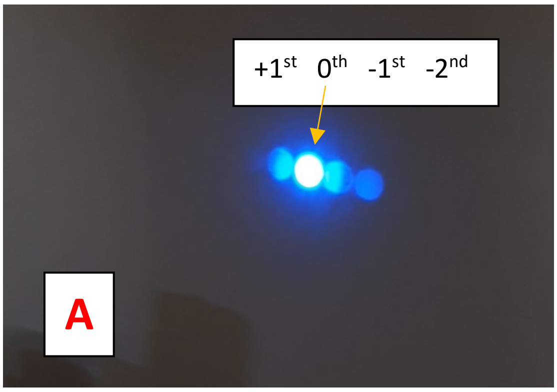


Angle Adjustment is extremely SENSITIVE.

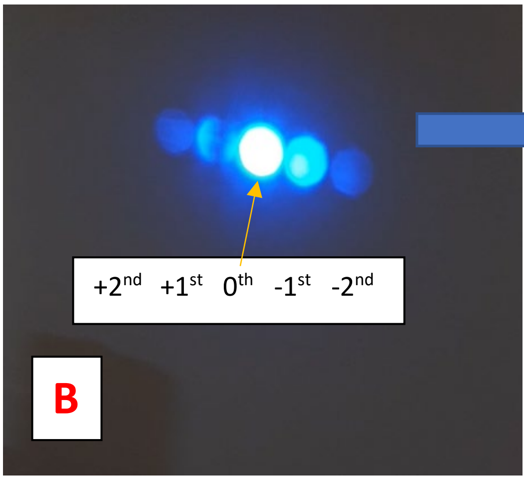
Similarly,

Adjusting Bragg angle for $+1^{st}$ Order Beam

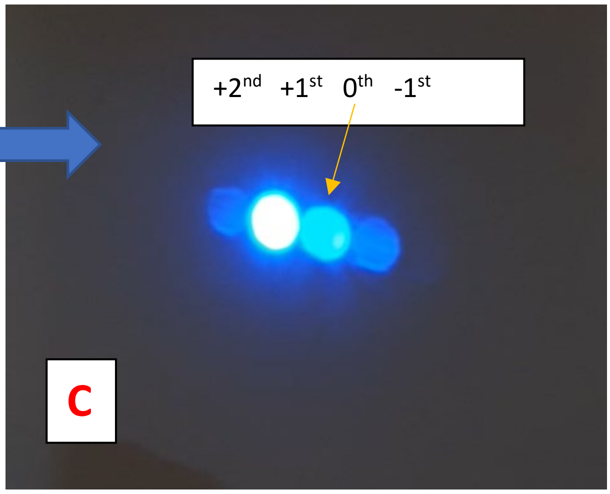
A: AOD normal to input laser Beam



B: Incorrect adjustment



C: Optimized adjustment



Angle adjustment is extremely SENSITIVE.