Fianium
ultrafast fiber lasers

AOTF

User Manual

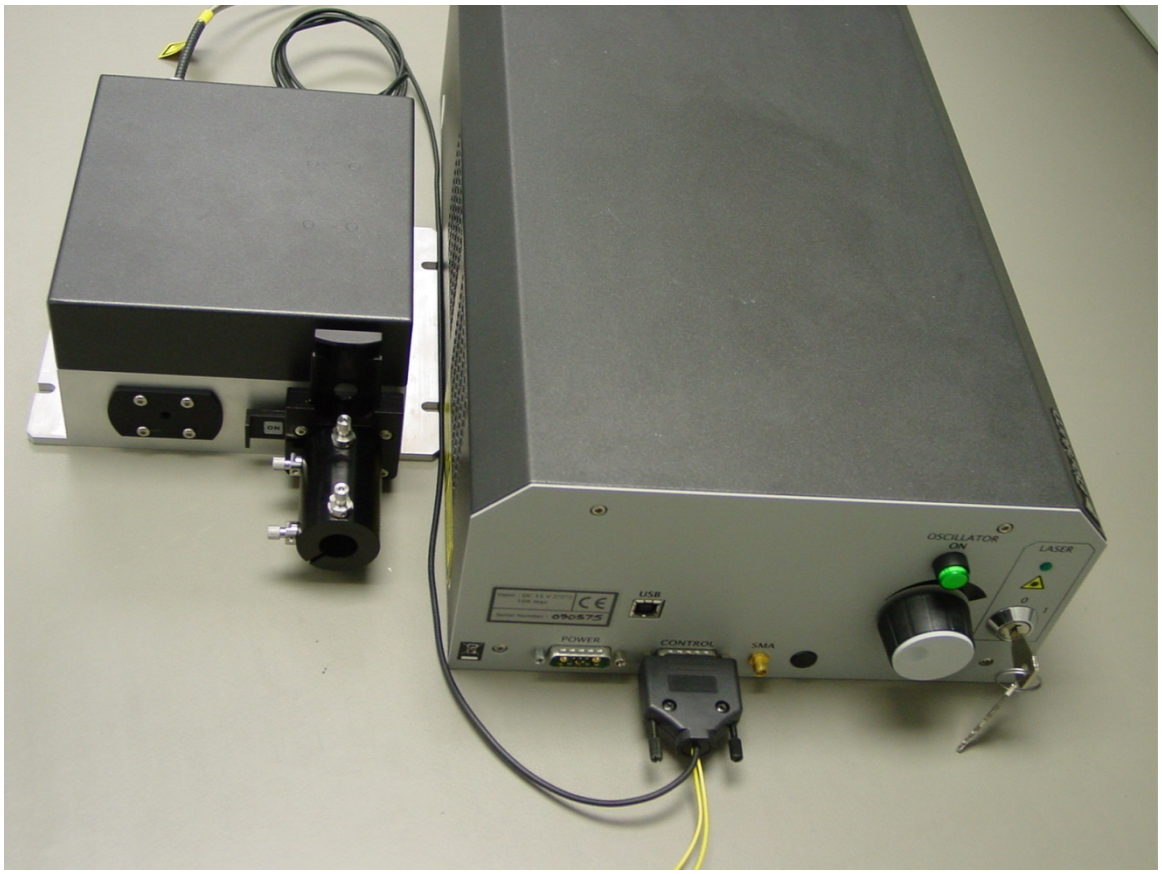


Table of Contents

1. Explanation of symbols

Important information. Non-compliance with the information within these sections may result in improper operation of the laser or adversely affect the performance of the system.

Critical information. Non-compliance with the information within these sections may result in serious system damage and potentially void your warranty.

Laser safety information. These sections advise on proper conduct when operating high power laser systems. Observe the instructions to avoid personal injuries.

2. Laser Safety

Use of controls or adjustments or performance of procedures other than those specified in this manual unless performed under the direction of Fianium Engineer, may result in hazardous radiation exposure for which Fianium Ltd will not be liable. In addition, any of these operations will also void the product warranty.

The laser beam is emitted from the front of unit where the laser aperture label is fixed. This is a collimated beam.

The AOTF safety interlock can be connected into your existing interlocks if required. This is the wire loop in the 15-pin D plug connector supplied with the system. For the system to be operated the interlock cable is required to be attached to the AOTF unit and the laser output lens tube inserted fully into the AOTF input housing in order for the interlock to be enabled. If the interlock is opened (if for example the laser output lens tube is removed from the AOTF unit during operation), the laser will be shut off.

This is a sealed laser unit. There is no reason to open the laser. The removal of any panels will invalidate the warranty

3. Labels Fixed to this Unit

Laser Aperture

(A)

Serial number label

(B)

3.1 Position of the labels

Labels A are fixed on the shutters, where light is emitted from the AOTF during operation.

Label B is fixed to the top surface of the AOTF.

4. Key Procedures to follow

Read safety section of this manual before operating the laser.

It is important to minimize the risk of back reflection into the laser. In particular:

1. In bulk-optic systems, try to make sure that all reflective optics are not creating spurious back reflected light into the laser. Also the optics should be bolted down to avoid accidental spurious back reflected light into the laser.
2. When setting up a new experiment for the first time, be careful not to cause back reflection into the amplifier.

Note: There is an automatic back reflection cut off in the laser. If the laser shuts down whilst aligning bulk optics, check optical train for alignment before turning power up again.

The AOTF is attached with an interlock such that if the laser lens tube is removed from the AOTF housing during operation the laser will be switched off. For more information on how to use the interlock system, see Section 7

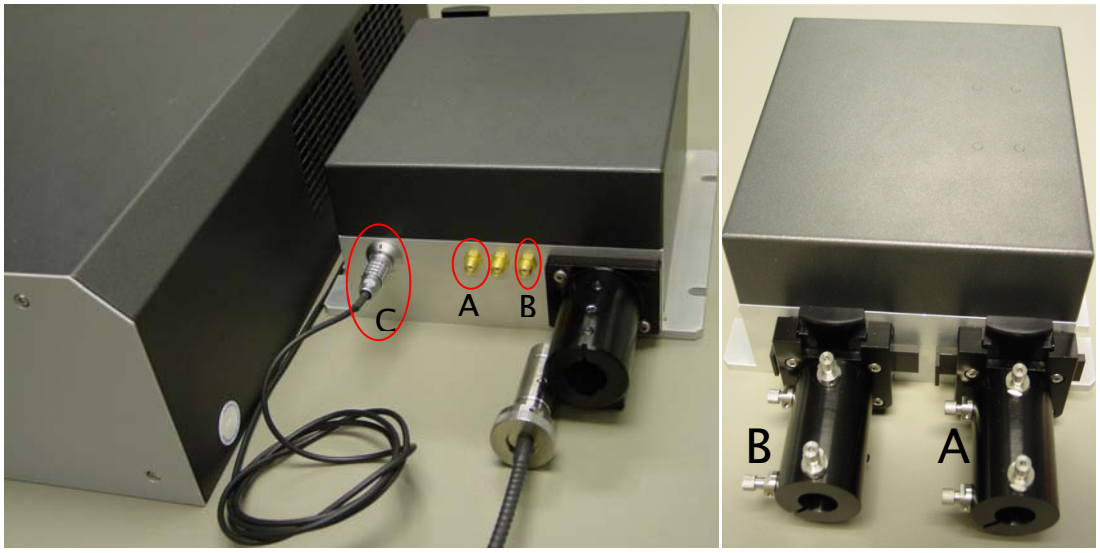
5. Introduction

This manual will cover the setup and use of each AOTF unit available from Fianium. There are two main variations of AOTF available – a single and a dual AOTF unit, and each can be customised to have either free space or fiber coupled outputs. The units can be fitted with a range of different AOTF crystals including visible (400-650nm), NIR1 (650-1100nm) or NIR2 (1100-2200nm) AOTF's. AOTF's with fiber coupled outputs will be covered in a separate section, following the description of operation of the free space output AOTF's. The section covering the fiber coupled output will only be relevant if this was specified on your AOTF order. This manual will first outline the dual AOTF system, and the user of dual or single AOTF units are advised to read through all sections of the manual. Section 12 will summarise the use of the high power (HP) AOTF unit, which also has a single AOTF output.

The use of single AOTF units is largely the same as for the dual system, but the differences will be summarised in Section 11.

6. Dual AOTF-FS system (free space output)

The Dual AOTF-FS has two free space outputs for the two beam lines of the two AOTF's. The AOTF input port secures and aligns the output lens tube of your super-continuum (SC) laser to the AOTF. **No alignment is required – the AOTF has plug and play usability**. The unit has two RF driver input ports, two of which will connect the AOTF to the RF drivers. These two ports will be labelled with their respective AOTF crystals which they address



6.1 fiber delivered dual output AOTF with supercontinuum system, labelled with output ports A and B, and the corresponding RF input ports A and B highlighted on the left. C labels the AOTF interlock system which must be connected to the AOTF and the lens tube

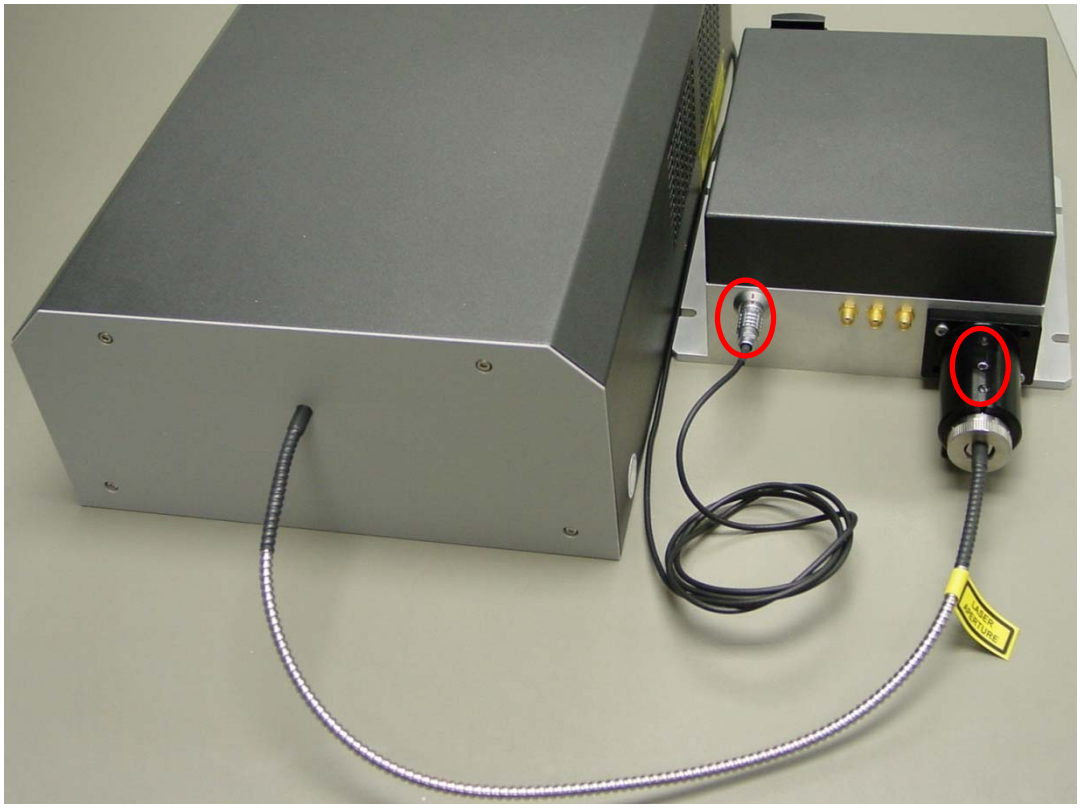
The configuration of the AOTF's inside the dual AOTF unit depend on the system ordered, and some possible configurations are outlined in Table 1. The table below gives possible configurations of the AOTF's, depending on your system ordered, and the input RF drive ports for AOTF's A and B are labelled as ports A and B in Figure 6.1 respectively.

Table 1 possible AOTF combinations, and identities of the AOTF's along each beam line

AOTF Combination	AOTF's on Ports B	AOTF's on Ports A
VIS / NIR1	NIR1	VIS
VIS / NIR2	NIR2	VIS
NIR1 / NIR2	NIR2	NIR1

7. Connecting up your AOTF and use of the AOTF interlock

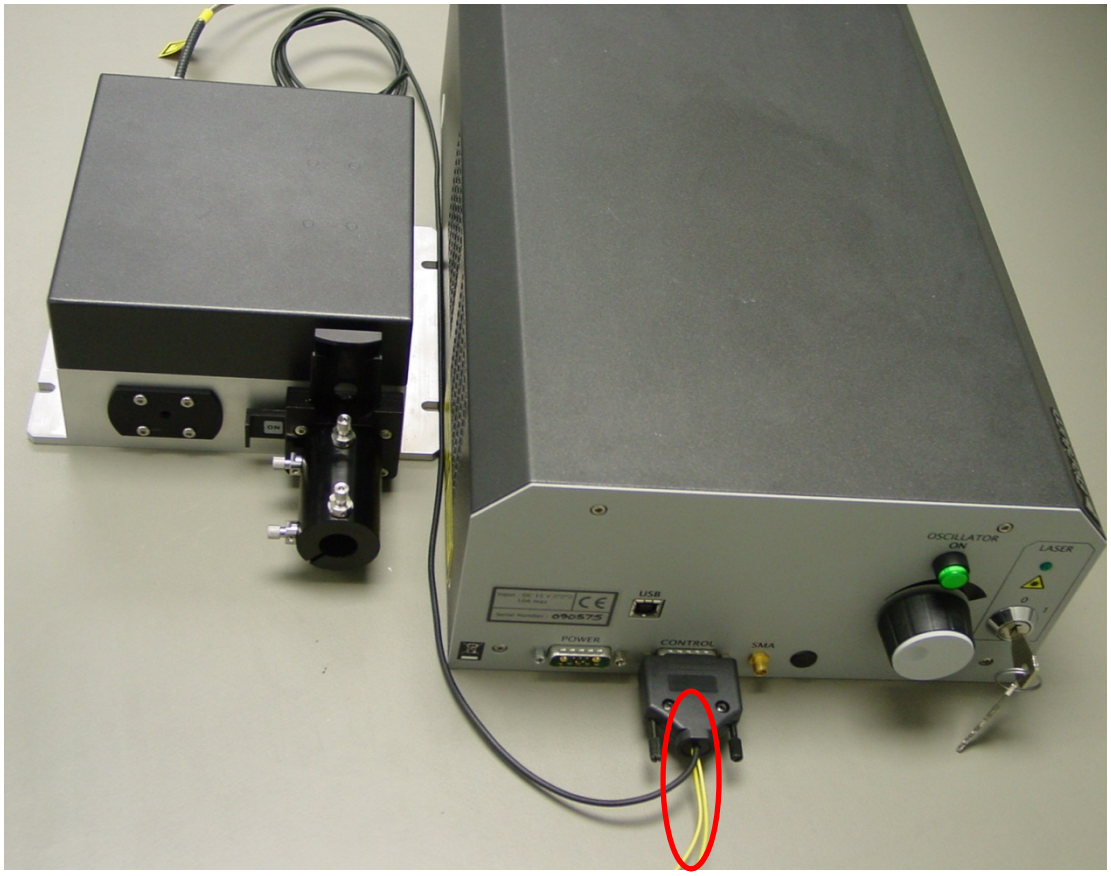
The output of the super-continuum laser should be inserted into the AOTF input as shown in Figure 7.1– the lens tube should click nicely in place, such that the orientation notch engages in the alignment block. Connect the interlock cable into the back of the AOTF (as shown in Figure 7.1).



7.1 Input lens tube alignment into the dual AOTF – the interlock is highlighted, as are the retaining screws for the laser lens tube – these should not need adjusting and are set for plug and play operation

If you wish to wire your AOTF interlock plug into an external system (into highlighted in Figure 7.2 and wire these into their external system. When using the AOTF interlock plug, the AOTF interlock cable is required to be connected to the AOTF housing (Figure 7.1) and the laser lens tube must be inserted into the AOTF input housing in order for the laser to turn on. If the SC laser lens tube is removed during laser operation, the interlock will be tripped and the laser will be shut off.

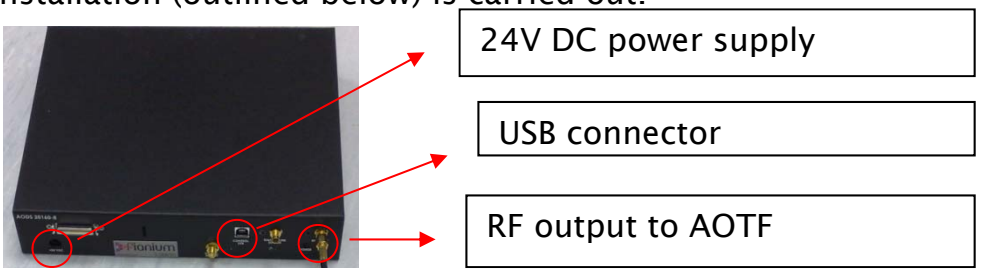
In order for the user to use the SC laser without the AOTF, the user must use the alternative laser interlock plug provided.



7.2 AOTF interlock cable and output ports of an AOTF unit. The red circle highlights the interlock flying leads that can be cut and wired into the users external interlock system (on a lab door for example).

Here, the setup will be described for the use of only one of the AOTF's in the dual AOTF system – if you have two RF drivers, repeat the setup procedure for the other AOTF crystal.

Attach an RF cable between the RF input port for the AOTF crystal (A, B or both if you have two RF drivers) that you intend to use and attach the other end of the RF cable to the AOTF driver. Connect the driver box to the computer using the USB cable provided and power up the RF driver using the power supply provided. Before connecting the driver to the computer for the first time, ensure that the software installation (outlined below) is carried out.



7.3 RF driver provided

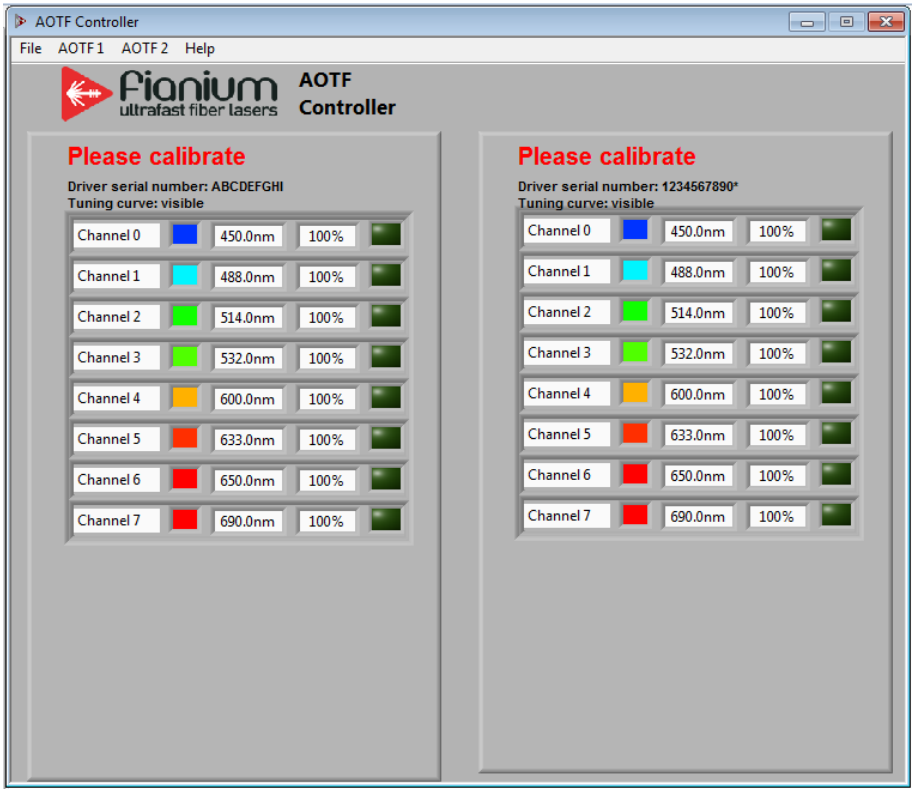
8. Using external filters on the output

The output of the unit is fitted with a removable housing that can hold commercially available filters that are 6mm thickness and 25mm diameter. To insert filters, lift out the filter housings from the mounts, place in your filters, and reinsert into the mounts. The filter housing can be placed in two positions, either out of the beam path (in the up position) or in the beam path (by pushing the filter housing down)

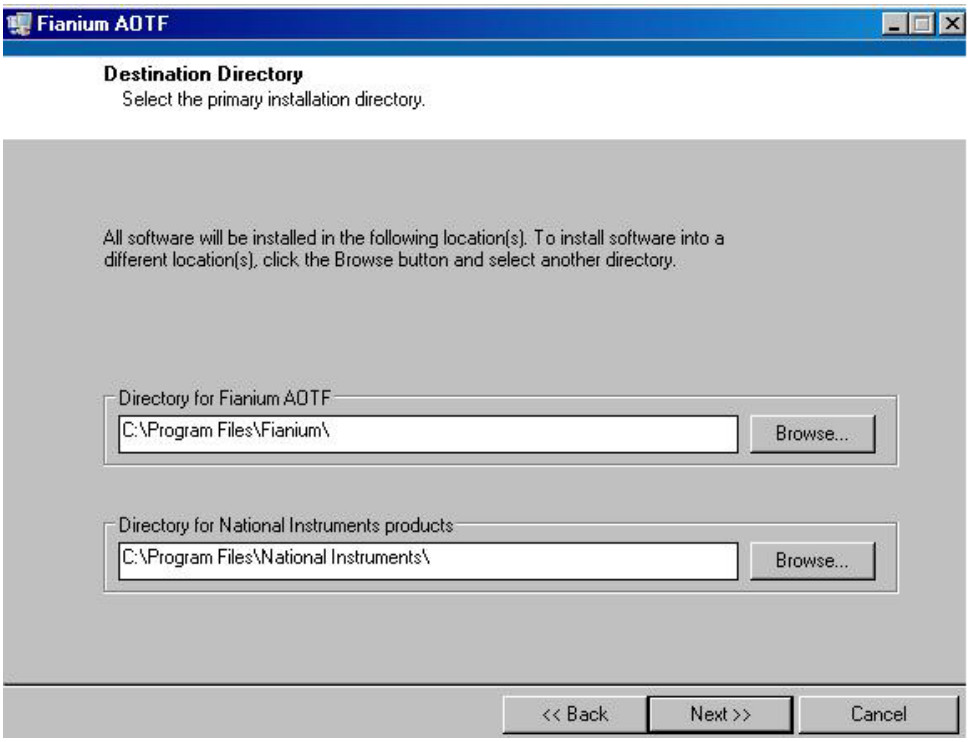
8.1 output filter holders. In this picture, both the filter housings are engaged so the filters have been placed in the optical paths.

9. Software Installation

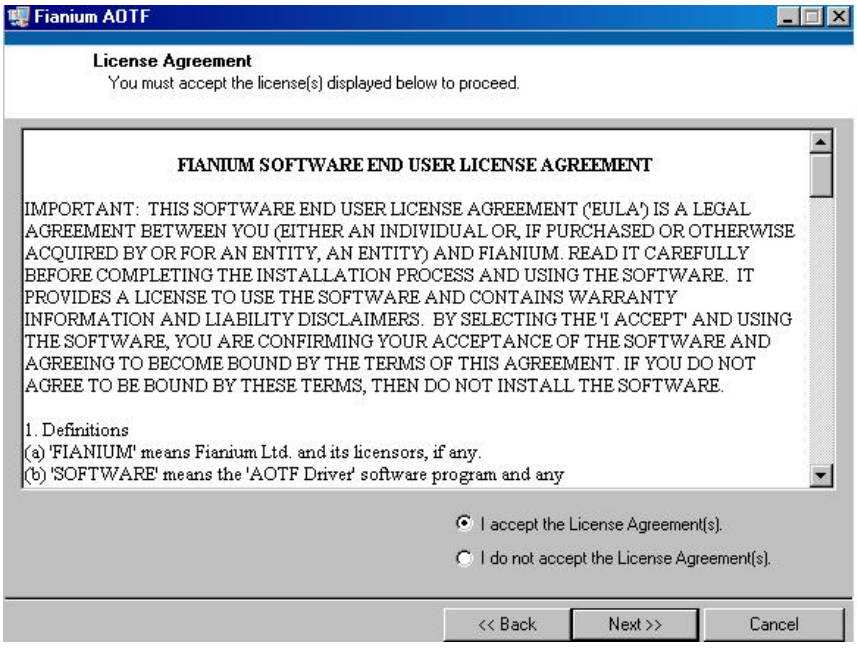
The dual AOTF GUI can be used to drive one or two drivers from a single user friendly graphical interface.



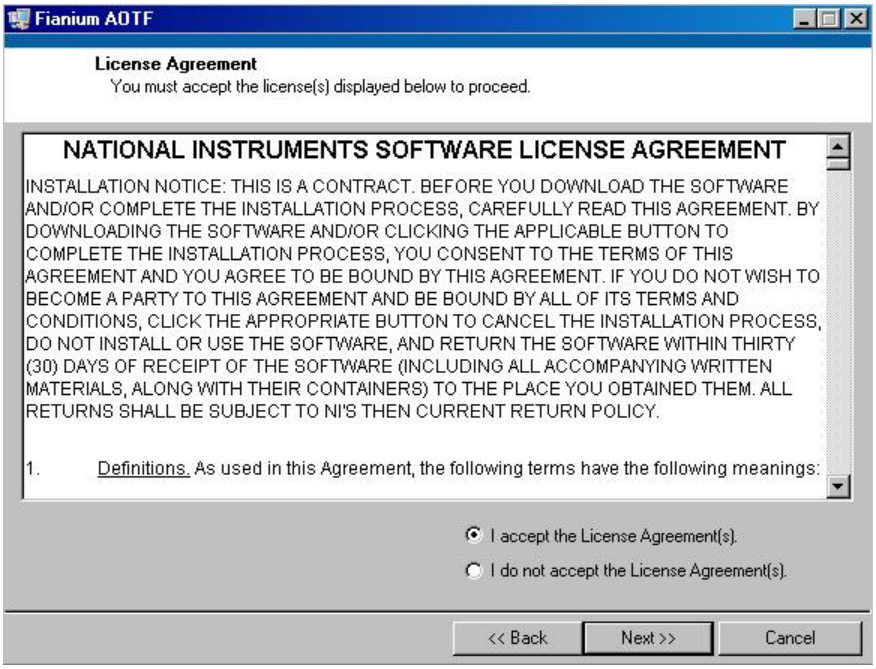
Copy the AOTF installer folder onto your desktop (or any other suitable location) and double click the 'setup.exe' file. The following prompt screens will appear – please select next.



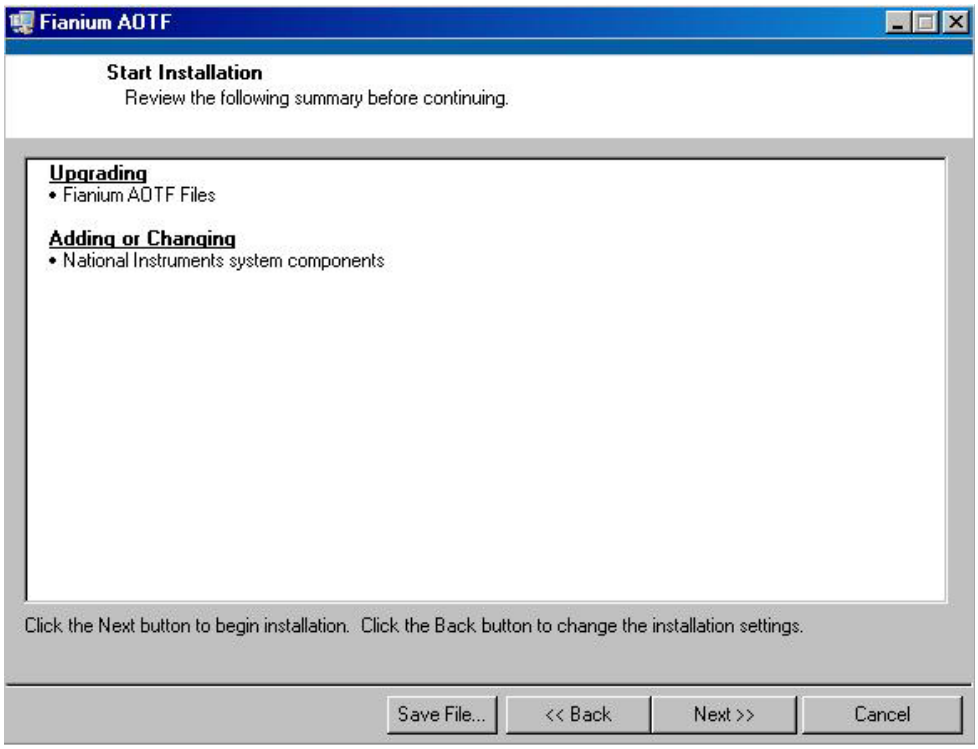
9.1 first prompt screen on the AOTF dual GUI installation.



9.2 second prompt screen on the AOTF dual GUI installation. Please accept the terms and conditions.



9.3 National Instruments terms and conditions – please accept.



9.4 Final screen on installation process.

9.1 Installation troubleshooting

If when connecting your AOTF driver to your computer for the first time the driver is not recognised by windows, please navigate to the AOTF driver in Windows device manager (control panel > system > device manager). Highlight the driver by right clicking it, and select update driver.

The USB driver can be found in C:\program files\Fianium\config files

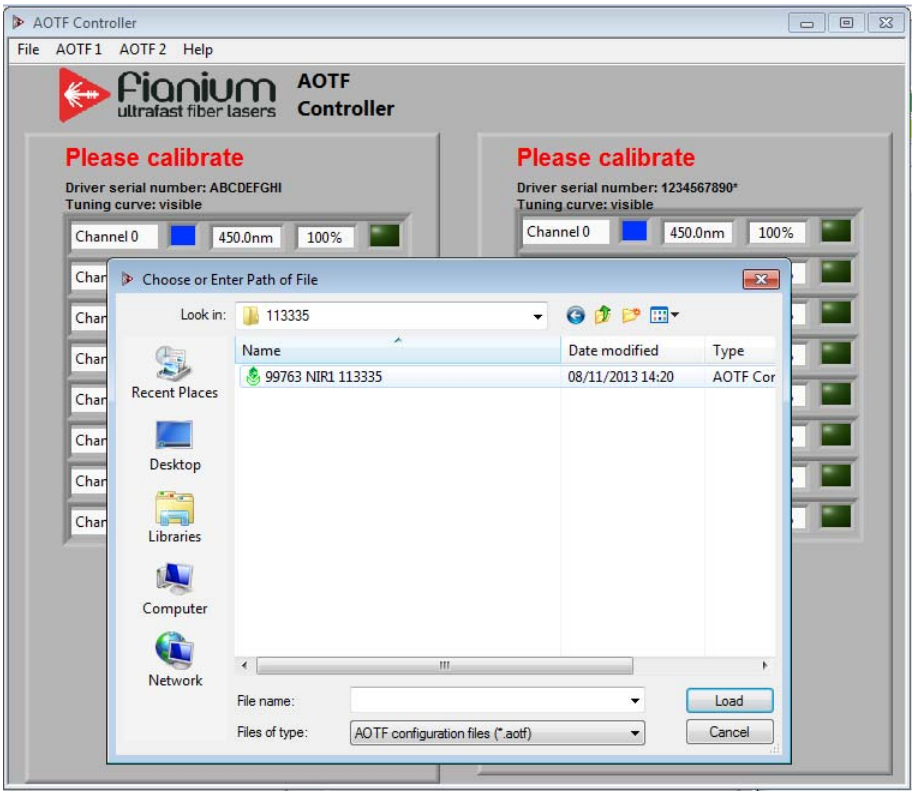
Navigating to this location should allow Windows to correctly locate the driver, and allow the computer to successfully communicate with the AOTF driver.

9.2 Calibration curves

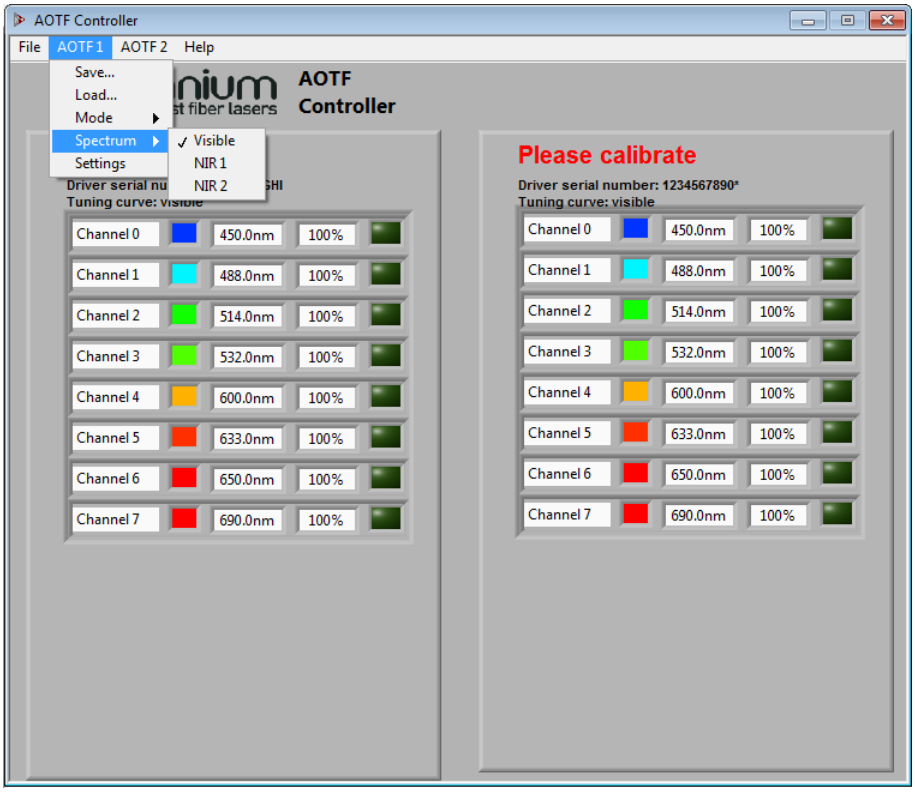
Finally, once you have installed the software, you will need to place the calibration curves for the AOTF crystals into an appropriate location such as the desktop.

9.3 Applying calibration curves

With the AOTF driver connected to your computer with the USB cable provided, and the power plugged in to the driver, double click the shortcut created on your desktop to open the dual AOTF controller GUI. The calibration curves must be applied to the AOTF's by using the "Load" button in the AOTF menus. Select the appropriate driver using the drop down menu, and navigate to the appropriate location to find the .aotf calibration files (see below) and select the correct file. Click apply and the calibration constants should be loaded into the driver constants under the relevant AOTF (Vis, NIR1 or NIR2). Once your calibration curves have been applied for both drivers, select ok. On the main display page, select the correct crystal for each driver (this is the AOTF to which the driver should be connected to).



9.5 applying calibration curves for each AOTF.

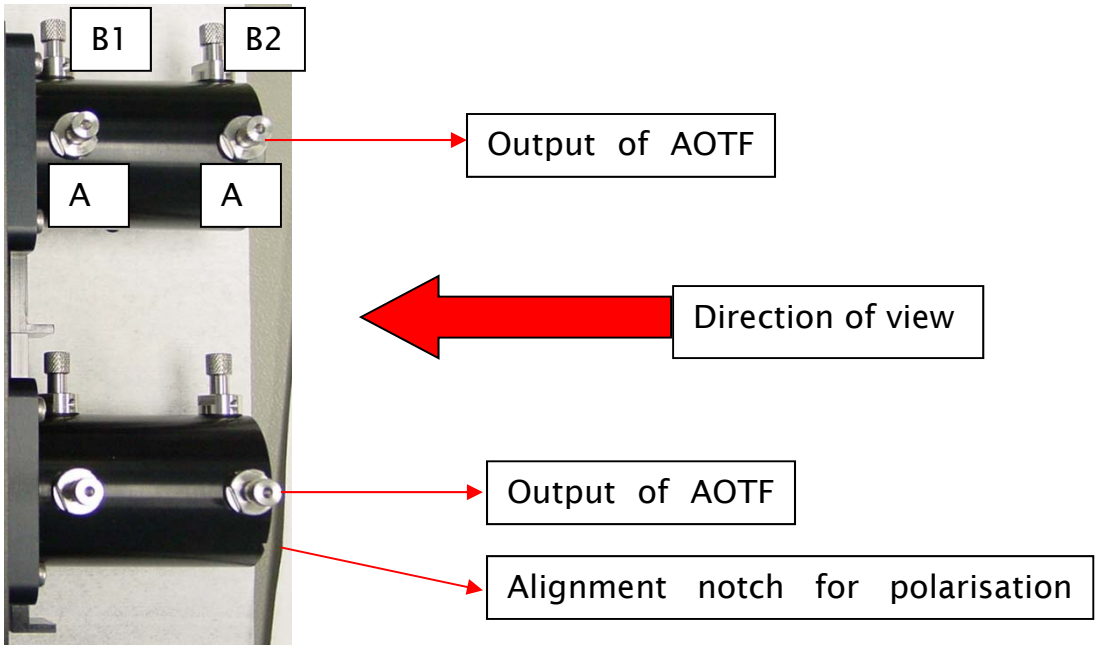


9.6 select the correct crystal for each driver.

For more information on using the Dual AOTF GUI, please see refer to Section 15

10. Dual AOTF Fiber Coupled System

Operation of the dual fiber coupled system is identical to that of the free space model described previously, except that rather than having a free space output for each AOTF, each beam line output is fitted with a manipulator, in which a fiber can be inserted in order to provide fiber coupled output from the AOTF.



10.1 fiber coupled outputs of the dual AOTF system. See Table 1 for the various configurations of AOTF's on beam lines A and B.

10.1 Fiber coupling the output of your AOTF – alignment

Depending on your system configuration, you may have been provided with two fibers (FDS's, or fiber delivery systems) which can be inserted into either manipulator A or B, depending on the fiber in question (note that poor fiber coupling will result if 'Fiber A' is coupled to the output of AOTF B (especially if the fiber is single moded)). Follow the setup procedure outlined above for the free space AOTF model, such that your wavelength of interest is output from the relevant output port when the channel is selected through the GUI. In order to achieve coupling to the fiber provided, shutter the manipulator and insert the fiber input lens tube (fitted with an alignment key) into the relevant manipulator, such that the alignment notch of the alignment ring fits into the alignment hole on the manipulator highlighted in Figure 10.1. Position the output lens tube of the fiber towards a power meter head (consider the laser safety implications) and open the shutter on the manipulator.

The notch alignment on the input lens tube of the fiber should be positioned into the hole on the manipulator in order to align the polarisation axis of the fiber to the polarisation axis of the AOTF output.

It is important to maximise the output power of the fiber, by adjusting the adjustor screws labelled A1/2 and B1/2 in Figure 10.1. The adjustor pins A1 and A2 change the vertical position and tilt of the lens tube, while B1 and B2 change the horizontal position and tilt. Move A1 and A2 clockwise (as viewed along the direction of the red arrow shown in Figure 10.1) together in order to scan the lens tube downwards, and B1 and B2 clockwise together in order to scan the lens tube to the left. Optimising the fiber coupling is an iterative

process that can take many cycles of vertical and horizontal adjustment – follow the guidelines below for maximizing the coupling efficiency:

- Adjust B1 by a ½ turn clockwise. Then adjust B2 by a ½ turn clockwise. If the output power is higher than before then the AOTF output and the fiber input are becoming better aligned in the horizontal plane. Continue walking the lens tube in this direction until you reach a maximum output.
- If the power is getting lower then repeat the process but this time turning the screws anti-clockwise.
- Now use the same walking process on screws A1 and A2.
- As you get closer to the optimum output you will find that you have to go from adjusting A1/2 to B1/2 and then back to A1/2.
- It may be necessary to adjust the position of the central spring pin in order to achieve the optimum position of the fiber lens tube (max output power). This can be done easily using your fingers to **rotate the pin, as appropriate.**

10.2 Using the fiber alignment tool

If using a fiber delivered AOTF, you should have been provided with a fiber alignment tool, which is a 50mm long tool with a pinhole located towards one end. If you are using a visible or NIR1 AOTF and absolutely no light can be detected to be coming out of the output lens tube of the delivery fiber (FDS), it may be necessary to check the rough position of the fiber lens tube with respect to the output axis of the AOTF. If so, please follow the following instructions:

1. Using the Dual AOTF GUI software, select a wavelength of 650nm and power of 20% for the AOTF. This should be sufficient for generating visible red light, which can be readily seen on a white card.
2. Remove the FDS lens tube from the output manipulator of the AOTF. Open the output shutter and shine the output onto a plain white card – red light should appear on the card. If so, shutter the output of the AOTF output. If no light appears from the AOTF when no fiber is present in the output manipulator (free space output operation), re check that the AOTF is correctly setup (laser, RF driver and RF cables).
3. Insert the fiber alignment tool into the manipulator, such that the pin hole is located furthest away from the AOTF. Open the shutter, and scan the alignment tool using A2 and B2 adjusts only iteratively to maximize the amount of red light exiting the pin hole.
4. Shutter the manipulator, remove the alignment tool, and reinsert it such that the pin hole is positioned closest to the AOTF unit.

5. 5 Open the shutter, and scan the alignment tool using A1 and B1 adjusts only iteratively to maximize the amount of red light exiting the pin hole.
6. Iteratively repeat instructions 3-5 to maximize the amount of light seen coming out of the alignment tool pin hole. This ensures a rough degree of co-alignment between the AOTF output and the position of the AOTF output manipulator.
7. Remove the alignment tool and reinsert the fiber input lens tube into the AOTF output manipulator. Unshutter the AOTF output and recheck the output of the fiber for optical alignment. Follow the instructions given at the beginning of this section for optimizing the fiber alignment for maximum power.

This alignment procedure may take some time, even for a skilled operator, depending on how far out the alignment of the fiber is from the AOTF output axis.

If using an NIR2 AOTF, since the lowest wavelength achievable is ~1100nm, the above white card procedure will not work. Even substituting the white card for an IR card is unlikely to work, since the minimum IR power required for the IR card to fluoresce maybe be too high to allow the coarse alignment. Thus, this alignment procedure is best performed using an accurate IR power meter, capable of recorded nanowatts or microwatts of IR radiation.

If after following this alignment procedure no output power from the fiber can be achieved, please contact Fianium Support.

10.3 Maximising power from the fiber

The RF drive power per channel can be set to any level between 0 and 100%. **To achieve maximum diffraction efficiency, the optimum drive conditions are typically between 20-40%.** The RF drive power adjusts the efficiency of the AOTF for a given wavelength, providing a means of power control up to a certain level, when the RF signal saturates the AOTF. When this limit of diffraction efficiency from the AOTF is reached, increasing the RF drive power of the AOTF can cause the output of the AOTF to degrade in a number of ways, including:

- Broadening of the spectral profile of a given channel.
- Reduction in the beam quality of the deflected beam, which will result in a degradation of coupling efficiency into a fiber.
- Reduction in the output power of the AOTF despite an increase in the RF drive power.

Once the fiber alignment has been set according to the guidelines provided above, the drive power should be adjusted in order to ensure that AOTF crystal is not being over driven. With the output of the fiber directed onto a power meter head, change the RF drive power in steps of 1 or 2% to see whether the fiber output power increases. Typical

optimal RF drive powers for a fiber coupled system will have been given to you in the characterization data provided with your AOTF.

11. Free space and Fiber Coupled Single AOTF units

This section will briefly explain the main differences between the dual and the single AOTF units. The operating procedure is identical to that of the dual system that has already been covered, but only one AOTF is fitted inside the metalwork. The AOTF is positioned along beam axis B (see Figure 6.1), so the AOTF is addressed by the RF driver using the RF port B. The free space operation will involve radiation exiting from output port B, whilst fiber coupled operation will involved fiber coupling to a manipulator place on port B. If requested on your AOTF order, a white light output can be selected along beam line A if required, and again this beam line can be delivered in free space or it can be fiber coupled.

12. High Power AOTF system

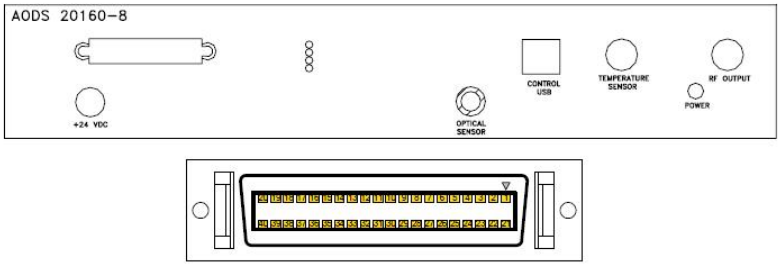
This section will outline the use of the HP AOTF – this has a single beam path that can be delivered in free space or via fiber delivery, such as that shown in Figure 12.1. Connect the driver(s) to the port(s) on the AOTF module and load the Dual AOTF GUI.

12.1 - HP AOTF module.

13. AOTF channel modulation

For applications requiring high-speed channel switching, an external modulation feature is provided with the AOTF driver. This feature enables the modulation of the AOTF channels at speeds much higher than those obtainable through the USB interface.

The amplitude of the AOTF channels can be modulated using external signals supplied to the 40-way MDR connector located on the front panel of the driver. Use the supplied MDR plug to feed signals to the AOTF driver. The figure below shows the pin layout of the MDR connector.

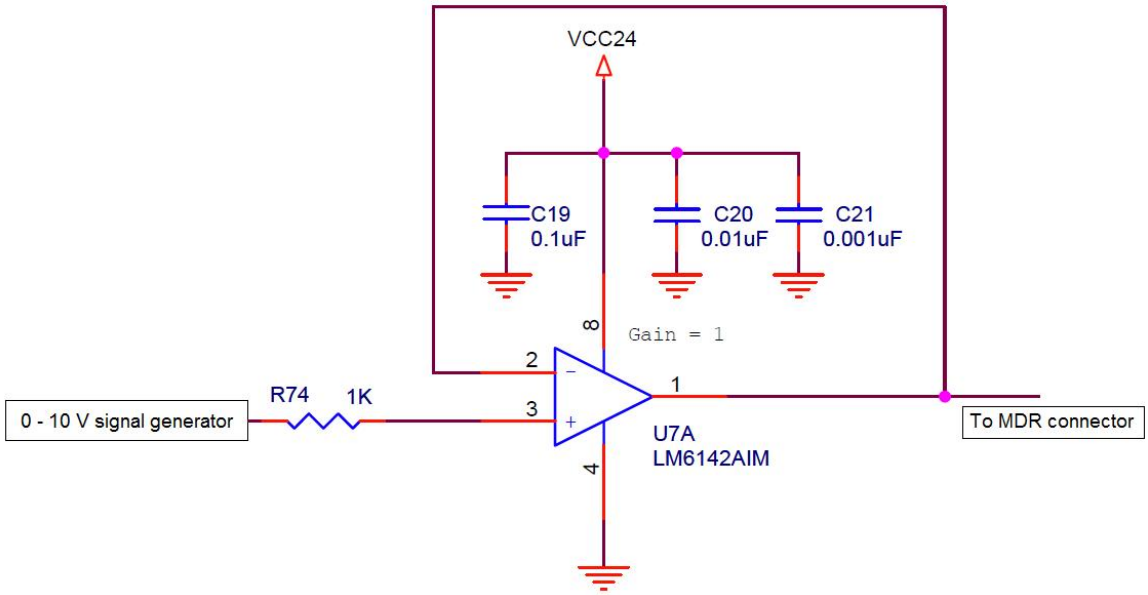


Modulation and FSK/Blank Connector Pin out

Pin	Function	Direction		Description	Pin	Function	Direction	
1	VCC24	-	-		21	VCC24	-	-
2	VCC24	-	-		22	GND	-	-
3	GRD	-	-		23	FSK1	-	-
4	GND	-	-		24	FSK1	-	-
5	GND	-	-		25	FSK2	-	-
6	GND	-	-		26	FSK3	-	-
7	GND	-	-		27	FSK4	-	-
8	GND	-	-		28	FSK5	-	-
9	GND	-	-		29	FSK6	-	-
10	GND	-	-		30	FSK7	-	-
11	GND	-	-		31	BLANK	-	-
12	GND	-	-		32	GRD	-	-
13	MOD 0	-	-		33	MOD 0+	-	-
14	MOD 1-	-	-		34	MOD 1+	-	-
15	MOD 2-	-	-		35	MOD 2+	-	-
16	MOD 3-	-	-		36	MOD 3+	-	-
17	MOD 4-	-	-		37	MOD 4+	-	-
18	MOD 5-	-	-		38	MOD 5+	-	-
19	MOD 6-	-	-		39	MOD 6+	-	-
20	MOD 7-	-	-		40	MOD 7+	-	-

The modulation input is analogue. Applying a voltage of 0 V to the input of a certain channel will set the channel amplitude to 0 (effectively switching off the channel). Increasing the input voltage to 10 V will result in increasing RF power being applied to the respective channel. 10 V will correspond to full RF power.

To modulate channels 0 – 7, the user needs to supply positive voltages to pins 33 – 40. The return connections for each channel should be applied to pins 13 – 20 (see figure above). The input impedance of the modulation inputs is 4.3 KOhm. If the user's signal generator requires higher impedance, a buffer circuit can be built between the generator and the driver. Refer to the circuit diagram below for a suggested buffer circuit.



The rise time of the modulated signal is 1.24μs, limited by the spot size on the AOTF and the velocity of the acoustic waves inside the crystal.

Using the external modulation features requires enabling the daughter card on the driver. The daughter card is controlled by the DAU function, issued on the driver's control panel (provided as an application on the installation CD). Below is a reference guide for the DAU command.

DAU:

- DAU EN – enables the daughter card. At this point, the RF power on each channel is controlled by the voltage applied at the corresponding pin on the MDR connector. The values set in the control software will be ignored.
- DAU DIS – disables the daughter card. The RF power on each channel is controlled by the control software. Input levels into the external modulation connector will be ignored.

CAUTION: The modulation pins are pulled up internally. Leaving the pins to float while issuing the DAU EN command will result in full RF power being applied to all channels. Before using the external modulation, make sure that pins 33-40 are connected to a known (preferably zero) voltage.

14. Using the FSK functionality

The FSK functionality allows 2 preset profiles to be saved for each of the 8 channels of the DDS driver. Using external modulation and TTL triggering it is possible to control both the RF drive power for each profile (and thus the optical power for a given profile) and toggle

between each of the two preset states per channel. External control is via the 40 way MDR connector on the front of the RF driver shown above.

Channels are labelled from 0 to 7 (8 channels in total). Controlling the RF drive power is performed by way of the voltage applied between the mod0 to mod7 pins labelled in the above diagram. For example, to adjust the RF drive power applied to channel 0 we apply a voltage between pins 13 (ground) and 33 (positive). The RF drive modulation is analogue, and in its default state the driver operates on a 0 to 10 volt analogue scale, where 0V corresponds to an external RF drive power of 0 and 10V to 16383 (2^14-1). Toggling between preset states is performed by applying TTL signals (3.3V) between pins 23 and 30 and pins (positive) and the grounding pin 32.

To enable FSK functionality, we must first load the preset states per channel into the driver. To do this we must know the RF drive frequency for the wavelengths of interest. Once these RF drive frequencies have been determined, they must be fed into the driver using the following set of commands. In this example, profiles 2 and 3 of channel 0 are preset to 90MHz and 120MHz respectively:

Dau en

DDS fsk 0 3

DDS F -p0 0 90

DDS F -p1 0 120

Dau dis

Now the RF drive power is determined by the analogue voltage, and profiles p0 and p1 can be toggled by means of TTL on FSK0 pin23.

For more information on FSK please contact Fianium Support.

15. Dual AOTF GUI functionality

15.1 Basic functions

The drivers are controlled using the front panel – the wavelength for each channel can be selected, the intensity changed, and the channel selected and deselected using the green tab. Each AOTF will only work within its relevant wavelength range.

The RF drive power per channel can be set at any level between 0 and 100. The RF drive power adjusts the efficiency of the AOTF for a given wavelength, providing a means of power control up to a certain level, where the RF signal saturates the AOTF and the resulting channel spectrum becomes distorted. When this limit of diffraction efficiency is reached, increasing the RF drive power of the AOTF can cause the output of the AOTF to degrade in a number of ways, including:

- Broadening of the spectral profile of a given channel.
- Reduction in the beam quality of the deflected beam (resulting in a degradation of coupling efficiency into a fiber, for example)
- Reduction in the output power of the AOTF despite an increase in the RF drive power.

Because the AOTF diffraction efficiency is a function of wavelength (varies as the inverse square of the diffracting wavelength), the RF levels need to be calibrated to meet the application requirements. Typical operating RF drive powers and the resulting optical powers from the AOTF recorded over a range of wavelengths is provided with the AOTF in the characterisation data.

Typically, the maximum efficiency is achieved at ~20-40% of the maximum RF power of the driver, and so 30% is the default intensity. Since each AOTF crystal is unique, please check the characterisation data sent with the AOTF to ascertain the appropriate values.

At any time, if the wavelength and power settings within the GUI need be saved, this can be achieved by clicking the “Save” option on the AOTF drop down menu. If previously saved setting need be restored us the “Load” function on the AOTF drop down menu.

Using the file>exit will turn off any channels from the AOTF’s and shut down the program.

15.2 Scan, demo and playback modes

The scan function allows the user to scan a given channel between two wavelengths using a specified scan rate and wavelength step. These

setting are specified on the configuration option of a given AOTF. The demo function allows the user to cycle through all 8 channels for a given AOTF at a specified scan rate. The minimum dwell time for any given step is 1 second (this is limited by the response rate of the driver in USB control mode).

The playback function allows a user to program a sequence of channel switches, and introduces a loop function so the sequence can be repeated indefinitely. The '.play' text file to use for playback mode is selected on the configuration dialog and are placed in the config folder. Use the shortcut '(control + F2)' to open the relevant folder for the 'play files.

The following functions may be used in the '.play' text files.

Wait(n): where 'n' is in seconds

Active(bbbbbbbb) : where 'b' can be 0 (channel off), 1 (channel on), x (no change) with order (CH8….CH1)

Channel(a,b,c): where 'a' is the channel, 'b' is the wavelength in nm, 'c' is the power in % of full power

Loop(x): where 'x' is the line number

e.g.

wait(2)

active(111X0011)

channel(6,480,30)

loop(1)

15.3 Command line

To control a given AOTF directly without the use of the calibration curves, the command line controller can be found under Tool>debug. Note that the driver will require RF drive frequencies rather than wavelengths. For more information on how to address the drivers using the command line please contact support@fianium.com.

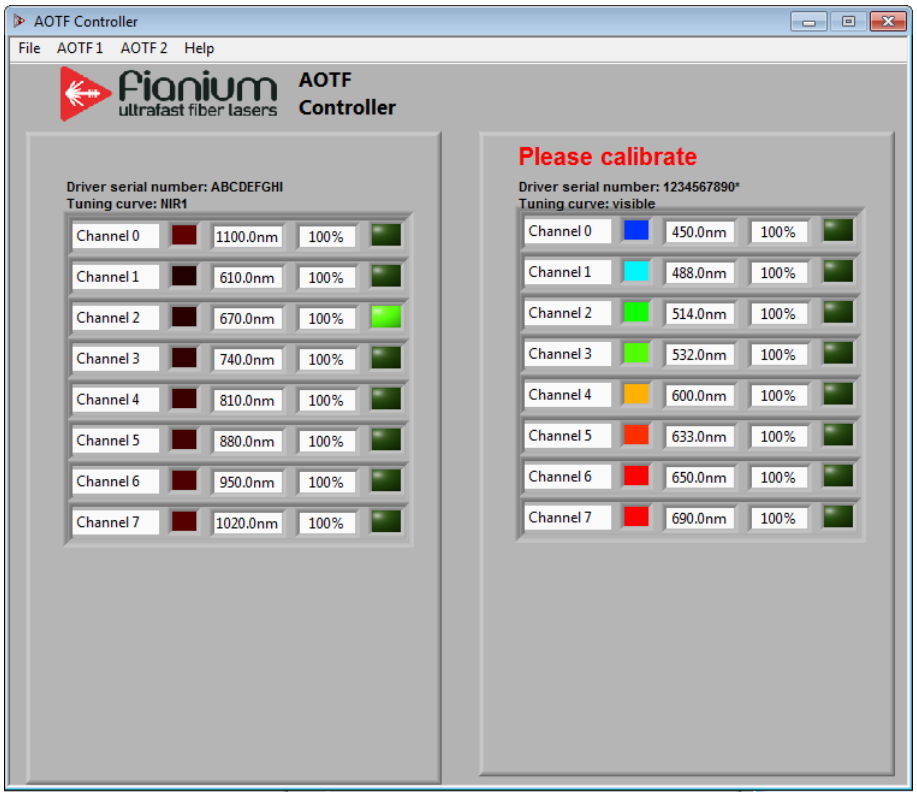
15.4 External modulation

The section will explain by way of example how a user would use the Dual AOTF GUI to setup the external modulation of channels. Let us presume a user has a visible AOTF and wants to use the GUI to setup external modulation on channel 2, at a wavelength of 670nm and an optimum drive power of 100%:

1. Load software and calibration constants for driver.

2. Type your 670nm and 100% into software.

3. Return to main screen and turn on channel: Debug screen – type dau dis – now the RF drive power will be calculated by (30/100*(modulation voltage/10))



4. Channel 2 is now turned on (with optimal power) and off by providing 10/0V across relevant modulation pin (please see section IX for pin identities). This means there is actually no need for analogue modulation at all, and all RF drive powers can be set in software and the external modulation simply used to turn channels on and off (digital modulation).

5. Note that the command "DAUGHTER GAIN * 36" applies for 0-10 VDC range for input modulation voltage. Below is a reference for some other common modulation schemes:

For modulation 0-1: DAUGHTER GAIN * 255

For modulation 0-5: DAUGHTER GAIN * 72

For modulation 0-10: DAUGHTER GAIN * 36

16. Appendix

16.1 How to get in contact with us

Fianium Support can be contacted via: support@fianium.com. Direct dial: +44 (0)2380 450408

Sales can be contacted via: info@fianium.com. Direct dial: +44 (0) 2380 450409

16.2 Trouble Shooting Guide

1. **Problem:** I can't get the any light in the blue region of the spectrum from the output of my visible AOTF, but I can see red light when I select it?
   Answer: Your laser isn't turned up to a high enough power for the spectrum of the supercontinuum output to have spread into the blue region of the spectrum.
2. **Problem:** There is no power deflected out of the AOTF when I have selected a channel in the GUI.
   Answer:
   - Enable or maximise the modulation in the GUI you are using.
   - Check the RF connection between the RF driver and the AOTF.
   - Check that your super-continuum (SC) laser is turned on, and that it is outputting power into the AOTF unit.
   - Ensure the shutters are open on the input and output sections of the AOTF.
   - Check that the power of your SC laser is high enough to achieve the wavelength you have selected.
   - Check that the wavelength or RF frequency selected is suitable for the AOTF unit that you are attempting to drive.
3. **Problem:** I am having problems with the power of the output beam of my AOTF – it is much lower than that specified in the characterisation data provided.
   Answer:
   - Ensure your laser is turned up to its highest power setting.
   - Ensure the RF drive power has been optimised in the GUI.
   - If you are looking at the fiber coupled output power, re-optimise the fiber coupling alignment.
   - If using a visible or an NIR1 AOTF, select a drive frequency in the AODS GUI of 90MHz and inspect the output beam in free space (remove the fiber) using a white card. If the beam looks extremely weak the alignment inside the AOTF unit may have drifted in transit, resulting in the clipping of

the output beam through the aperture. **Contact Fianium Support for adjustment instructions.**

4. **Problem:** although the free space power output from the AOTF is okay, the fiber coupled power is very low.
   Answer:
   - Compare your recorded values to those on your characterisation data sheet.
   - Ensure you are not overdriving the AOTF – try turning the RF drive power down to see if the fiber coupled power increases.
   - Ensure the fiber is correctly aligned to the AOTF output axis.
5. **Problem:** I would like to externally modulate between preset channels using analogue signals applied to the MDR connector.
   Answer: See the AOTF channel modulation section below.
6. **Problem:** I have only very limited movement on the adjustor screws on the fiber coupled manipulators.
   Answer: Move the spring pin in our out, as this may be limiting the degree of motion, or not providing enough force to push the lens tube onto the adjustor screws.
7. **Problem:** even having followed all the alignment procedures outlined in this manual I still have problems with the output of the AOTF.
   Answer: Contact Fianium Support.

17. Customer Service

In the unlikely event of a malfunction within your system, contact Fianium Ltd for onsite diagnosis or return (support@fianium.com).

If the product is to be returned to Fianium, ensure that all relevant return documentation is included within the shipment. Details of the documentation required can be obtained from Fianium Ltd.

The system source should be returned within the original packaging and include all accessories and documentation as originally delivered in order to prevent damage to the product during transport. If the original packaging is unavailable, please contact Fianium Ltd for a replacement

End of document