

General Purpose Optical Bench with External MCT Detector Accessory

PerkinElmer Frontier IR Systems, Spectrum 400 Series and Spectrum 100 Series instruments can be fitted with a General Purpose Optical Bench. The optical bench is supplied with a parabolic mirror assembly, an external MCT detector and a pre-amplifier module. The optical bench is bolted to the external accessory bracket, which is fitted in the handhold on the right of the instrument. The accessory uses the external beam port with an attenuator attached.

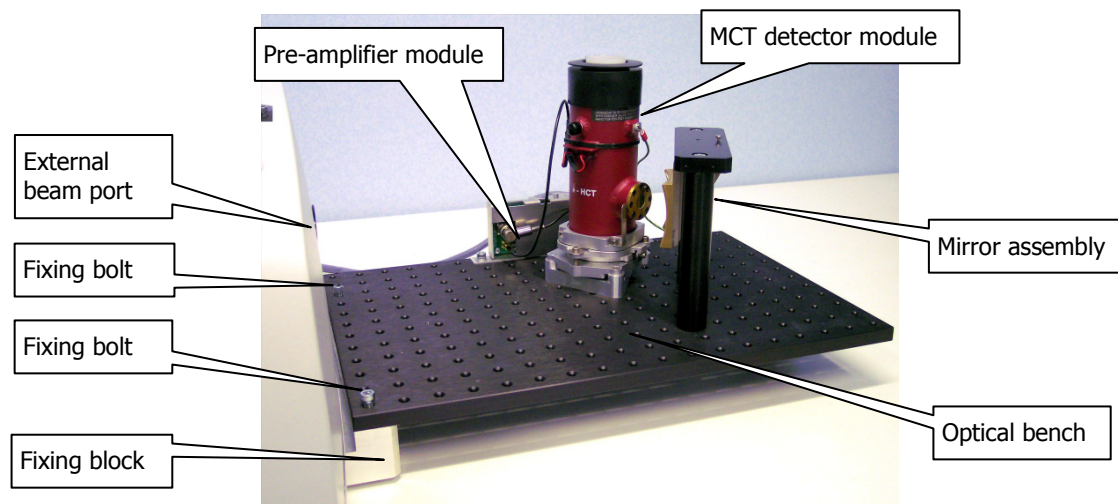


Figure 1 General Purpose Optical Bench with external MCT detector

This document describes how to:

- Install a window in the right hand external beam port;
- Fit, and remove, the optical bench;
- Fit the mirror, detector and pre-amplifier modules to the optical bench;
- Configure Spectrum software to use an external detector;
- Use Spectrum software to select the accessory;
- Optimize the performance of the detector/pre-amplifier;
- Connect another type of detector/pre-amplifier to the instrument.



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Produced in the UK.

Warnings and safety information

Electrical safety

Fitting the external beam port window requires you to open the main cover of the spectrometer.



WARNING

Switch off the mains power supply to the spectrometer, wait 60 seconds, and disconnect the power cable before you open the cover of the spectrometer. This makes sure that you are safe from electrical shock and laser radiation.

CAUTION

Some components when mounted on the optical bench may need to be connected to instrument earth. Connect earth leads to the underside of the optical bench at a position in the 3 x 3 block of mounting points in the far right corner, where the anodized surface of the underside of the bench has been removed. No other position is suitable.

The pre-amplifier module is powered by the instrument; no separate power supply is required. The instrument has no provision for powering any other component. If necessary, you must provide a separate power supply and ensure that the arrangement meets all the applicable safety standards.

External electromagnetic interference and electromagnetic compatibility

CAUTION

Disconnection of a protective earth terminal could damage the pre-amplifier or detector.

The General Purpose Optical Bench with External MCT Detector accessory is supplied for use as an experimental test bed. The user-configurable nature of this product means that PerkinElmer cannot guarantee the level of immunity to external electromagnetic interference (EMI) or the possibility that the product may itself cause interference to other nearby equipment. It is therefore the responsibility of the user to consider Electromagnetic Compatibility (EMC) issues when selecting a suitable site for the system and to install any additional EMC protection that may be required for that location.

Radiation emitted by the instrument source

Do not direct the full energy of the source onto the external MCT detector. The detector could be permanently damaged.

CAUTION

Cover the external beam port using one of the supplied filters to attenuate the beam to a level appropriate for your experiment. When no strongly absorbing sample is present, use the MIR source with the 4%T filter, or the NIR source with the 1%T filter.

The NIR source used in PerkinElmer Frontier FT-NIR, Frontier FT-IR/FT-NIR, Spectrum 100N FT-NIR, and Spectrum 400 FT-IR/FT-NIR spectrometers is a quartz halogen bulb that emits ultraviolet, visible and infrared radiation. The majority of this energy is in the infrared region. Do not stare into the beam produced by this bulb. For further safety and warning information, refer to the appropriate User's Guide for your instrument. These are distributed, as .pdf files, on the IR & Raman Manuals CD (L1050002).

CAUTION

Liquid nitrogen

The external MCT detector module is cooled using liquid nitrogen. Before use, ensure that an appropriate risk assessment has been carried out.



WARNING

Liquid nitrogen can cause severe cryogenic burns. Skin can adhere to cooled surfaces, and then tear when removed. When handling liquid nitrogen, follow all the applicable personal protection protocols defined for your site, especially for eye protection. Minimize the possibility of skin contact.

Never use liquid nitrogen in a poorly ventilated area. A liter of liquid nitrogen evolves to 700 l (approximately 25 cubic feet) of nitrogen gas, which can cause oxygen depletion in an enclosed space. The cold vapor can pool at floor level. Oxygen depletion does not trigger a gasping reflex, and errors of judgment, confusion or unconsciousness can occur in seconds and without warning.

Consider proper actions in the event of accidental spillage. This could include immediate evacuation of the area. Do not attempt to pick up any cold or dropped equipment until the liquid and evolved gas has cleared.

Humidity

CAUTION

Never remove the window in the external beam and leave this port open to atmosphere. If the spectrometer is fitted with KBr or CsI optics, do not exchange the window if the humidity is >45% relative humidity.

The humidity sensitive optics will be damaged if subjected to a relative humidity in excess of the specified level.

Contamination

CAUTION

Be careful not to touch, or otherwise contaminate, sensitive optical components such as the parabolic mirror assembly.

These precision optical devices are easily scratched and may not be easy to clean.

Safe handling



WARNING

The spectrometer is a heavy precision instrument, so two people are required for safe handling.

CAUTION

Do not attempt to lift the instrument, or to move it to another location, when the optical bench, or any other external accessory, is attached.

The optical alignment of the external accessory bracket may be disturbed.

Fitting and removing the optical bench

In the first instance, the General Purpose Optical Bench is installed by a PerkinElmer Service Engineer, who will install: a right-hand beam moveable mirror and any other internal parts required; and an external accessory bracket in the handhold on the right of the instrument (if not already fitted). This external accessory bracket should not be removed.

For Frontier IR Systems, these components form part of the External Beam Path Kit which provides support for a wide range of external beam accessories. See the User's Guide supplied with your instrument for details.



Figure 2 Handhold with external accessory bracket fitted

The optical bench should not be removed unless:

- You want to use the external beam port on the right of the instrument with a different external accessory;
- The spectrometer must be moved to a new location.
For information about moving your spectrometer, refer to the appropriate User's Guide for your instrument. These are distributed, as .pdf files, on the *IR & Raman Manuals CD* (L1050002).

Before you begin, make sure you have read and understood the *Warnings and safety information* beginning on page 2.

Fitting a window in the right-hand external beam port

NOTE: The External Beam Path Kit for Frontier IR Systems includes left-hand, right-hand, and rear (external input beam port) windows. All three will be installed, in the first instance, by a PerkinElmer Service Engineer.

1. Switch off the spectrometer, and then remove the power cable.
2. Undo the locks on the front of the spectrometer, and then open the main cover.
For detailed instructions, refer to the appropriate User's Guide for your instrument. These are distributed, as .pdf files, on the *IR & Raman Manuals CD* (L1050002).
3. Using the hexagonal wrench supplied, slacken and remove the M2.5 screws securing the right hand external beam port cover to the main cover.
4. Remove the beam port cover and seal. Retain for further use.

5. Ensure the seal is fitted to the window and is correctly seated (Figure 3).

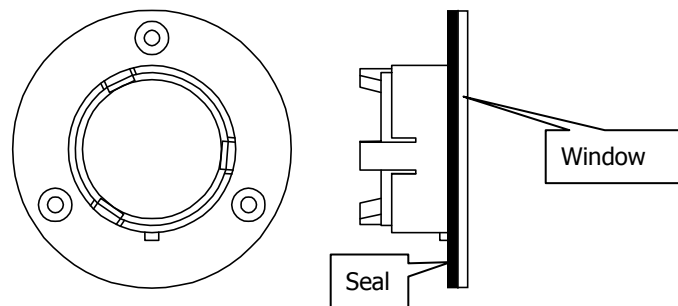


Figure 3 Seal fitted to window

6. Fit the window to the main cover from the outside in.
Ensure the seal is fully seated and the key on the window lines up with the notch in the main cover.

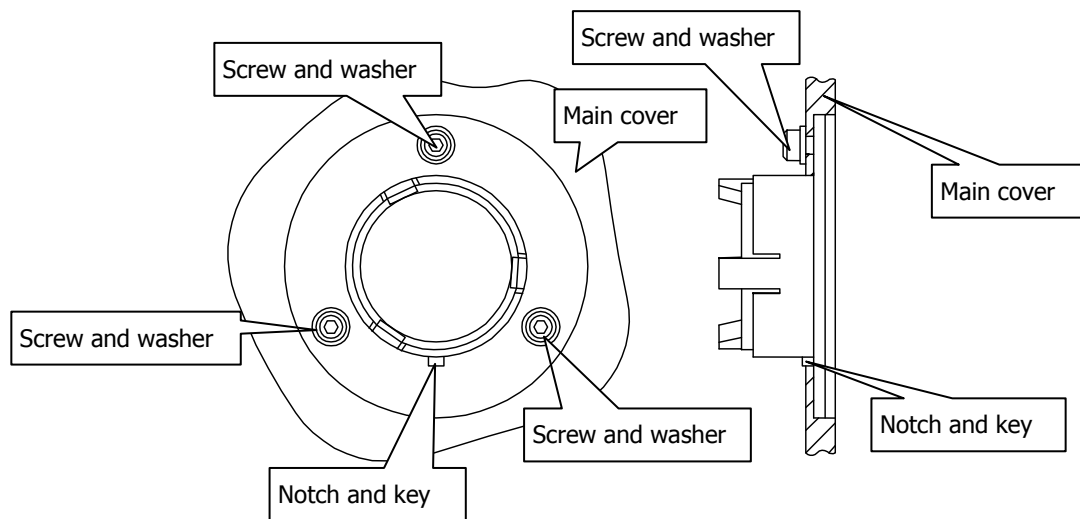


Figure 4 Window installed in main cover

7. Secure the window to the main cover by fitting the screws and washers and tightening the screws using the hexagonal wrench (Figure 4).
8. Close and secure the main cover.
9. Plug in and switch on the instrument.

Fitting the optical bench

Before you begin, make sure that:

- The instrument's external beam port is fitted with a suitable window;
 - There is at least 500 mm (18 inches) of free bench space to the right of the instrument;
 - An external accessory bracket is fitted in the handhold on the right of the instrument;
 - The spectrometer is switched off and disconnected from the power supply.
1. If necessary, remove the fixing block from the underside of the left edge of the optical bench. Use a suitable hexagonal wrench to undo the two M6 socket head bolts from the threaded fixing positions at the near left and far left corners of the optical bench until the fixing block is free.
 2. Place a spring washer and then a plain washer on each bolt, push the M8 bolts supplied through the plain holes in the fixing block, and then carefully align the bolts with the threaded holes in the external accessory bracket.

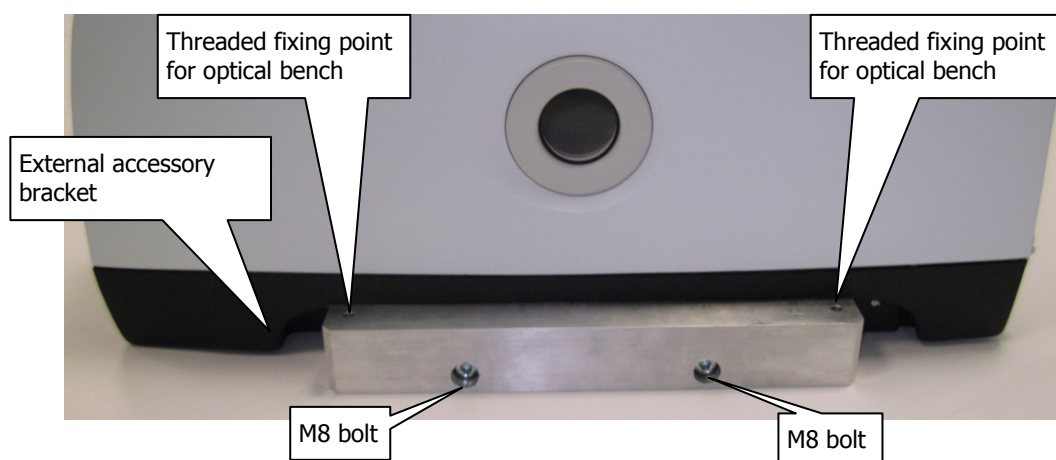


Figure 5 Attaching the fixing block to the external accessory bracket

3. Use a 6 mm hexagonal wrench to turn each bolt until it engages in the external accessory bracket, make sure the bolts are perpendicular to the bracket, and then carefully and evenly tighten the bolts.

NOTE: If these bolts engage incorrectly, the accessory may be misaligned or its fixings damaged.

4. Screw the two M6 socket head bolts into the threaded fixing positions at the front left and back left of the optical bench, as shown in Figure 6.

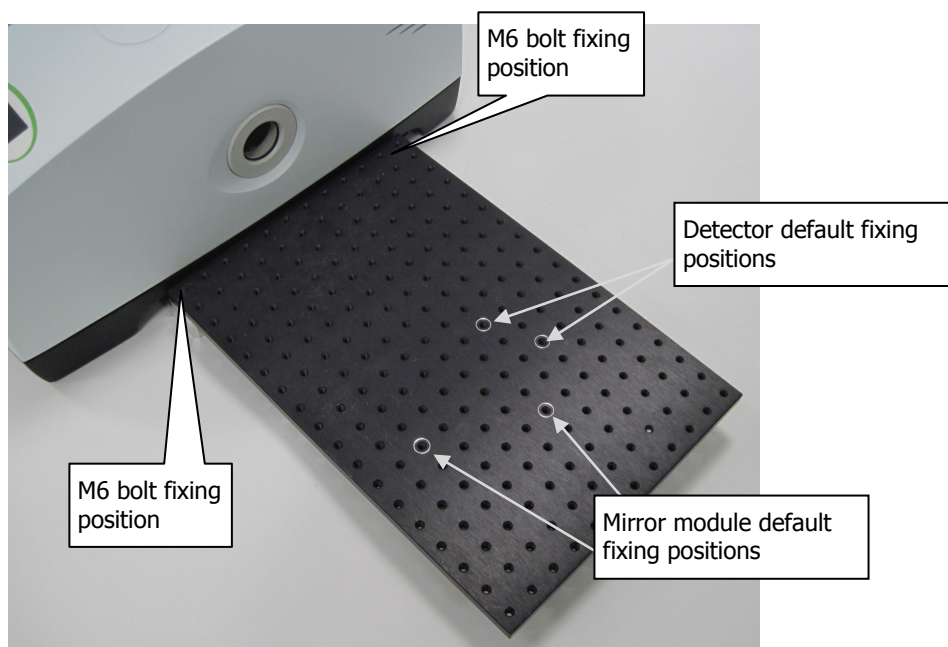


Figure 6 Bench fitted to fixing block

5. Align the optical bench with the fixing block, and then carefully and evenly tighten the bolts.

NOTE: If these bolts engage incorrectly, the accessory may be misaligned or its fixings damaged.

6. Place the 1%T attenuator over the external beam port.
The attenuator attaches to the external beam port magnetically.
This step avoids any inadvertent damage to the external detector.

Removing the optical bench

Before you begin, make sure that:

- The spectrometer is switched off and disconnected from the power supply;
 - All the components associated with the optical bench are disconnected from the spectrometer, and that no component is powered.
1. Use a hexagonal wrench to carefully and evenly undo the two M6 socket head bolts from the threaded fixing positions at the near-left and far-left corners of the optical bench until the bench is free of the fixing block.
 2. Lift the optical bench off the fixing block and carefully place it to one side.
 3. Using a 6 mm hexagonal wrench, undo the two M8 socket head bolts that attach the fixing block to the external accessory bracket.
The fixing block is attached to the external accessory bracket using two M8 socket head bolts, two plain washers and two spring washers.
Do not attempt remove the accessory bracket itself.

It may be convenient to refit the fixing block to the optical bench for safe storage.

Fitting the detector, pre-amplifier and mirror modules

Both modules are fixed to the optical bench using M6 bolts. The default fixing positions for the pillars are marked on the optical bench; see Figure 6.

CAUTION

Take care not to touch the detector window or any of the circuit-board components of the detector/preamplifier module, as they may be damaged by static electricity.

Detector module

1. Bolt the detector module sub-base to the optical bench using two M6 bolts.

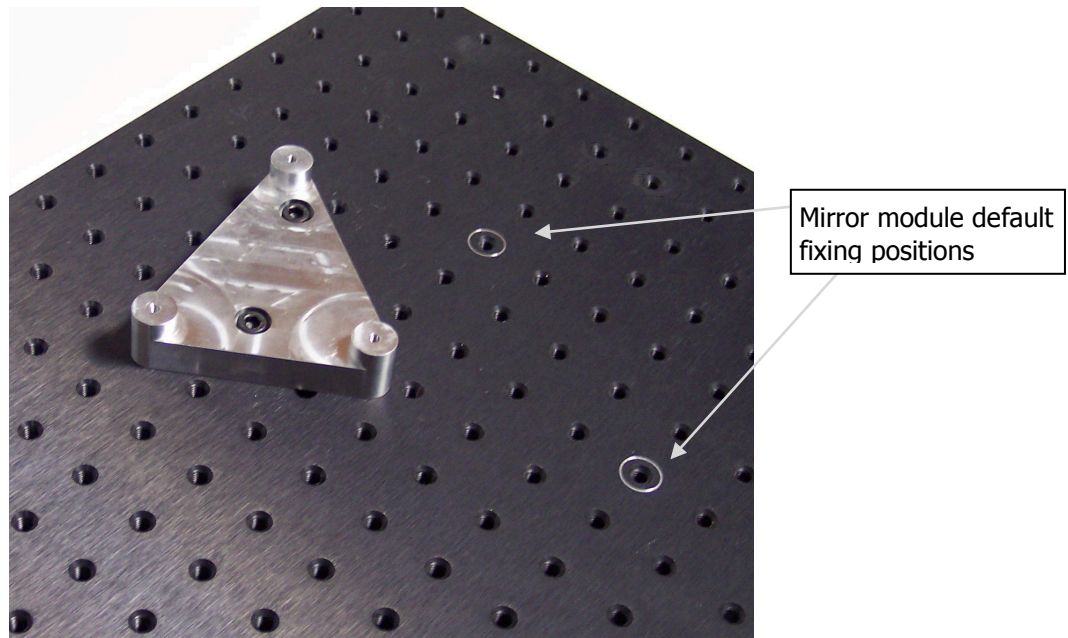


Figure 7 Detector sub-base fitted to bench

The triangular sub-base is asymmetric. The default fixing positions are marked on the optical bench.

- Orientate the detector module so that the detector window faces the mirror fixing point, and then use the three mounting screws provided to fix the detector module to the sub-base.

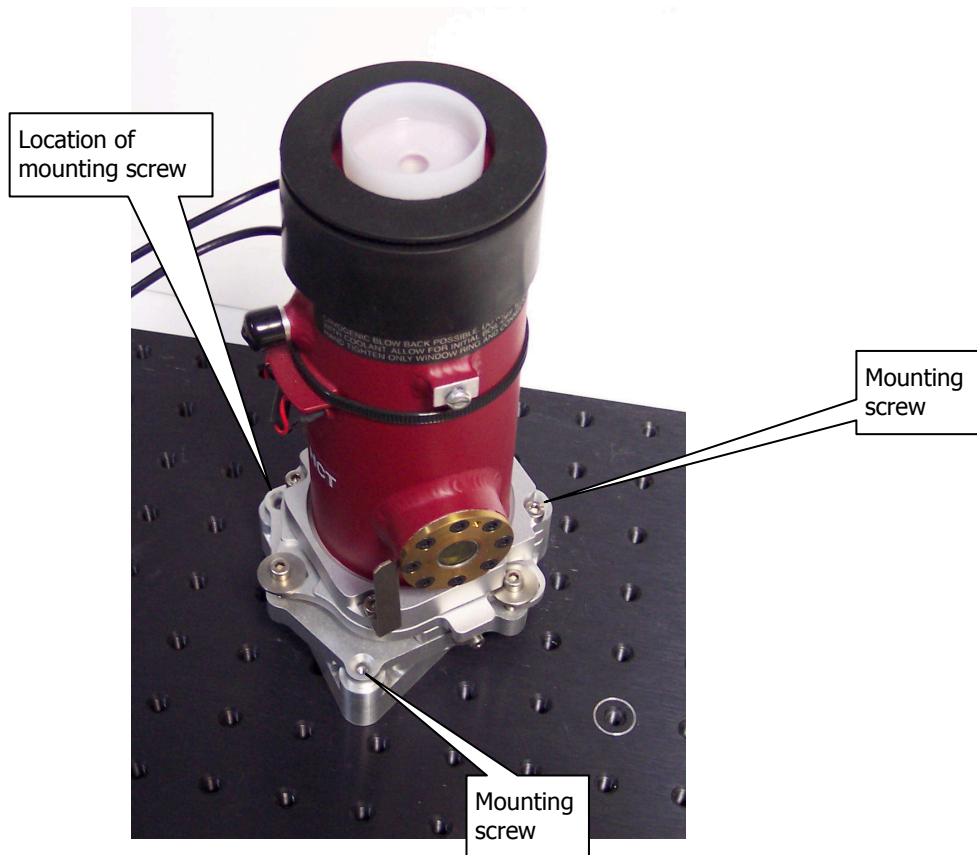


Figure 8 Detector fitted to bench

- Connect the earth lead from the detector module to the underside of the optical bench at a position in the 3 x 3 block of mounting points in the far right corner where the anodized surface of the underside of the bench has been removed. No other position is suitable.

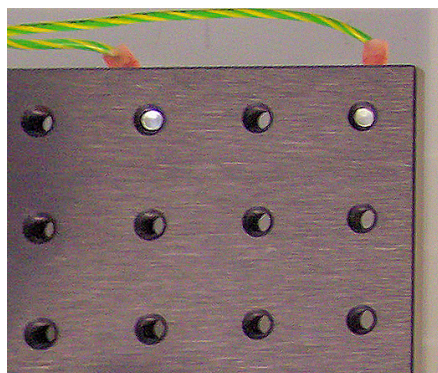


Figure 9 Detector earthing points

Pre-amplifier module

Before you begin, make sure that the spectrometer is switched off.

1. Bolt the two pre-amplifier mounting points to the optical bench.
It is usually convenient to mount the pre-amplifier behind the detector module.

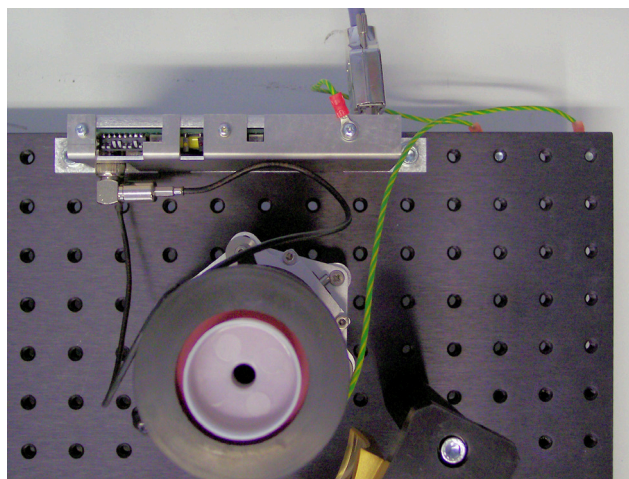


Figure 10 Pre-amplifier mounted on bench

2. Connect the earth leads from the detector module and pre-amplifier modules to the underside of the optical bench at a position in the 3 x 3 block of mounting points in the far right corner where the anodized surface of the underside of the bench has been removed.
No other position is suitable.
3. Connect the detector BNC and temperature sensor leads from the detector module to the pre-amplifier module.

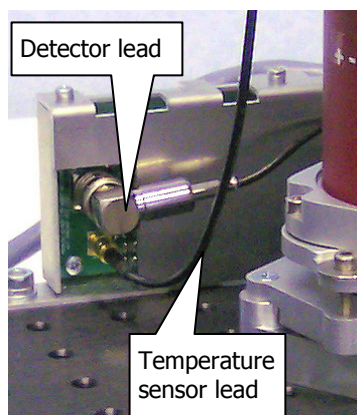


Figure 11 Connecting the detector to the pre-amplifier

4. The pre-amplifier bias current and detector gain settings are adjusted during installation by the PerkinElmer Service Engineer to suit the supplied MCT detector.
If you are using the supplied MCT detector, continue from Step 9.
If you are (or have been) using a different detector, make sure that the pre-amplifier bias current, and gain setting links, are correct as described in Steps 5–8.
5. Set switches 1–6 in the correct combination to supply the bias current required by the detector to the nearest mA.

CAUTION

The pre-amplifier is sensitive to electrostatic charge. Make sure that the module is connected to instrument earth, and ground yourself to earth before touching any switches mounted on the circuit board.

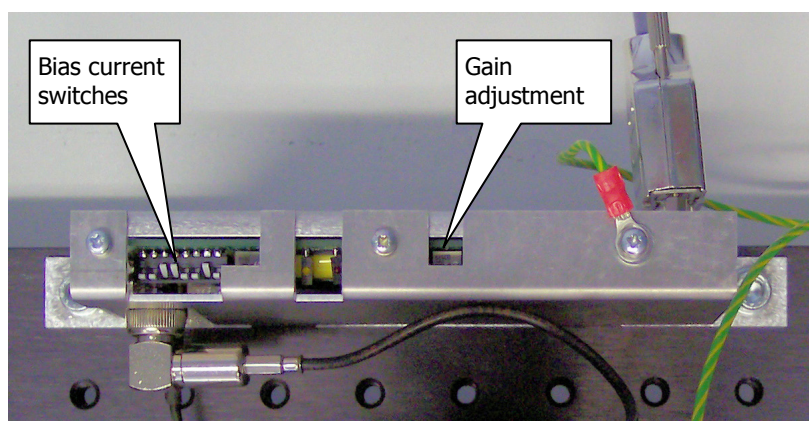


Figure 12 Pre-amplifier bias current and gain controls

The bias current required is written on the side of the detector, and the switches are binary weighted.

Switch when ON	Current (mA)
Switch 6	32
Switch 5	16
Switch 4	8
Switch 3	4
Switch 2	2
Switch 1	1

Switches 7 and 8 are not used.

6. If required, set the Gain Links.
The gain of the circuit is determined by pre-set gain links that do not need to be changed unless the pre-amplifier is, or has been, used with another type of detector module.
The gain links are not accessible unless you temporarily remove the module cover, which is held in place by the three cross-head screws. The links are located at the lower right of the printed circuit board.

For the MCT MIR detector supplied, set links 2 and 4.

Detector Type	Link Setting	Approximate Gain
Narrow band	Link 3 and 4	2
Mid band	Link 2 and 4	5
Wide band	Link 1 and 3	12

7. If you removed the pre-amplifier cover, replace it.
8. The gain adjustment potentiometer provides further adjustment to give an acceptable signal level. To ensure that some signal is present when the power is applied, set the gain potentiometer to maximum (clockwise).
9. Connect the detector and temperature sensor leads.
10. Connect the cable to the pre-amplifier and the instrument EXT.R connector.

For more information about the pre-amplifier settings and aligning the detector, see *Optimizing performance* on page 16.

Mirror module

Bolt the two pillars and cross-bar that support the parabolic mirror to the optical bench, oriented to that the mirror faces the detector. See Figure 6 for details of fixing position.

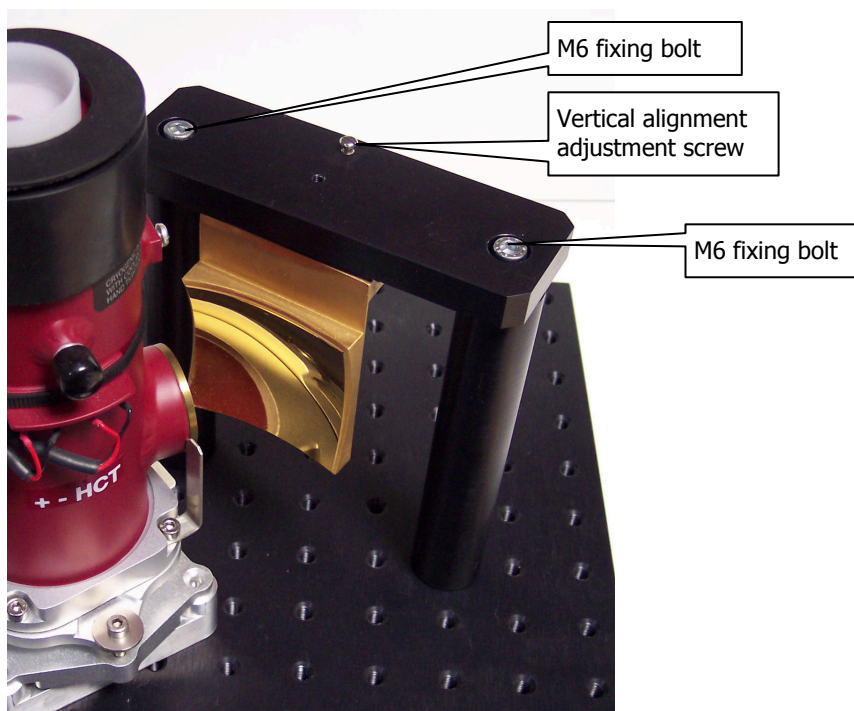


Figure 13 Mirror assembly fitted to bench

Later, you can adjust the vertical alignment of the parabolic mirror to the detector using the adjustment screw in the cross bar. See *Optimizing performance* on page 16.

Configuring Spectrum to use an external detector

This section describes how to create a modified instrument configuration file for use with an external detector.

NOTE: It is not necessary to power the instrument to complete this procedure.

1. Browse to C:\pel_apps\bin\
The instrument configuration file is named C*****.cfg, where ***** is the serial number of the instrument.
The spectrometer serial number is located on its base casting, in the sample compartment, under the sample accessory baseplate.
2. Copy the appropriate C*****.cfg file and save it as, for example, C*****.intdet

NOTE: Make sure you save this backup of the original instrument configuration file. If you remove the optical bench, you will re-instate this file.

3. Browse to the C:\Program Files\PerkinElmer\ServiceIR or C:\Program Files (x86)\PerkinElmer\ServiceIR directory.

CAUTION

The ServiceIR folder contains a number of utilities, many of which are for use solely by a PerkinElmer Service Engineer.

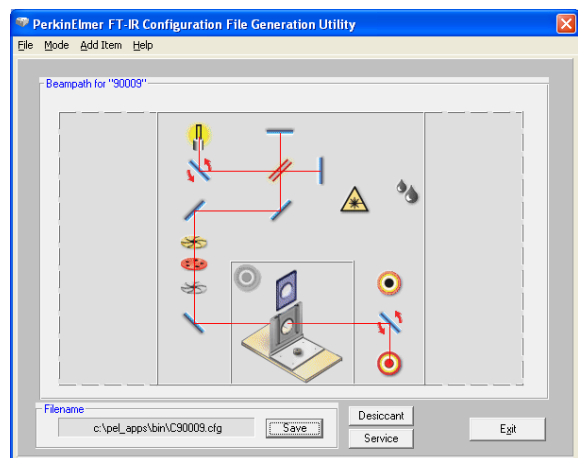
If used incorrectly, some utilities could damage the instrument.

4. If you have Spectrum v.10.3.7, or later, double-click the **Frontier Configuration** shortcut.

OR

If you have Spectrum v.10.0.0–v.10.3.6, double-click **S1_Config.exe**.

The Configuration File utility opens.



5. Click **Load** in the File menu, and then select the instrument serial number.
The configuration file is opened for editing.

6. Click **Add Item**, and then select the **Right Hand GPOB (MCT)** option.
The Beampath representation is updated to show the new configuration.
7. Click **Save**.
The configuration file is updated.
8. Click **Exit**.

Re-instating the configuration file

To revert to a standard instrument configuration file:

1. Browse to C:\pel_apps\bin\
The instrument configuration file is named C*****.cfg, where ***** is the serial number of the instrument.
The spectrometer serial number is located on its base casting, in the sample compartment, under the sample accessory baseplate.
2. Copy the appropriate C*****.cfg file, and save it as, for example C*****.extdet

NOTE: Make sure that you save this backup of the external detector configuration file. You may want to re-instate, or edit, this file when you use an external detector on another occasion.

3. Rename C*****.intdet (the backup of your original internal detector configuration file) as C*****.cfg

NOTE: If a backup of the original configuration file was not made, uninstall the instrument and then re-install it using the configuration disk supplied with the instrument.

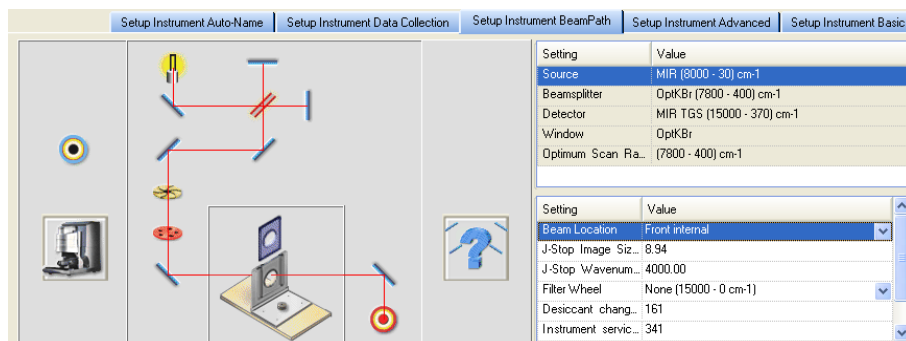
Selecting the external detector using Spectrum

Before you begin, make sure that:

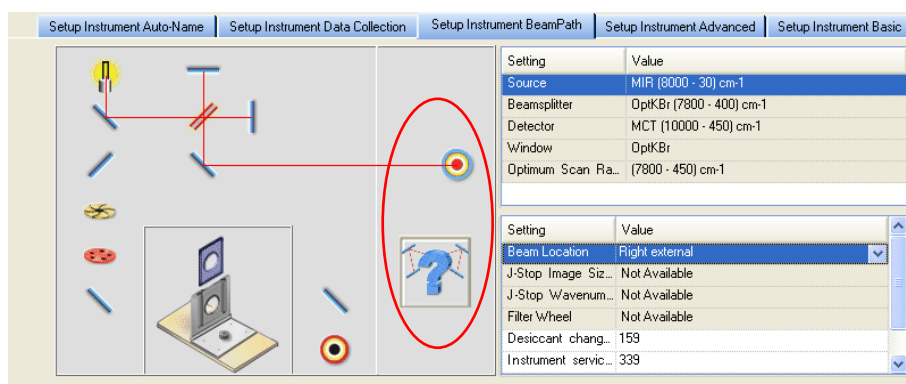
- The external beam port is covered by a suitable attenuator (4%T for MIR; 1%T for NIR).
The attenuator attaches to the external beam port magnetically.
- The instrument is powered on and has been allowed to stabilize.

To select the external detector in Spectrum software:

1. Start Spectrum, select the Setup menu and then click **Instrument**.
2. Select the **Setup Instrument BeamPath** tab.



3. Select **Right external** as the **Beam Location** from the drop-down list.
The external MCT detector is selected.



NOTE: The **Beam Location** field is displayed in the settings table only when an external detector is configured.

Optimizing performance

This section describes adjusting the pre-amplifier settings and detector alignment for optimum performance.

1. Attach a suitable attenuator (4%T for MIR; 1%T for NIR) to the external beam port on the right of the instrument.
The attenuator attaches to the external beam port magnetically.
A different attenuator can be used if the signal is too low or saturates when adjusting the detector or setting the gain.

- Switch on the instrument, fill the MCT dewar with liquid nitrogen, and wait until the yellow temperature LED goes off.

The standard MCT detector is cooled using liquid nitrogen. When the pre-amplifier is powered, its yellow LED will be on until the detector has been sufficiently cooled.

This LED is also off when the temperature sensor lead is not connected.

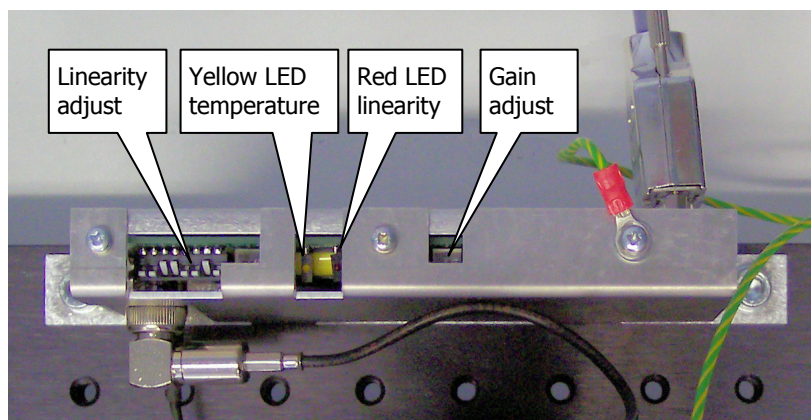



Figure 14 Pre-amplifier adjustment controls and LEDs

- Start Spectrum, select the Setup menu and then click **Instrument**.
- Ensure that the external detector is selected on the beam path tab.
- If you have Spectrum software, switch to **Monitor** by clicking  on the Measurement toolbar, and then click **Energy** to display the signal detected by the MCT detector. The Live tab is displayed.
- Loosen the three clamp screws on the detector mount. (The third clamp screw is hidden behind the detector.)

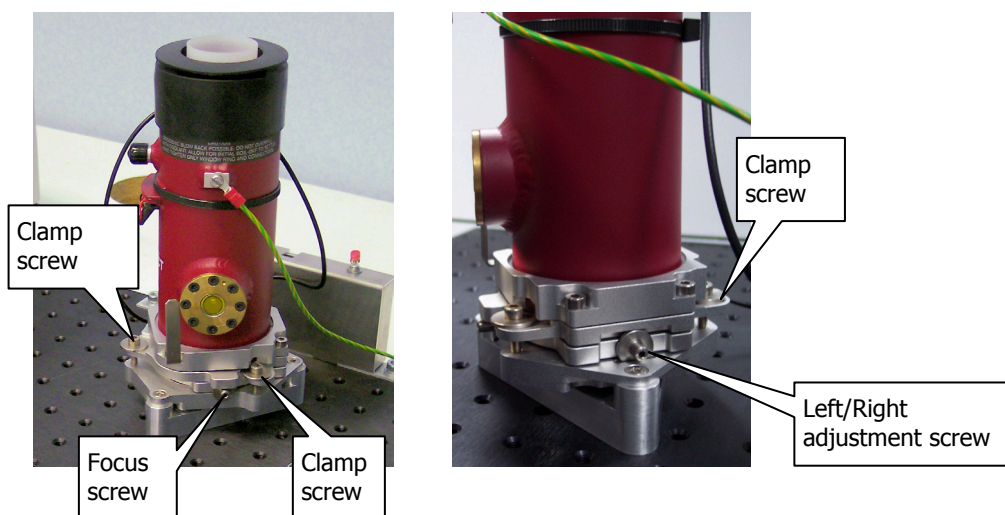


Figure 15 Detector focus and left/right adjustment screws

7. Use the detector focus screw and the left/right adjustment screw, and the mirror module vertical adjustment screw to obtain the maximum energy.
8. When you have completed the adjustment, tighten the clamping screws on the detector.
9. Display the interferogram, and then adjust its height with the gain adjustment potentiometer to give a signal with a peak of about 0.5 units.
If the interferogram is inverted, the peak should be about -0.5 units.
10. Adjust the linearity potentiometer for a flat energy response below 400 cm^{-1}
The energy should be less than 1% of the peak.
11. Adjust the gain pot so that the height of the interferogram is about $+0.8$ units.

If the required signal cannot be achieved, switch off the system, amend the pre-amplifier gain links, and then repeat this procedure.

For more information about the pre-amplifier gain links, see Step 6 on page 12.

Connecting another type of detector/pre-amplifier to the instrument

For details of how to use another type of detector/preamplifier module with the General Purpose Optical Bench, refer to the leaflet *Right-hand External Beam Option* (L1050093) provided on the *IR & Raman Manuals CD* (L1050002).