

Model D48 Detector Module  
User Manual  
Version 1.0

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## Chapter 1: Overview

Thank you for purchasing the C&L Instruments Model D48 Detector Module. The Detector Module is equipped with a 1 inch diameter end-on photomultiplier (PMT) that is configured to operate in the photon counting mode. In this configuration, it stands as the most sensitive and linear means currently available to measure low light levels. Proper use of this module will insure continued low noise detection for fluorescence measurements for many years.

The PMT provided in the Detector Module is preset and requires no user intervention. It exhibits a very low “dark” count and a linear output to  $10 \times 10^6$  counts per second. The PMT output is available via the BNC connector on the back panel of the Detector Module as TTL pulses. This output can be used to interface the Detector Module to a stand-alone TTL pulse counter, or to one of several fluorescence systems offered by C&L Instruments.

The Model D48 Detector Module is equipped with a filter wheel for wavelength selection. Either a four position filter wheel with 1 inch diameter filters or an eight position filter wheel with ½ inch diameter filter wheels can be used. Either type of wheel can be used interchangeably and the user can easily exchange filter wheels that may be tailored for specific detection methodologies.

Please follow the instructions provided in this manual to insure maintenance-free operation of the Detector Module.

## Chapter 2: Setup

### Cable Connections

There are three electrical cables that connect to the Model D48 Detector Module. These are:

1. The power cord.
2. The BNC connector for the output of the photomultiplier tube.
3. The 15 pin ribbon cable for control of the Detector Module.

Attach the supplied power cable to the connector located on the back panel of the Detector Module. The Detector Module has a universal power input, 100-240 VAC, 50/60 Hz. It will automatically select for voltages in this range. The Detector Module is supplied with a power cord for operation in either North America or Europe. In the event that the supplied power cord is incompatible with your electric utility, you may have to obtain either an adapter or a power cord locally. The power entry module is a standard IEC type.

Attach the supplied BNC cable to the connector located on the back panel of the Detector Module. One end is connected to the photomultiplier (PMT) output of the Detector Module and the other end is attached to either the PC-DAQ Controller card, RS-DAQ-Controller or other type of photon-counting instrument provided with our Detector Module. There is only one BNC connector on the PC-DAQ Controller card. The correct BNC connector on the RS-DAQ Controller is marked "PMT".

Attach the supplied 15 pin ribbon cable to the connector located on the back panel of the Detector Module. One end is attached to the connector labeled EMISSION on the Detector Module and the other end is attached to a similarly labeled connector on the Breakout Box that is supplied as the auxiliary component of the PC-DAQ Controller. If you are using the RS-DAQ Controller, attach the ribbon cable to the connector marked EMISSION.

### Optical Connection

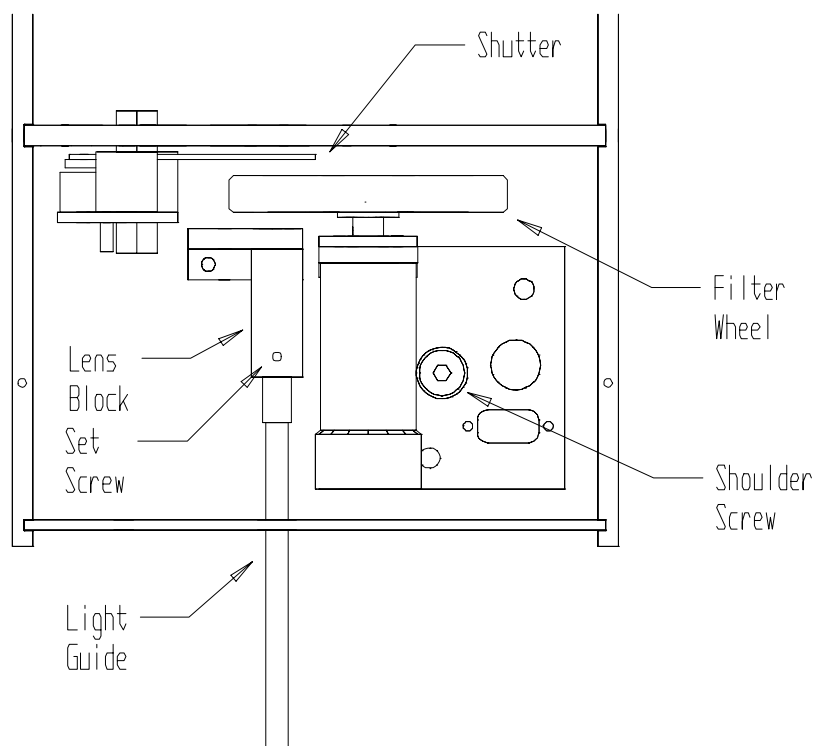
Light is input to the Detector Module through a light guide. The light guide supplied with your detector module may be either a quartz liquid light guide or a silica fiber optic bundle. Either type of light guide connects to the Detector Module in the same manner.

The light guide attaches to the Detector Module through the black grommet located on the front panel of detector. To attach the light guide, remove the top cover of the Detector Module using the four thumbscrews. Carefully insert the fiber through the grommet. Push on the fiber from the outside of the detector module while carefully pulling on the light guide from the inside of the module. Insert the tip of the light guide into the lens block. It is fully inserted when only a small portion of the silver-colored portion of the ferrule remains visible. Refer to Figure 1 for a diagram. Carefully tighten the set screw with a 1/16 inch Allen key. Replace the cover.

The other end of the light guide attaches to either a microscope adapter or the Model CV1 Cuvette Accessory. If you purchased a microscope adapter with the Model D48 Detector

Module, the light guide is attached to the microscope accessory by inserting the guide into the output end of the adapter. Carefully tighten the set screw to hold the guide in the microscope adapter. If you purchased the Model CV1 Cuvette Accessory, refer to the instructions supplied with the accessory.

The Detector Module can be used for measuring light intensity from other custom sources using the light guide input. Contact C&L Instruments for other available accessories to your Model D48 Detector Module or for details on how to input light into the light guide for custom applications.



**Figure 1.** Top view of the front portion of the Detector Module.

This figure illustrates the connection of the light guide to the lens block and the filter wheel assembly.

## Chapter 3: Using the Detector Module

### Power on considerations

To use your Detector module safely and as a component of other equipment from C&L Instruments, a specific sequence should be followed when turning the equipment on and off. Please follow these steps:

1. Always turn the illumination system on before turning on the computer or any other components, including the Detector Module. This is a good practice to follow if C&L Instruments or any other manufacturer supplies the illumination source. It is possible that the initial illumination of an arc lamp assembly can damage other components due to electromagnetic discharge.
2. After igniting the arc lamp assembly, all other components can be turned on, including the Detector Module.
3. The computer should be turned on last since the computer may need to recognize that other components are powered on and are available. When the software provided by C&L Instruments is started, it will detect the presence of the Detector Module. Verify that the cables are connected correctly and the module is turned on, as described in the previous chapter, if the software fails to detect the Detector Module.

### Shutter considerations

By default, the internal shutter of the Detector Module will be in the closed state when power to the module is initially turned on. In addition, when the software provided by C&L Instruments is first started, the internal shutter of the Detector Module will remain in the closed state. These features prevent light from reaching the PMT until the user has opened the shutter using the controls provided in the software.

It is important to note that if you quit the C&L Instruments software with the shutter in the open state, the shutter will be in the open state when the software is restarted. To prevent this occurrence, it is good practice to close the shutter(s) prior to exiting the software. The shutters will always be in the closed state after the computer is rebooted.

### The filter wheel

Filters housed in the filter wheel, and the filter wheel itself, can easily be replaced for different types of fluorescence measurements. The positions in the filter wheel can hold bandpass interference filters, cutoff filters, neutral density filters, balancing weights, or any combinations thereof. The total thickness available in the filter wheel for these combinations is approximately 0.32 inches (8.1 mm).

#### Filter and filter wheel replacement

To replace filters or the filter wheel, the filter wheel assembly is removed from the Detector Module. Either turn the power switch to the Detector Module, located on the

back panel, to the off position or disconnect the power cable. Remove the lid of the Detector Module by removing the four thumbscrews.

Refer to Figure 1 for a diagram of the filter wheel assembly. The filter wheel assembly is attached to the Detector Module using one large shoulder screw. Remove the shoulder screw using a 3/16 inch Allen key. The detector module can then be lifted out of the Detector Module while still attached by the electrical cables. It is not necessary to remove the electrical connections from the filter wheel assembly to exchange filters or the filter wheel. The electrical connections can be disassembled from the filter wheel assembly if desired, although this is not usually necessary. If these connections are removed, note the manner in which the connections are made for reassembly.

The filter wheel is connected to the motor hub of the filter wheel motor using three 4-40 flat head screws. Remove these screws using a 1/16 inch Allen key to remove the filter wheel from the hub. It is not necessary to remove the hub from the motor shaft in order to remove the wheel. In addition, it is not necessary to remove the filter wheel from the filter wheel assembly in order to change filters in the filter wheel.

The filters are retained in the filter wheel with a threaded plastic retaining ring. Loosen the retaining ring using the tool provided in the Balancing Kit to remove filter and any available balancing weights that may have been inserted with the filter into the wheel. Handle the filters by the edges only and avoid touching the filters with bare fingers. Reinsert filter, with or without balancing weights, or optical blanks in the filter wheel and secure the components in place with the retaining ring. Tighten the retaining ring with finger pressure only, using the provided tool and do not over tighten.

Reattach the filter wheel to the motor hub, if required. Alignment pins in the motor hub insure that the filter wheel is attached in the correct orientation. Reinsert the filter wheel assembly in the Detector Module. *Be sure to reattach and tighten the shoulder screw.*

It is advisable that all positions in the filter wheel contain either filters or a solid optical blank. Solid optical blanks are supplied in the Balancing Kit. It is *inadvisable* to leave any filter position in the filter wheel completely open without having either an optical blank (i.e., solid disc) or a filter in place. An open filter position could provide excessive light, resulting in potential damage to the PMT.

### Filter wheel balancing

Filters can be placed in the filter wheel in any position to achieve any desired pairing between excitation and emission wavelengths. For optimal performance, especially during high-speed operation, the filter wheel should be weight balanced. The weights are used to compensate for weight variations in filters. A Balancing Kit of special weights is supplied with either the Detector Module or the C&L Instruments Dye Fluorometer. If needed, additional balancing weights can be obtained from C&L Instruments. Use of other types of weights is not recommended.

The weights are used to increase the weight of a particular filter when filters located on opposite sides of the filter wheel are mismatched. To achieve balance, weights are applied to the position having the lighter filter of an opposing pair. In order to use the weights, you will need to know the difference in weight between the opposing filters.

Weigh each filter, determine the weight difference in between the filters and add the necessary weights from the Balancing Kit to the filter position in the wheel that will contain the filter having the lighter weight.

For example, if one filter of a pair weighs 3.00 grams and the other weighs 2.65 grams the difference is 0.35 gram. You would make up the weight difference using the weights provided in the balancing kit. The weights in the balancing kit are supplied in a binary series, with successive sizes doubling in weight. To correct an imbalance of 0.35g, weights of 0.20, 0.10 and 0.05 grams would be added to the filter with the lighter weight. Position the weights in the filter wheel between the filter and the retaining. The provided balances can be used to correct weight imbalances to within 0.05 g (1/2 inch diameter). Obviously, more care is required to balance the wheel when high-speed operation is desired. When the wheel is used only in the fixed or slowly varying mixed mode, a slight imbalance will not be noticeable. It is good practice, however, to keep the wheels balanced so they are ready for any situation.

## Chapter 4: Maintenance and Service

### Maintenance

#### Safety interlock

There is a safety interlock designed to disconnect power to the PMT when top lid of the Detector Module is removed. This is designed to prevent room light from reaching the PMT when the lid is removed. It is good practice, however, to turn power to the Detector Module off before removing the cover. Avoid exposing the PMT to room light even when unpowered in order to maintain low noise operation.

Under the top lid there is a second inner metal shield covering the back half of the Detector Module. Power should *always* be disconnected before removing the inner shield since there are live voltages present under the inner shield.

#### Internal shutter

The Detector Module contains an internal shutter that blocks light passing through the filter wheel from reaching the PMT. The shutter is assembled at the factory and should not require adjustment. Refer any service questions to C&L Instruments.

#### System fuse

A fuse holder is located on the back panel of the Detector Module. The fuse is a 1.6A slow blow fuse, ¼ by 1 ¼ inch. If necessary, replace with same type of fuse.

#### Power supply

The Detector Module contains a 12 Volt power supply that is used to power the PMT and filter wheel assembly. The power supply is located under the inner shield. Power should *always* be disconnected before removing the inner shield since there are live voltages present under the inner shield.

The 12 Volt power supply contains a separate 2A fast blow, 5 mm fuse. The power supply must be removed from the Detector Module for access to this fuse. If you suspect that this fuse is blown or the power supply is faulty, contact C&L Instruments.

#### PMT replacement

Under normal circumstances, the PMT does not require service. The standard PMT supplied with the Model D48 Detector Module is a bialkali type with a borosilicate glass window. The sensitivity range is from approximately 300 to 680 nm. This can be replaced with either a PMT having a different window if UV detection is required or a multialkali PMT if extended red sensitivity is required. Refer any service questions to C&L Instruments.

## Service

If you believe your Detector Module requires service, contact C&L Instruments to discuss the return of the module. C&L Instruments will provide shipping instructions and a return authorization RMA number. Units must be shipped prepaid to C&L Instruments. Units returned to C&L Instruments without prior authorization and an RMA number will be returned unopened.

If you purchased your Detector Module from a Distributor and not directly from C&L Instruments, contact the Distributor to arrange for service.

You can contact C&L Instruments by telephone or email ([support@fluorescence.com](mailto:support@fluorescence.com)).

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Should you have any questions concerning this agreement, you may contact C&L at 314 Scout Lane, Hummelstown, PA, USA, 717-566-3642.