

## LAMBDA DG-4/DG-5 HIGH SPEED WAVELENGTH SWITCHER



The **Lambda DG-4/DG-5** offers speed and versatility for experiments requiring rapid wavelength switching. The instrument retains all the advantages of interference filter based systems, yet eliminates the temporal constraints imposed by traditional filter changing devices like filter wheels. Switching between any two wavelengths is achieved in less than the 1.2msec vertical retrace period of a video signal, allowing the user to perform real-time video imaging. The high switching speed of the **Lambda DG-4/DG-5** facilitates the ability to follow fast changes in ion concentrations in dual wavelength ratio imaging applications and to monitor other concomitant changes in the studied system at additional wavelengths.

Narrow bandpass systems, such as single cavity interference filters, grating monochromators, and A.O. modulators, pass unwanted harmonics of the desired

wavelength. Also, with variable wavelength devices, it is not always possible to obtain sufficient blocking of out-of-band wavelengths. Modern interference filters, as used in the **Lambda DG-4/DG-5**, do not pass harmonics and have integral blocking characteristics 1000 times better than typical monochromator systems. For the same full width at half maximum (FWHM), interference filters have a narrower spectral bandpass due to the absence of the slit function.

The dual galvanometer design of the **Lambda DG-4/DG-5** allows tuning of the relative intensities at each wavelength. This adjustment, in variable wavelength devices with a single optical path, is difficult to obtain. Unlike monochromators and other wavelength selective systems, the **Lambda DG-4/DG-5** can be used as a source of white light when required.

*How it works:*

This unique optical design of the **Lambda DG-4/DG-5** is based on dual scanning galvanometers utilizing interference filters for wavelength selection. The light from the xenon arc lamp is focused on the first galvanometer mirror which directs it via a parabolic mirror, through one of the interference filter channels. Following the filter, a second parabolic and a second galvanometer mirror collect and redirect the light into the light guide. A cold mirror in the beginning of the light path eliminates the IR radiation, reducing significantly the amount of heat absorbed by the optics and the sample. Cold mirrors modified to pass near-IR to 780 to 880nm are also available.

A built-in shutter function allows reduction of light intensity by six orders of magnitude. For applications requiring mechanical shuttering, like time lapse experiments or very sensitive samples, the **SmartShutter™** can be integrated into the device to assure that the light is completely blocked.

The standard system, the **Lambda DG-4**, holds up to four 25mm interference filters. The **Lambda DG-5**, a five filter version, accommodates three 18mm and two 25mm filters. While the switching time between any two wavelengths is done in less than 1.2msec, the dwell time at any wavelength is arbitrarily set by the user.

The liquid light guide can be coupled to the illumination port of most microscopes using an optional adapter. Please refer to the "Microscope Adapters" section for further information.

**SPECIFICATIONS**  
 > **LAMBDA DG-4**
**Output Range**

330nm to 700nm - Ozone free  
 300nm to 700nm - Full spectrum  
 (requires ozone removal)

**Lamp Type**

175 or 300 Watt ozone free or  
 full spectrum xenon arc bulb

**Lamp Lifetime**

Expected lifetime 1,000 hours  
 (All bulbs have a prorated  
 warranty for 500 hours)

**Power Consumption**

350 Watts

**Filter Diameter**

DG-4: Four, 25mm (1 inch)  
 DG-5: Two, 1in (25mm) and  
 Three (18mm)

**Dimensions**

10in x 10in x 19in  
 25cm x 25cm x 48cm

**Light Guide**

2 meters long  
 3mm diameter

**Weight**

45lbs  
 20kg

**Electrical**

115/230 Volts  
 50/60 Hertz power line

## FEATURES

### > LAMBDA DG-4/DG-5

#### Complete system for wavelength switching

The **Lambda DG-4 / DG-5** is a complete integrated 175 (or 300) Watt light source and wavelength switching excitation system.

Four or five interference filters can be easily installed in the **DG-4** or **DG-5**, respectively. An additional standard neutral density filter can be inserted in the common path of the light.

The light guide output from the **Lambda DG-4 / DG-5** provides uniform spacial illumination, as well as vibration isolation from your microscope.

#### Integral shuttering

The **Lambda DG-4 / DG-5** provides a high speed shutter function with open/close times of 500 $\mu$ s. The shutter function reduces light intensity by 5 to 6 orders of magnitude. When switching between non-adjacent filter positions is necessary, this built-in shutter can be used between filter transitions to prevent transmission through the intermediate filters.

If complete light shuttering is required, a mechanical shutter (i.e. **SmartShutter™**) can be incorporated into the **Lambda DG-4 / DG-5**.

#### Integral neutral density filtering

Neutral density filtering is achieved by offsetting the output galvanometer such that the light is not centered on the liquid light guide. Up to 15 logical filters can be defined with this method. Due to the scrambling effect of the light guide, the output still has excellent uniformity.

Direct insertion of neutral density optical filters is also possible in the filter holders at any of the four optical channels. A final neutral density optical filter can be placed in the exiting light path which will reduce the light output from all 4 optical channels.

#### Two outputs for monitoring filter position

A 4 bit TTL signal transmits the current optical channel (filter) position.

A digital-to-analog converter (DAC) output produces a voltage showing which filter is in use.

## METHODS OF CONTROL

### > LAMBDA DG-4/DG-5

#### Direct Computer Control via Parallel or Serial Interface

When operated in these modes, the **Lambda DG-4 / DG-5** control commands are a subset of our **Lambda 10-2** controller and will operate with software written for the **Lambda 10-2**.

*If you plan to control the DG-4 with other interfaces, please contact Sutter for specific issues.*

#### Strobe-Pulsed Ring Buffer Control

A sequence of up to 32 filter values can be loaded into a ring buffer via keypad or computer. The system will switch to the next filter in the buffer on a TTL level (trigger) strobe pulse. After executing the last filter change in the string the system resets to the first filter and continues.

#### Video Sync Pulsed Ring Buffer Control

In this mode, a video sync pulse can be used to initiate and/or execute the filter change for a sequence of filter values stored in the ring buffer.

#### Video Sync with Strobe Low

In this mode, the system will implement a filter change on the video sync pulse, but only if the strobe line is held low. This allows a computer to override the sync pulse.

*(View of Lambda DG-4 back panel)*

