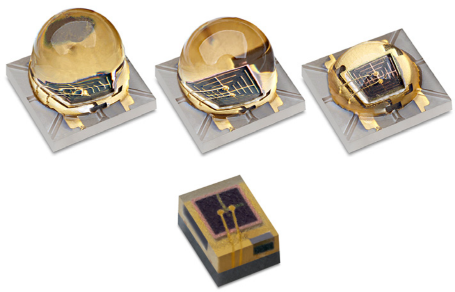
INFRARED

LUXEON IR Family Optical Performance in Pulsed Mode

Assembly and Handling Guidelines



Introduction

Optical performance of LUXEON IR products depends on a number of factors. Some of them are external (like the ambient temperature), others are related to the operating regime of the device (like forward current or pulse length when operating in pulsed mode). This application brief addresses the recommended assembly and handling guidelines for the LUXEON IR Family (LUXEON IR Domed Line and LUXEON IR Compact Line), both available in 850nm and 940nm versions. Proper assembly and handling, as outlined in this application brief, ensures high optical output and long light output maintenance of LUXEON IR emitters.

Scope

The assembly and handling guidelines in this application brief apply to both product lines and both wavelengths, unless otherwise specified.

In the remainder of this document, the term LUXEON IR Family refers to any product in the LUXEON IR Domed Line or the LUXEON IR Compact Line.

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1. Permissible Pulse Handling Characteristics

1.1 Description

This section deals with permissible pulsed regime that LUXEON IR Family products can be operated in, taking into account pulse length and duty cycle.

The radiant flux output is limited by the maximum allowed forward current, which typically depends on thermal considerations. A forward current below these limits guarantees nominal performance over the lifetime of the device

Operating in pulsed regime allows you to safely increase the current to values above the DC operating limit. However, the safety limit depends on the actual pulse characteristics; for a short pulse length and a low duty cycle, the IR emitter can be driven at a higher current than for a long pulse length and a high duty cycle.

In Figure 1 shown below, it shows guaranteed operational limits at 85°C under various pulse conditions.

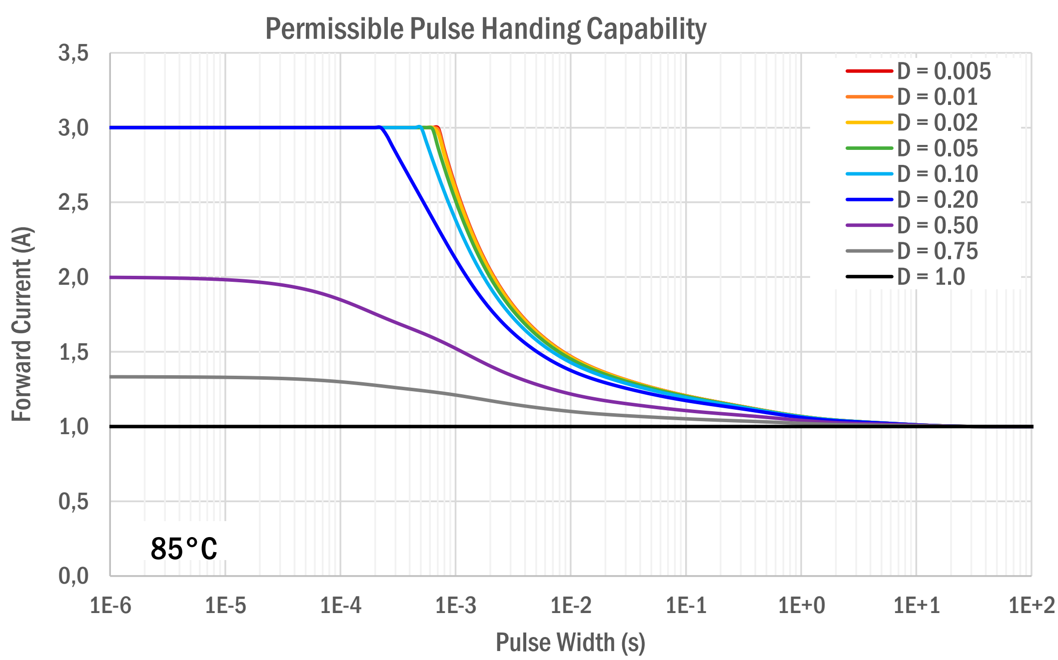

Figure 1. Permissible pulse handling characteristics for the LUXEON IR Family at case temperature T_c= 85°C, as a function of pulse length for different Duty Cycle (D) values.

Please note that some of the data presented further in this document were measured outside the recommended limits given in this section; this was done for characterization purposes only. Please make sure you are observing the applicable limits when designing the LUXEON IR products in your application.

2. Rise and Fall Times under High Speed Switching Conditions

This section focuses on the typical rise/fall times of the optical signal.

2.1 Background

Rise and fall times (t_r and t_f) are strongly dependent on the forward current (I_f), with the rise/fall time being inversely proportional to the forward current. The rise/fall time plots shown in this section are based on an empirical fit of measured data, based on rise/fall time dependency, versus forward current (I_f) of the type $t_{r,f} = a * I_f^b$. Fit parameters 'a' and 'b' are also given for the 850nm and 950nm LUXEON IR family products, respectively.

2.2 Measurement Conditions

Measurements were done at ambient temperature, a pulse length of 40ns and a duty cycle of 50%. A high speed photodetector (150ps rise/fall time) was used to acquire the optical signal.

The test circuit used in this case is based on a fast high amplitude pulse generator terminated by the device under test in a series with a 50 Ω resistor. The diagram of the circuit is shown below in Figure 2.

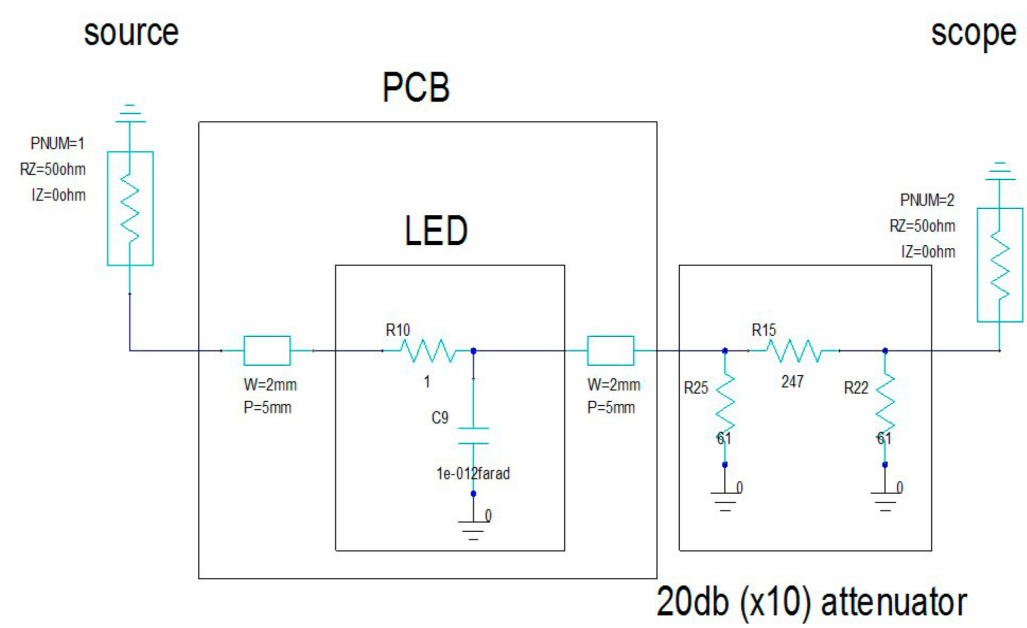

Figure 2. Test circuit used for the rise and fall time measurement.

2.3 Rise and Fall Time Definitions

In Figure 3 shown below, it shows how the rise and fall times are defined; unless otherwise specified, the rise and fall times are always measured between 10–90% thresholds.

Besides the optical signal rise/fall, there is an additional delay between the application of the electrical signal and the moment the optical signal actually starts to rise. This time depends on the pulse current and RC time constant of the device under test. While this time is not critical for most applications, it can be decreased by applying a bias to the device (either voltage or current, depending on how the device is driven). For the measurements shown in this section, a 1mA DC bias was used.

Note that an additional delay is introduced by the actual rise and fall times of the current pulse itself; for the setup presented here, this time is ~1.5ns, much shorter than the optical rise and fall times.

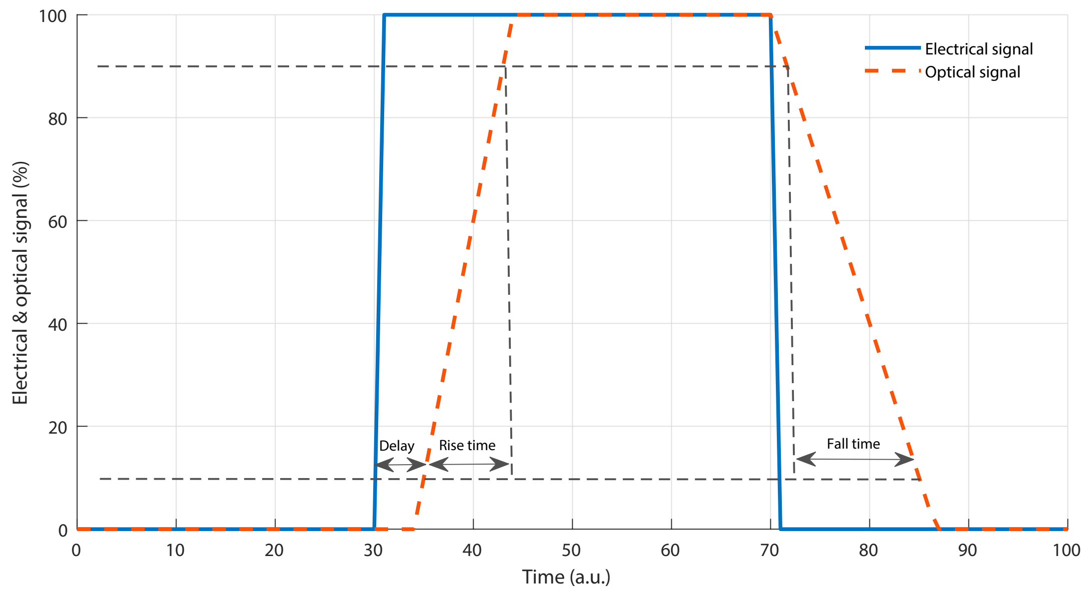

Figure 3. Definition of rise and fall times.

2.4 Rise and Fall Time vs. Forward Current

Figure 4 shows the measured rise and fall times at room temperature for the 850nm and 940nm LUXEON IR Family products. Measurement data was fitted according to a $t_{r,f} = a * I_f^b$ relationship. The fit parameters for each plot are summarized below.

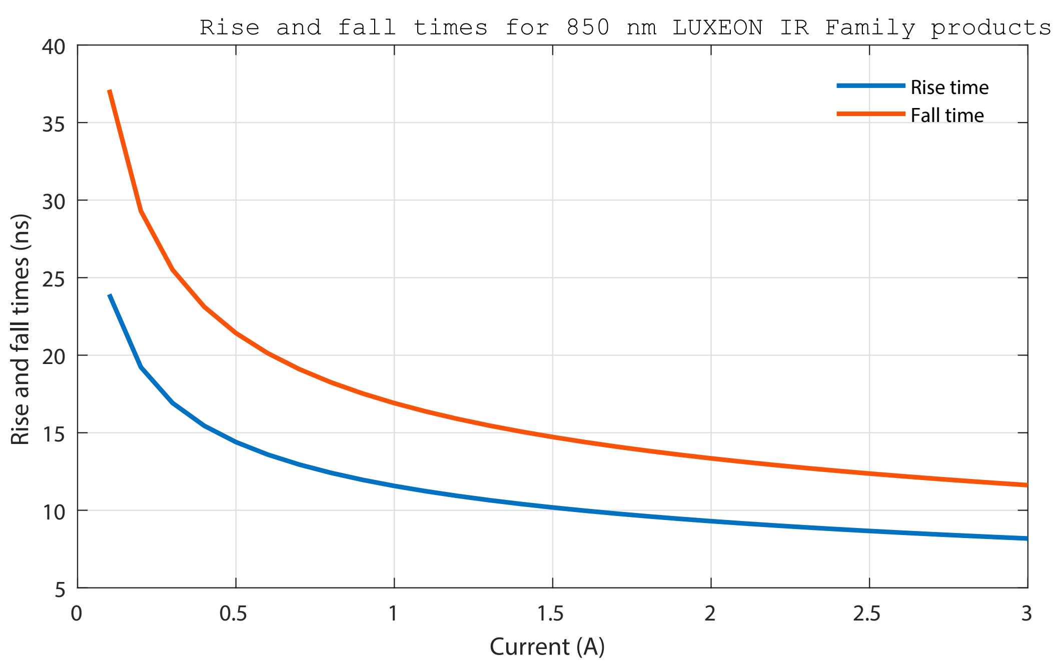

Figure 4. Rise and fall times for 850nm LUXEON IR Family products.

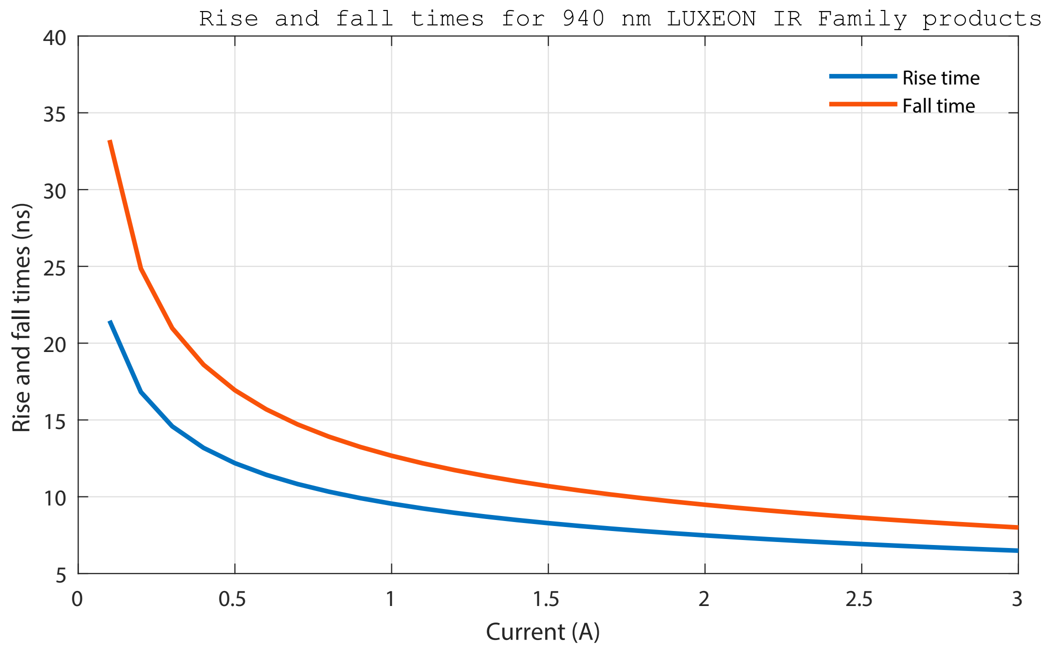

Figure 5. Rise and fall times for 940nm LUXEON IR Family products.

Table 1. Fit parameters for LUXEON IR Family rise and fall times.

WAVELENGTH		a	b
850 nm	Rise	11.6	-0.32
	Fall	16.9	-0.34
940 nm	Rise	9.6	- 0.35
	Fall	12.7	-0.42

3. Optical Performance in Pulsed Regime

This section summarizes typical optical performance of LUXEON IR Family products under various forward current values and pulse lengths; the parameters covered in this section are total radiant flux, peak emission wavelength and Full Width Half Maximum (FWHM) of emitted spectrum.

3.1 Background

Junction temperature plays a crucial role in determining the properties of the optical output; however, the junction temperature depends on multiple factors such as case and ambient temperatures, forward current, pulse length and pulse duty cycle. These factors are usually independent of each other; therefore, knowing the impact of each of them on the optical output parameters allows additional freedom in balancing them in order to extract maximum performance for any given application.

3.2 Measurement Conditions

1. Case temperature T_c: 25°C, 85°C and 125°C
2. Pulse length: 75µs, 100µs, 500µs, 1ms, 2ms and 20ms
3. Duty cycle: in all cases, the duty cycle is 10%, except for the 75µs pulse length (duty cycle is 7.5%) and 20ms (monopulse)

3.3 Optical Performance Parameter Definitions

Data shown in this document is normalized with respect to the standard qualification conditions used by Lumileds for LUXEON IR Domed and Compact products: 20ms (monopulse) of 1000mA at a case temperature T_c of 25°C.

Spectrum-related parameters are defined in Figure 6 shown below, using a normalized spectrum as reference.

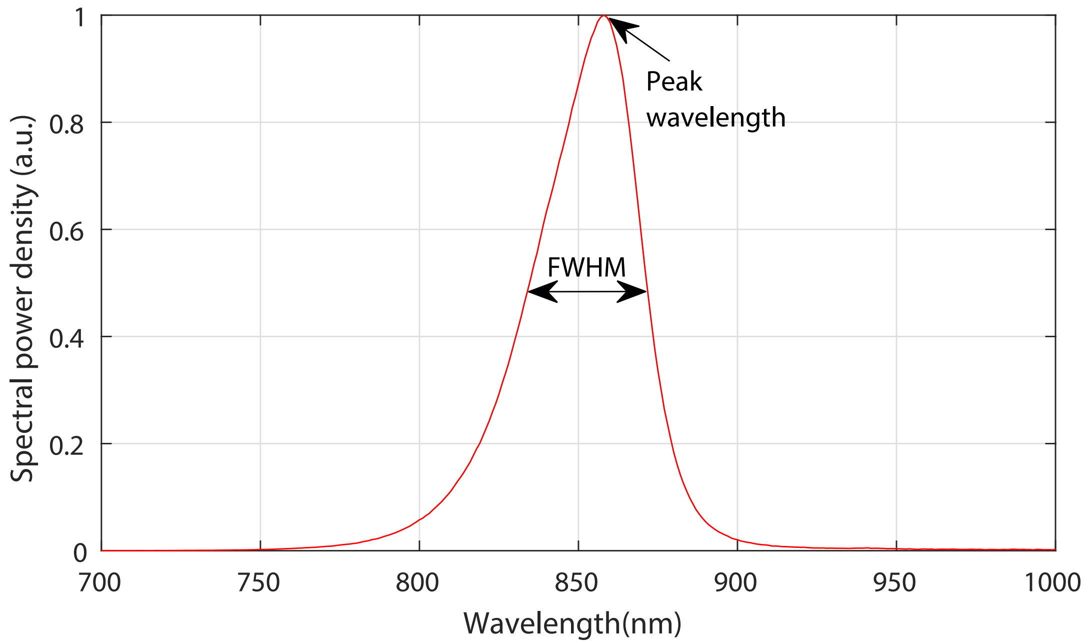

Figure 6. Definition of spectral parameters.

3.4 Radiant Flux, Peak Wavelength and FWHM vs. Forward Current

The optical performance parameters shown in this section were done at a case temperature T_c= 25°C; optical parameters at other temperatures can be derived from the plots shown in this document from the flux and peak wavelength vs. T_c dependency characteristics given in the datasheet of each LUXEON IR product.

Since case temperature significantly influences the optical performance, its impact on measured parameters will be mentioned in this document in order to give an idea of its relative contribution to flux variation and wavelength shift compared to the pulse length.

Radiant Flux

At lower temperatures, increasing the forward current leads to a proportional increase in the output flux; as expected, for a given current and duty cycle, shorter pulses produce a higher flux. Please note that the case temperature has a significant impact on the output flux; at maximum operating current, a difference of 60° in case temperature can lead to a 20% lower radiant flux output (assuming current and pulse length are the same at both temperatures).

Peak Wavelength

The case temperature has a very significant impact on the wavelength behavior; as a rule of thumb, a 30°C increase leads to a wavelength shift of 6 to 8nm (for a given forward current, pulse length and duty cycle). Pulse length becomes especially important for 1ms pulses and longer; for a given temperature, carefully choosing pulse length can drastically reduce the wavelength shift (as evidenced by the 75µs pulse plots for the 840nm LUXEON IR product).

The impact of forward current is relatively limited when operating at pulse lengths on the order of 1ms or less, leading to a typical wavelength shift on the order of 2 to 3nm; for the 840nm LUXEON IR product, the shift is towards longer wavelengths, while for the 940nm LUXEON IR product it is towards shorter wavelengths at moderate forward currents, then moves again to longer wavelengths at higher currents.

FWHM

At low forward currents, changing the pulse length has no impact on the output flux, peak wavelength and FWHM; however, at currents close to 3A, reducing the pulse length allows an increase of the flux on the order of 10%, a shift of the peak wavelength by ~5nm to shorter wavelengths, and a decrease of ~5nm in FWHM.

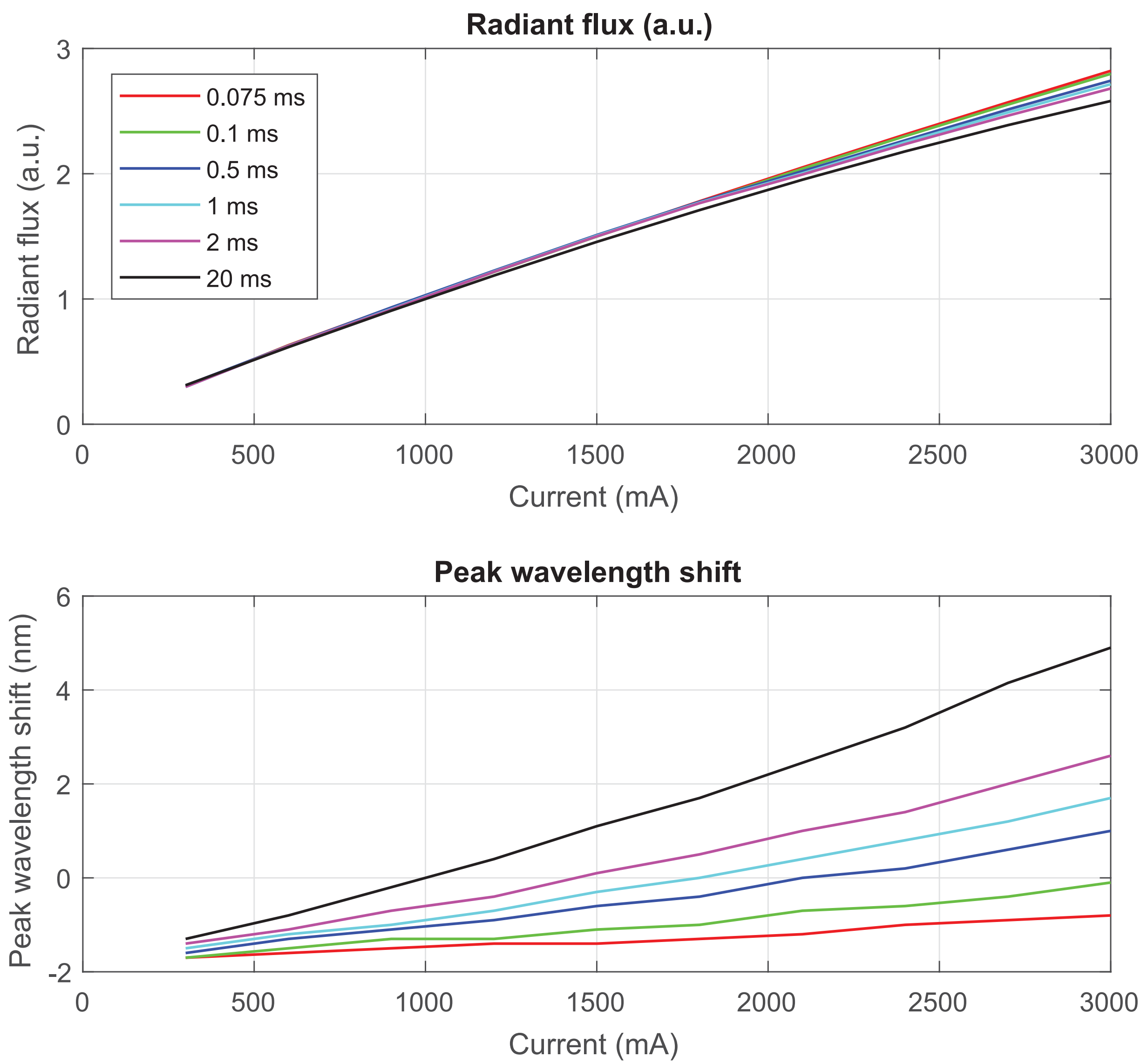

Figure 7. Typical behavior of output flux and peak wavelength shift at different forward currents, and pulse lengths for 850nm LUXEON IR Family products. Plot color indicates pulse length. Case temperature T_c=25°C.

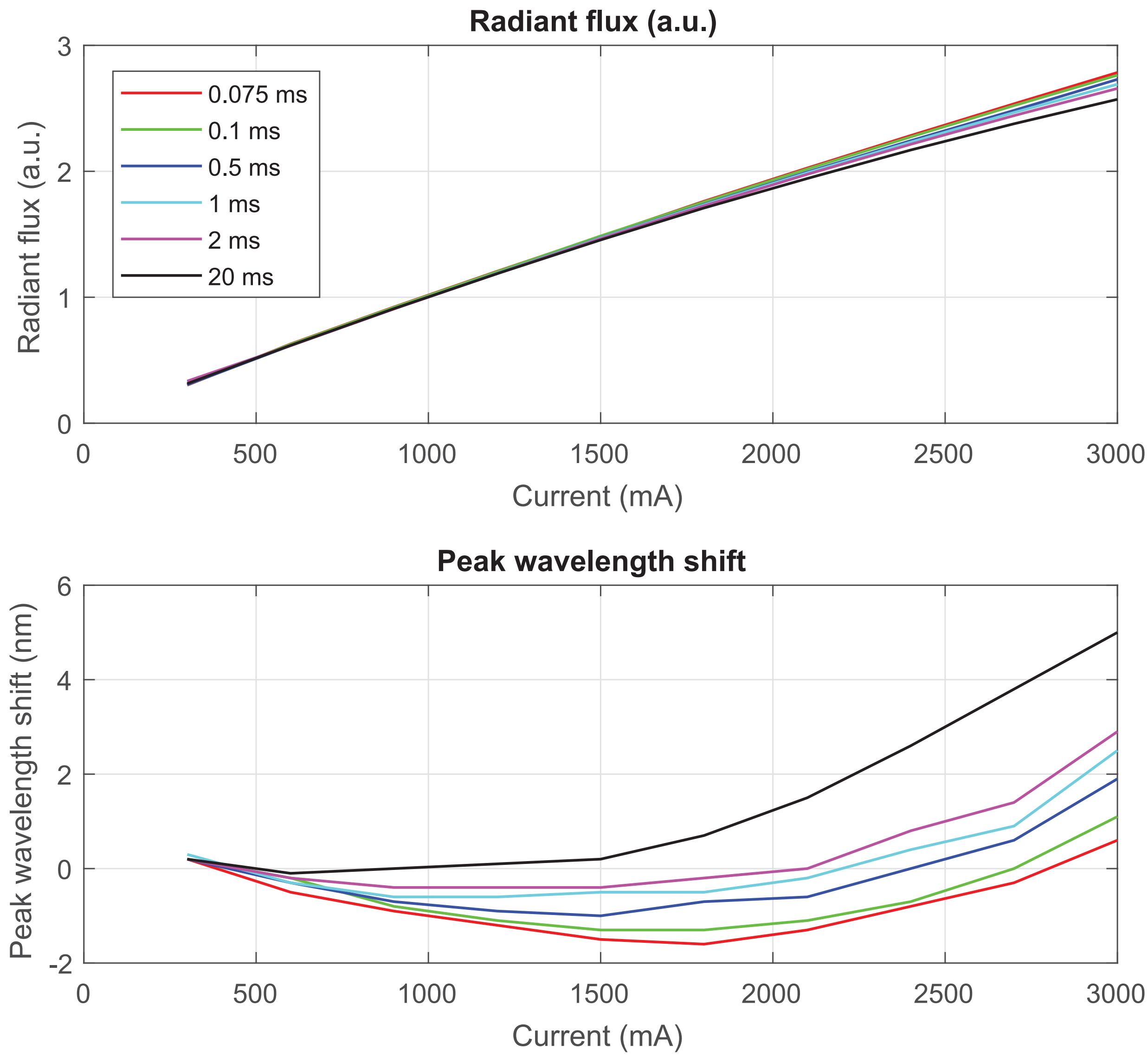

Figure 8. Typical behavior of output flux and peak wavelength shift at different forward currents, and pulse lengths for 940nm LUXEON IR Family products. Plot color indicates pulse length. Case temperature T_c=25°C.

3.5 Radiant Flux, Peak Wavelength and FWHM vs. Pulse Length

The same data can be plotted as a function of pulse length for a given current. This makes it easier to visualize the influence of pulse length on the optical output, since all other parameters (forward current, duty cycle and temperature) are the same for each plot.

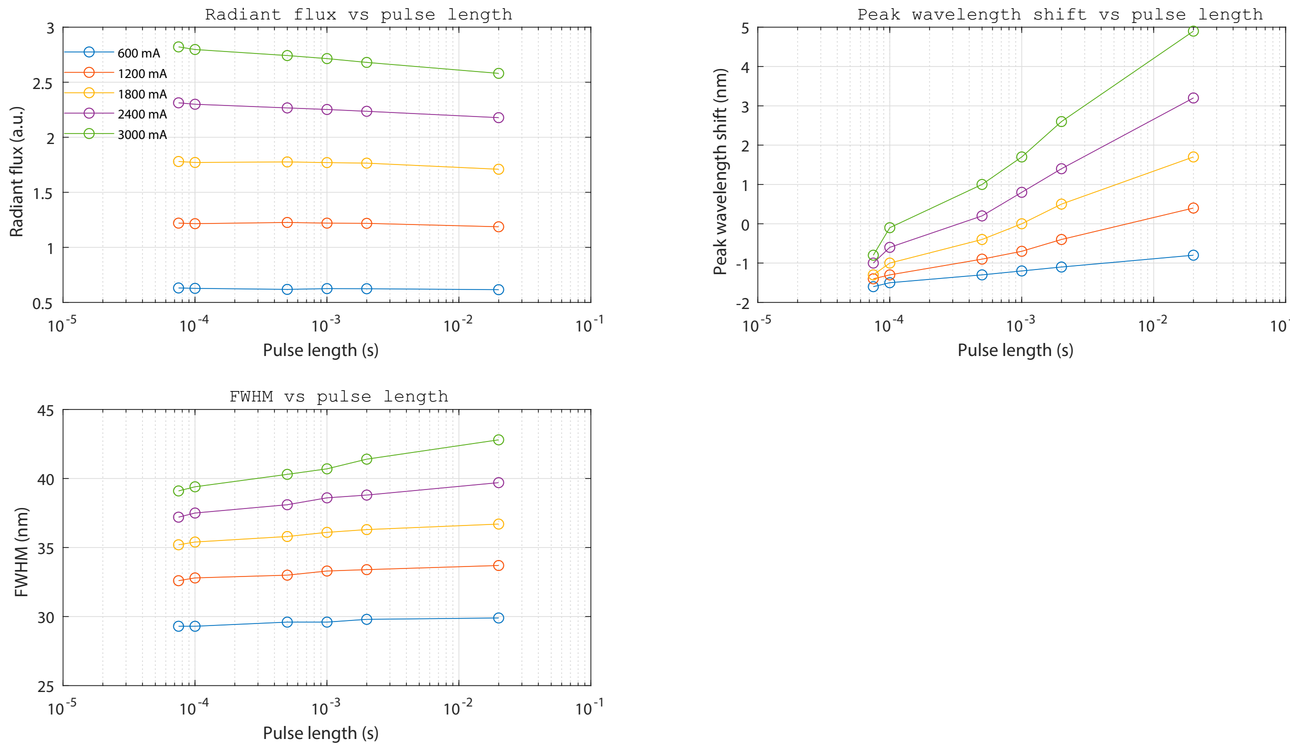

Figure 9. Typical behavior of radiant flux, peak wavelength and FWHM at different forward currents, and pulse lengths for 850nm LUXEON IR Family products. Plot color indicates forward current. Case temperature is 25° C.

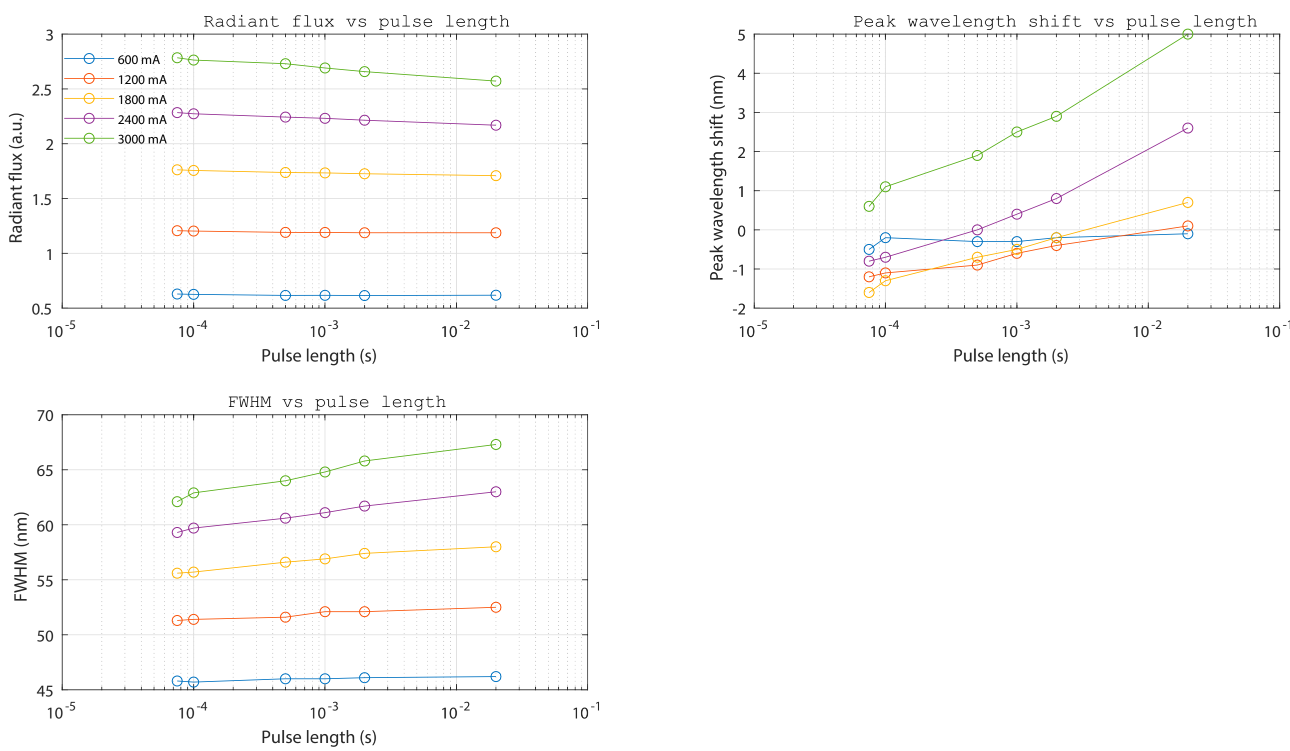

Figure 10. Typical behavior of radiant flux, peak wavelength and FWHM at different forward currents, and pulse lengths for 940nm LUXEON IR Family products. Plot color indicates forward current. Case temperature is 25°C.

About Lumileds

Companies developing automotive, mobile, IoT and illumination lighting applications need a partner who can collaborate with them to push the boundaries of light. With over 100 years of inventions and industry firsts, Lumileds is a global lighting solutions company that helps customers around the world deliver differentiated solutions to gain and maintain a competitive edge. As the inventor of Xenon technology, a pioneer in halogen lighting and the leader in high performance LEDs, Lumileds builds innovation, quality and reliability into its technology, products and every customer engagement. Together with its customers, Lumileds is making the world safer, better and more beautiful—with light.

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