# PKI  Xenon Flash Solution for Mobile Phone Camera

## PerkinElmer New slim Xenon Flash Module IMCR 3703 PK01 (H)

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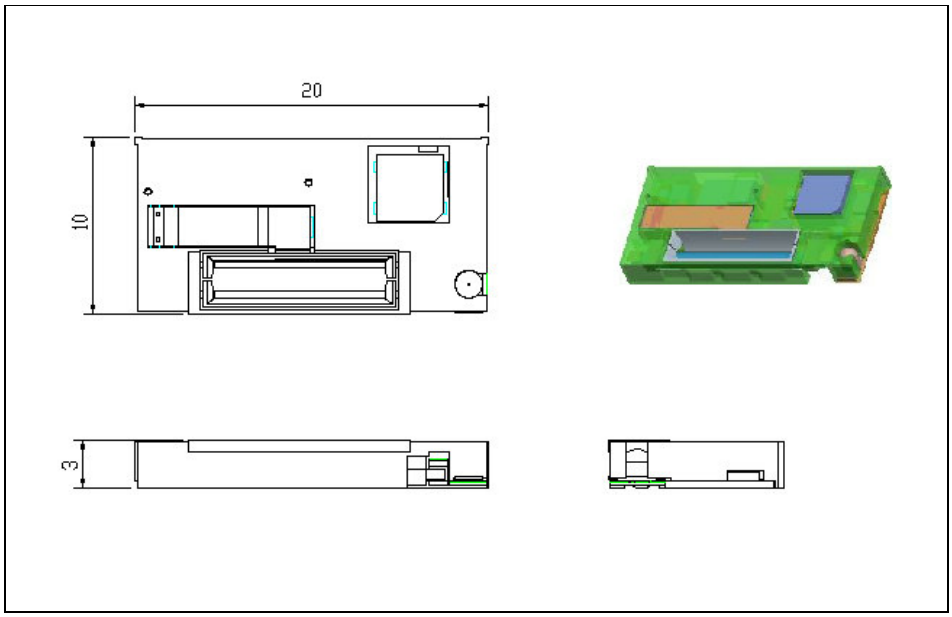
| Capacitor (uF) | 15 | 20 | 22 |
|---|---|---|---|
| Light Output (GN) | 2.5*[1] | 3.0*[1] | 3.2*[1] |
| Light Distribution ( 54° x42°) | | | |
| Horizontal (%)<br>Vertical (%)<br>Diagonal (%) | > 55<br>> 48<br>> 35 | > 55<br>> 48<br>> 35 | > 55<br>> 48<br>> 35 |
| Colour Temperature (K) | 6500 +/- 500 | 6500 +/- 500 | 6500 +/- 500 |
| AF LED Luminous Intensity (cd)<br>- Wavelength: (612 ~ 624) nm | 7 | 7 | 7 |
| Max Charging Current @ 3.7V (mA) | < 380 | < 380 | <380 |
| Max Charging Time @ 3.7V (sec) | < 3.5 | < 3.5 | < 3.5 |
| Operating Voltage (V) | 2.5 – 5.5 | 2.5 – 5.5 | 2.5 – 5.5 |
| Interface signals : | | | |
| - Charge Control | H=1.8V (active HIGH) | H=1.8V (active HIGH) | H=1.8V (active HIGH) |
| - Flash Trigger | H=1.8V (active HIGH) | H=1.8V (active HIGH) | H=1.8V (active HIGH) |
| - Ready (open drain output) | L=0.1V (active LOW) | L=0.1V (active LOW) | L=0.1V (active LOW) |
| Flash Module Unit Size (mm) | 20 x 10 x 3*[2] | 20 x 10 x 3*[2] | 20 x 10 x 3*[2] |

*[1] - Light output is taken at reflector level without Fresnel lens
*[2] – Module does not include Fresnel lens




| Optical Unit | | Energy Bank | | | | Total Volume ($mm^3$) |
|---|---|---|---|---|---|---|
| Size (mm) | Volume ($mm^3$) | (uF) | D (mm) | L (mm) | Volume ($mm^3$) | |
| Xenon | | | | | | |
| 20 x 10 x 3 | 600 | 15 | 6.1 | 20.6 | 601.7 | 1201.7 |
| 20 x 10 x 3 | 600 | 20 | 6.1 | 25.8 | 753.6 | 1353.6 |
| 20 x 10 x 3 | 600 | 22 | 6.1 | 27.9 | 815.0 | 1415.0 |

## Xenon Flash: The Ultimate Choice For Today's Camera Phones

3 conditions must exist simultaneously to capture a high quality picture: **sufficient lighting**, **colour temperature close to natural light** and **object content is stationary**.

In outdoor photography, it is easy to achieve a high quality picture even for an amateur photographer due to the presence of excellent quality light from the sun. The picture will appear sharp even when the object may be moving as small exposure time can be used.

The small exposure time provides the "freezing of motion" effect of the object content that minimizes multiple or ghostly picture which can be the most annoying artifacts. This "freezing of motion" effect can be illustrated through the rotating fan and flying ribbon experiment as shown on Table 1.

The camera is set with exposure time of 33.3, 16.7 and 8 ms. It clearly shows that motion cannot be frozen at exposure time equal to 8ms or above. When the picture is taken with xenon flash, the rotating fan's blade and flying ribbon are stationary at the actual location where the picture is taken. This is made possible in the presence of short duration (< 1ms) of xenon light pulse.

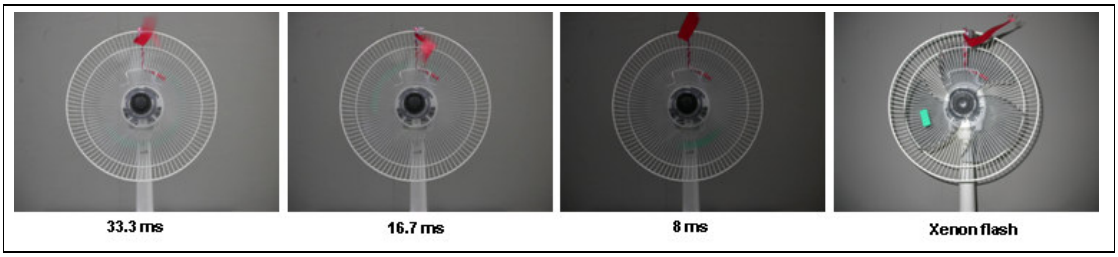



**Table 1: Different exposure time to demonstrate "stop-action" effect**

- Photos are also taken indoor and during the night. Most of times, the photo turns out to be disappointing due to poor quality lighting. In these situations, the camera will attempt to increase the exposure time and imager sensitivity to allow more light to be captured. However, by doing this, the picture taken will be subjected to high degree of handshake causes multiple or ghostly images and unwanted noise that creeps into the picture.

- Typically for LED, pulse in the range of 100ms is in used in order to deliver sufficient light. However, the above picture shows that pulse range more than 1ms is too long to "freeze motion".

Xenon light has been selected as the de-facto standard as it is capable to provide the 3 essential conditions:

1. Intense illuminance that can reach very far distance,
2. Close to natural light colour temperature of 6000K with very high CRI,
3. The short light pulse (most important) that delivers the "freeze-action" effect. There is no further requirement for image stabilization function.

## Xenon Flash vs. LED Light Output Comparison

| Distance | Light Source | Peak luminance (lux) | 1 ms (Freeze Motion) Light output (lux.s) | 1/60th second (DSC flash sync speed) Light output (lux.s) |
|---|---|---|---|---|
| 0.5 m | Trim Xe Xenon Flash (28 uF) | 350000 | 70 | 70 |
| | MPC LED* (~350 mA) | 60 | 0.035 | 0.58 |
| | LED (1000 mA) Measured outside MPC** | 171 | 0.092 | 1.53 |
| 1.0 m | Trim Xe Xenon Flash (28 uF) | 90000 | 18 | 18 |
| | MPC LED* (~350 mA) | 15 | 0.009 | 0.15 |
| | LED (1000 mA) Measured outside MPC** | 43 | 0.023 | 0.39 |
| 1.5 m | Trim Xe Xenon Flash (28 uF) | 40000 | 8 | 8 |
| | MPC LED* (~350 mA) | 6.8 | 0.004 | 0.068 |
| | LED (1000 mA) Measured outside MPC** | 20 | 0.011 | 0.175 |
| 2.0 m | Trim Xe Xenon Flash (28 uF) | 22500 | 4.5 | 4.5 |
| | MPC LED* (~350 mA) | 3.7 | 0.002 | 0.036 |
| | LED (1000 mA) Measured outside MPC** | 11.25 | 0.0059 | 0.1 |

* Single die LED in mobile phone with beam shaping optics
** LED mounted on Linear Tech demo board

For the past 2 years, xenon light begins to be adopted into the mobile phone through its **aggressive miniaturization roadmap.** As space is a premium, smaller light energy is compromised to provide sufficient light for 2-3 meters photography. Xenon is a matured technology that can be easily equipped with higher energy as long as space allows.

Xenon has been used in successful camera phones that demonstrated its compatibility to be incorporated without compromise in overall phone size. Table 2 shows a comparison in terms of size between xenon and 2x LED solutions (driven with supercapacitor). 2x LED driven with 1.5A are compared as this is the best solution available in terms of amount of light energy.

| Optical Unit | | Energy Bank | | | | Total Volume ($mm^3$) |
|---|---|---|---|---|---|---|
| Size (mm) | Volume ($mm^3$) | (uF) | D (mm) | L (mm) | Volume ($mm^3$) | |
| | | | | | | |
| **Xenon** | | | | | | |
| 20 x 10 x 3 | 600 | 15 | 6.1 | 20.6 | 601.7 | 1201.7 |
| 20 x 10 x 3 | 600 | 20 | 6.1 | 25.8 | 753.6 | 1353.6 |
| 20 x 10 x 3 | 600 | 22 | 6.1 | 27.9 | 815.0 | 1415.0 |
| | | | | | | |
| **LEDs (2x)** | | | | | | |
| 43.25 x 3.14 | 135.9 | 420000 | 20 x 18 x 3.2 | | 1152 | 1287.9 |

**Table 2: Size comparison between Xenon and LED / Supercapacitor**

The table shows that xenon solution with 15uF or less, the total volume space can be less than LED solution but still delivering sufficient energy for about 2m photography.

Xenon has been demonstrated capable of reaching longer distance and at the same time suitable for macro distance photography. This can be done in 2 ways:

1. Using a photosensor circuitry to auto-regulate the light
2. Pulse-width controlled the amount of light energy discharge. This approach comes at no cost and size as it can be easily implemented via software algorithm which has been proven in the DSC products

As the energy for the light discharge is stored in secondary capacitor, charging current can be moderated to suit the battery load. There is no real time demand that will draw unusual peak load from the battery which is damaging for the battery lifespan and in worse case situation, de-stabilise the phone which may affect the normal phone operation.

## The Advantages of the xenon light:

- 1000x–2000x Brighter (Lux-s) than the brightest LEDs (@ 200 µS pulse width; 2.0 m distance) - illuminates targets at a longer distance
- 100-150x Faster shutter speeds compared with LED “flash”
- Delivers great user experience in MPCs without that awful squinting
- Freezes motion—less blur and better action detail
- Sharp, bright, clear, crisp, and colorful photos— even in dim-light conditions
- Same great image quality as in DSCs
- Image quality worthy of transmitting, storing and printing
- Accurate color temperature —close to natural daylight
- Require no “band-aids” such as brightness/ contrast/color correction and image stabilization software
- 35% Smaller than prior generation Xenon flash modules—perfect for today’s trim and ultra slim mobile phones
- 2x Longer life
- Higher LOP efficiency—LOP drop over life <10%