Baby Shutter Tester mark II

User manual

1. Introduction

The Baby Shutter Tester Mark II is a tool for measuring the shutter speed of film cameras.
Its compact and lightweight design, battery-powered operation, and calibration-free operation make it ideal for testing cameras before purchase at fairs or flea markets.
Its excellent accuracy also makes it a very good workshop tool for testing cameras and determining whether or not they require servicing.

This tester was designed in accordance with the recommendations of the international standard ISO-516-2019. As such, it offers professional-level measurement accuracy. It has also been designed to be easy to use, allowing it to be used without any specific technical knowledge.

To get the most out of it, however, it is recommended to read this manual carefully.

2. Presentation

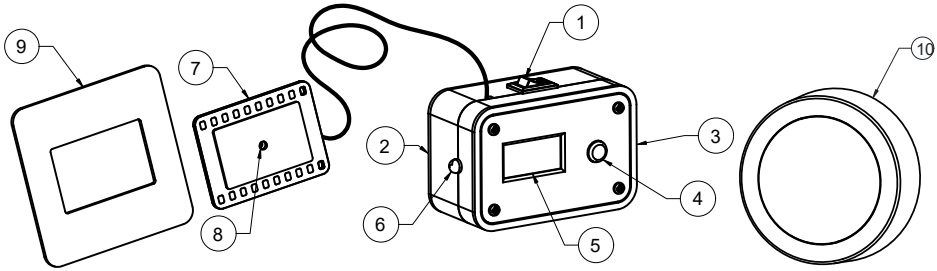

Figure 1 : Presentation

1. On/Off switch
2. LR03/AAA battery compartment
3. Micro USB port
4. Reset and mode selection button
5. Display screen
6. Lighting LED
7. Sensor support
8. Light sensitive sensor
9. Removable 6x6 medium format adapter
10. Light source with diffuser (optional)

The device can be powered either by a micro-USB cable or by two LR03 (AAA) batteries.
When the battery voltage is too low, a low battery indicator ( ) is displayed on the screen and the device cannot be operated.
The light source with diffuser (optional) uses USB-C rechargeable batteries.

Remove the batteries when not using the device for an extended period.
The Baby Shutter Tester should be kept away from moisture and heat sources.
It is designed to operate within a temperature range of 5 to 40°C.

3. Setup: quick inspection of a focal plane shutter camera (SLR or rangefinder type)

- Open the back of your camera.
- Place the sensor on the back of the camera, in place of the film.
  Remove the lens from the camera body.
- Place the tester's LED opposite the camera mount, pointing towards the sensor.
- Turn on the tester.
- Trigger the camera.
- The tester will then display the measured shutter speed.
- The measured value is updated with each new shutter release.

Handheld, the camera is capable of producing **extremely reliable results from 1/15s to 1/1000s** using this procedure, without requiring any calibration.

To obtain reliable results for other use cases (central shutter, slow shutter speeds, etc.), refer to the detailed description in this manual.

4. Measurement Modes

The Baby Shutter Tester has two operating modes: automatic mode and global mode.

- **Automatic mode** should be used for **handheld tests between 1/15s and 1/1000s**
  - with the **built-in LED** for **focal plane** shutters,
  - and with the **light source with diffuser** for **central shutters**.
- **Global mode has no limits** on the speeds to be measured,
  - with the light source with diffuser
  - **from the slowest speed to the fastest speed**.
  - **With identical lighting from one measurement to the next**

See below for further explanations of these two measurement modes

5. Display description and results interpretation

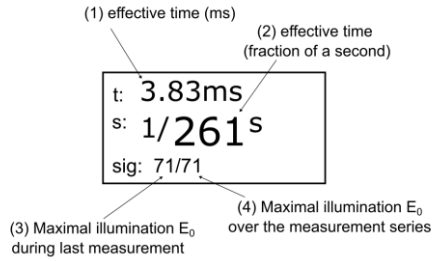

Figure 2: display of the measurement result

After each measurement, the Baby Shutter Tester displays the following:

1) The effective time t_e, expressed in milliseconds
2) The effective time t_e, expressed in fractions of a second
3) The maximum illumination value E_0 during the last measurement
4) The maximum illumination value E_0 over the measurement series (global mode), or "Auto" (automatic mode)

The effective time value, expressed in fractions of a second, should be compared to the shutter speed selected on the camera, for example, 1/250s.
It is important to be aware of the tolerance on these values. The standard tolerance on shutter speed values for new cameras was around 30%. Thus, for a selected shutter speed of 1/250 seconds, the permissible shutter speed values are between 1/187 seconds and 1/350 seconds. This high tolerance should be considered compared with the exposure tolerance of film, for which a 30% increase or decrease in exposure generally has little impact.

The E_0 value, the maximum illumination value, is a unitless value that can vary between 0 and 100 depending on lighting conditions. A value above 90 indicates a value close to saturation. It is necessary to decrease the illumination (move the light source away from the sensor) to maintain reliable measurements.
A value below 10 indicates low illumination. This has the effect of reducing the signal-to-noise ratio, and therefore decreasing the reliability of the measurement.
If, for strictly identical lighting conditions, the E0 value decreases for the highest speeds, this indicates that the operating situation illustrated in Figure 5 is present. To maintain reliable measurements, it is necessary to switch to global measurement mode.

6. Operating principle of shutters and tester

6.1. Shutters

6.1.1. Two families of shutters

There are two types of shutters: front shutters and focal plane shutters.

- A **focal plane shutter** is a shutter located near the camera's focal plane. Focal plane shutters are found on almost all 35mm SLR and 35mm rangefinder cameras, as well as a number of medium format cameras. Focal plane shutters have the characteristic of illuminating the image incrementally.
- A **front shutter** (also called a central shutter or leaf shutter) is a shutter located near or inside the lens. Front shutters have the characteristic of illuminating the entire image simultaneously. Front shutters are found on large format cameras, a large number of medium format cameras (folding, twin-lens, Hasselblad, etc.), but also on many small format cameras with fixed lenses. **The reliable measurement of central shutters is only possible with a light source with a diffuser** (see below).

6.1.2. Perfect Shutter

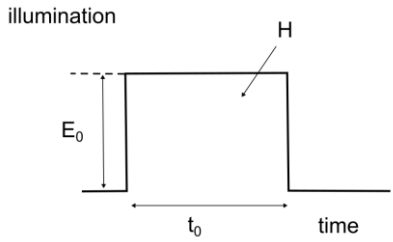

Figure 3 : Illustration of a perfect shutter

The function of a shutter is to limit the exposure of an image to light over time.
Exposure H (the total amount of light received by a point in the image) is the product of the light intensity E_0 and the open time t_0.

$$H = t_0 \times E_0$$

Conversely,

$$t_0 = {}^{H}/_{E_0}$$

Shutter speed is expressed in units of time: the second. To compare this value with camera speed markings, this time is also expressed as a fraction of a second (e.g., 1/125s = 0.008s).

6.1.3. Real shutter

The operation of a perfect shutter is represented in Figure 3. It is either fully closed or fully open.

The real operation of a shutter involves a transition between the fully open position and the fully closed position, the proportion of which can be significant, especially at high speeds.

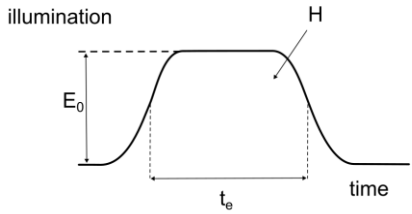

Figure 4: Operation of a Real Shutter

The effective time t_e is then defined by:

$$t_e = {}^{H}/_{E_0}$$

Since the Baby Shutter Tester is capable of measuring E_0 and H, it deduces the effective time t_e using the previous formula.

6.1.4. Degraded case

In the very degraded case, which can be encountered at high speeds, the light intensity measured at a point in the image may begin to decrease before reaching the maximum E_0.

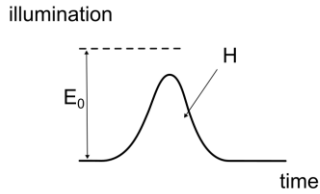

Figure 5: Extreme case of shutter operation

In this case, the E_0 value cannot be determined directly. However, it can be deduced from previous measurements, taken under the same conditions but at a lower speed.
When this case is encountered with a central shutter, it indicates a malfunction (it does not open to its maximum at high speeds).
With a focal plane shutter, this does not indicate a malfunction. This effect is due to the progressive illumination of the sensor's sensitive surface.

6.2. Baby Shutter Tester Measurement Modes

The Baby Shutter Tester has two measurement modes: automatic mode and global mode.

6.2.1. Automatic Mode

In automatic mode, the default operating mode, in addition to measuring exposure H, the tester determines E_0 as the maximum illumination during a measurement.
This allows the tester to determine the effective time in the ideal case shown in Figure 3, or the actual time shown in Figure 4.
For a reliable measurement, the illumination must be constant throughout the measurement.

6.2.2. Global Mode

To also handle the extreme case shown in Figure 5, the device needs to memorize the maximum illumination E_0 from previous measurements.
This is achieved using global mode. In this mode, the maximum illumination E_0 value is retained from one measurement to the next. By performing speed measurements **from the slowest to the fastest, it allows the effective time to be correctly determined, even for speeds above 1/1000s**.
The E_0 value is reset after a short press of the camera's reset/mode button.
Restrictions:

- The lighting must be strictly identical from one measurement to the next. Specifically, this can be achieved by placing the light source with diffuser on the camera mount or lens. Using the built-in LED is not recommended for this mode.
- The aperture value must not be changed from one measurement to the next.
- Some point and shoot cameras have an automatic aperture adjustment that cannot be disengaged. Global mode should not be used for these cameras.

For reliable measurement results in global mode, it is essential that the light is constant during the measurement, as well as from one measurement to the next.
To switch from automatic mode to global mode, and vice versa, press and hold (> 2 seconds) the reset/mode button.

7. Light Sources

To take measurements, the device can use either its built-in LED or a light source with a diffuser (optional).
The light sources supplied with the device have been specifically designed for their stability and suitability for the sensor's sensitivity. The reliability of measurement results cannot be guaranteed with any other light source.

7.1. Built-in LED

The ISO-516-2019 standard recommends to use a light source with diffuser.
However, experience shows that, **in the case of focal plane shutters, for speeds ranging from 15s to 1/1000s**, measurements made with the LED give values very close to those made with the light source with a diffuser.
Place the LED as close as possible to the mount, pointing toward the sensor.
Note that the high sensitivity of the sensor allows measurements to be taken even when the LED is far away. However, this leads to a degradation of the measurement signal-to-noise ratio.

7.2. Light source with diffuser (optional)

The light source with diffuser should be placed against the lens or on the camera mount. This ensures an optimal signal-to-noise ratio and high illumination stability. This last point is particularly critical when using global mode or for measuring slow shutter speeds.

The light source with diffuser is recommended in the following cases:

- Cameras with a central shutter
- Slow shutter speeds
- Using global mode

8. Measurement accuracy

Measurement accuracy is limited by two categories of errors:

- Experimental errors
- Equipment errors

Experimental errors are all phenomena not caused by the device: lighting fluctuations, electromagnetic interference, incorrect sensor positioning, etc.

Experimental errors depend solely on the user.
The equipment error is estimated to be less than 1% + 10 microseconds.

Note that its operating principle does not require calibration.

The validity of this device's measurements has been verified using two different methods:

- The graphical method described in the ISO-516-2019 standard
- Measurements carried out on a shutter model whose speed is known with certainty.

9. Recommendations for use

The table below provides a summary of the tester's usage recommendations.

Use case	Light source	Measurement mode
Quick handheld testing of a SLR or other focal plane shutter camera	Built-in LED	Automatic
Quick testing of a central shutter camera	Light Source with Diffuser	Automatic
Complete workshop testing	Light Source with Diffuser	Global

10. Limitation of warranty

The Baby Shutter Tester has been designed and manufactured with care. However, the manufacturer declines all responsibility for the consequences of its use.

All warranties, express or implied, including, but not limited to, implied warranties of merchantability and fitness for a particular purpose, are disclaimed. In no event shall the manufacturer be liable for any direct, indirect, incidental, special, exemplary or consequential damages (including, but not limited to, loss of use or profits, or business interruption), however caused, arising in any way out of the use of this equipment, even if advised of the possibility of such damages.

11. Manufacture

This product has been designed and manufactured in France. Its assembly is made according to an artisanal process. The case is printed individually on a 3D printer with a bio sourced raw material produced in Europe.
Its design is an extension of the Shutter Speed Tester open-source project (github.com/sebastienroy/shutter_speed_tester).

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