Two Close-up Lens Sets (+1, +2 and +4) for Raspberry Pi HQ Camera 16 mm Telephoto Lens

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Higher magnification of subjects can be achieved by adding close-up lenses to a Raspberry Pi 16 mm telephoto lens. Magnification is due to a shorter focal length which allows to capture pictures closer to the subject.

Two sets of a 37 mm +1, +2 and +4 diopters stackable close-up lenses where used in July 2020 to determine the minimum focusing distance of the subject (a ruler) and to calculate the magnification as a function of diopters. The camera was moved to the shortest distance of the subject which the lens or lens and close-up lens(es) could be focused. Focusing distances were measured in these experiments from the camera sensor to the subject.

Figure 1 shows the minimum focusing distance:

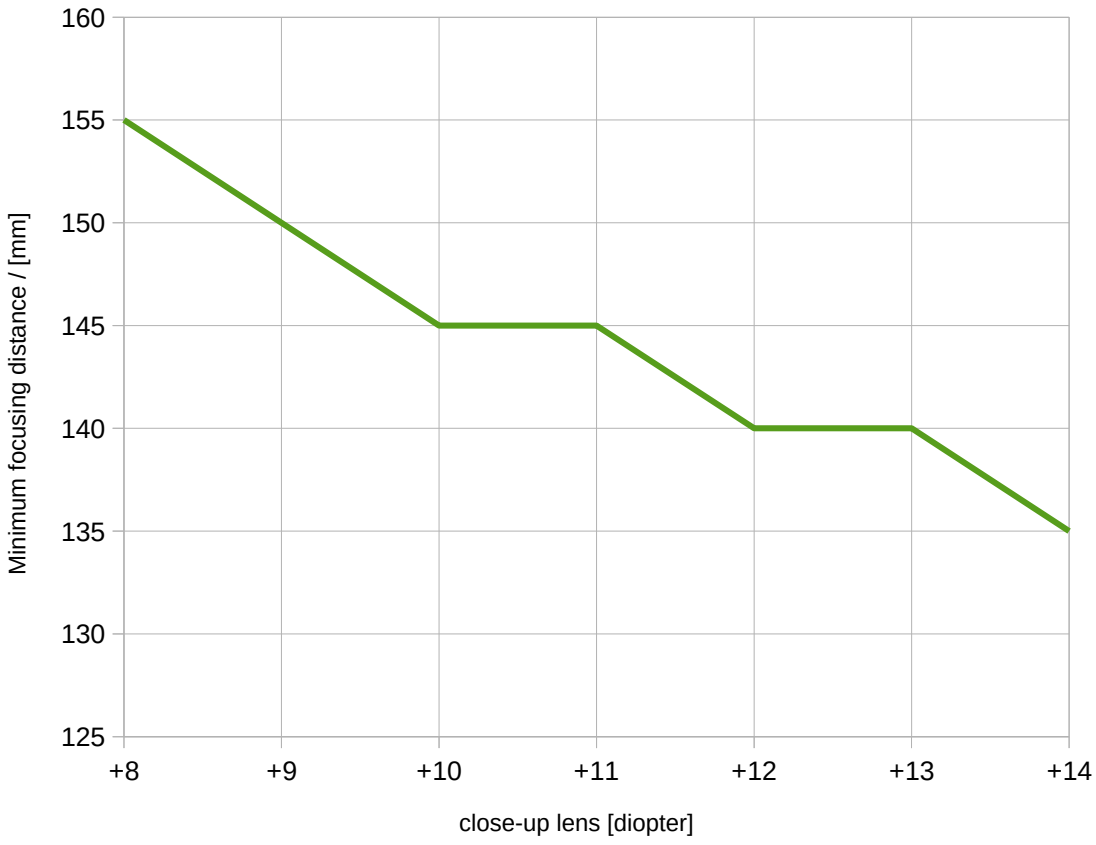

Figure 1. Minimum focusing distance between camera sensor and the subject.

Image magnification is defined as $\beta = y'/y$, where y' is sensor size and y *is* subject size. A HQ camera sensor area is 6.287 mm x 4.712 mm, from where 6.287 mm were used for the calculation of β. The results are shown in Table 1 and Figure 2.

Close-up [diopter]	Configuration	y [mm]	β	d [mm]
0	tele	93.0	0.068	290
+8	tele+4+4	35.0	0.180	155
+9	tele+4+4+1	33.0	0.191	150
+10	tele+4+4+2	31.0	0.203	145
+11	tele+4+4+2+1	29.0	0.217	145
+12	tele+4+4+2+2	27.5	0.229	140
+13	tele+4+4+2+2+1	26.2	0.240	140
+14	tele+4+4+2+2+1+1	25.5	0.247	135

Table 1. Subject size (y), configuration of lenses, image magnification (β) and minimum focusing distances (d) with different close-up lens combinations.

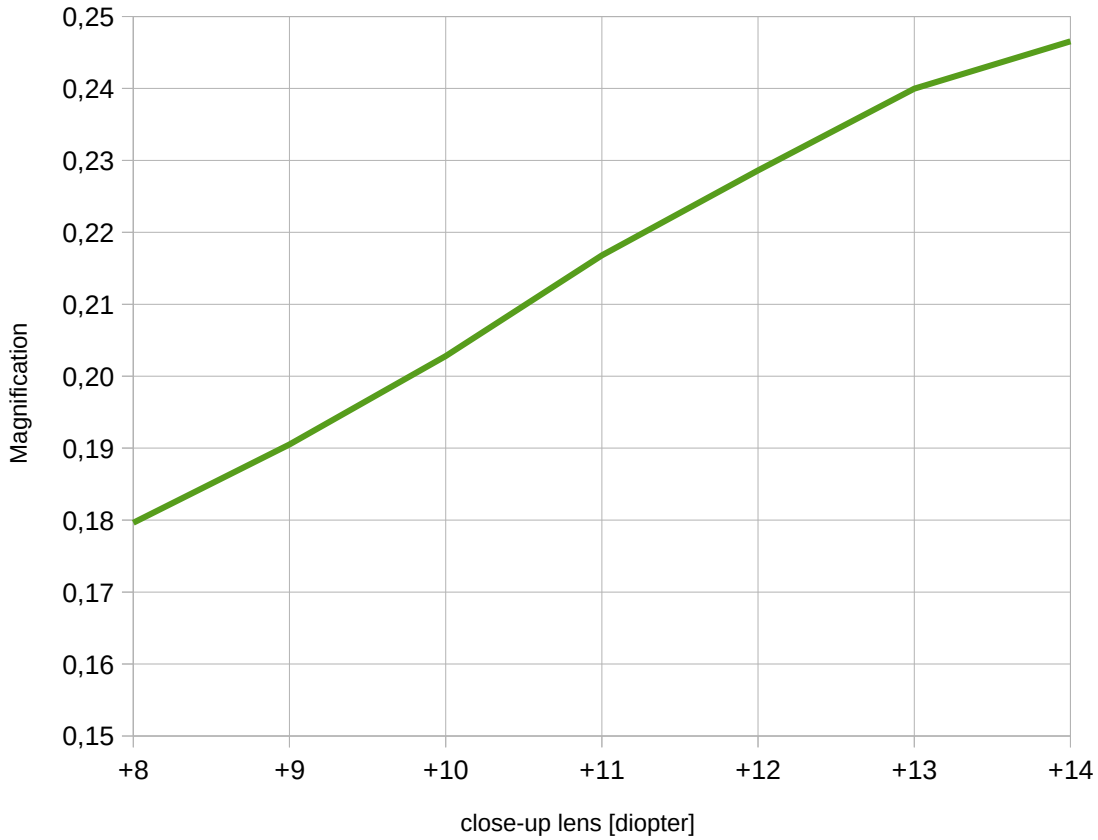

Figure 2. Magnification of different close-up lens combinations.

The magnification capability of a telephoto lens combined with +14 diopter close-up lenses are demonstrated in the following figures:

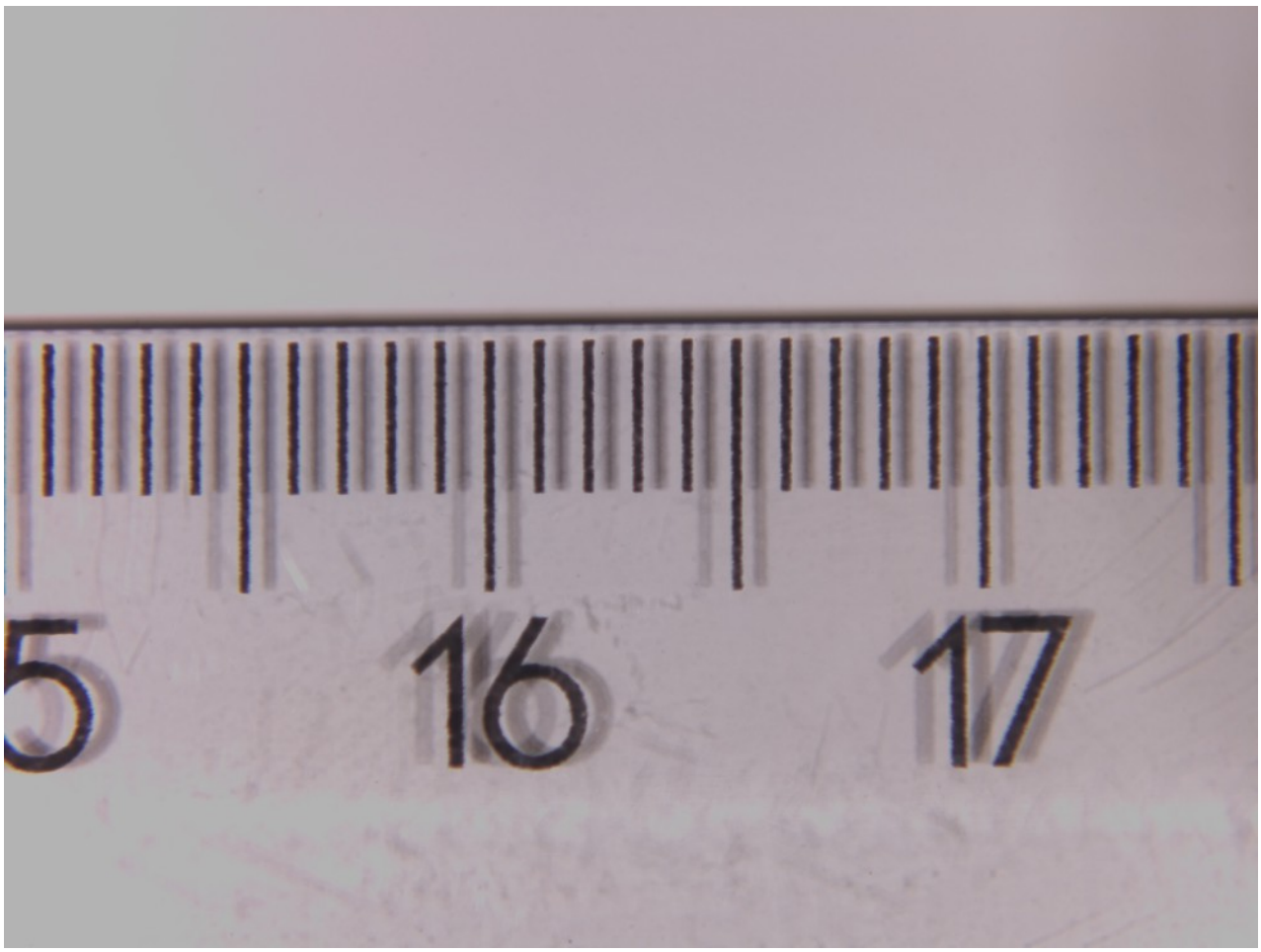

Figure 3. Part of a ruler: full field of view.

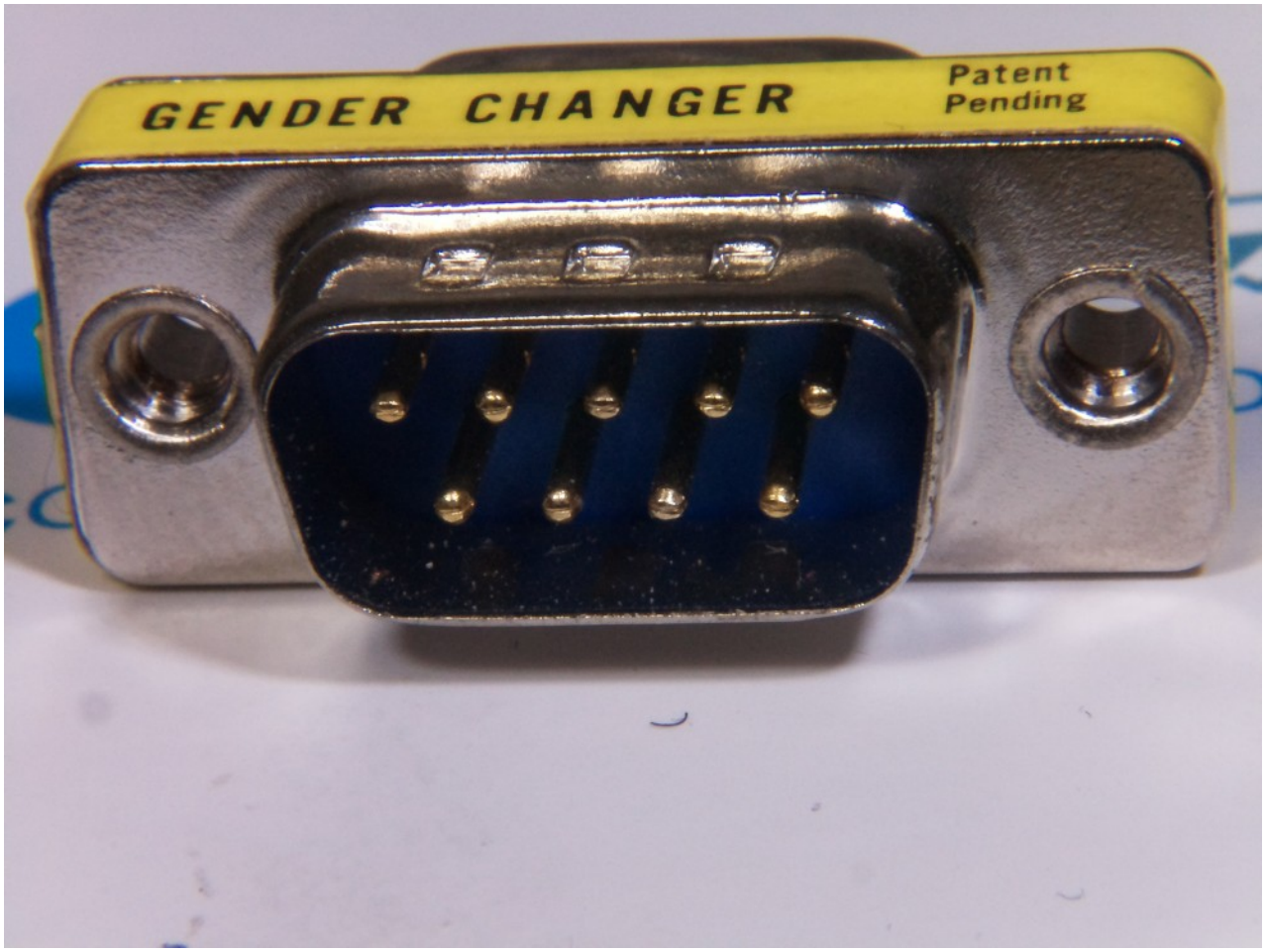

Figure 4. RS-232 gender changer: full field of view.

Figure 5. RS-232 gender changer: cropped view.

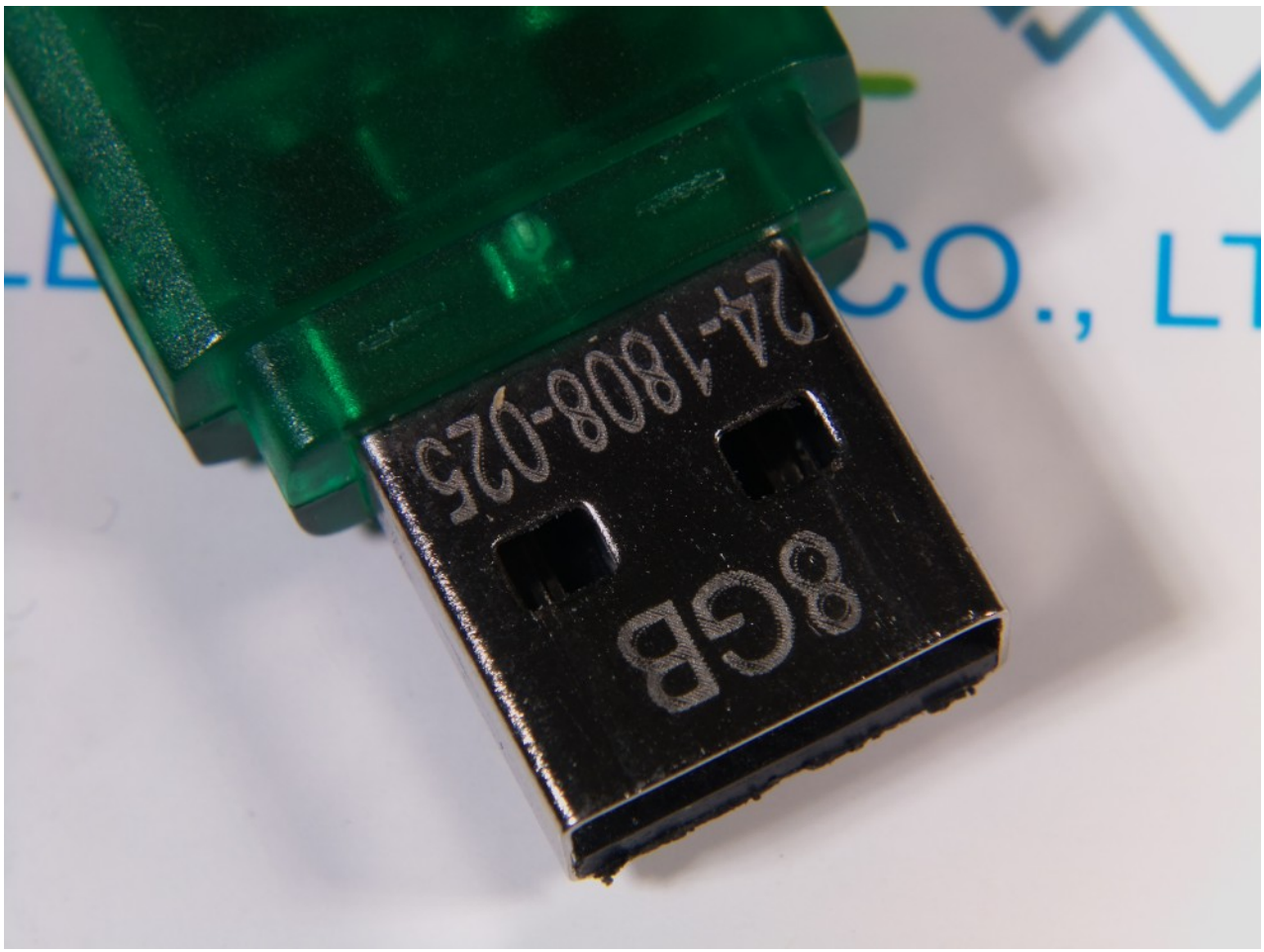

Figure 6. USB flash drive: full field of view.

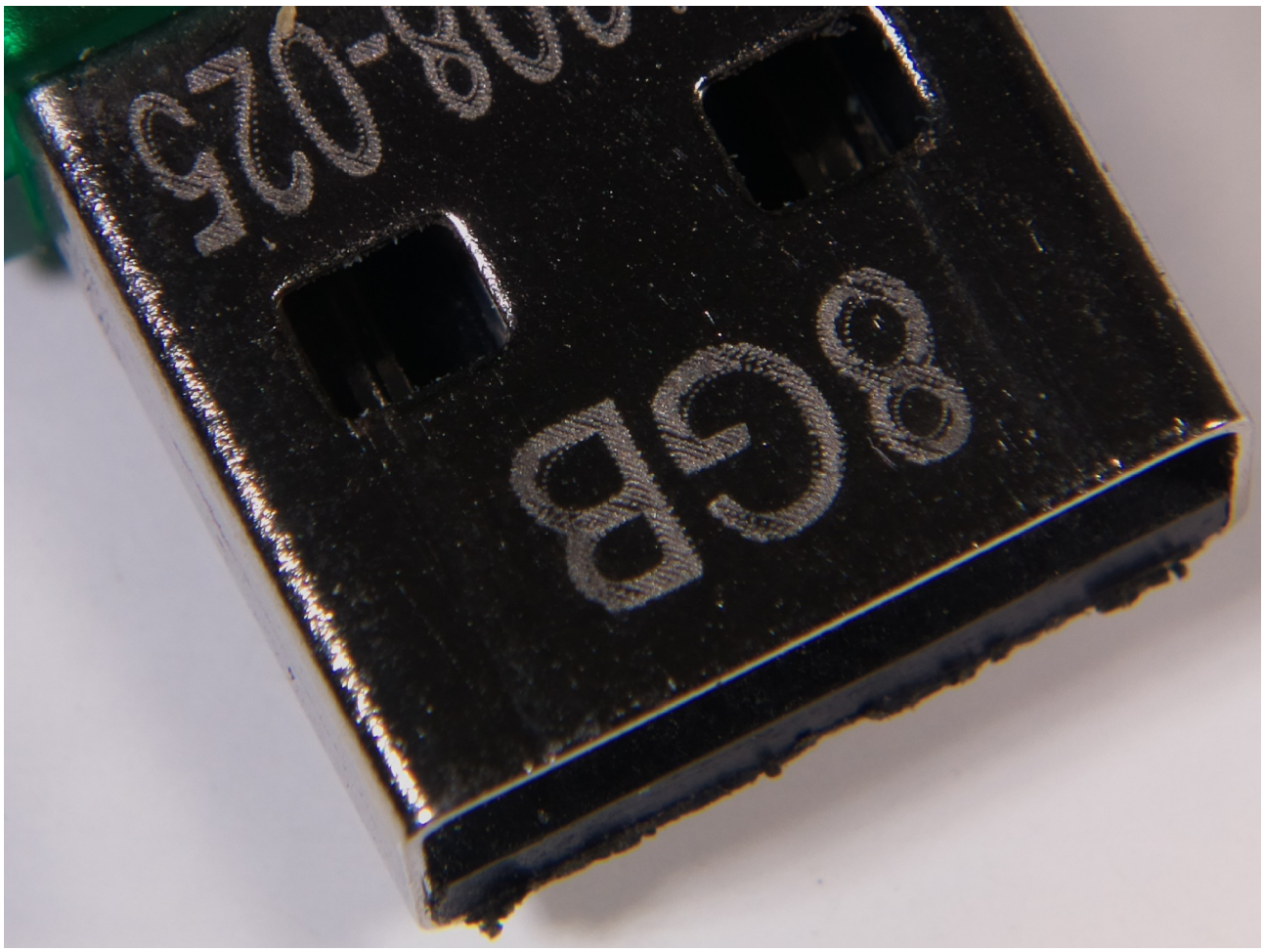

Figure 7. USB flash drive: cropped view.