[Description]

This function is used to adjust the image quality in real time. In specific, the function consists of the adjustment of the tone of the whole area (Base Tone) and the local tone adjustment of low luminance and medium luminance (Low Tone and Mid Tone), and these adjustments can be performed at the same time in a superimposed manner. With the Base Tone adjustment, the luminance of the whole area can be increased or decreased so that its influence would become greater as the luminance becomes higher. With the Low Tone and Mid Tone adjustments, it is possible to increase or decrease the luminance by making smooth peaks or valleys for the low and medium luminance areas.
Since this function is applied at the position shown in Fig. 1 below, it is applied to both HDR and SDR outputs in simultaneous production operation of HDR and SDR. Therefore, when converting the HDR signal to SDR in a later stage, it is possible to obtain an image equivalent to the SDR output from the camera and the BPU.

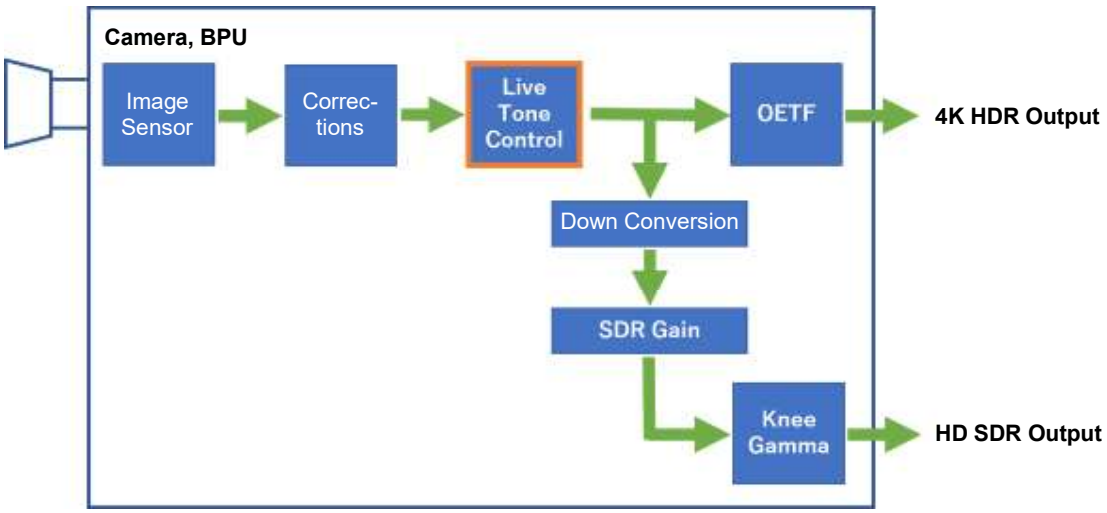


Fig. 1: Position where Live Tone Control is applied

In this function, four luminance level values of Red (R Level), Green (G Level), Blue (B Level) and Master (Master Level) can be set for each of Base Tone, Low Tone and Mid Tone. The setting values of R Level, G Level, and B Level are applied when adjusting the tones of the R-ch, G-ch, and B-ch received by the sensor, whereas the setting value of Master is added to the setting values of R Level, G Level, and B Level. As other setting items, Base Tone has the degree of curvature of curves (Curve), Low Tone has the range to be adjusted (Width), and Mid Tone has the range to be adjusted (Width) and its median value (Center).

● Description of each parameter
Table 1 below shows the descriptions of each parameter of this function. The values of Base Tone, Low Tone and Mid Tone in the RCP and MSU menus are equivalent to Master of Base Tone, Master of Low Tone and Master of Mid Tone, respectively.

Table 1: Parameter descriptions

Parameter Name	Parameter Description
Live Tone Control ON/OFF	ON/OFF of the Live Tone Control function
Base Tone ON/OFF	ON/OFF of the adjustment of the whole area
Low Tone ON/OFF	ON/OFF of the adjustment of low luminance area
Mid Tone ON/OFF	ON/OFF of the adjustment of middle luminance area

R, G and B Levels of each Tone: -99 to 99	Setting of each luminance level. 0 makes no adjustment Positive value increases luminance and negative value decreases luminance
Master Level of each Tone: -99 to 99 (Same as Base/Low/Mid Tone in the Live Tone Control 1 menu)	Setting of the master luminance level of each Tone 0 makes no adjustment (linear) Positive value increases luminance and negative value decreases luminance
Low Width: -99 to 99	Setting of the adjustment range of low luminance area Positive value expands the range and negative value narrows the range
Mid Center: -99 to 99	Setting of the median of the adjustment range of the medium luminance area Positive value increases median and negative value decreases median
Mid Width: -99 to 99	Setting of the adjustment range of medium luminance area Positive value expands the range and negative value narrows the range
Base Curve: -99 to 99	Setting of the curvature of curves over the whole area Positive value makes the curve steeper and negative value makes it shallower

The range where each Tone becomes effective is about 0 to 1300% for Base Tone, about 0 to 50% for Low Tone, and about 0 to 400% for Mid Tone. Fig. 2 below illustrates this.

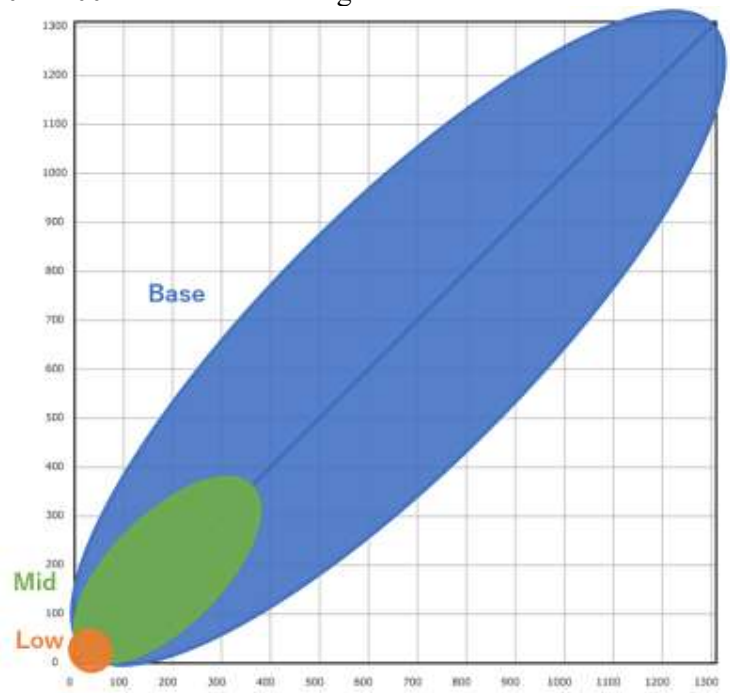


Fig. 2: Range where the effect of each Tone appears in the linear axis

Also, Fig. 3 below roughly shows the relationship between each parameter and the tone curve. However, note that the axis scale differs for Base Tone, Low Tone, and Mid Tone in Fig. 3 (0 to 1300% for Base Tone, 0 to 100% for Low Tone, and 0 to 350% for Mid Tone). For convenience, Master, R, G, and B Levels are hereafter collectively referred to as Level.

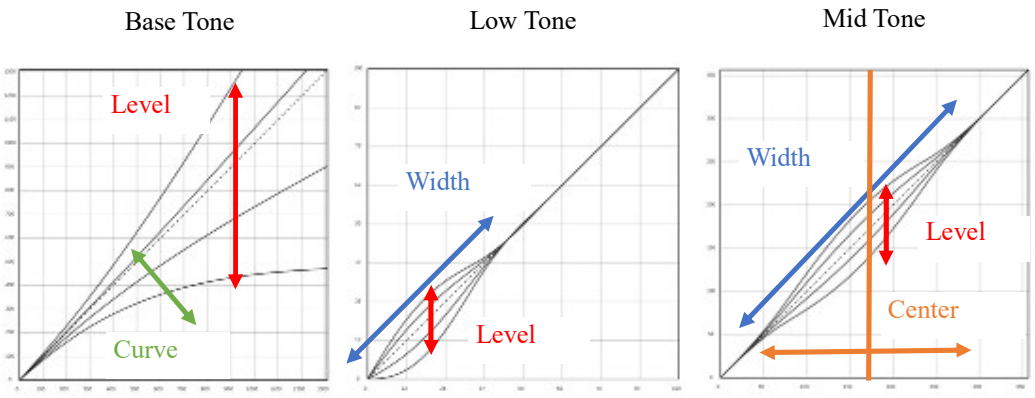


Fig. 3: Relationship between each parameter and tone curve

- Relationship between values of various parameters and tone curve
  The relationship between the Base Curve value and the tone curve is as shown in Fig. 4 below. The red line shows the case where Level is the maximum (99), the green line shows the case where Level is -50, and the blue line shows the case where Level is the minimum (-99). Note that the axes of the graphs in Fig. 4 are all 0 to 1300%.

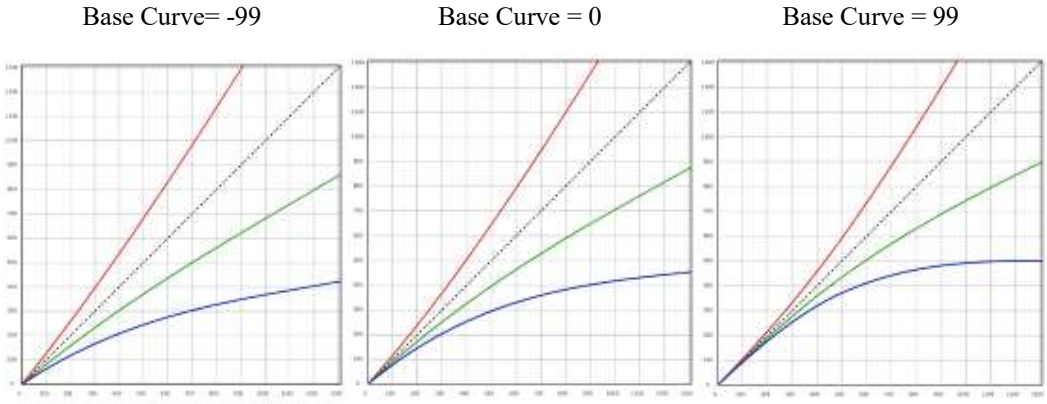


Fig. 4: Relation between the Base Curve value and the tone curve

The relationship between the value of Low Width and the tone curve is as shown in Fig. 5 below. The red line shows the case where Level is the maximum (99), and the blue line shows the case where Level is the minimum (-99). Note that the axes of the graphs in Fig. 5 are all 0 to 50%.

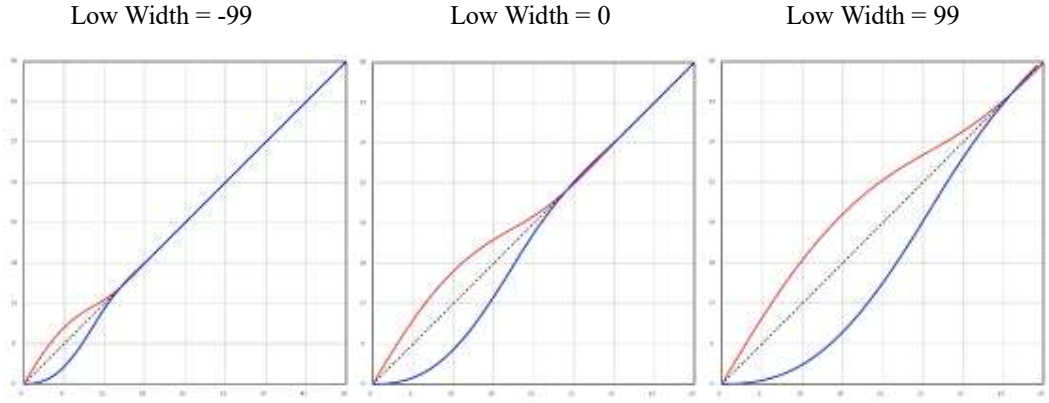


Fig. 5: Relationship between Low Width and tone curve

Table 2 below shows the ranges of luminance to be adjusted in Fig. 5.

Table 2: Relationship between the Low Width values and the ranges of luminance to be adjusted

Low Width value	Range of luminance to be adjusted
-99	0 to 15%
0	0 to 30%
99	0 to 45%

Table 3 below shows the relationship between the Mid Center and Mid Width values and the tone curves. The red line shows the case where Level is the maximum (99), and the blue line shows the case where Level is the minimum (-99). Note that the axes of the graphs in Table 3 are all 0 to 400%.

Table 3: Relationship between the Mid Center and Mid Width values and the tone curves

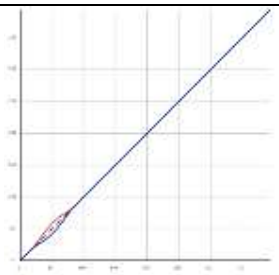
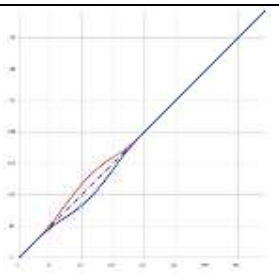
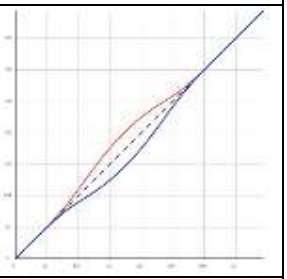
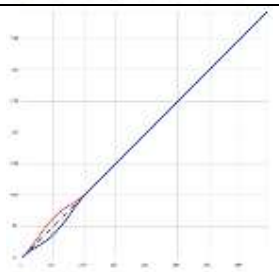
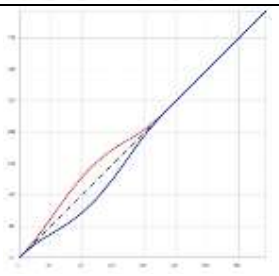
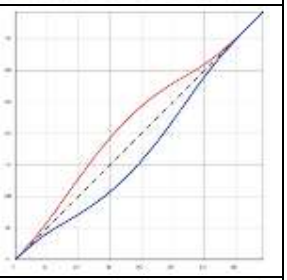
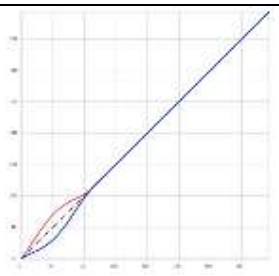
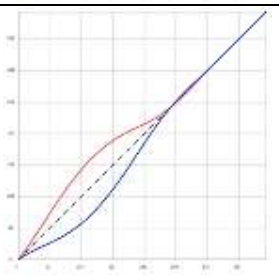
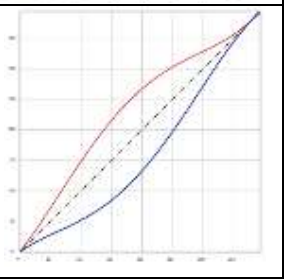
Mid Width value \ Mid Center value	-99	0	99
-99			
0			
99			

Table 4 below shows the ranges of luminance to be adjusted in Table 3.

Table 4: Relationship between the Mid Center and Mid Width values and the range of luminance to be adjusted

	Mid Center = -99	Mid Center = 0	Mid Center = 99
Mid Width = -99	15 to 85%	30 to 190%	45 to 295%
Mid Width = 0	0 to 105%	0 to 230%	0 to 360%
Mid Width = 99	0 to 110%	0 to 240%	0 to 375%