WHITE PAPER:
THEIA™ SERIES MICRO-MINIATURE FLEXIBLE ENDOSCOPY SYSTEM

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Micro-Miniature Flexible Endoscopy System by Brandon Morioka

The Theia™ is an LED illuminator with an integrated video processing unit (VPU) for original equipment manufacturers (OEMs) in microendocsopy applications. The two Theia models include a 160k-pixel resolution and a 40k-pixel resolution system with the latest CMOS image sensor technology. The **Theia 160** has auto-gain and auto-exposure features for endoscopes as small as 1.7mm outside diameter (OD). The **Theia 40** is used in applications that require the smallest endoscopes (1.1mm) and does not allow the auto-gain or auto-exposure circuitry, but it comes with auto-LED brightness. This article is an overview of the Theia 160 and Theia 40 features and benefits with the different Theia VPU imaging modes for ease of use.

Both Theia VPUs have a programmable measurement window or region of interest (ROI). The VPU overlays a virtual window border over an image allowing ROI changes to the sides of the center window border without impacting the image size or frame rate.

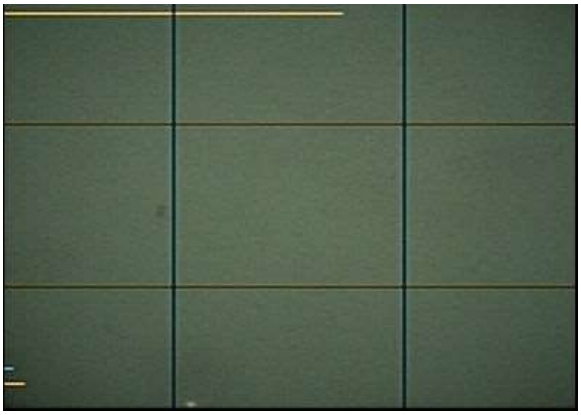

Figure-1: Theia VPU with virtual window enabled.
The ROI has no impact on image size or frame rate.

In general, the Theia VPU uses a defined target gray value and calculates the mean gray value within the ROI. The firmware then decides whether to either increase the brightness, keep the brightness, or decrease the brightness with the optimal image setting.

Theia 160 Auto-Gain & Auto-Exposure

Increase in brightness: The Theia 160 will first increase the exposure time. If the max exposure time is reached, then the gain will be increased by pixel voltage amplification.
Decrease in brightness: The Theia 160 will first decrease the gain that lowers image noise. If the minimum gain is reached, then the exposure time is lowered.

Auto Mode

There are three different target values in auto mode: Low, Default and High. The user can toggle the Auto Mode and the Theia VPU will re-balance the mean to the selected target gray value.

Figure-2: From left to right: Theia 160 Low, Default and High auto modes.

Manual Mode

There are also three fixed exposure and gain settings in manual mode. The user can select the corresponding exposure and gain value and the Theia VPU will re-balance to the settings. See Figure-3 for the Manual modes and compare between Auto and Manual modes that gives the user more flexibility for their application.

Figure-3: From left to right: Theia 160 Low, Medium and High manual modes.

Theia 40 Auto-LED Brightness

The Theia 40 is again ideal for the smallest endoscopes available, as small as 1.1mm OD. The small OD endoscope does not allow for auto-gain or auto-exposure, but the Theia VPU has an auto-LED brightness feature for ease of use.

Auto Mode

There are three different target values in auto mode: low, default and high. The user can toggle the Auto Mode and the Theia VPU will re-balance the LED illumination intensity to the selected target value.

Figure-4: From left to right: Theia 40 Low, Default and High auto LED-brightness modes.

Manual Mode

In manual mode, the user can select the corresponding LED illumination intensity based on the best image and the Theia 40 VPU will re-balance to the settings. See Figure-5.

Figure-5: From left to right: Theia 40 Low, Medium and High manual modes.

Summary

Both the Theia 160 and the Theia 40 offer the highest video quality and resolution with the smallest OD endoscope sizes available on the market. The standard Theia VPU features auto-gain and auto-exposure, or auto-LED brightness depending on the model required for the end-user's application.

Custom VPU, LED, and videoscope options are available, including trade dress for OEMs. Let us know how Ushio can help.

Contact VermontSales@ushio.com for more information.

Will be designed in accordance with IEC60601-1, 3rd ed., 60601-2-18 Particular requirements for basic safety and essential performance of endoscopic equipment, IEC 62471 Photobiological Safety of Lamp Systems.

RoHS COMPLIANT

Certified System

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