**UBS 3.0 – NIOS II Interface**

**Nomenclature:**

* **Tx:** Transmit to USB 3.0;
* **Rx:** Receive from USB 3.0.

**Concept:**

* All Tx data is transmitted through a double buffer of 16 kiB (8 kiB + 8 kiB):
  + The double buffer is accessed by the same address.
  + All Double Buffer access is by DMA (NIOS cannot read/write directly to it).
* All Rx data is received through a double buffer of 16 kiB (8 kiB + 8 kiB)
  + The double buffer is accessed by the same address.
  + All Double Buffer access is by DMA (NIOS cannot read/write directly to it).

**Interrupts:**

* **Rx Buffer 0 Full:** Rx Buffer 0 to receive data from USB 3.0 is full of data (8 kiB) and ready to be read.
* **Rx Buffer 1 Full:** Rx Buffer 1 to receive data from USB 3.0 is full of data (8 kiB) and ready to be read.
* **Rx Last Buffer:** Rx Last Buffer of a transmission is ready. This flag is used to indicate an end of transmission (since the last buffer can be smaller than 8 kiB).
* **Rx Communication Protocol Error:** An error occurred with the Communication Protocol to receive data (a request of a full image).
* **Tx Buffer 0 Empty:** Tx Buffer 0 is empty and ready to receive data (8 kiB).
* **Tx Buffer 1 Empty:** Tx Buffer 1 is empty and ready to receive data (8 kiB).
* **LUT Transmitted:** LUT was finished being transmitted to the USB 3.0.
* **Tx Communication Protocol Error:** An error occurred with the Communication Protocol to transmit data (the transmission of a LUT).

**Controls:**

* **FEE:** FEE number/ID for a Full-Image Request or a LUT Transmission. Range from 0 to 5.
* **CCD:** CCD number/ID for a Full-Image Request or a LUT Transmission. Range from 0 to 3.
* **Side:** CCD Side for a Full-Image Request or a LUT Transmission. Can be “Left” or “Right”.
* **Exposure Number:** Exposure Number for a Full-Image Request (not used in a LUT Transmission). Range from 0 to 16383.
* **Request Full-Image:** instruct the HW to send a Full-Image Request using the values of “FEE”, “CCD”, “Side” and “Exposure Number” fields;
* **LUT Length:** LUT data length in bytes for a LUT Transmission (not used for a Full-Image Request). Have a maximum size of 4GB;
* **Transmit LUT:** instruct the HW to send a LUT Transmission using the values of “FEE”, “CCD”, “Side” and “LUT Length” fields;
* **LUT Last Buffer:** indicates to the HW that the Last Buffer or a LUT Transmission was configured in the DMA.

Status:

* **FEE:** FEE number/ID of a Full-Image Request or a LUT Transmission. Range from 0 to 5.
* **CCD:** CCD number/ID of a Full-Image Request or a LUT Transmission. Range from 0 to 3.
* **Side:** CCD Side of a Full-Image Request or a LUT Transmission. Can be “Left” or “Right”.
* **Exposure Number:** Exposure Number of a Full-Image Request (not used in a LUT Transmission). Range from 0 to 16383.
* **Image Length:** Image Length in bytes of a Full-Image Request (not used in a LUT Transmission). Have a maximum size of 4GB;
* **Full-Image Received:** Indicates to the SW that a Full-Image Request was answered, with the values in the “FEE”, “CCD”, “Side”, “Exposure Number” and “Image Length” fields;
* **Rx Busy:** Indicates that the HW is in the middle of a data receive from the USB 3.0;
* **Rx Buffer Full:** Indicates that at least one of the Rx Double Buffer buffers is full of data (8 kiB).
* **Last Rx Buffer:** Indicates that the current Rx Buffer is the last buffer of a transmission. This flag is used to indicate an end of transmission (since the last buffer can be smaller than 8 kiB).
* **LUT Transmitted:** Indicates a LUT finished being transmitted to the USB 3.0;
* **Tx Busy:** Indicates that the HW is in the middle of a data transmission for the USB 3.0;
* **Tx Buffer Empty:** Indicates that at least one of the Tx Double Buffer buffers is empty and ready for data (8 kiB).