TSL2771 EVM2

USER'S GUIDE TAOS

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TSL2771 LIGHT-TO-DIGITAL AMBIENT LIGHT / PROXIMITY SENSOR EVALUATION SYSTEM

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INITIAL HARDWARE SETUP

The software should be installed prior to connecting any hardware to the computer. Follow the instructions found in the Quick Start Guide (QSG). This will load the required driver for the USB interface and also the control software and graphical user interface (GUI).

The hardware consists of the Controller EVM v2.1 motherboard, the TSL2771 evaluation daughterboard and a USB interface cable.

When the USB cable is connected the green LED should light up indicating that power is being received via the USB interface, and the motherboard processor is running. If both the green and blue LED's light up there is a problem and the USB cable should be disconnected immediately. Recheck the adapter card interconnection to the motherboard and try again. If the green & blue LED's continue to both come on contact TAOS for a replacement motherboard.

ESTABLISHING BASIC FUNCTIONALITY

The software should be started using the desktop icon or by double clicking the TSL2771 EVM.EXE file from the installation directory. The default installation directory is:

C:\Program Files\TAOS\TSL2771EVM   Windows 32 bit operating systems
C:\Program Files (x86)\TAOS\TSL2771EVM   Windows 64 bit operating systems

although the installer may not have used the default. When started, the following windows will open on the PC. The bottom window is the main user interface and should be positioned on the screen for easy access. The top window is not typically needed and may be placed out of the way.
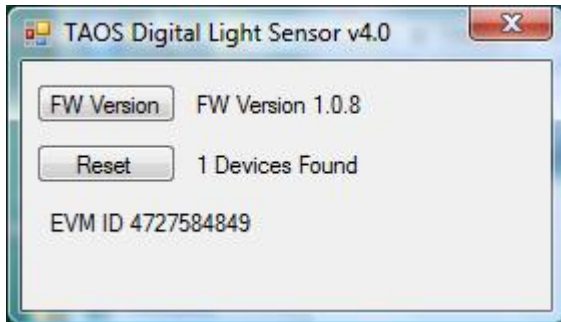
Clicking on the red "X" on the top window will close the application. Clicking on the red "X" on the bottom window will close only the bottom window.

The "Functional" tabs on both the left and right side of the main display (bottom window) should be selected by default. On the right side numbers should be changing showing that the ALS and proximity functions are operational. By changing the ambient light source or waving your hand over the sensor at <4 inch (100mm) separation you should see the ALS and proximity readings change correspondingly.
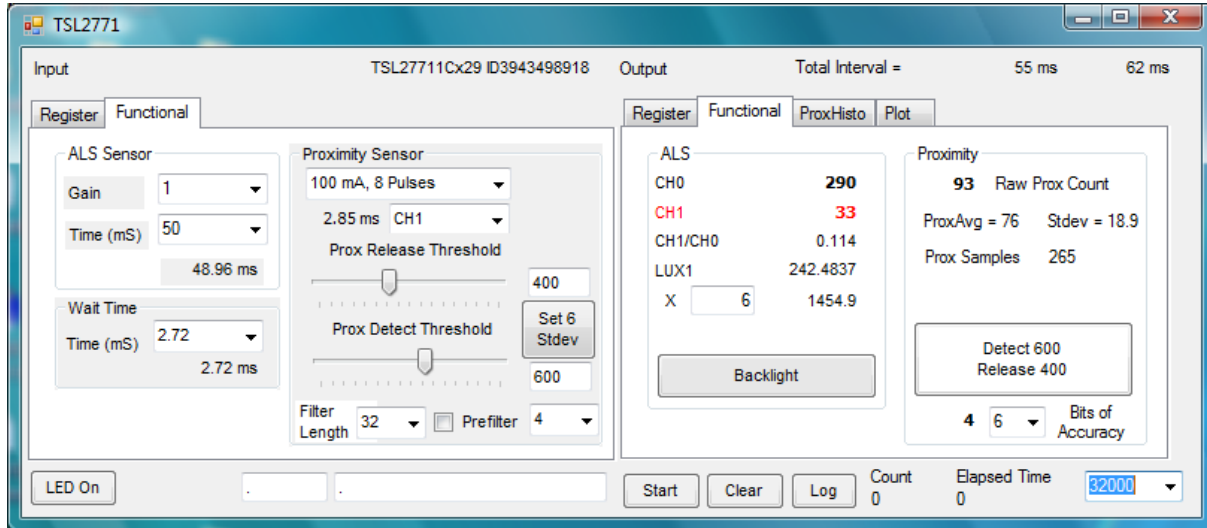

The balance of this document identifies and describes the controls available on the different tabs of the GUI. In combination with the TSL2771 datasheet, the QSG and application notes available on the TAOS website www.TAOSinc.com there should be enough information to allow evaluation of the TSL2771 device.

# TSL2771 EVM GRAPHICAL USER INTERFACE (GUI)

SOFTWARE OVERVIEW

On initialization the software displays two windows – a smaller "TAOS Digital Light Sensor" window and a larger window containing controls pertinent to the device connected.
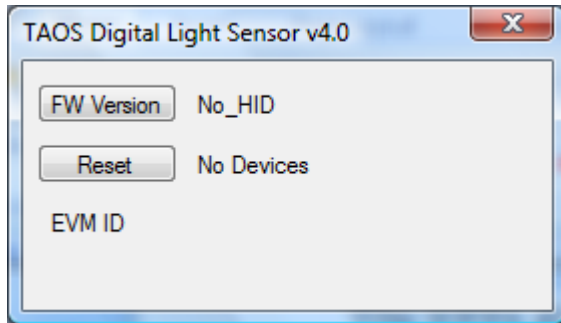
If "No Devices" appears, verify that the daughterboard is connected to the motherboard properly. If "No_HID" appears, verify the USB cable is connected. A green LED on the motherboard indicates that the USB cable is connected and providing power to the system.

The "Reset" button can be pressed or the software can be restarted to reinitialize the system.

The larger window contains the user interface with control buttons, fields, selection boxes and output values for the identified device connected. Tabs are used to make control and evaluation of specific device functions easy. For the TSL2771 devices the initial display screen is shown:
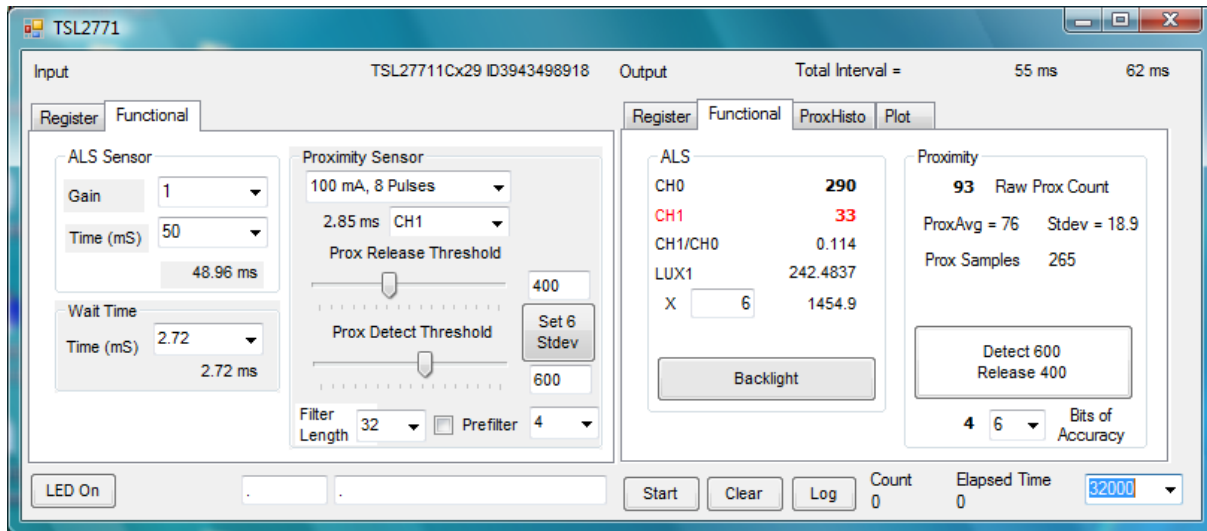
This window has inputs organized on the left, and outputs organized on the right. Values for register variables may be set using multiple techniques. The Functional tab is commonly used to quickly evaluate the device with nominal settings. The Input Register tab allows the register settings to be changed, and the Output Register tab allows registers to be viewed. Other tabs provide additional demonstration and test features for evaluation.

By default the "Functional" tabs have the focus. The values shown in this document will not exactly match a users system but the basic window and controls should be identical. This document will identify the usage and operation of these items in detail.

Always visible along the bottom are the following controls:

- LED Off – ON/OFF/ON toggle for the green motherboard LED. This LED is a good power-on indicator but can introduce errors in the optical tests. It is recommended for accurate measurements to turn the LED off.
- A section containing logging controls and sampling status information:

1. Toggles LED on the motherboard.
2. Text entered here is appended to the default file name. The file name contains the Part Name and address shown in the large "TAOS Digital Light Sensor" window, an underscore "_" and the text entered. The default if nothing is entered is a period(".").
3. Secondary comment box. Text entered here is also appended to the log file name. . The default if nothing is entered is a period(".").

   Sample:

4. The start button tells the program to start logging. The fields entered in #2 and #3 will be used as field names in the output. If you change the values in #2 or #3, the corresponding field names will change in the output beginning at the time of the change, but the log file name will not change after logging is started.
5. Clear –The Clear button will flush the previous optical sample readings and reset the elapsed time indicator (see #7).
6. Log – Creates a text log file with data. The name will be assigned as explained in #3. This will cause the system to write out any data currently in the log buffer.
7. Count of samples in the log buffer. When that number reaches the limit selected in #9, the system will show a file dialog to save the log in a named file.
8. The elapsed time since the beginning of logging data.
9. The number of log samples collected before log entry is written to the log file.

INPUT SIDE, "FUNCTIONAL" TAB

Simple commonly used controls exist for the ALS functionality, the proximity detection functionality, the wait time between samples, and the proximity threshold level.
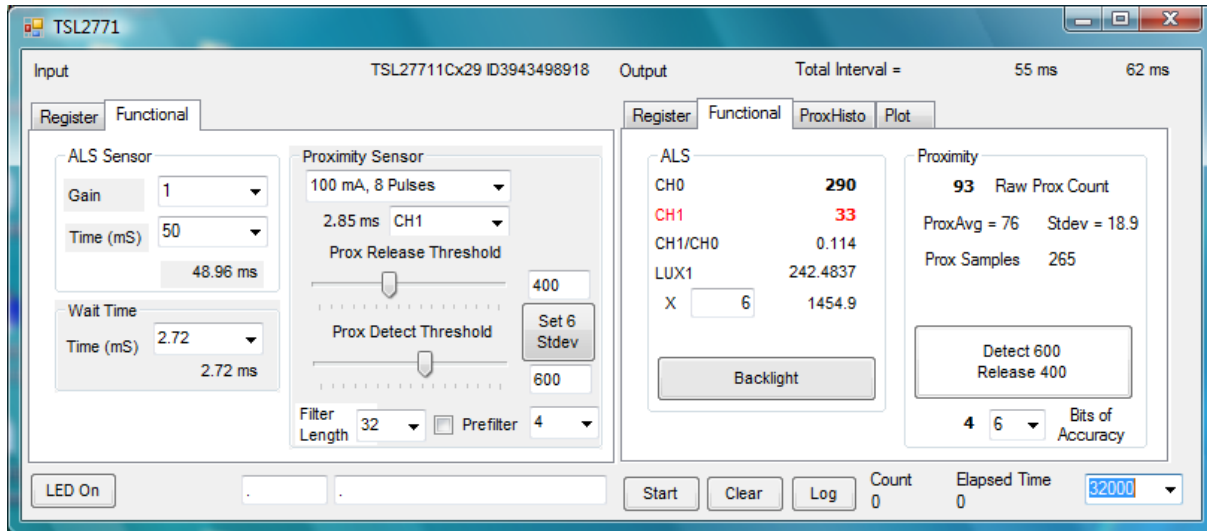
ALS SENSOR

- Gain - The gain control allows the user access to the AGAIN settings in the Control Register (0x0F). The gain amplifies the ADC signal to increase sensitivity. The gain options include 1x, 8x, 16x and 120x and are selected from the list box when the down arrow is depressed.
- Time (mS) – This list box has numerous preselected values for the integration time of both channels (Ch0 and Ch1). If a value other than what is shown in the list box is desired it must be entered manually using the Register tab (documented later). Manually entering a value will NOT work in this location. The actual integration time is shown on the line below.

  NOTE: The saturation level of the device is partially dependant on the integration time. Digital saturation occurs when the ADC output registers overflow. Digital saturation is reached at 65,536, thus the full-scale output of the TSL2771 is 65,535 (16-bits). If the integration time is set less than 172ms, however, the dynamic range of the device will be limited to the following:

  Integration Time > 172ms   Saturation = 65,535
  Integration Time < 172ms   Saturation = ((Integration Time / 2.7) x 1024) – 1

WAIT TIME

When the software initializes, a default wait period of 2.7mS is inserted between the Prox execution and the ALS execution. This duration can be adjusted in 2.72mS steps from 0 to 696mS. A wait multiplier (WLONG=1) may also be used to multiply the wait period by 12x. Using these controls the duration of the wait may be adjusted from none (WEN=0) to 8.3 seconds (WEN=1, WLONG=1, WTIME=0x00).

The Wait Time list box provides a quick mechanism for setting preselected wait periods from 2.72mS to 696mS. The wait period is completely disabled by setting WEN=0 (Enable Register (0x00, bit3).

PROXIMITY SENSOR / PROX THRESHOLD

The control fields to vary the proximity sensor settings are found in this section. Two drop-down controls allow adjustment of the sink current and number of LED pulses, and selection of which photodiodes are used to detect the reflected energy. Two slider controls are provided for selection of proximity release and proximity detection thresholds.

The first list box allows rapid selection of LED sink current and the number of LED pulses. Clicking the down arrow brings up a list box with several predefined combinations:

- Individual settings for the sink current and/or number of pulses can also be made using the device registers as documented later in this manual.
- The photodiodes receiving the reflected optical energy are chosen in the second line. The list box shows options for Neither, Ch 0, Ch 1 or Both.
- The "Prox Release Threshold" and "Prox Detect Threshold" sliders allow a threshold (with hysteresis) to be selected to determine when a proximity detection occurs. The thresholds can be set to any value from 1 to 1022. The values selected are shown numerically below the sliders.

INPUT SIDE, "REGISTER" TAB
"Control" Sub Tab

The Register tab provides for direct control of the registers of the device.

The Control sub-tab allows enabling and disabling functionality in the part and also controls the wait time multiplier (WLONG).

Additionally, a list box provides options for turning ON all parts (All On) of the device or turning OFF all parts (All Off) of the device simultaneously.

- Enable Register (0x00) – Provides the ON/OFF control of the device.
- Check boxes are provided to allow selection of specific functions on the device:
    1. PON – Power on. Activates internal oscillator. When =0 device is in standby.
    2. AEN – ALS Enable. Writing a one (1) enables the ALS
    3. PEN – Proximity Enable. Writing a one (1) enables the proximity detection.
    4. WEN – Wait Enable. Writing a one (1) activates the wait timer.
    5. AIEN – ALS Interrupt Enable. Writing a one (1) enables the ALS interrupt.
    6. PIEN - Proximity Interrupt Enable. Writing a one (1) enables the Proximity interrupt.
- WTIME (0x03) – Wait time in 2.72ms increments, unless the WLONG bit is set, in which case the wait time is multiplied by 12. The number to the right is the computed WTIME. See the ATIME note in the ALS Sub Tab description.
- Config Register (0x0D) – Controls the wait time multiplication factor of x12.
    1. WLONG – Wait Long. When checked (=1) enables the wait multiplier.

"ALS" Sub Tab

The ALS tab shows the registers associated with ambient light sensing control. Register values in hex are shown on the left, preselected values are available in list boxes in the middle, and actual values are shown on the right.
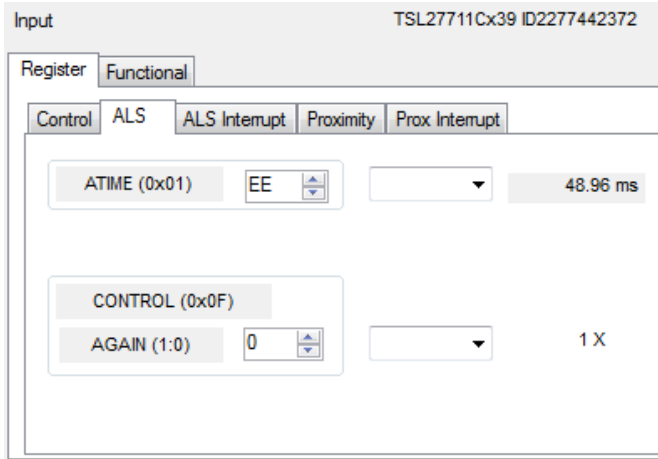

Note: The column on the right is the computed value for ATIME and is always correct. Sometimes the value shown in the list box will be one of the preselected values but it has not been selected. If this happens the number will not be the same as the computed number for WTIME on the Control Sub-Tab. The computed value is the one that is correct. This can be fixed by selecting a preselected value from the list box or by cycling the register value UP/DOWN or DOWN/UP. This will set the list box value or clear the value from the list box so the screen is correct.

"ALS Interrupt" Sub Tab

This tab contains the settings for controlling the generation of ALS interrupts to a control processor.

The AILT and AIHT values are 16 bit thresholds for the upper and lower trigger points. Each is set using two 8-bit registers. Another control (APERS) establishes the required persistence of the interrupt signal.

Also on this screen is a control that will automatically generate the register values to provide threshold settings 25% higher and lower than the currently measured amount of ambient light.
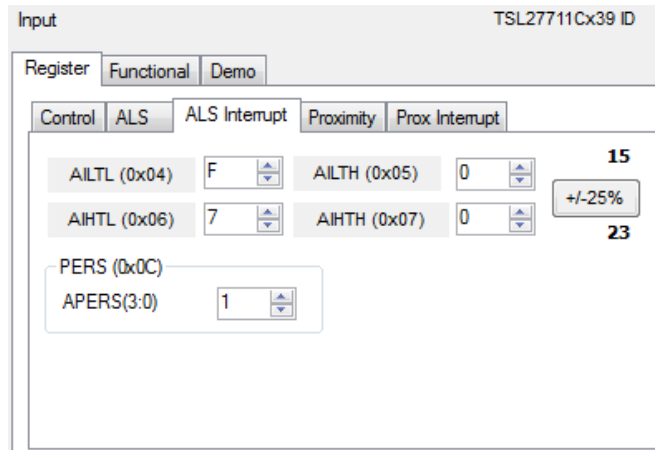
- ALS Interrupt Low Threshold (0x04, 0x05) – Low light threshold for ALS interrupt.
    1. AILTL (0x04) – The lower 8 bits of the 16 bit low threshold value.
    2. AILTH (0x05) – The upper 8 bits of the 16 bit low threshold value.
- ALS Interrupt High Threshold (0x06, 0x07) – High light threshold for ALS interrupt.
    1. AIHTL (0x06) – The lower 8 bits of the 16 bit high threshold value.
    2. AIHTH (0x07) – The upper 8 bits of the 16 bit high threshold value.

- PERS (0x0C) – The APERS field (bits 3:0) allows the number of times the ALS interrupt threshold (AILT, AIHT) is exceeded before the interrupt is generated to be controlled. Setting a zero means an interrupt is generated on every ALS reading.
- The +/-25% button takes the current ambient light reading and automatically computes new values for the AILT and AIHT registers, each with a 25% wider latitude.

"Proximity" Sub Tab

The Proximity tab shows editable registers associated with proximity sensing control.

Register values in hex are shown on the left, the middle section contains preset controls for quick configurations, and the column on the right displays the actual values in use.

Note: Values entered via the registers and list boxes for PDRIVE and PDIODE do not automatically update the other, so the values displayed may not match. The computed value on the right is always correct and show the values is currently in use.

- PTIME (0x02) – Sets the integration time of the proximity ADC in 2.72mS increments.
- PPULSE (0x0E) - This control allows the user to select the number of LED pulses for proximity detection.   The pulses have a frequency of 125kHz and a 50% duty cycle.
- PDRIVE – sets the sink current through the IR LED.
- PDIODE – choses the active photodiode(s) for proximity sensing.

"Prox Interrupt" Sub Tab

This tab contains the settings for controlling the generation of Prox interrupts to a control processor.

The PILT and PIHT values are 16 bit thresholds for the upper and lower trigger points. Each is set using two 8-bit registers. Another control (PPERS) establishes the required persistence of the interrupt signal.

Also on this screen is a control that will automatically generate the register values to provide threshold settings 25% higher and lower than the Proximity Data Register value.

- Proximity Interrupt Low Threshold (0x04, 0x05) – Low threshold for proximity interrupt.
    1. PILTL (0x08) – The lower 8 bits of the 16 bit low threshold value.
    2. PILTH (0x09) – The upper 8 bits of the 16 bit low threshold value.
- Proximity Interrupt High Threshold (0x06, 0x07) – High threshold for proximity interrupt.
    1. PIHTL (0x0A) – The lower 8 bits of the 16 bit high threshold value.
    2. PIHTH (0x0B) – The upper 8 bits of the 16 bit high threshold value.
- PERS (0x0C) – The PPERS field (bits 7:4) allows the number of times the Prox interrupt threshold (PILT, PIHT) is exceeded before the interrupt is generated to be controlled. Setting a zero means an interrupt is generated on every proximity reading.
- The +/-25% button takes the current Proximity Data Register value and automatically computes new values for the PILT and PIHT registers, each with a 25% wider latitude.

OUTPUT SIDE, "REGISTER" TAB

The value of internal registers is displayed on this tab. Register values cannot be set here. To set registers use the Register tab on the input side of the screen.

Controls are provided for clearing the Proximity interrupt (PINT) and the ALS interrupt (AINT). The current interrupt status is also shown.

The CDATA, IRDATA and PDATA values are the ADC values for the Ch 0 and Ch 1 photodiode and the proximity detection value. Each is read via two 8-bit registers.

- Status (0x13) – Internal status. Interrupts active (2 bits) and ALS valid bits are here.
- ID (0x12) – The ID register provides the value for the part number.
- CDATA (0x14, 0x15):
    1. CDATA (0x14) – The lower 8 ADC bits of the Ch 0 photodiode.
    2. CDATAH (0x15) – The upper 8 ADC bits of the Ch 0 photodiode.
- IRDATA (0x16, 0x17):
    1. IRDATA (0x16) – The lower 8 ADC bits of the Ch 1 photodiode.
    2. IRDATAH (0x17) – The upper 8 ADC bits of the Ch 1 photodiode.
- PDATA (0x18, 0x19):
    1. PDATA (0x18) – The lower 8 bits of the proximity value.
    2. PDATAH (0x19) – The upper 8 bits of the proximity value.

OUTPUT SIDE, "FUNCTIONAL" TAB
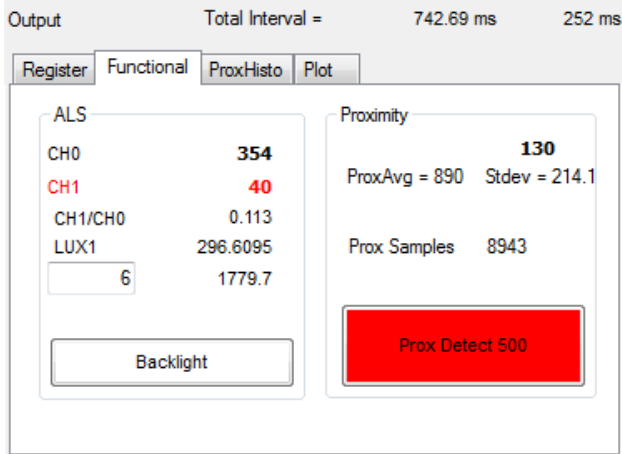
The Prox indication shows the current reading (right number) and the rolling average (left number). The average is computed over the number of samples specified on the INPUT/TEST tab.

The Ch 0 and Ch 1 photodiodes output value is shown, and the ratio is shown below.

LUX is computed. When saturation occurs, "Saturated" will appear as the LUX1 value.

A scaling factor in the box below LUX1 will scale the LUX value. This is useful for scaling for configurations such as dark glass.

The box in the lower right is a visual indicator of proximity detection. When the prox threshold is exceeded the box will turn red, as shown in the example.

OUTPUT SIDE, "PROXHISTO" TAB

This tab contains a histogram of the recent prox evaluations. It is displayed as a rolling histogram spanning the number of readings in the Test tab of the input.

Stdev – standard deviation of the displayed data

Max-Min – difference between the maximum reading and the minimum reading

Horizontal axis numbers show the minimum value and the maximum value, along with the mean. The red vertical line shows the proximity detection threshold as set by the sliders on the input side of the GUI.
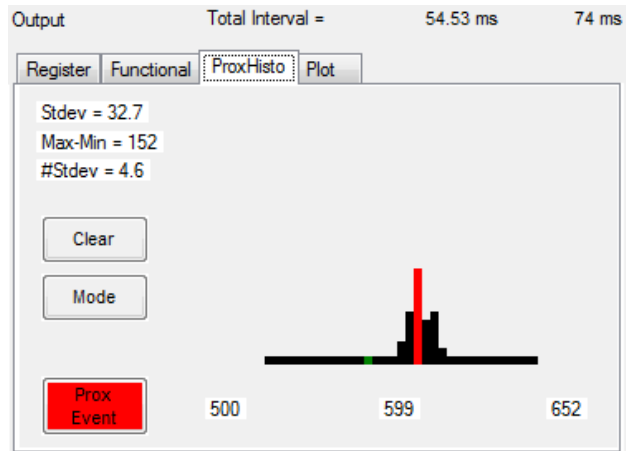
OUTPUT SIDE, "PLOT" TAB

The two photodiodes, the prox reading and the LUX can be displayed vs. time on the graph.
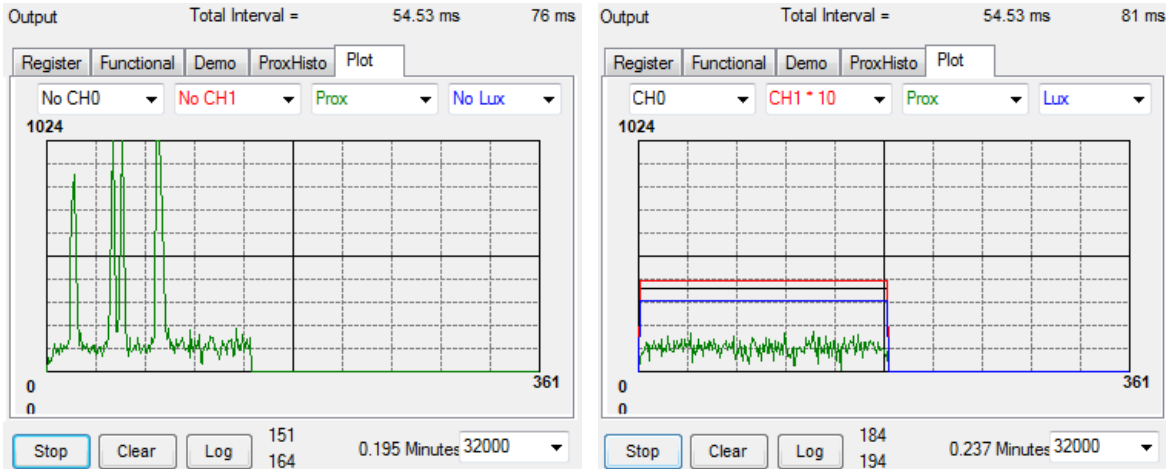
The first plot shows proximity events happening and the second graph shows all outputs for a static system. Multipliers (selected from the list boxes) may be used to scale the display accordingly. On the second plot the Ch1 photodiode is scaled by a factor of 10x relative to the other plotted signals.

RESOURCES
TSL2771 datasheet
Quick Start Guide (QSG)
Application Notes

For additional information regarding the TSL2771, please refer to the datasheet. For information regarding the installation of the TSL2771 EVM host application please refer to the Quick Start Guide.

Application notes dealing with various aspects of optical measurement and optical measurement applications are available.

All content is available on the TAOS website www.TAOSinc.com

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Телефон: +7 812 627 14 35

Электронная почта: sales@st-electron.ru

Адрес: 198099, Санкт-Петербург, Промышленная ул, дом № 19, литера Н, помещение 100-Н Офис 331