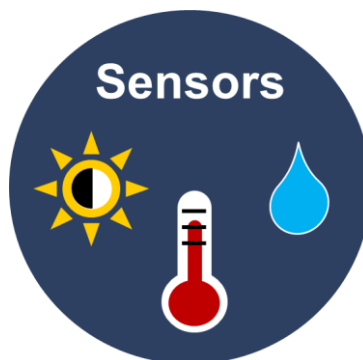




**ON Semiconductor®**

## **Sensors User Guide STR-SENSORS-GEVK**



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## Introduction

The Sensors platform offers evaluation of four different types of sensors using the Strata Developer Studio. The LC717A10AR touch sensor is shared for the touch, proximity, LC717A10AR and tabs with the Strata user interface

- Touch using the LC717A10AR
- Proximity using the LC717A10AR
- Light using the LV0104CS
- Local and remote temperature using the NCT72

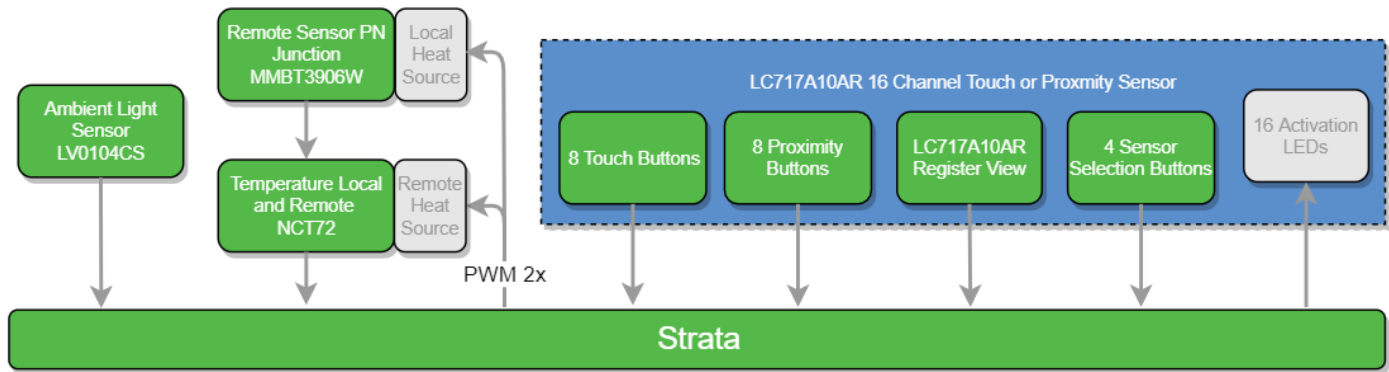
## Features

|                     |  |
|---------------------|--|
| Touch and Proximity | <ul style="list-style-type: none"> <li>• Detection system: Differential capacitance detection (Mutual capacitance type)</li> <li>• Input capacitance resolution: Can detect capacitance changes in the femto Farad order</li> <li>• Measurement interval (16 differential inputs): 30ms (Typ) (at initial configuration), 6ms (Typ) (at minimum interval configuration)</li> <li>• External components for measurement: Not required</li> <li>• Interface: I2C compatible bus or SPI selectable.</li> <li>• Current consumption: 570 <math>\mu</math>A (Typ) (VDD = 2.8 V), 1.3 mA (Typ) (VDD = 5.5 V)</li> <li>• Supply voltage: 2.6 V to 5.5 V</li> <li>• Detection operations: Switch</li> </ul>  |
| Light               | <ul style="list-style-type: none"> <li>• Smallest OD-CSP package in the world (1.08mm x 1.08mm thickness: 0.6mm)</li> <li>• Superior spectrum sensitivity characteristics</li> <li>• 16-bit digital output for CODEC by I2C serial bus</li> </ul>  |
| Temperature         | <ul style="list-style-type: none"> <li>• On-Chip and Remote Temperature Sensor</li> <li>• 0.25°C Resolution/1°C Accuracy on Remote Channel</li> <li>• 1°C Resolution/1°C Accuracy on Local Channel</li> <li>• Series Resistance Cancellation up to 1.5 k<math>\Omega</math></li> <li>• Extended, Switchable Temperature Measurement Range 0°C to +127°C (Default) or -64°C to +191°C</li> <li>• Pin and Register Compatible with NCT1008</li> <li>• Remote /THERM limit of 108°C</li> <li>• 2-Wire SMBus/I2C Serial Interface with SMBus Alert Support</li> <li>• Programmable Over/Undertemperature Limits</li> <li>• Offset Registers for System Calibration</li> <li>• Up to Two Overtemperature Fail-Safe /THERM Outputs</li> <li>• 240 <math>\mu</math>A Operating Current, 5 <math>\mu</math>A Standby Current</li> <li>• Compatible with 1.8 V Logic</li> </ul> |

## Applications

|                     |   |
|---------------------|---|
| Touch and Proximity | <ul style="list-style-type: none"> <li>• White goods</li> <li>• Black goods</li> <li>• PC peripherals</li> <li>• Office Automation</li> </ul> |
| Light               | <ul style="list-style-type: none"> <li>• Ambient Light Sensor</li> </ul>  |
| Temperature         | <ul style="list-style-type: none"> <li>• Thermal Management</li> </ul>  |

## Block Diagram



### Touch

There are 8 capacitive touch buttons labelled 0 through 7 each with their own LED indicator directly above the sensor. The sensor pattern is embedded in the inner layers of a 6 layer PCB and aligned in a 2x4 grid. The STR-SENSORS-GEVK and the LC717A10AR touch sensor IC is automatically configured by default and is immediately operational when the evaluation board is plugged into the computer. The LC717A10AR is a high-performance and low-cost capacitance-digital-converter LSI for electrostatic capacitive touch sensor.

### Proximity

There are 4 capacitive proximity buttons labelled A, B, C, and D each with their own LED indicator directly above the sensor. The sensor pattern is the same as the touch sensor, however, the STR-SENSORS-GEVK and the LC717A10AR touch sensor IC is automatically configured to operate as a proximity sensor by modifying the configuration settings. The LC717A10AR is a high-performance and low-cost capacitance-digital-converter LSI for electrostatic capacitive touch sensor.

### Light

The light sensor uses the LV0104CS and reports a 16-bit Lux (lx) light reading. LV0104CS is a Photo IC for ultra- small package Ambient Light sensor which has the characteristics of spectral response similar to that of human eyes. It is suitable for the applications like mobile phone (for Digital-TV, One-segment), LCD-TV, laptop computer, PDA, DSC and Camcorder.

### Temperature

The temperature sensor uses the NCT72 dual temperature sensor and offers full control over every digital register configuration the NCT72 has to offer. A local temperature sensor is inside the device and a remote sensor is located about 30 mm above the local temperature IC using the PN junction of the MMBT3906W transistor. It offers under/over temperature alarm or thermal limits and is intended for use in PCs and thermal management systems.

### LC717A10AR

The LC717A10AR has an extended configuration from the simpler touch and proximity controls in Strata. The LC717A10AR tab offers full control over every digital register configuration the LC717A10AR has to offer. All 16 capacitive touch sensors can be configured unlike the touch and proximity controls – including the 4 touch sensors intended to switch between the 4 sensors labelled in the silkscreen on the PCB.

### User Guide

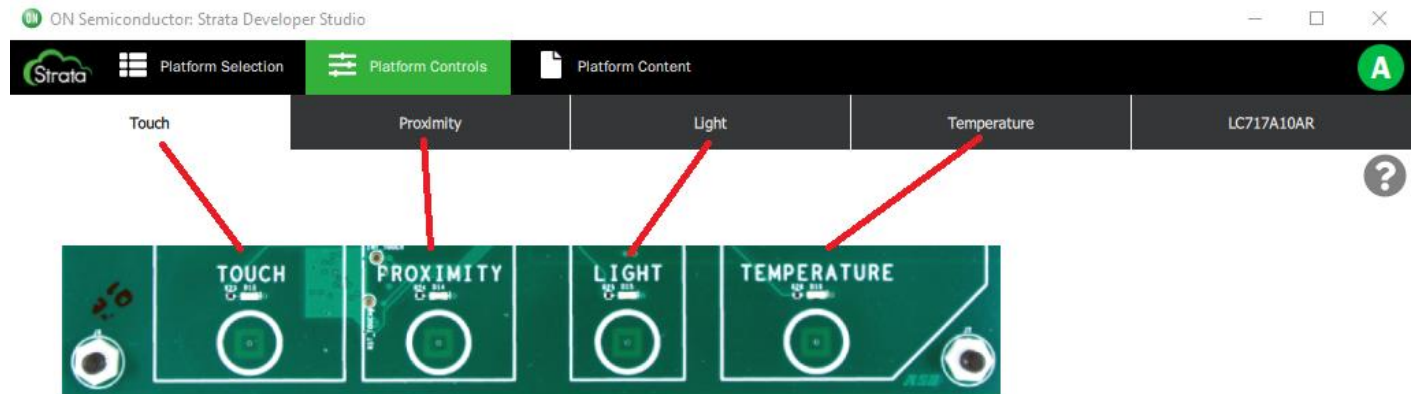
Install Strata, open Strata, and plug in the STR-SENSORS-GEVK to a computer using the USB port. The sensor UI (User Interface) will automatically open and the touch sensor tab will be activated by default.

### Selecting Between Sensors

The touch, proximity, light, and temperature sensors can be activated two ways: 1) by clicking the applicable tab inside Strata and the evaluation board will update or 2) by touching any of the 4 button labelled with a sensor on the PCB and then the UI will update.

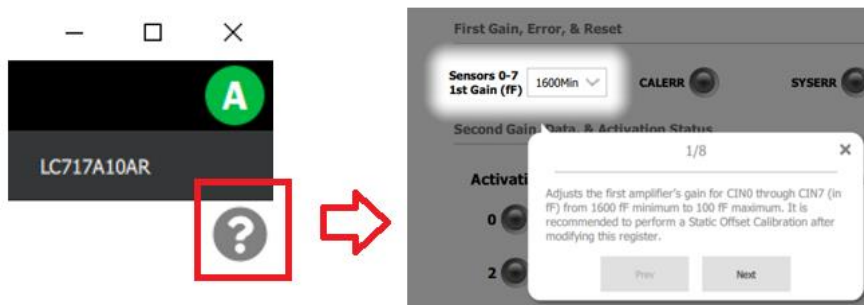
The LC717A10AR tab is special as it does not have a PCB button. The only way to activate this sensor is to click the tab in the UI. To exit the LC717A10AR mode 1 of the 4 other tabs in the Strata UI must be clicked; this is because the LC717A10AR sensor is used to switch between the 4 sensors on the PCB and in LC717A10AR those buttons can be configured differently by the user.

Switching between the tabs using either the PCB buttons or clicking the tabs will result in the default sensor values being reloaded for the touch, proximity, and LC717A10AR tabs. The light and temperature values will remain the same as the last configuration.



### Help Messages

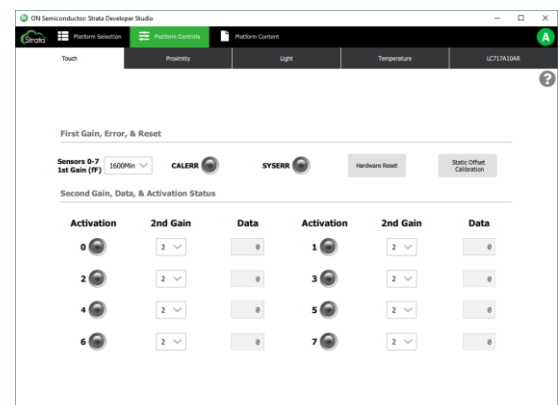
Each UI element has a help message to help the user better understand the purpose of each control. Click the small question mark button to activate the help tour. The arrow keys can be used to navigate through the tour.



### Touch

The touch sensor tab has limited control of the LC717A10AR registers. The activation state, i.e. ON/OFF, of each sensor is determined by the data value crossing the threshold value configured in the LC717A10AR registers. The default threshold is 10. The global first gain for sensors CIN0 through CIN7 and the individual second gain can be adjusted. It is recommended to perform a static offset calibration after changing either gain. The hardware reset can be used to clear any errors.

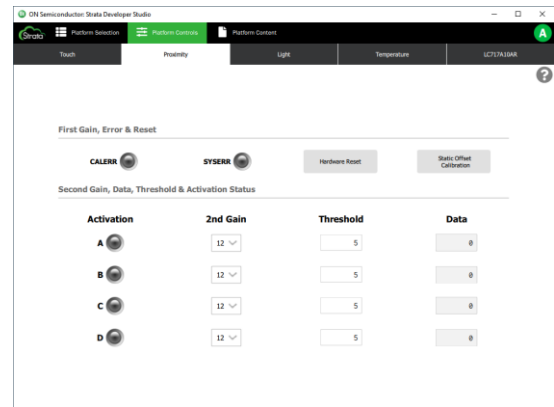
It is highly recommended to review the help messages using the help tour mentioned in the [Help Messages](#) section above.



## Proximity

The proximity sensor operates the same as the touch sensor but the register configuration changes to allow for a lower default threshold of activation and a higher sensor gain. The individual second gain and the threshold of each CIN sensor channel can be adjusted to change the sensor proximity threshold. The hardware reset can be used to clear any errors.

It is highly recommended to review the help messages using the help tour mentioned in the [Help Messages](#) section above.



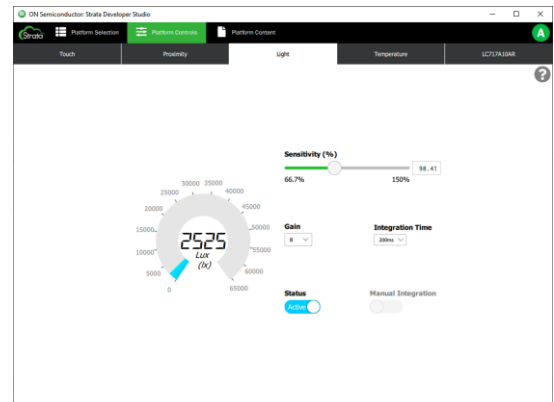
## Light

The light sensor displays a 16-bit light value in Lux (lx). In normal office conditions the lx value will be around 2500 lx. Exposing to more or less light will adjust this value.

It is highly recommended to review the help messages using the help tour mentioned in the [Help Messages](#) section above.

The gain and sensitivity can be adjusted to alter the lx reading. The sensitivity ranges from 66.7% up to 150% and will be coerced to the nearest valid value according to the sensitivity calculation in the LV0104CS datasheet. The calculation imposes more resolution around 100%. The gain simply has three options: 8, 2, 1, 0.25.

The integration time adjusts how often the Lux (lx) gauge will be updated. Setting the Integration Time to Manual will enable the Manual Integration toggle to manually start and stop integration. Manual integration toggle is enabled only when Integration Time is set to Manual and Status is set to Active. Set Manual Integration to Start and then Stop to specify manual integration time and the Lux (lx) gauge will be updated accordingly.



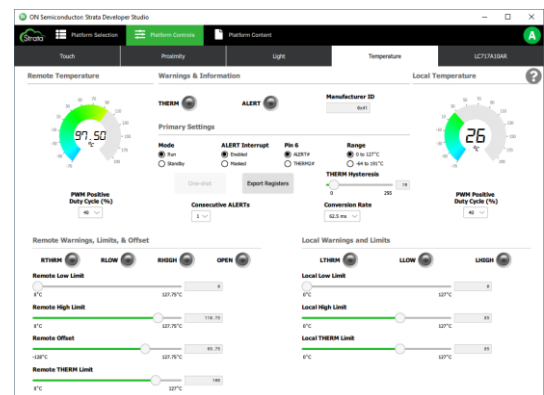
## Temperature

The temperature sensor consists of two sensors: one local inside the NCT72 and the other remote and 30mm away from the NCT72. An onboard heat generation circuit dissipates power close to each of the temperature sensors. The power from the USB cable is PWM'ed across a 24.9Ω resistor. The ground plane underneath each of the resistors is voided to allow for a larger heat generation range. The PWM duty cycle can be adjusted from 0 to 100% in the Remote and Local Temperature sections of the UI.

It is highly recommended to review the help messages using the help tour mentioned in the [Help Messages](#) section above.

The Warnings & Information section displays the two hardware interrupt pins on the NCT72: THERM and ALERT/THERM2. As well as the manufacturer ID read from the NCT72 on startup.

The Primary Settings section allows for various configuration settings as described in the NCT72 datasheet. This section also allows for the export of the I2C registers in a text file to allow the customer to program a device on their PCB using the Strata UI as a guideline. The Pin 6 radio button will toggle the functionality of Pin 6 and update the label of the



ALERT/THERM2 control in the Warnings & Information section. The Conversion Rate adjust the period of time between ADC conversions of the temperature sensor; subsequently, changing the period of the update to both the Remote and Local Temperature gauges.

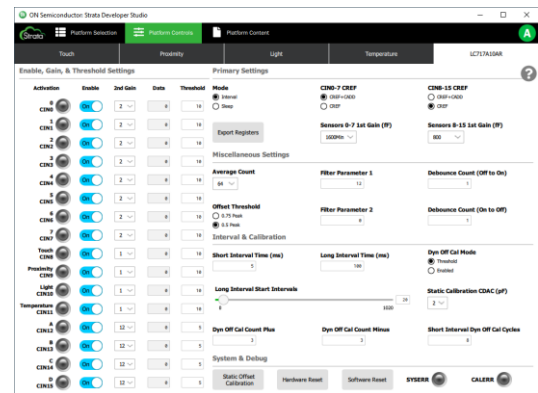
The Remote and Local Warnings, Limits, & Offset sections change the limit and offset register that trigger the THERM or ALERT interrupts and the 3 flags for both sensors THRM, LOW, and HIGH. The limits do not automatically update when the Range is changed but the Offset will remain the same.

## LC717A10AR

The LC717A10AR tab offers complete evaluation of the LC717A10AR capacitive touch sensor. By default the sensor is configured exactly the same as it is on the touch and proximity sensors, i.e. CIN0-11 are touch and CIN12-15 are proximity.

It is highly recommended to review the help messages using the help tour mentioned in the [Help Messages](#) section above.

Refer to the application notes listed on the [LC717A10AR product page](#) for more information about the configuration of the registers.



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