TSL2541
ALS, Light-to-Digital Sensor

General Description
The TSL2541 is a very-high sensitivity light-to-digital converter that transforms light intensity into a digital signal output capable of direct I²C interface. The ALS sensor features 2 output channels, a visible channel and an IR channel. The visible channel has a photodiode with a UV and IR blocking filter whereas the IR channel has a photodiode with an IR pass filter. Each channel has a dedicated data converter producing a 16-bit output. This architecture allows applications to accurately measure ambient light which enables devices to calculate illuminance to control a display backlight.

Ordering Information and Content Guide appear at end of datasheet.

Key Benefits & Features
The benefits and features of TSL2541, ALS, Light-to-Digital Sensor are listed below:

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Single device integrated optical solution</td>
<td>• 2.0mm x 2.0mm x 0.5mm</td>
</tr>
<tr>
<td></td>
<td>• Power management features</td>
</tr>
<tr>
<td></td>
<td>• I²C fast mode interface compatible</td>
</tr>
<tr>
<td>• Accurate ambient light sensing</td>
<td>• Photopic ambient light sense (ALS)</td>
</tr>
<tr>
<td></td>
<td>• UV / IR blocking filter</td>
</tr>
<tr>
<td>• Reduced power consumption</td>
<td>• Programmable gain and integration time</td>
</tr>
<tr>
<td></td>
<td>• 1.8V power supply with 1.8V I²C bus</td>
</tr>
</tbody>
</table>
Applications
The TSL2541 applications include:

- Ambient light sensing
- Display backlight control

Block Diagram
The functional blocks of this device are shown below:

Figure 2: Functional Blocks of TSL2541
Pin Assignment

Figure 3:
Pin Diagram of TSL2541

Figure 4:
Pin Description of TSL2541 (10-Pin QFN)

<table>
<thead>
<tr>
<th>Pin Number</th>
<th>Pin Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PGND</td>
<td>Power ground</td>
</tr>
<tr>
<td>2</td>
<td>INT</td>
<td>Interrupt. Open drain output (active low)</td>
</tr>
<tr>
<td>3</td>
<td>SCL</td>
<td>I²C serial clock input terminal</td>
</tr>
<tr>
<td>4</td>
<td>SDA</td>
<td>I²C serial data I/O terminal</td>
</tr>
<tr>
<td>5</td>
<td>VDD</td>
<td>Supply voltage</td>
</tr>
<tr>
<td>6</td>
<td>NC</td>
<td>No connection</td>
</tr>
<tr>
<td>7</td>
<td>NC</td>
<td>No connection</td>
</tr>
<tr>
<td>8</td>
<td>NC</td>
<td>No connection</td>
</tr>
<tr>
<td>9</td>
<td>VSS</td>
<td>Ground. All voltages are referenced to VSS</td>
</tr>
<tr>
<td>10</td>
<td>I/C</td>
<td>Internal connection. Leave floating</td>
</tr>
</tbody>
</table>
**Absolute Maximum Ratings**

Stresses beyond those listed under **Absolute Maximum Ratings** may cause permanent damage to the device. These are stress ratings only. Functional operation of the device at these or any other conditions beyond those indicated under **Electrical Characteristics** is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

**Figure 5:**
**Absolute Maximum Ratings**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Min</th>
<th>Max</th>
<th>Units</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{DD}$</td>
<td>Supply voltage</td>
<td>-0.3</td>
<td>2.2</td>
<td>V</td>
<td>All voltages are with respect to GND</td>
</tr>
<tr>
<td>$V_{IO}$</td>
<td>Digital I/O terminal voltage</td>
<td>-0.3</td>
<td>3.6</td>
<td>V</td>
<td>INT, SCL and SDA</td>
</tr>
<tr>
<td>$I_{out}$</td>
<td>Output terminal current</td>
<td>-1</td>
<td>20</td>
<td>mA</td>
<td>INT and SDA</td>
</tr>
<tr>
<td>$T_{strg}$</td>
<td>Storage temperature range</td>
<td>-40</td>
<td>85</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>$I_{SCR}$</td>
<td>Input current (latch up immunity) JEDEC JESD78D</td>
<td>± 100</td>
<td>mA</td>
<td>Class II</td>
<td></td>
</tr>
<tr>
<td>$ESD_{HBM}$</td>
<td>Electrostatic discharge HBM JS-001-2014</td>
<td>± 2000</td>
<td>V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$ESD_{CDM}$</td>
<td>Electrostatic discharge CDM JEDEC JESD22-C101F</td>
<td>± 500</td>
<td>V</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Electrical Characteristics

All limits are guaranteed. The parameters with min and max values are guaranteed with production tests or SQC (Statistical Quality Control) methods.

Figure 6: Recommended Operating Conditions

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{DD}$</td>
<td>Supply voltage</td>
<td>1.7</td>
<td>1.8</td>
<td>2.0</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>Supply voltage accuracy, $V_{DD}$ total error including transients</td>
<td>-3</td>
<td>3</td>
<td></td>
<td>%</td>
</tr>
<tr>
<td>$T_A$</td>
<td>Operating free-air temperature $^{(1)}$</td>
<td>-30</td>
<td></td>
<td>85</td>
<td>°C</td>
</tr>
</tbody>
</table>

Note(s):
1. While the device is operational across the temperature range, performance will vary with temperature. Specifications are stated at 25°C unless otherwise noted.

Figure 7: Operating Characteristics, $V_{DD} = 1.8V$, $T_A = 25°C$

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>$f_{OSC}$</td>
<td>Oscillator frequency</td>
<td></td>
<td>8.107</td>
<td></td>
<td></td>
<td>MHz</td>
</tr>
<tr>
<td>$I_{DD}$</td>
<td>Supply current</td>
<td>Active ALS State $^{(1)}$ (PON=AEN=1)</td>
<td>50</td>
<td>90</td>
<td>150</td>
<td>µA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Idle State $^{(2)}$ (PON=1,AEN=0)</td>
<td>30</td>
<td>60</td>
<td></td>
<td>µA</td>
</tr>
<tr>
<td></td>
<td>Sleep State $^{(3)}$</td>
<td></td>
<td>0.7</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$V_{OL}$</td>
<td>INT, SDA output low voltage</td>
<td>6mA sink current</td>
<td>0.6</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>$I_{LEAK}$</td>
<td>Leakage current, INT, SCL and SDA</td>
<td></td>
<td>-5</td>
<td>5</td>
<td></td>
<td>µA</td>
</tr>
<tr>
<td>$V_{IH}$</td>
<td>SCL, SDA input high voltage $^{(4)}$</td>
<td></td>
<td>1.26</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>$V_{IL}$</td>
<td>SCL, SDA input low voltage</td>
<td></td>
<td>0.54</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>$T_{Active}$</td>
<td>Time from power-on to ready to receive I²C commands</td>
<td></td>
<td>1.5</td>
<td></td>
<td></td>
<td>ms</td>
</tr>
</tbody>
</table>

Note(s):
1. This parameter indicates the supply current during periods of ALS integration. If Wait is enabled (WEN=1), the supply current is lower during the Wait period.
2. Idle state occurs when PON=1 and all functions are not enabled.
3. Sleep state occurs when PON = 0 and i²C bus is idle. If Sleep state has been entered as the result of operational flow, SAI = 1, PON will remain high.
4. Digital pins: SDA, SCL, INT, are tolerant to a communication voltage up to 3.0V.
## Typical Operating Characteristics

Figure 8: ALS Operating Characteristics, $V_{DD} = 1.8V$, $T_A = 25°C$

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integration time step size</td>
<td></td>
<td>2.68</td>
<td>2.78</td>
<td>2.90</td>
<td>ms</td>
</tr>
<tr>
<td>Number of integration steps</td>
<td></td>
<td>1</td>
<td>256</td>
<td></td>
<td>steps</td>
</tr>
<tr>
<td>Dark ADC count value</td>
<td>$E_e = 0 \mu W/ cm^2$; AGAIN = 64x; ATIME = 100ms (0xDC)</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>counts</td>
</tr>
<tr>
<td>$R_e$</td>
<td>Irradiance responsivity (1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Settings</td>
<td>AGAIN = 16x; ATIME = 400ms</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visible Channel</td>
<td>White LED, 2700K</td>
<td>101</td>
<td>119</td>
<td>137</td>
<td>counts/$\mu W/cm^2$</td>
</tr>
<tr>
<td>IR Channel</td>
<td>$\lambda_D = 950$ nm LED</td>
<td>359</td>
<td></td>
<td></td>
<td>counts/$\mu W/cm^2$</td>
</tr>
<tr>
<td>Gain scaling, relative to 1x gain setting</td>
<td>AGAIN = 4x</td>
<td>4</td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>AGAIN = 16x</td>
<td>16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>AGAIN = 64x</td>
<td>67</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>AGAIN = 128x</td>
<td>140</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADC noise</td>
<td>AGAIN = 16x</td>
<td>0.005</td>
<td></td>
<td></td>
<td>% full scale</td>
</tr>
</tbody>
</table>

**Note(s):**

1. For the Visible Channel, the values in this parameter are achieved by scaling the Visible Channel output (counts) via software by an adjustment factor stored in the VISADJ Register (Address 0xE6).
Figure 9: Spectral Responsivity

![Spectral Responsivity Graph](image_url)

Figure 10: ALS Responsivity vs Angular Displacement

![Normalized Angular Response Graph](image_url)
Detailed Description

Ambient Light Sensing
The ALS reception signal path begins as photodiodes receive filtered light and ends with the 16-bit results in the VISDATAL/H and IRDATAL/H registers. The visible channel's photodiode is filtered with a UV and IR filter to receive only visible light. The IR channel’s photodiode is filtered to receive only IR. Signals from the photodiodes simultaneously accumulate for a period of time set by the value in ATIME before the results are available. Gain is adjustable from 1x to 128x to facilitate operation over a wide range of lighting conditions. Custom Lux equations can be created for specific applications and system designs.

I²C Characteristics
The device uses I²C serial communication protocol for communication. The device supports 7-bit chip addressing and both standard and fast clock frequency modes with a chip address of 0x39. Read and Write transactions comply with the standard set by Philips (now NXP).

Internal to the device, an 8-bit buffer stores the register address location of the desired byte to read or write. This buffer auto-increments upon each byte transfer and is retained between transaction events (i.e. valid even after the master issues a STOP command and the I²C bus is released).

During consecutive Read transactions, the future/repeated I²C Read transaction may omit the memory address byte normally following the chip address byte; the buffer retains the last register address + 1.

I²C Write Transaction
A Write transaction consists of a START, CHIP-ADDRESSWRITE, REGISTER-ADDRESS, DATA BYTE(S), and STOP. Following each byte (9th clock pulse) the slave places an ACKNOWLEDGE/NOT-ACKNOWLEDGE (ACK/NACK) on the bus. If NACK is transmitted by the slave, the master may issue a STOP.

I²C Read Transaction
A Read transaction consists of a START, CHIP-ADDRESSWRITE, REGISTER-ADDRESS, START, CHIP-ADDRESSREAD, DATA BYTE(S), and STOP. Following all but the final byte the master places an ACK on the bus (9TH clock pulse). Termination of the Read transaction is indicated by a NACK being placed on the bus by the master, followed by STOP.

Alternately, if the previous I²C transaction was a Read, the internal register address buffer is still valid, allowing the transaction to proceed without “re”-specifying the register address. In this case the transaction consists of a START, CHIP-ADDRESSREAD, DATA BYTE(S), and STOP. Following all but
the final byte the master places an ACK on the bus (9th clock pulse). Termination of the Read transaction is indicated by a NACK being placed on the bus by the master, followed by STOP.

The I²C bus protocol was developed by Philips (now NXP). For a complete description of the I²C protocol, please review the NXP I²C design specification at:

www.i2c-bus.org/references/

**Timing Diagrams**

![Timing Diagram](image)

**Principles of Operation**

**System State Machine**

An internal state machine provides system control of the ALS, proximity detection, and power management features of the device. At power up, an internal power-on-reset initializes the device and puts it in a low power Sleep state. When a write on I²C bus to the Enable register (0x80) PON bit is set, the device transitions to the Idle state. If PON is disabled, the device will return to the Sleep state to save power. Otherwise, the device will remain in the Idle state until the ALS function is enabled. Once enabled, the device will execute the ALS and Wait states in sequence as indicated in Figure 12. Upon completion, the device will automatically begin a new ALS-Wait cycle as long as PON and AEN remain enabled. If the ALS function generates an interrupt and the Sleep-After-Interrupt (SAI) feature is enabled, the device will transition to the Sleep state and remain in a low-power mode until an I²C command is received clearing the interrupts in the STATUS register. See Interrupts for additional information.
Note(s):
1. An I²C write to az-nth-iteration register, except of the value 00h (disable-az), resets az-done independent of actual cntrl-state. In consequence, a new autozero calibration will be started in advance to the next ALS integration cycle.
## Register Description

Figure 13: Register Overview

<table>
<thead>
<tr>
<th>Address</th>
<th>Register Name</th>
<th>R/W</th>
<th>Register Function</th>
<th>Reset Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x80</td>
<td>ENABLE</td>
<td>R/W</td>
<td>Enables states and functions</td>
<td>0x00</td>
</tr>
<tr>
<td>0x81</td>
<td>ATIME</td>
<td>R/W</td>
<td>ALS integration time</td>
<td>0x00</td>
</tr>
<tr>
<td>0x83</td>
<td>WTIME</td>
<td>R/W</td>
<td>Wait time</td>
<td>0x00</td>
</tr>
<tr>
<td>0x84</td>
<td>AILTL</td>
<td>R/W</td>
<td>ALS interrupt low threshold low byte</td>
<td>0x00</td>
</tr>
<tr>
<td>0x85</td>
<td>AILTH</td>
<td>R/W</td>
<td>ALS interrupt low threshold high byte</td>
<td>0x00</td>
</tr>
<tr>
<td>0x86</td>
<td>AIHTL</td>
<td>R/W</td>
<td>ALS interrupt high threshold low byte</td>
<td>0x00</td>
</tr>
<tr>
<td>0x87</td>
<td>AIHTH</td>
<td>R/W</td>
<td>ALS interrupt high threshold high byte</td>
<td>0x00</td>
</tr>
<tr>
<td>0x8C</td>
<td>PERS</td>
<td>R/W</td>
<td>ALS interrupt persistence filters</td>
<td>0x00</td>
</tr>
<tr>
<td>0x8D</td>
<td>CFG0</td>
<td>R/W</td>
<td>Configuration register zero</td>
<td>0x80</td>
</tr>
<tr>
<td>0x90</td>
<td>CFG1</td>
<td>R/W</td>
<td>Configuration register one</td>
<td>0x00</td>
</tr>
<tr>
<td>0x91</td>
<td>REVID</td>
<td>R</td>
<td>Revision ID</td>
<td>0x61</td>
</tr>
<tr>
<td>0x92</td>
<td>ID</td>
<td>R</td>
<td>Device ID</td>
<td>0xE4</td>
</tr>
<tr>
<td>0x93</td>
<td>STATUS</td>
<td>R</td>
<td>Device status register</td>
<td>0x00</td>
</tr>
<tr>
<td>0x94</td>
<td>VISDATAL</td>
<td>R</td>
<td>Visible channel data low byte</td>
<td>0x00</td>
</tr>
<tr>
<td>0x95</td>
<td>VISDATAH</td>
<td>R</td>
<td>Visible channel data high byte</td>
<td>0x00</td>
</tr>
<tr>
<td>0x96</td>
<td>IRDATAL</td>
<td>R</td>
<td>IR channel data low byte</td>
<td>0x00</td>
</tr>
<tr>
<td>0x97</td>
<td>IRDATAH</td>
<td>R</td>
<td>IR channel data high byte</td>
<td>0x00</td>
</tr>
<tr>
<td>0x9E</td>
<td>REVID2</td>
<td>R</td>
<td>Auxiliary ID</td>
<td>0x02</td>
</tr>
<tr>
<td>0x9F</td>
<td>CFG2</td>
<td>R/W</td>
<td>Configuration register two</td>
<td>0x04</td>
</tr>
<tr>
<td>0xAB</td>
<td>CFG3</td>
<td>R/W</td>
<td>Configuration register three</td>
<td>0x0C</td>
</tr>
<tr>
<td>0xD6</td>
<td>AZ_CONFIG</td>
<td>R/W</td>
<td>Autozero configuration</td>
<td>0x7F</td>
</tr>
<tr>
<td>0xDD</td>
<td>INTENAB</td>
<td>R/W</td>
<td>Interrupt enables</td>
<td>0x00</td>
</tr>
<tr>
<td>0xE6</td>
<td>VISADJ</td>
<td>R</td>
<td>Visible channel adjustment factor</td>
<td>FS (1)</td>
</tr>
</tbody>
</table>

**Note(s):**
1. This value is Factory Set (FS) during electrical test of the device.
2. Register Access:
   - R = Read Only
   - W = Write Only
   - R/W = Read or Write
   - SC = Self Clearing after access
## Detailed Register Description

### Enable Register (Address 0x80)

**Figure 14:** Enable Register

<table>
<thead>
<tr>
<th>Addr: 0x80</th>
<th>Enable</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bit</strong></td>
<td><strong>Bit Name</strong></td>
</tr>
<tr>
<td>7:4</td>
<td>Reserved</td>
</tr>
<tr>
<td>3</td>
<td>WEN</td>
</tr>
<tr>
<td>2</td>
<td>Reserved</td>
</tr>
<tr>
<td>1</td>
<td>AEN</td>
</tr>
<tr>
<td>0</td>
<td>PON</td>
</tr>
</tbody>
</table>

Before activating AEN, preset each applicable operating mode registers and bits.
Figure 15: ATIME Register

The ATIME register controls the integration time of the ALS ADCs. The timer is implemented with a down counter with 0x00 as the terminal count. The timer is clocked at a 2.8ms nominal rate. Loading 0x00 will generate a 2.8ms integration time, loading 0x01 will generate a 5.6ms integration time, and so forth. The RC oscillator runs at 8MHz nominal rate. This gets divided by 11 to generate the integration clock of 727kHz. One count in ATIME (nominal 2.8ms) are 2.81ms. This is 2048 integration clock cycles: 125ns*11*8*256=2.81ms.

<table>
<thead>
<tr>
<th>Addr: 0x81</th>
<th>ATIME</th>
<th>Value</th>
<th>Integration Cycles</th>
<th>Integration Time</th>
<th>Maximum ALS Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit</td>
<td>Bit Name</td>
<td>Default</td>
<td>Access</td>
<td>Bit Description</td>
<td>0x00</td>
</tr>
<tr>
<td>7:0</td>
<td>ATIME</td>
<td>0x00</td>
<td>RW</td>
<td>ALS value that specifies the integration time in 2.81ms intervals. 0x00 indicates 2.8ms. The maximum ALS value depends on the integration time. For every 2.81ms, the maximum value increases by 1024. This means that to be able to reach ALS full scale, the integration time has to be at least 64*2.8ms.</td>
<td></td>
</tr>
<tr>
<td>0x01</td>
<td></td>
<td>2</td>
<td></td>
<td>5.6ms</td>
<td>2047</td>
</tr>
<tr>
<td>…</td>
<td>…</td>
<td>…</td>
<td>…</td>
<td>…</td>
<td>…</td>
</tr>
<tr>
<td>0x3F</td>
<td></td>
<td>64</td>
<td></td>
<td>180ms</td>
<td>65535</td>
</tr>
<tr>
<td>…</td>
<td>…</td>
<td>…</td>
<td>…</td>
<td>…</td>
<td>…</td>
</tr>
<tr>
<td>0xFF</td>
<td></td>
<td>256</td>
<td></td>
<td>721ms</td>
<td>65535</td>
</tr>
</tbody>
</table>
**WTIME Register (Address 0x83)**

The wait timer is implemented using a down counter. Wait time = (value +1) x 2.8ms. If WLONG is enabled then Wait time = (value +1) x 2.8ms x 12.

<table>
<thead>
<tr>
<th>Addr: 0x83</th>
<th>WTIME</th>
<th></th>
<th>Bit Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit</td>
<td>Bit Name</td>
<td>Default</td>
<td>Access</td>
</tr>
<tr>
<td>7:0</td>
<td>WTIME</td>
<td>0x00</td>
<td>RW</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**AILTL Register (Address 0x84)**

The Visible (Vis) channel is compared against low-going 16-bit threshold value set by AILTL and AILTH.

<table>
<thead>
<tr>
<th>Addr: 0x84</th>
<th>AILTL</th>
<th></th>
<th>Bit Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit</td>
<td>Bit Name</td>
<td>Default</td>
<td>Access</td>
</tr>
<tr>
<td>7:0</td>
<td>AILTL</td>
<td>0x00</td>
<td>RW</td>
</tr>
</tbody>
</table>
AILTH Register (Address 0x85)

Figure 18: AILTH Register

<table>
<thead>
<tr>
<th>Addr: 0x85</th>
<th>AILTH</th>
<th></th>
<th></th>
<th>Bit Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit</td>
<td>Bit Name</td>
<td>Default</td>
<td>Access</td>
<td></td>
</tr>
<tr>
<td>7:0</td>
<td>AILTH</td>
<td>0x00</td>
<td>RW</td>
<td>This register sets the high byte of the LOW ALS threshold.</td>
</tr>
</tbody>
</table>

The Visible (Vis) channel is compared against low-going 16-bit threshold value set by AILTL and AILTH. The contents of the AILTH and AILTL registers are combined and treated as a sixteen bit threshold value. If the value generated by the C channel is below the AILTL/H threshold and the APERS value is reached, the AINT bit is asserted. If AIEN is set, then the INT pin will also assert. When setting the 16-bit ALS threshold AILTL must be written first, immediately followed by AILTH. Internally, the lower 8-bits are buffered until the upper 8-bits are written. As the upper 8-bits are written both the high and low bytes are simultaneously latched as a 16-bit value.

AIHTL Register (Address 0x86)

Figure 19: AIHTL Register

<table>
<thead>
<tr>
<th>Addr: 0x86</th>
<th>AIHTL</th>
<th></th>
<th></th>
<th>Bit Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit</td>
<td>Bit Name</td>
<td>Default</td>
<td>Access</td>
<td></td>
</tr>
<tr>
<td>7:0</td>
<td>AIHTL</td>
<td>0x00</td>
<td>RW</td>
<td>This register sets the low byte of the HIGH ALS threshold.</td>
</tr>
</tbody>
</table>

The Visible (Vis) channel is compared against high-going 16-bit threshold value set by AIHTL and AIHTH. The contents of the AIHTH and AIHTL registers are combined and treated as a sixteen bit threshold value. If the value generated by the C channel is above the AIHTL/H threshold and the APERS value is reached, the AINT bit is asserted. If AIEN is set, then the INT pin will also assert. When setting the 16-bit ALS threshold AIHTL must be written first, immediately followed by AIHTH. Internally, the lower 8-bits are buffered until the upper 8-bits are written. As the upper 8-bits are written both the high and low bytes are simultaneously latched as a 16-bit value.
**AIHTH Register (Address 0x87)**

The Visible (Vis) channel is compared against high-going 16-bit threshold value set by AIHTL and AIHTH.

The contents of the AIHTH and AIHTL registers are combined and treated as a sixteen bit threshold value. If the value generated by the C channel is above the AIHTL/H threshold and the APERS value is reached, the AINT bit is asserted. If AIEN is set, then the INT pin will also assert.

When setting the 16-bit ALS threshold AIHTL must be written first, immediately follow by AIHTH. Internally, the lower 8-bits are buffered until the upper 8-bits are written. As the upper 8-bits are written both the high and low bytes are simultaneously latched as a 16-bit value.

<table>
<thead>
<tr>
<th>Addr: 0x87</th>
<th>AIHTH</th>
<th>Bit Name</th>
<th>Default</th>
<th>Access</th>
<th>Bit Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:0</td>
<td>AIHTH</td>
<td>0x00</td>
<td>RW</td>
<td></td>
<td>This register sets the high byte of the HIGH ALS threshold.</td>
</tr>
</tbody>
</table>
**PERS Register (Address 0x8C)**

The frequency of consecutive visible channel results outside of threshold limits are counted; this count value is compared against the APEARS value. If the counter is equal to the APERS setting an interrupt is asserted. Any time a clear channel result is inside the threshold values the counter is cleared.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Bit Name</th>
<th>Default</th>
<th>Access</th>
<th>Bit Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:4</td>
<td>Reserved</td>
<td>0000</td>
<td>RW</td>
<td>Reserved.</td>
</tr>
<tr>
<td>3:0</td>
<td>APERS</td>
<td>0000</td>
<td>RW</td>
<td>This register sets the ALS persistence filter.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>...</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>13</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>14</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15</td>
</tr>
</tbody>
</table>
The wait timer is implemented using a down counter. 
Wait time = (value +1) x 2.8ms. If WLONG is enabled then 
Wait time = (value +1) x 2.8ms x 12.

### CFG0 Register (Address 0x8D)

#### Table

<table>
<thead>
<tr>
<th>Addr: 0x8D</th>
<th>CFG0</th>
<th>Bit</th>
<th>Bit Name</th>
<th>Default</th>
<th>Access</th>
<th>Bit Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>7:3</td>
<td>Reserved</td>
<td>10000</td>
<td>RW</td>
<td>This field must be set to the default value.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>WLONG</td>
<td>0</td>
<td>RW</td>
<td>When Wait Long is asserted the wait period as set by WTIME is increased by a factor of 12.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1:0</td>
<td>Reserved</td>
<td>00</td>
<td>RW</td>
<td>This field must be set to the default value.</td>
</tr>
</tbody>
</table>
**CFG1 Register (Address 0x90)**

Figure 23: CFG1 Register

<table>
<thead>
<tr>
<th>Addr: 0x90</th>
<th>CFG1</th>
<th>Bit Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit</td>
<td>Bit Name</td>
<td>Default</td>
</tr>
<tr>
<td>7:2</td>
<td>Reserved</td>
<td>000000</td>
</tr>
<tr>
<td>1:0</td>
<td>AGAIN</td>
<td>00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**REVID Register (Address 0x91)**

Figure 24: REVID Register

<table>
<thead>
<tr>
<th>Addr: 0x91</th>
<th>REVID</th>
<th>Bit Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit</td>
<td>Bit Name</td>
<td>Default</td>
</tr>
<tr>
<td>7:3</td>
<td>Reserved</td>
<td>01100</td>
</tr>
<tr>
<td>2:0</td>
<td>REV_ID</td>
<td>001</td>
</tr>
</tbody>
</table>
**ID Register (Address 0x92)**

Figure 25: ID Register

<table>
<thead>
<tr>
<th>Addr: 0x92</th>
<th>ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit</td>
<td>Bit Name</td>
</tr>
<tr>
<td>7:2</td>
<td>ID</td>
</tr>
<tr>
<td>1:0</td>
<td>Reserved</td>
</tr>
</tbody>
</table>

**Status Register (Address 0x93)**

Figure 26: Status Register

<table>
<thead>
<tr>
<th>Addr: 0x93</th>
<th>Status Register</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit</td>
<td>Bit Name</td>
</tr>
<tr>
<td>7</td>
<td>ASAT</td>
</tr>
<tr>
<td>6:5</td>
<td>Reserved</td>
</tr>
<tr>
<td>4</td>
<td>AINT</td>
</tr>
<tr>
<td>3</td>
<td>CINT</td>
</tr>
<tr>
<td>2:0</td>
<td>Reserved</td>
</tr>
</tbody>
</table>

All flags in this register can be cleared by setting the bit high. Alternatively, if the CFG3.int_read_clear bit is set, then simply reading this register automatically clears all eight flags.

**VISDATAL Register (Address 0x94)**

Figure 27: VISDATAL Register

<table>
<thead>
<tr>
<th>Addr: 0x94</th>
<th>VISDATAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit</td>
<td>Bit Name</td>
</tr>
<tr>
<td>7:0</td>
<td>VISDATAL</td>
</tr>
</tbody>
</table>
**VISDATAH Register (Address 0x95)**

![Figure 28: VISDATAH Register](image)

<table>
<thead>
<tr>
<th>Addr: 0x95</th>
<th>VISDATAH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit</td>
<td>Bit Name</td>
</tr>
<tr>
<td>7:0</td>
<td>VISDATAH</td>
</tr>
</tbody>
</table>

**IRDATAL Register (Address 0x96)**

![Figure 29: IRDATAL Register](image)

<table>
<thead>
<tr>
<th>Addr: 0x96</th>
<th>IRDATAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit</td>
<td>Bit Name</td>
</tr>
<tr>
<td>7:0</td>
<td>IRDATAL</td>
</tr>
</tbody>
</table>

**IRDATAH Register (Address 0x97)**

![Figure 30: IRDATAH Register](image)

<table>
<thead>
<tr>
<th>Addr: 0x97</th>
<th>IRDATAH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit</td>
<td>Bit Name</td>
</tr>
<tr>
<td>7:0</td>
<td>IRDATAH</td>
</tr>
</tbody>
</table>

**REVID2 Register (Address 0x9E)**

![Figure 31: REVID2 Register](image)

<table>
<thead>
<tr>
<th>Addr: 0x9E</th>
<th>REVID2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit</td>
<td>Bit Name</td>
</tr>
<tr>
<td>7:4</td>
<td>Reserved</td>
</tr>
<tr>
<td>3:0</td>
<td>REVID2</td>
</tr>
</tbody>
</table>
**CFG2 Register (Address 0x9F)**

The ALS gain can be adjusted by setting the two AGAIN bits as well as the AGAINMAX and AGAINL bits which yields an overall range from $\frac{1}{2}x$ to 128x.

### CFG2 Register

<table>
<thead>
<tr>
<th>Bit</th>
<th>Bit Name</th>
<th>Default</th>
<th>Access</th>
<th>Bit Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:5</td>
<td>Reserved</td>
<td>000</td>
<td>RW</td>
<td>Reserved.</td>
</tr>
<tr>
<td>4</td>
<td>AGAINMAX</td>
<td>0</td>
<td>RW</td>
<td>This bit adjusts the overall ALS gain factor. See Figure 33 for recommended settings and corresponding overall ALS gain factor.</td>
</tr>
<tr>
<td>3</td>
<td>Reserved</td>
<td>0</td>
<td>RW</td>
<td>Reserved.</td>
</tr>
<tr>
<td>2</td>
<td>AGAINL</td>
<td>1</td>
<td>RW</td>
<td>This bit adjusts the overall ALS gain factor. See Figure 33 for recommended settings and corresponding overall ALS gain factor.</td>
</tr>
<tr>
<td>1:0</td>
<td>Reserved</td>
<td>00</td>
<td>RW</td>
<td>Reserved.</td>
</tr>
</tbody>
</table>

### AGAIN[1] AGAIN[0] AGAINMAX AGAINL Overall ALS Gain

<table>
<thead>
<tr>
<th>AGAIN[1]</th>
<th>AGAIN[0]</th>
<th>AGAINMAX</th>
<th>AGAINL</th>
<th>Overall ALS Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>$\frac{1}{2}$</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>16</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>64</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>128</td>
</tr>
</tbody>
</table>
### CFG3 Register (Address 0xAB)

Figure 34: CFG3 Register

<table>
<thead>
<tr>
<th>Addr: 0xAB</th>
<th>CFG3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit</td>
<td>Bit Name</td>
</tr>
<tr>
<td>7</td>
<td>INT_READ_CLEAR</td>
</tr>
<tr>
<td>6:5</td>
<td>Reserved</td>
</tr>
<tr>
<td>4</td>
<td>SAI</td>
</tr>
<tr>
<td>3:0</td>
<td>Reserved</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PON</th>
<th>SAI</th>
<th>INT</th>
<th>Oscillator</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>X</td>
<td>X</td>
<td>OFF</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>X</td>
<td>ON</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>ON</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>0</td>
<td>OFF</td>
</tr>
</tbody>
</table>

The SAI bit sets the device operational mode following the completion of an ALS or proximity cycle. If AINT and AIEN are both set or if PINT and PIEN are both set, causing an interrupt on the INT pin, and the SAI bit is set, then the oscillator will deactivate. The Device will appear as if PON = 0, however, PON will read as 1. The device can only be reactivated (oscillator enabled) by clearing the interrupts in the STATUS register.
AZ_CONFIG Register (Address 0xD6)

Figure 35: AZ_CONFIG Register

<table>
<thead>
<tr>
<th>Addr: 0xD6</th>
<th>AZ_CONFIG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit</td>
<td>Bit Name</td>
</tr>
<tr>
<td>7</td>
<td>Reserved</td>
</tr>
<tr>
<td>6:0</td>
<td>AZ_NTH_ITERATION</td>
</tr>
</tbody>
</table>

INTENAB Register (Address 0xDD)

Figure 36: INTENAB Register

<table>
<thead>
<tr>
<th>Addr: 0xDD</th>
<th>INTENAB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit</td>
<td>Bit Name</td>
</tr>
<tr>
<td>7</td>
<td>ASIEN</td>
</tr>
<tr>
<td>6:5</td>
<td>Reserved</td>
</tr>
<tr>
<td>4</td>
<td>AIEN</td>
</tr>
<tr>
<td>3:0</td>
<td>Reserved</td>
</tr>
</tbody>
</table>
VISADJ Register (Address 0xE6)

Figure 37: VISADJ Register

<table>
<thead>
<tr>
<th>Addr: 0xE6</th>
<th>Bit</th>
<th>Bit Name</th>
<th>Default</th>
<th>Access</th>
<th>Bit Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:0</td>
<td>VISADJ</td>
<td>FS</td>
<td>R</td>
<td></td>
<td>This register provides the output scaling factor for the visible channel.</td>
</tr>
</tbody>
</table>

The output of the visible channel should be adjusted via software based on the value of this register. This register holds an adjustment factor in which the MSB is a sign bit and the remaining bits represent the percent change to be made to the output. A few examples of the output adjustment factor can be seen in Figure 38.

Figure 38: Output Adjustment Factor

<table>
<thead>
<tr>
<th>Register Value</th>
<th>Adjustment (%)</th>
<th>Adjustment Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>0001 0100</td>
<td>20</td>
<td>1.20</td>
</tr>
<tr>
<td>0000 1000</td>
<td>8</td>
<td>1.08</td>
</tr>
<tr>
<td>0000 0011</td>
<td>3</td>
<td>1.03</td>
</tr>
<tr>
<td>0000 0000</td>
<td>0</td>
<td>1.00</td>
</tr>
<tr>
<td>1000 0000</td>
<td>0</td>
<td>1.00</td>
</tr>
<tr>
<td>1000 0011</td>
<td>-3</td>
<td>0.97</td>
</tr>
<tr>
<td>1000 1000</td>
<td>-8</td>
<td>0.92</td>
</tr>
<tr>
<td>1001 0100</td>
<td>-20</td>
<td>0.80</td>
</tr>
</tbody>
</table>
Figure 39: Typical Applications Circuit

Note(s):
1. The value of the I²C pull up resistors RPU should be based on the 1.8V bus voltage, system bus speed and trace capacitance.
2. The bulk capacitor can affect the stability of a regulated supply output and should be chosen with the regulator characteristics in mind.
3. VSS and PGND should be connected to the same solid ground plane as close to the device as possible.
TSL2541 – Package Drawings & Markings

Figure 40: Package Drawing

Note(s):
1. All linear dimensions are in micrometers. Dimension tolerance is ±20 μm unless otherwise stated.
2. The die is centered vertically within the package within a tolerance of ±75 μm.
3. Package top surface is molded with an electrically nonconductive black plastic compound having an index of refraction of 1.55.
4. Contact finish is Copper Alloy A194 with pre-plated NiPdAu lead finish.
5. This package contains no lead (Pb).
6. This drawing is subject to change without notice.
Figure 41:
Recommended PCB Pad Layout

Note(s):
1. All dimensions are in micrometers.
2. Dimension tolerances are 50μm unless otherwise noted.
3. This drawing is subject to change without notice.
Tape & Reel Information

Figure 42: Tape and Reel Information

Note(s):
1. All linear dimensions are in millimeters.
2. For missing tolerances and dimensions, refer to EIA-481.
The QFN package has been tested and has demonstrated an ability to be reflow soldered to a PCB substrate. The solder reflow profile describes the expected maximum heat exposure of components during the solder reflow process of product on a PCB. Temperature is measured on top of component. The components should be limited to a maximum of three passes through this solder reflow profile.

Figure 43: Solder Reflow Profile

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Reference</th>
<th>Device</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average temperature gradient in preheating</td>
<td></td>
<td>2.5°C/s</td>
</tr>
<tr>
<td>Soak time</td>
<td>$t_{SOAK}$</td>
<td>2 to 3 minutes</td>
</tr>
<tr>
<td>Time above 217°C ($T_1$)</td>
<td>$t_1$</td>
<td>Max 60s</td>
</tr>
<tr>
<td>Time above 230°C ($T_2$)</td>
<td>$t_2$</td>
<td>Max 50s</td>
</tr>
<tr>
<td>Time above $T_{peak} - 10°C$ ($T_3$)</td>
<td>$t_3$</td>
<td>Max 10s</td>
</tr>
<tr>
<td>Peak temperature in reflow</td>
<td>$T_{peak}$</td>
<td>260°C</td>
</tr>
<tr>
<td>Temperature gradient in cooling</td>
<td></td>
<td>Max - 5°C/s</td>
</tr>
</tbody>
</table>

Figure 44: Solder Reflow Profile Graph

Not to scale — for reference only
Storage Information

Moisture Sensitivity Optical characteristics of the device can be adversely affected during the soldering process by the release and vaporization of moisture that has been previously absorbed into the package. To ensure the package contains the smallest amount of absorbed moisture possible, each device is baked prior to being dry packed for shipping. Devices are dry packed in a sealed aluminized envelope called a moisture-barrier bag with silica gel to protect them from ambient moisture during shipping, handling, and storage before use.

Shelf Life

The calculated shelf life of the device in an unopened moisture barrier bag is 12 months from the date code on the bag when stored under the following conditions:

- Shelf Life: 12 months
- Ambient Temperature: <40°C
- Relative Humidity: <90%

Rebaking of the devices will be required if the devices exceed the 12 month shelf life or the Humidity Indicator Card shows that the devices were exposed to conditions beyond the allowable moisture region.

Floor Life

The QFN package has been assigned a moisture sensitivity level of MSL 3. As a result, the floor life of devices removed from the moisture barrier bag is 168 hours from the time the bag was opened, provided that the devices are stored under the following conditions:

- Floor Life: 168 hours
- Ambient Temperature: <30°C
- Relative Humidity: <60%

If the floor life or the temperature/humidity conditions have been exceeded, the devices must be rebaked prior to solder reflow or dry packing.

Rebaking Instructions

When the shelf life or floor life limits have been exceeded, rebake at 50°C for 12 hours.
Ordering & Contact Information

Figure 45:
Ordering Information

<table>
<thead>
<tr>
<th>Ordering Code</th>
<th>I²C Bus</th>
<th>I²C Address</th>
<th>Delivery Form</th>
<th>Delivery Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSL25413</td>
<td>1.8V</td>
<td>39h</td>
<td>Tape and Reel</td>
<td>10000 pcs/reel</td>
</tr>
<tr>
<td>TSL25413M</td>
<td>1.8V</td>
<td>39h</td>
<td>Tape and Reel</td>
<td>1000 pcs/reel</td>
</tr>
</tbody>
</table>

Buy our products or get free samples online at:
www.ams.com/ICdirect

Technical Support is available at:
www.ams.com/Technical-Support

Provide feedback about this document at:

For further information and requests, e-mail us at:
ams_sales@ams.com

For sales offices, distributors and representatives, please visit:
www.ams.com/contact

Headquarters
ams AG
Tobelbader Strasse 30
8141 Premstaetten
Austria, Europe

Tel: +43 (0) 3136 500 0
Website: www.ams.com
RoHS Compliant & ams Green Statement

RoHS: The term RoHS compliant means that ams AG products fully comply with current RoHS directives. Our semiconductor products do not contain any chemicals for all 6 substance categories, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, RoHS compliant products are suitable for use in specified lead-free processes.

ams Green (RoHS compliant and no Sb/Br): ams Green defines that in addition to RoHS compliance, our products are free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material).

Important Information: The information provided in this statement represents ams AG knowledge and belief as of the date that it is provided. ams AG bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. ams AG has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. ams AG and ams AG suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.
Copyright ams AG, Tobelbader Strasse 30, 8141 Premstaetten, Austria-Europe. Trademarks Registered. All rights reserved. The material herein may not be reproduced, adapted, merged, translated, stored, or used without the prior written consent of the copyright owner.

Devices sold by ams AG are covered by the warranty and patent indemnification provisions appearing in its General Terms of Trade. ams AG makes no warranty, express, statutory, implied, or by description regarding the information set forth herein. ams AG reserves the right to change specifications and prices at any time and without notice. Therefore, prior to designing this product into a system, it is necessary to check with ams AG for current information. This product is intended for use in commercial applications. Applications requiring extended temperature range, unusual environmental requirements, or high reliability applications, such as military, medical life-support or life-sustaining equipment are specifically not recommended without additional processing by ams AG for each application. This product is provided by ams AG “AS IS” and any express or implied warranties, including, but not limited to the implied warranties of merchantability and fitness for a particular purpose are disclaimed.

ams AG shall not be liable to recipient or any third party for any damages, including but not limited to personal injury, property damage, loss of profits, loss of use, interruption of business or indirect, special, incidental or consequential damages, of any kind, in connection with or arising out of the furnishing, performance or use of the technical data herein. No obligation or liability to recipient or any third party shall arise or flow out of ams AG rendering of technical or other services.
# Document Status

<table>
<thead>
<tr>
<th>Document Status</th>
<th>Product Status</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product Preview</td>
<td>Pre-Development</td>
<td>Information in this datasheet is based on product ideas in the planning phase of development. All specifications are design goals without any warranty and are subject to change without notice</td>
</tr>
<tr>
<td>Preliminary Datasheet</td>
<td>Pre-Production</td>
<td>Information in this datasheet is based on products in the design, validation or qualification phase of development. The performance and parameters shown in this document are preliminary without any warranty and are subject to change without notice</td>
</tr>
<tr>
<td>Datasheet</td>
<td>Production</td>
<td>Information in this datasheet is based on products in ramp-up to full production or full production which conform to specifications in accordance with the terms of ams AG standard warranty as given in the General Terms of Trade</td>
</tr>
<tr>
<td>Datasheet (discontinued)</td>
<td>Discontinued</td>
<td>Information in this datasheet is based on products which conform to specifications in accordance with the terms of ams AG standard warranty as given in the General Terms of Trade, but these products have been superseded and should not be used for new designs</td>
</tr>
</tbody>
</table>
### Revision Information

<table>
<thead>
<tr>
<th>Changes from 1-00 (2017-Oct-19) to current revision 1-01 (2018-Jan-23)</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Updated Figure 8 and added note below</td>
<td>6</td>
</tr>
<tr>
<td>Updated Figure 13 and added note below</td>
<td>11</td>
</tr>
<tr>
<td>Added VISADJ Register (Address 0xE6) and Figure 38</td>
<td>25</td>
</tr>
</tbody>
</table>

**Note(s):**
1. Page and figure numbers for the previous version may differ from page and figure numbers in the current revision.
2. Correction of typographical errors is not explicitly mentioned.
Content Guide

1 General Description
   1 Key Benefits & Features
   2 Applications
   2 Block Diagram

3 Pin Assignment
4 Absolute Maximum Ratings
5 Electrical Characteristics
6 Typical Operating Characteristics

8 Detailed Description
   8 Ambient Light Sensing
   8 I²C Characteristics
   8 I²C Write Transaction
   8 I²C Read Transaction
   9 Timing Diagrams
   9 Principles of Operation
   9 System State Machine

11 Register Description
12 Detailed Register Description
   12 Enable Register (Address 0x80)
   13 ATIME Register (Address 0x81)
   14 WTIME Register (Address 0x83)
   14 AILTL Register (Address 0x84)
   15 AILTH Register (Address 0x85)
   15 AIHTL Register (Address 0x86)
   16 AIHTH Register (Address 0x87)
   17 PERS Register (Address 0x8C)
   18 CFG0 Register (Address 0x8D)
   19 CFG1 Register (Address 0x90)
   19 REVID Register (Address 0x91)
   20 ID Register (Address 0x92)
   20 Status Register (Address 0x93)
   20 VISDATAL Register (Address 0x94)
   21 VISDATAH Register (Address 0x95)
   21 IRDATAL Register (Address 0x96)
   21 IRDATAH Register (Address 0x97)
   21 REVID2 Register (Address 0x9E)
   22 CFG2 Register (Address 0x9F)
   23 CFG3 Register (Address 0xAB)
   24 AZ_CONFIG Register (Address 0xD6)
   24 INTENAB Register (Address 0xDD)
   25 VISADJ Register (Address 0xE6)

26 Application Information
26 Schematic

27 Package Drawings & Markings
29 Tape & Reel Information

30 Soldering & Storage Information
31 Storage Information
31 Shelf Life