



## Eval Kit Manual

# AS7221

## Smart Lighting Integration Kit (SLIK) User Guide

## Content Guide

1	AS7221 SLIK Overview .....	4
2	AS7221 SLIK hardware description .....	5
2.1	Constant Current Integration Kit .....	6
2.2	AS7221 SLIK - Constant Current Configuration w/UART Network Interface .....	6
2.3	AS7221 SLIK - Constant Current Configuration w/Bluetooth Network Interface .....	8
2.4	Configuring the AS7221 SLIK for PWM1 Digital Deep Dimming .....	9
3	AS7221 SLIK - Operation .....	9
3.1	AS7221 SLIK – Adding Daylighting Control via I <sup>2</sup> C using the AS4531 .....	11
4	Contact Information.....	15
5	Copyrights & Disclaimer.....	16
6	Revision Information .....	17

# **Network-Enabled Smart Lighting Technology for White Color Tuning Applications Enabling the *Internet of Awareness*<sup>™</sup>**

## 1 AS7221 SLIK Overview

The AS7221 Smart Lighting Integration Kit (SLIK) is a complete color tuning luminaire reference design solution, built around the ams AS7221 Network-Enabled Smart Lighting Manager.

The AS7221 SLIK is built from three interconnected modules: an AS7221 module, a Bluetooth module and an LED module with two strings of white LEDs for tuning (warm and cool). It is shipped with the LED module removed and mounted on the AS7221 module to allow for diffusion and sensing of the LED light by the AS7221. For operation of the SLIK as shipped, which includes a diffuser, refer to the ams Dashboard software and documentation, which is also included on the SLIK USB memory stick.

The AS7221 SLIK can also be used with only one or two of the modules, depending on usage. Such operation is described in this document.

Note that this SLIK user guide document applies to the AS7221 SLIK a0061e0\_CSS board assembly.

### In the AS7221 SLIK box

- A fully assembled three-module AS7221 SLIK (a0061e0\_CSS board assembly)
- Optional AS4531 assembly for adding Daylighting operation to the AS7221 SLIK
- SLIK AC/DC 12V power supply (including US plug adapter, as required)
- USB cable assembly for installation into the SLIK (for serial UART interface dashboard connectivity)
- USB stick containing SLIK User Guide (this document), ams Spectral Sensor Dashboard software and associated user guide, and the latest AS7221 device datasheet

### Powering up SLIK

The AS7221 SLIK will power up with the following default factory settings:

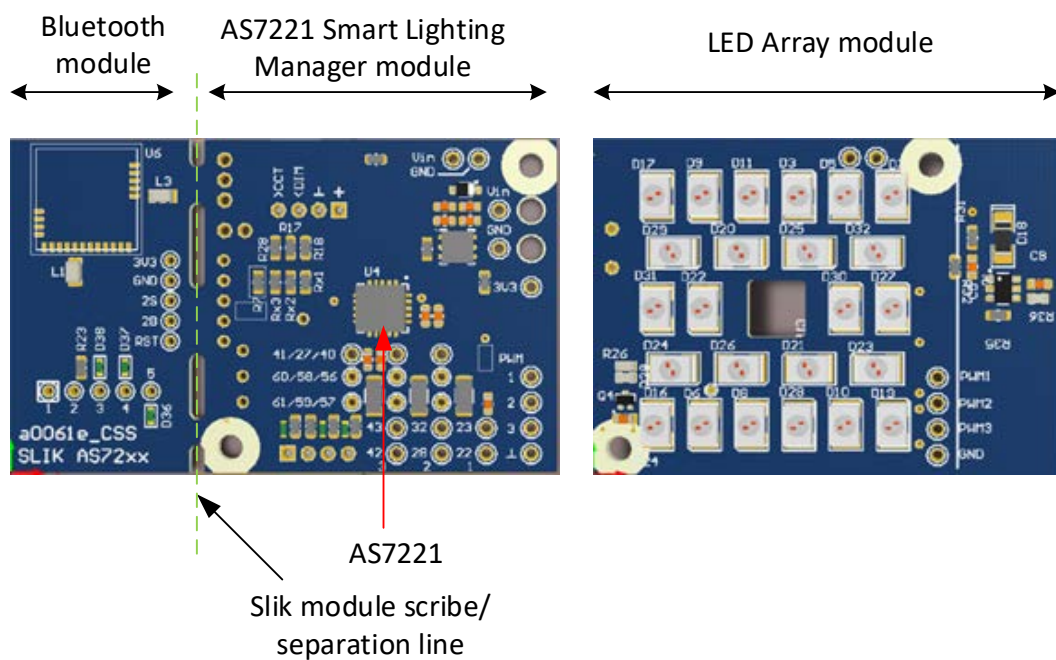
- Assumes 12VIN operation with AS7221 factory MODE setting (MODE = 0)
- Color Tuning is enabled
- External dimming control is enabled
- External occupancy control input is in standby, but automatically enables upon first usage
- Computer communication, for AS7221 Dashboard operation, is done using the ams provided USB cable which is installed into SLIK after installing software from the USB stick. This USB interface should not be used if using the Bluetooth module (which requires an ams smartphone app)

*The SLIK module configuration is not electrically isolated. Care should be taken to place the module in the appropriate position to meet electrical and physical safety requirements as set forth in international standards.*

## 2 AS7221 SLIK hardware description

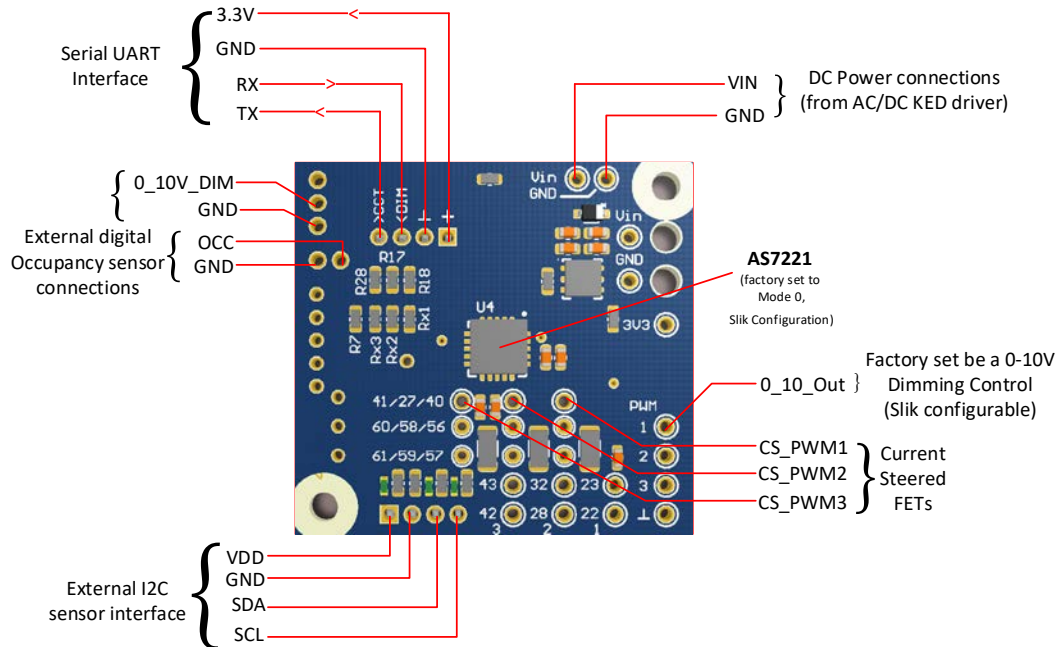
The AS7221 Smart Lighting Integration Kit (SLIK) is a complete smart color luminaire reference design solution built around the ams AS7221 Smart Lighting Manager. As shown in the figure below, SLIK consists of two interconnected modules (Bluetooth and AS7221 Smart Lighting) and one LED array module. The interconnected modules are scribed and can be separated as needed for compatibility with various luminaire control architectures.

The SLIK LED Array module is mounted on the AS7221 Smart Lighting Manager module before shipment to allow easy operation of an external diffuser for color tuning of the LED array by the AS7221 device.

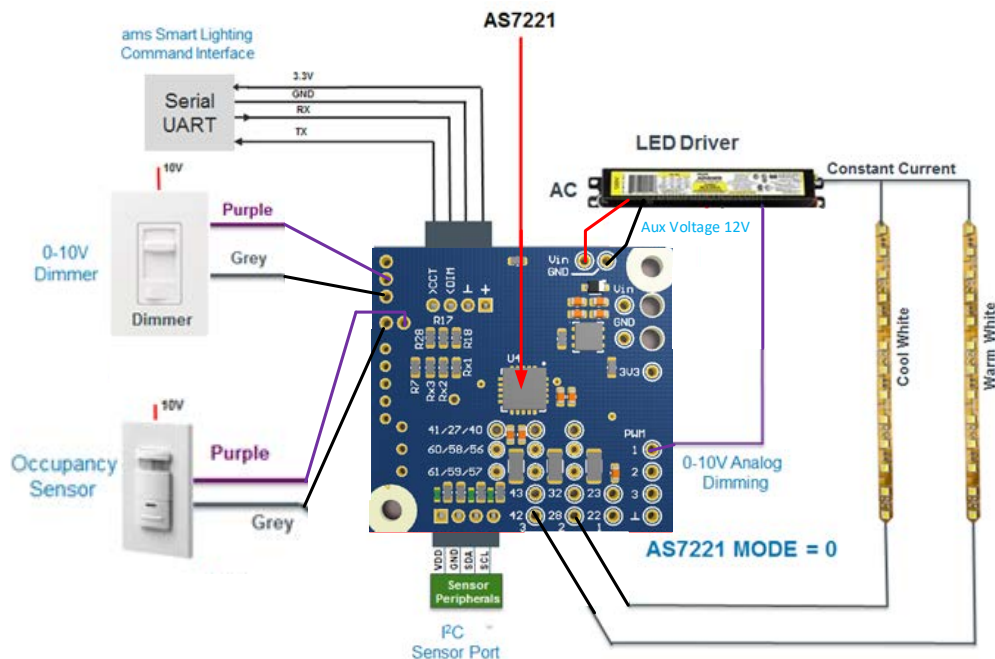


## 2.1 Constant Current Integration Kit

### SLIK - Constant Current Luminaire Connections

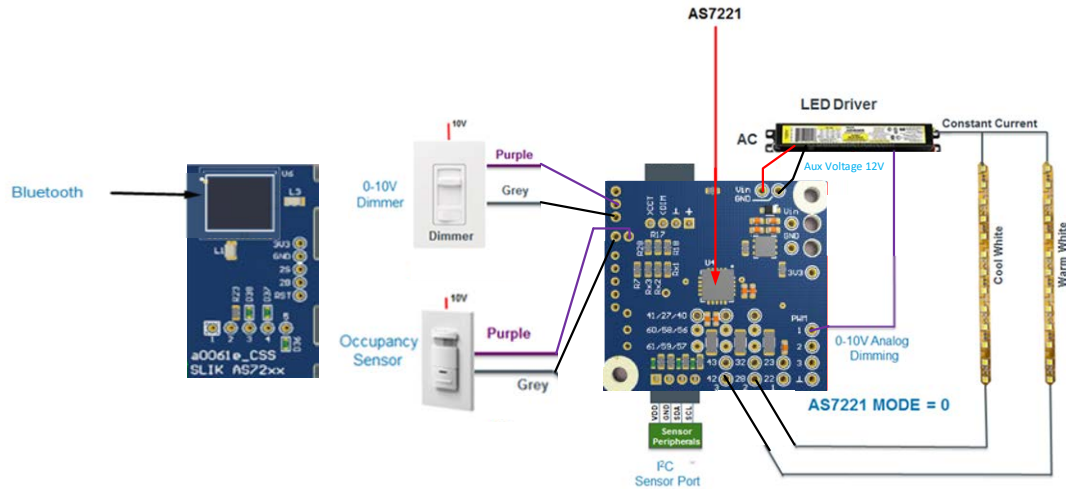


## 2.2 AS7221 SLIK - Constant Current Configuration w/UART Network Interface



SLIK Connection	Connection Description	Connection Type
DIM	0-10V input for Luminaire dimming control from an external dimmer. Dimming range to the Luminaire is from 100% (no dimming) to 10% dimming.	Local Control Inputs
GND	Ground return for external dimmer	
OCCN	Digital input for occupancy detection from an external sensor	
GND	Ground return for external OCC sensor.	
TX	UART Transmit	Serial UART Interface
RX	UART Receive	
GND (-)	UART Interface Ground	
3.3V (+)	Power output from SLIK (<50mA)	
SLC	I <sup>2</sup> C clock	External Sensor Port
SDA	I <sup>2</sup> C data	
GND (-)	I <sup>2</sup> C interface ground	
VDD (+)	I <sup>2</sup> C interface power (3.3V) provided by SLIK	
PWM1 (or 0-10V_O)	Used for control of an external Ballast or LED Driver	LED Driver Dimming Control
PWM2, PWM3	Current steered PWM outputs, FET buffered	Digital Color PWM Controls
GND	Ground return for VIN	DC Power Inputs
VIN	12VDC $\pm$ 10% input which powers the entire SLIK assembly (from Ballast/LED Driver)	

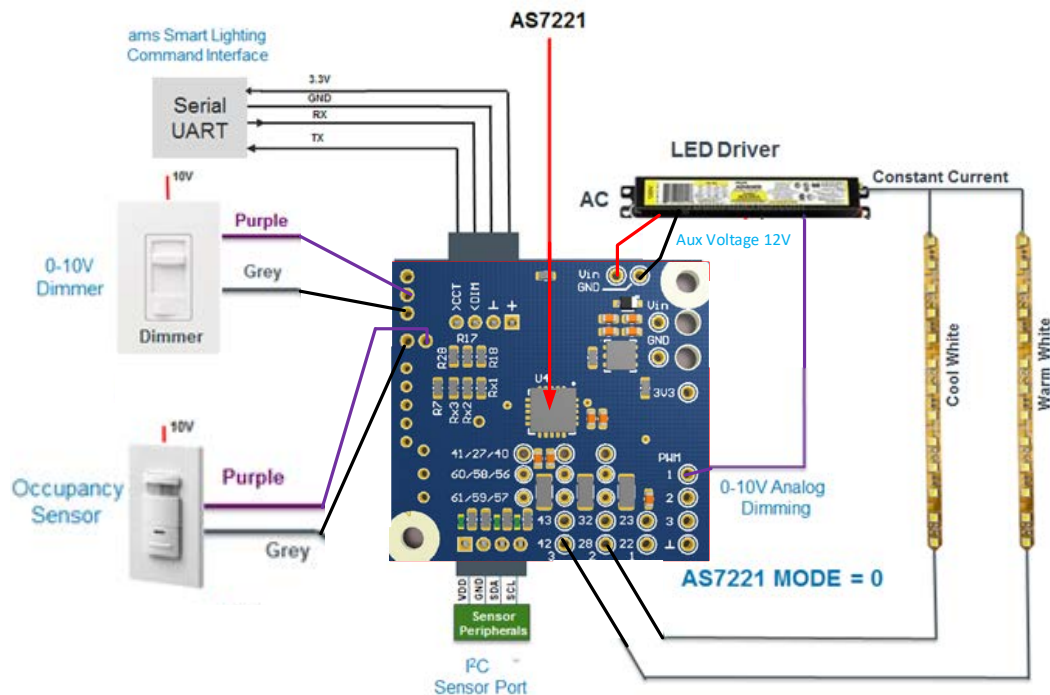
## 2.3 AS7221 SLIK - Constant Current Configuration w/Bluetooth Network Interface



SLIK Connection	Connection Description	Connection Type
DIM	0-10V input for Luminaire dimming control from an external dimmer. Dimming range to the Luminaire is from 100% (no dimming) to 10% dimming.	Local Control Inputs
GND (Grey)	Ground return for external dimmer	
OCCN	Digital input for occupancy detection from an external sensor	
GND	Ground return for external OCC sensor.	
SLC	I <sup>2</sup> C clock	External Sensor Port
SDA	I <sup>2</sup> C data	
GND (-)	I <sup>2</sup> C interface ground	
VDD (+)	I <sup>2</sup> C interface power (3.3V) provided by SLIK	
PWM1 (or 0-0V_O)	Used for control of an external Ballast or LED Driver	LED Driver Dimming Control
PWM2, PWM3	Current steered PWM outputs, FET buffered	Digital Color PWM Controls
GND	Ground return for VIN	DC Power Inputs
VIN	12VDC $\pm$ 10% input which powers the entire SLIK assembly (from Ballast/LED Driver).	



## 2.4 Configuring the AS7221 SLIK for PWM1 Digital Deep Dimming



- Provide a VIN of 12V  $\pm$ 5%
  - As shown in the figure above, SLIK regulates the AC/DC LED Driver Aux output
  - Or, a 12V AC/DC wall brick converter (not shown above) could also be used in place of the 12V LED Driver power. Connect to the 12V factory shipped AC/DC power unit connection.
- Set the AS7221 MODE pin resistor setting for 10V Digital PWM dimming (range is 1-100%, enabling deep dimming).

## 3 AS7221 SLIK - Operation

When a SLIK-controlled luminaire is turned off by SLIK (via the Smart Lighting Command Interface, SLIK dimming or SLIK occupancy sensor), the most recent color temperature target setting, LUX target setting and dimming input level are saved. After power is restored (by SLIK control or AC/DC power-up) the luminaire will begin operation at the stored levels.

### **Automatic SLIK Color Tuning Compensation**

When automatic color tuning compensation is enabled, the PWM2 and PWM3 output controls are slaved to the AS7221 color sensors. As changes to internal Luminaire light color is detected (or color target changed by the Smart Lighting Interface) those outputs will be automatically adjusted to maintain a constant CCT color.

White Color (XYZ) tuning can be enabled or disabled via commands from the Smart Lighting Command Interface (serial UART), for example over Bluetooth from a Smartphone with the appropriate SLIK application installed. Default for the SLIK is to be enabled.

### ***SLIK Dimming Operation***

Local dimming of SLIK is controlled by an external 0-10V dimmer or by the Smart Lighting Command Interface. The 0-10V dimming input allows the luminaire output to vary from 10% to 100%. The Smart Lighting Command Interface can also dim the output from 1% to 100% using a digital PWM (0/10) interface. Again refer to the AS7221 Data Sheet for more details.

TRIAC-based dimmers only affect the absolute max LUX setting of the luminaire, and do not affect SLIK Smart Lighting Command Interface settings which implement changes in LUX percent (%). Note that when using the factory shipped SLIK LED Array Daylighting Configuration, TRIAC based dimming is not available as it is powered by a voltage source.

### ***Setting SLIK Color target***

Setting the target Color for the illuminated space is achieved via the Smart Lighting Command Interface.

### ***Connecting to the Occupancy Control***

The SLIK Occupancy control input is placed in a standby state after any SLIK AC/DC power up. If an external occupancy sensor is connected to SLIK (via the OCCN connection), and is pulsed low continuously for at least 500ms indicating an occupant, the SLIK occupancy control input is automatically activated, and begins a 10 minute countdown timer. As the timer counts down it is set back up to 10 minutes by either: 1) The external occupancy 500ms sensor trigger, or 2) usage of the SLIK external dimming sensor input.

Once the 10 minute occupancy timer expires, indicating no occupant, the luminaire is turned OFF using a smooth dimming-down ramp. The luminaire will be turned back on by either: 1) The external occupancy 500ms sensor trigger, or 2) usage of the SLIK external dimming sensor input.

The OCCN input uses digital input thresholds (0/VDD). Usage of the occupancy sensor input is not required for the other control inputs (Smart Lighting Command Interface or 0-10V dimming) to properly operate.

### ***USB Computer Interface and Dashboard Software Operation***

The AS7221 SLIK uses its Tx/Rx interface to connect to a standard USB computer interface.

This is accomplished using application software and a serial to USB cable which plugs directly into SLIK, both available from ams. Do not operate the built-in SLIK Bluetooth module and the SLIK external UART interface (USB, etc.) at the same time.

The Dashboard software application uses the SLIK Smart Lighting Command Interface to let the user observe and log AS7221 test data.

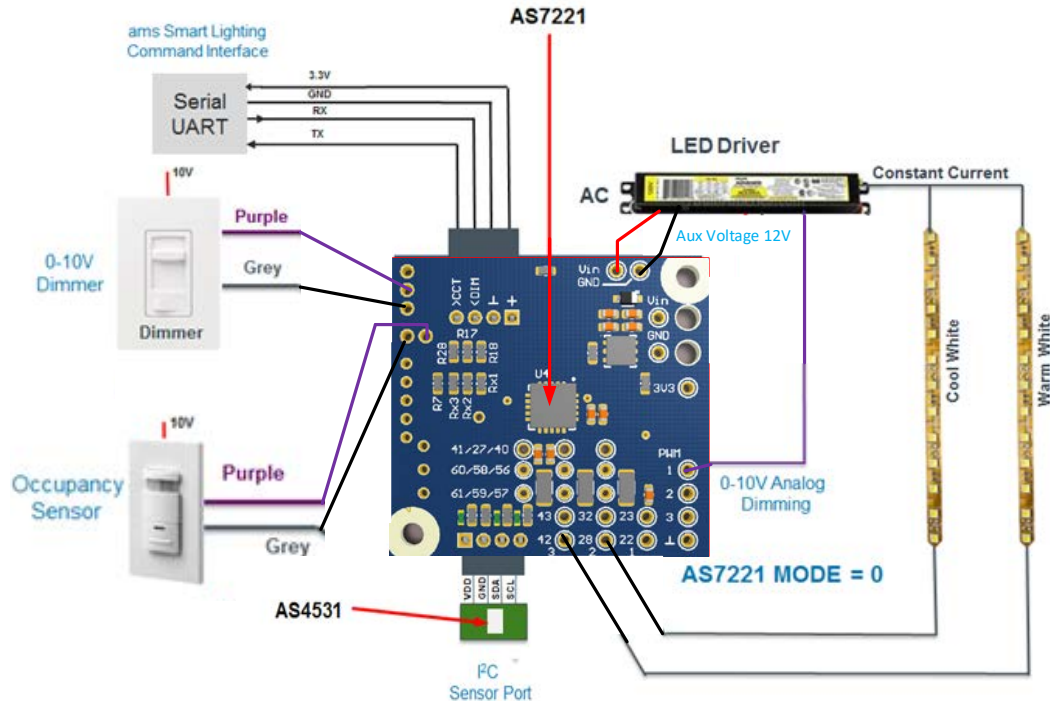
Please refer to the separate AS7221 SLIK Dashboard document for USB and Software installation/usage.

### ***Bluetooth Module Operation***

The AS7221 SLIK uses the AS7221 Tx/Rx interface to connect to the built in Bluetooth BLE module. This is accomplished using application software available from ams. Do not operate the built-in SLIK Bluetooth module and the external SLIK UART interface (USB, etc.) at the same time.

### 3.1 AS7221 SLIK – Adding Daylighting Control via I<sup>2</sup>C using the AS4531

#### Constant Current Configuration

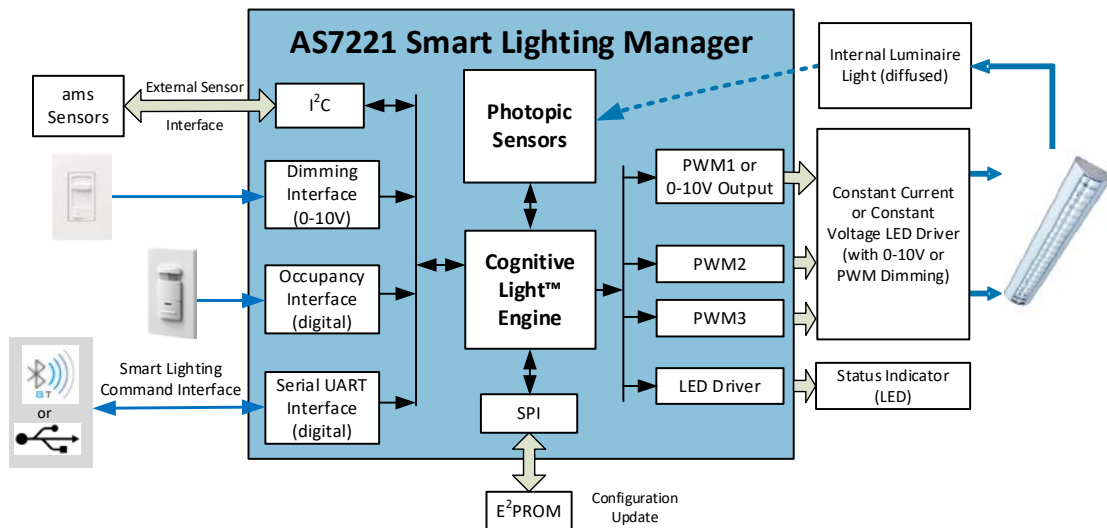


As shown above, a Color Tuning AS7221 SLIK adds Daylighting with a simple inclusion of an AS4531 via I<sup>2</sup>C:

- With this addition the Luminaire can concurrently control both Color Tuning and Daylighting
- Color Tuning uses the AS7221 as both the Smart Lighting Manager and XYZ Color Sensor
- Daylighting is accomplished by the AS4531 sensor which reports to the AS7221 Smart Lighting Manager via I<sup>2</sup>C
- The AS7221 is physically looking toward the internal Luminaire mixed color space
- The AS4531 is physically looking toward the external Luminaire daylight space
- Detection and operation of the AS4531 with the AS7221 is automatic

## Appendix A: AS7221 Block Diagram

The block diagram below illustrates the control connectivity and functionality of the AS7221 Sensor-Integrated Smart Daylighting Manager, which SLIK is built around.



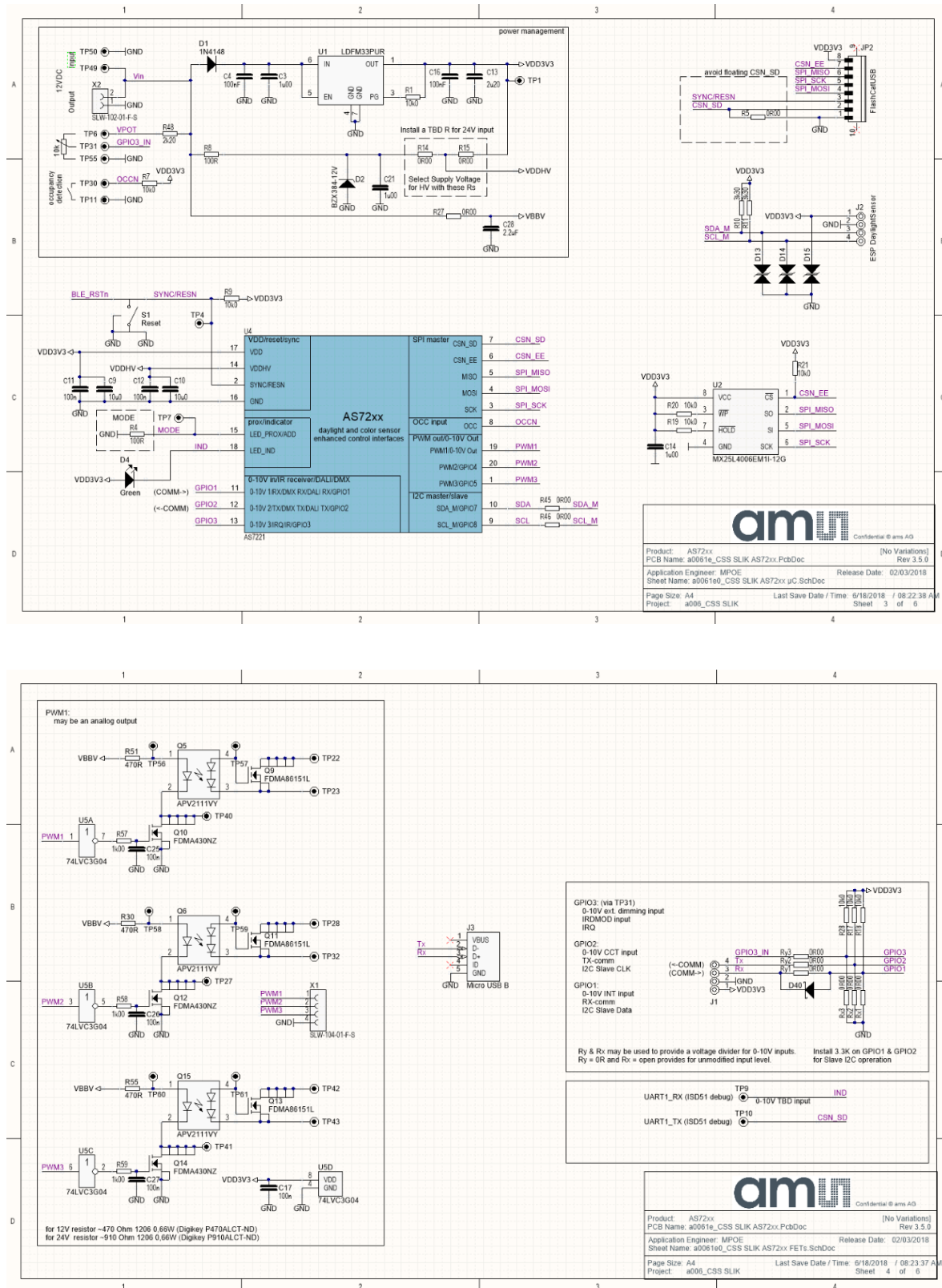
### AS7221 external interfaces:

- External Sensor Port (I²C)
- Local Control Inputs
- Smart Lighting Command Interface (Bluetooth, Serial)
- PWM Outputs

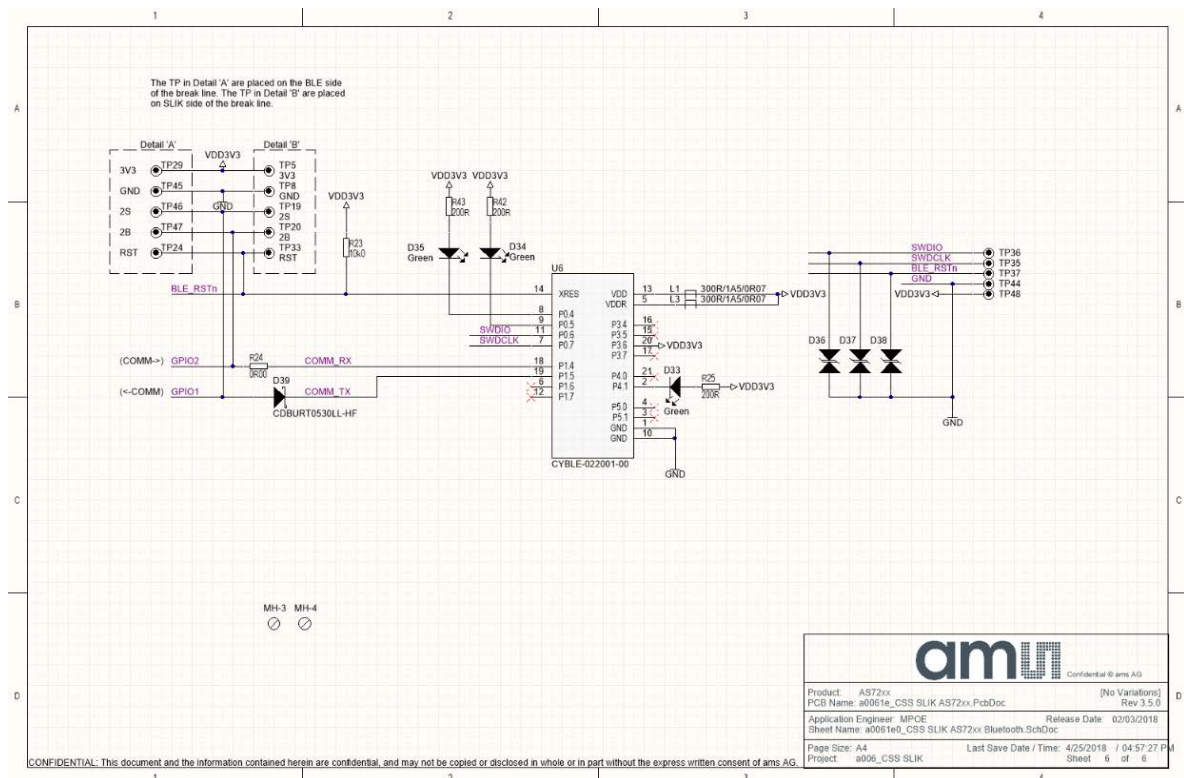
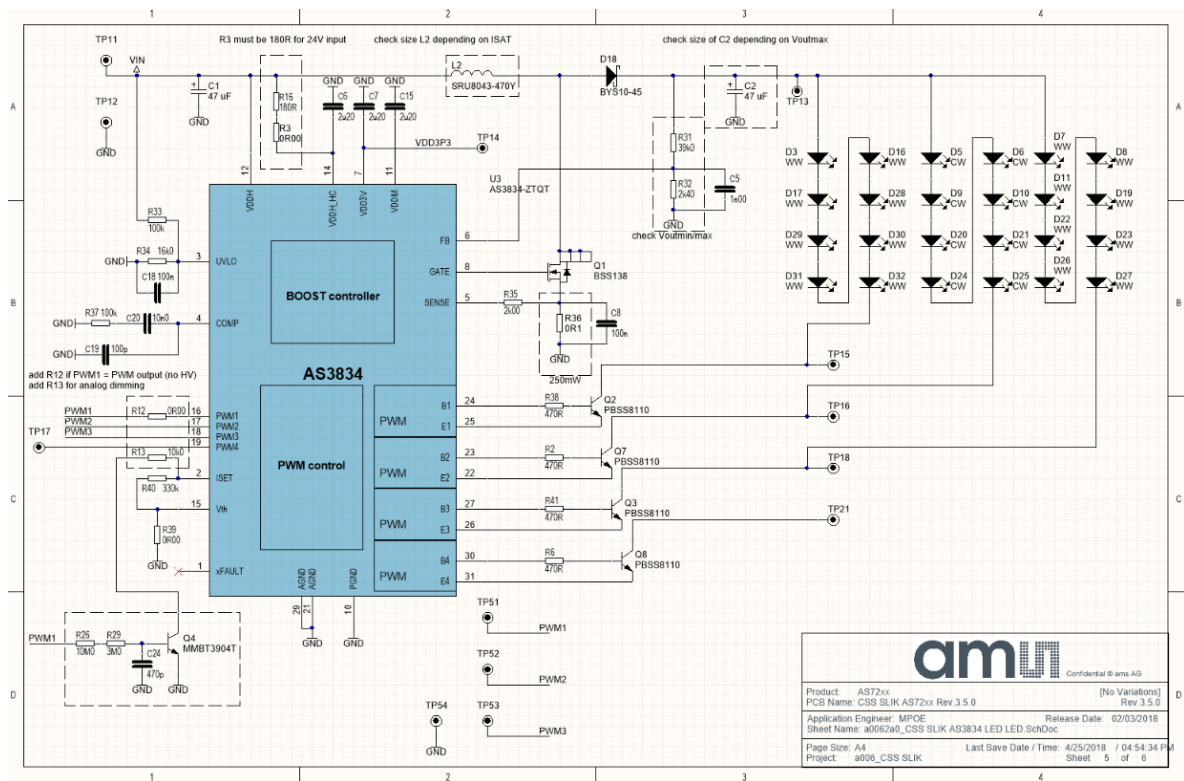
Additional AS7221 device documentation is also available from ams (contact [www.ams.com](http://www.ams.com)):

- AS7221 Datasheet
- AS7221 User Guide
- AS7221 Smart Lighting Command Set

## Appendix B: AS7221 SLIK (v3.2) Schematic







## 4 Contact Information

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## 6 Revision Information

Revision	Date	Owner	Description
3.2.01	14 Sept 2015	KH	Initial AS7221 User Guide for 3v2 assembly
3.2.02	27 Jan 2016	KH	Updated AS7221 MODE settings

**Note:** Page numbers for the previous version may differ from page numbers in the current revision.  
Correction of typographical errors is not explicitly mentioned.

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