Eval Kit Manual

AS7221

Smart Lighting Integration Kit (SLIK) User Guide

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Network-Enabled Smart Lighting Technology for White Color Tuning Applications
Enabling the *Internet of Awareness™*

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:

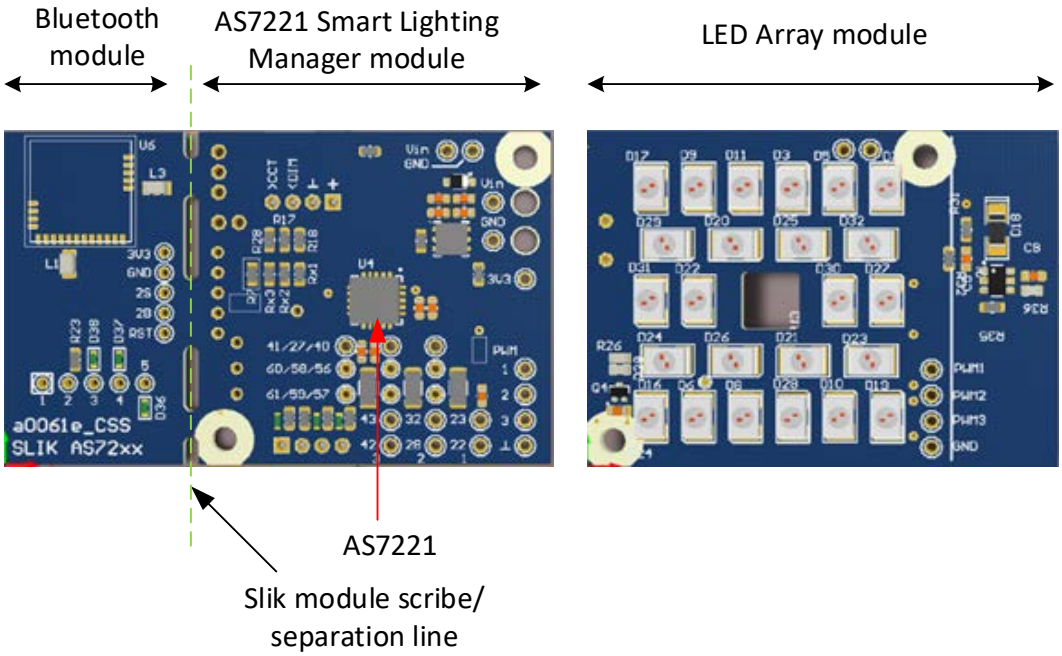
- Assumes 12VIN operation with AS7221 factory MODE setting (MODE = 0)
- Color Tuning is enabled
- External dimming control is enabled
- External occupancy control input is in standby, but automatically enables upon first usage
- Computer communication, for AS7221 Dashboard operation, is done using the 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

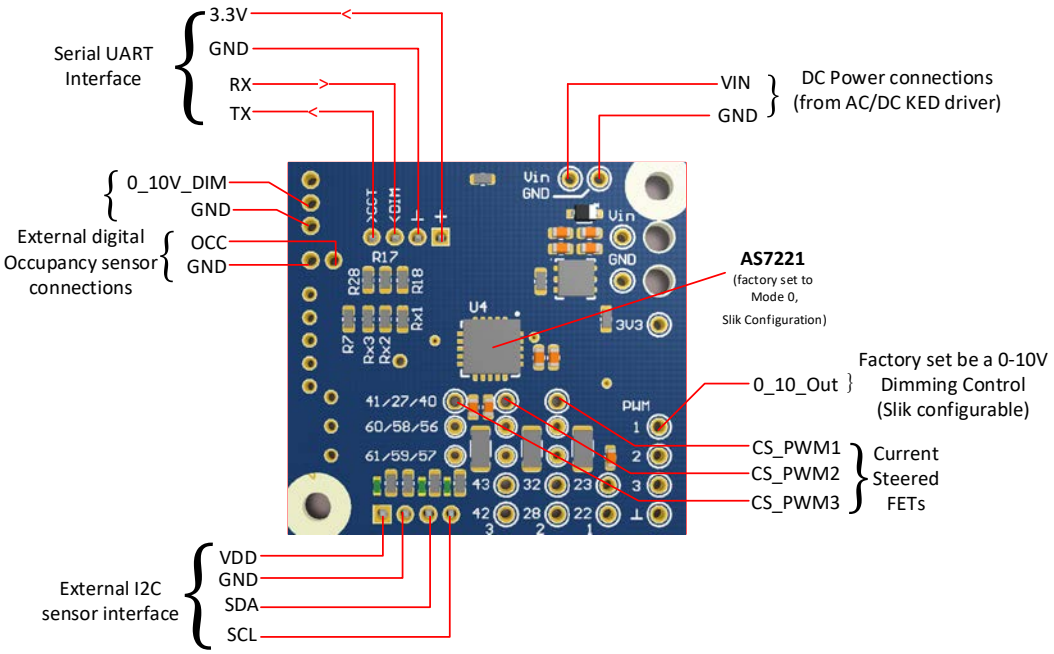
The AS7221 Smart Lighting Integration Kit (SLIK) is a complete smart color luminaire reference design solution built around the ams AS7221 Smart Lighting Manager. As shown in the figure below, SLIK consists of two interconnected modules (Bluetooth and AS7221 Smart Lighting) and one LED array module. 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.

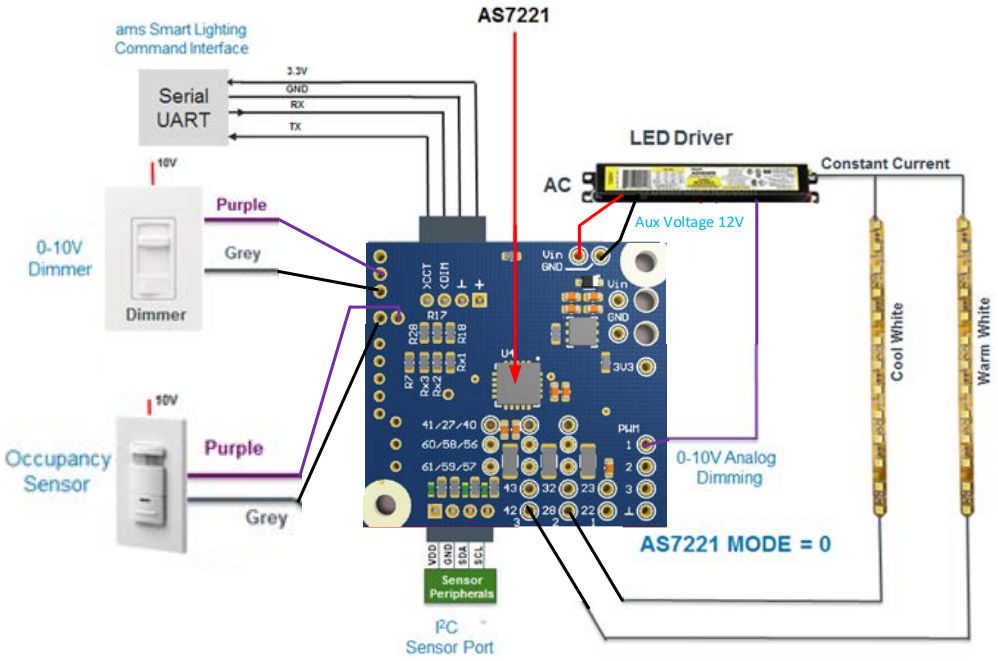


2.1 Constant Current Integration Kit

SLIK - Constant Current Luminaire Connections

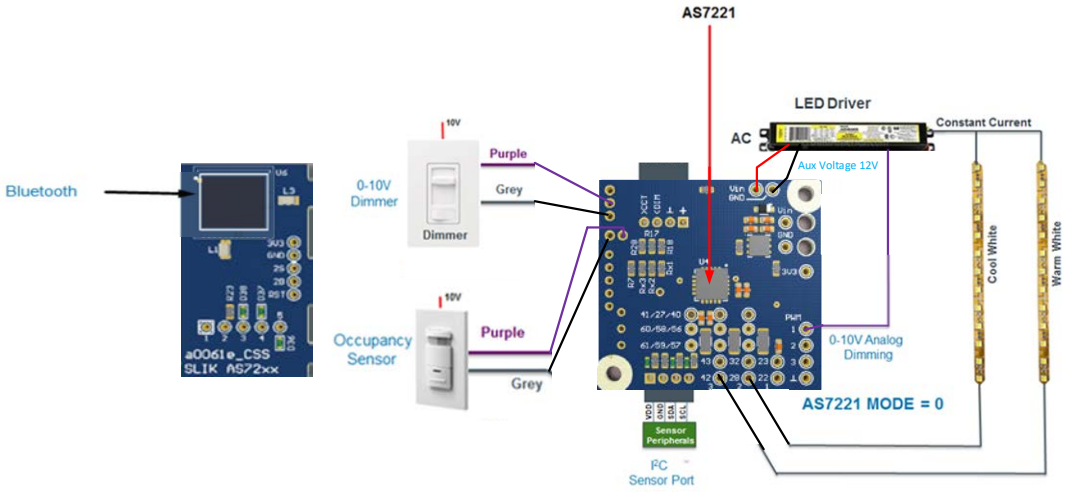


2.2 AS7221 SLIK - Constant Current Configuration w/UART Network Interface



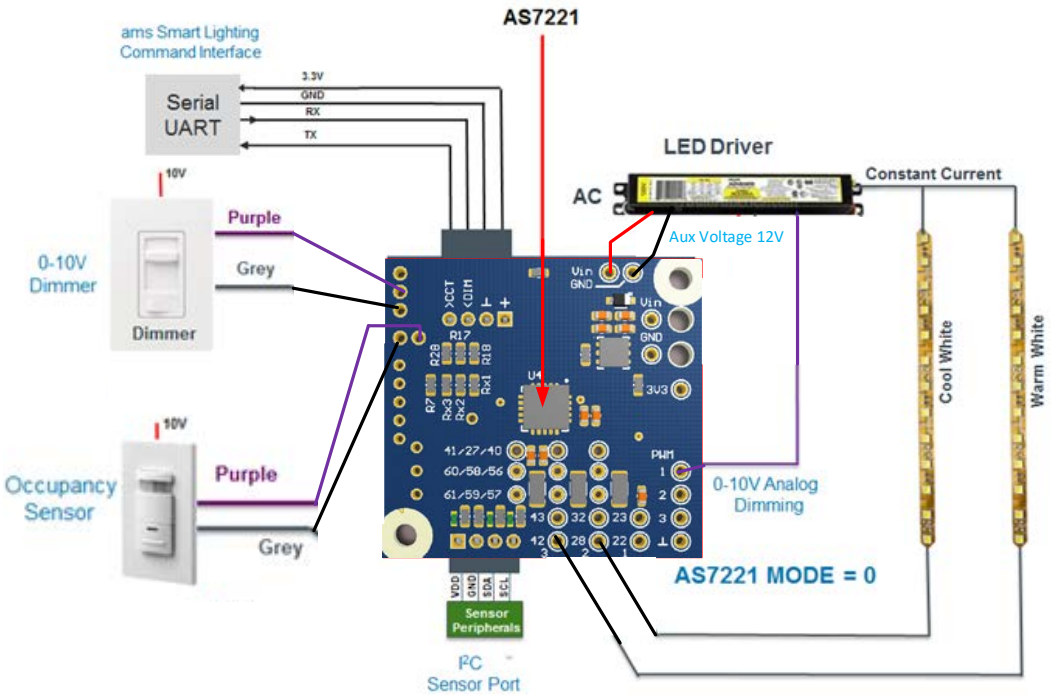
SLIK Connection	Connection Description	Connection Type
DIM	0-10V input for Luminaire dimming control from an external dimmer. Dimming range to the Luminaire is from 100% (no dimming) to 10% dimming.	Local Control Inputs
GND	Ground return for external dimmer	
OCCN	Digital input for occupancy detection 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^2C clock	External Sensor Port
SDA	I^2C data	
GND (-)	I^2C interface ground	
VDD (+)	I^2C 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 ±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^2C clock	External Sensor Port
SDA	I^2C data	
GND (-)	I^2C interface ground	
VDD (+)	I^2C 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 ±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 ±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

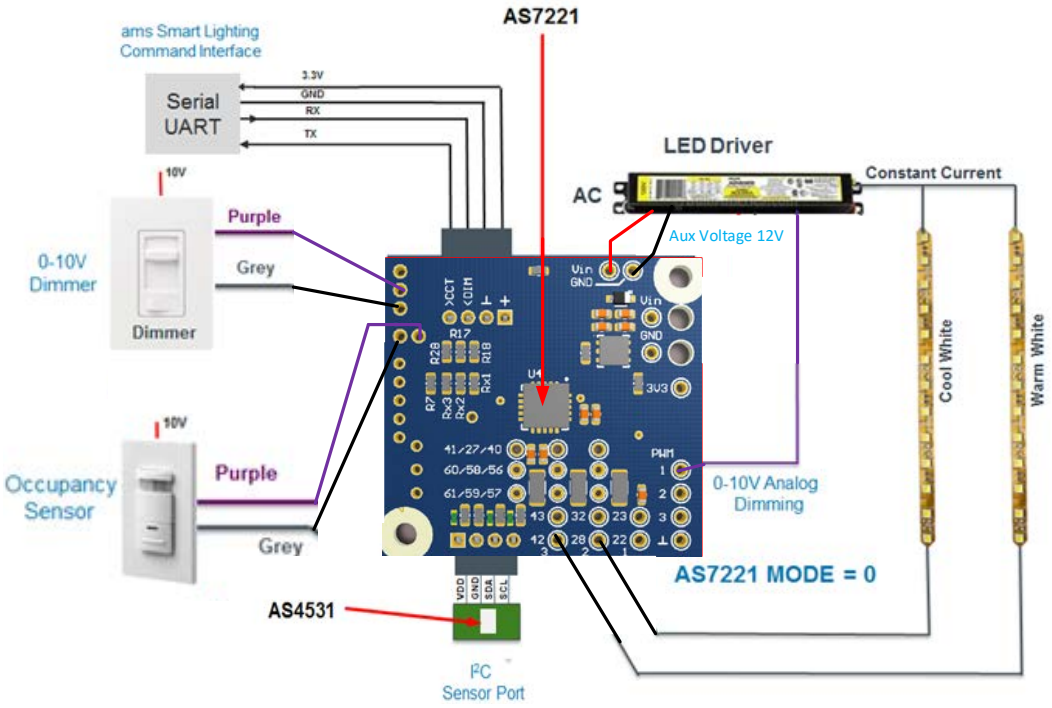
The AS7221 SLIK uses its Tx/Rx interface to connect to a standard USB computer interface.
This is accomplished using application software and a serial to USB cable which plugs directly into SLIK, both available from ams. Do not operate the built-in SLIK Bluetooth module and the SLIK external UART interface (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 I²C using the AS4531

Constant Current Configuration

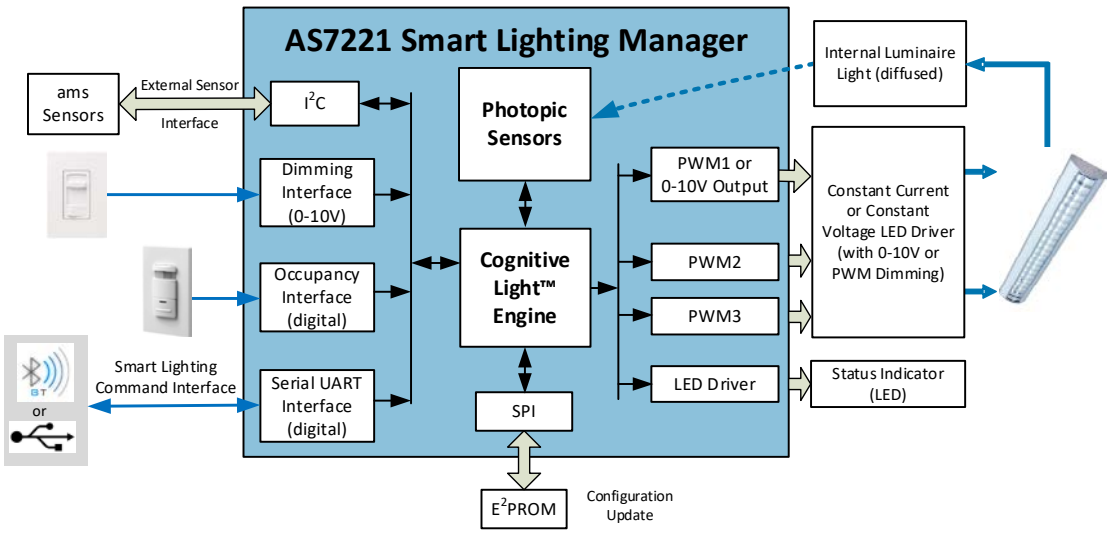


As shown above, a Color Tuning AS7221 SLIK adds Daylighting with a simple inclusion of an AS4531 via I²C:

- 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 I²C
- 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.



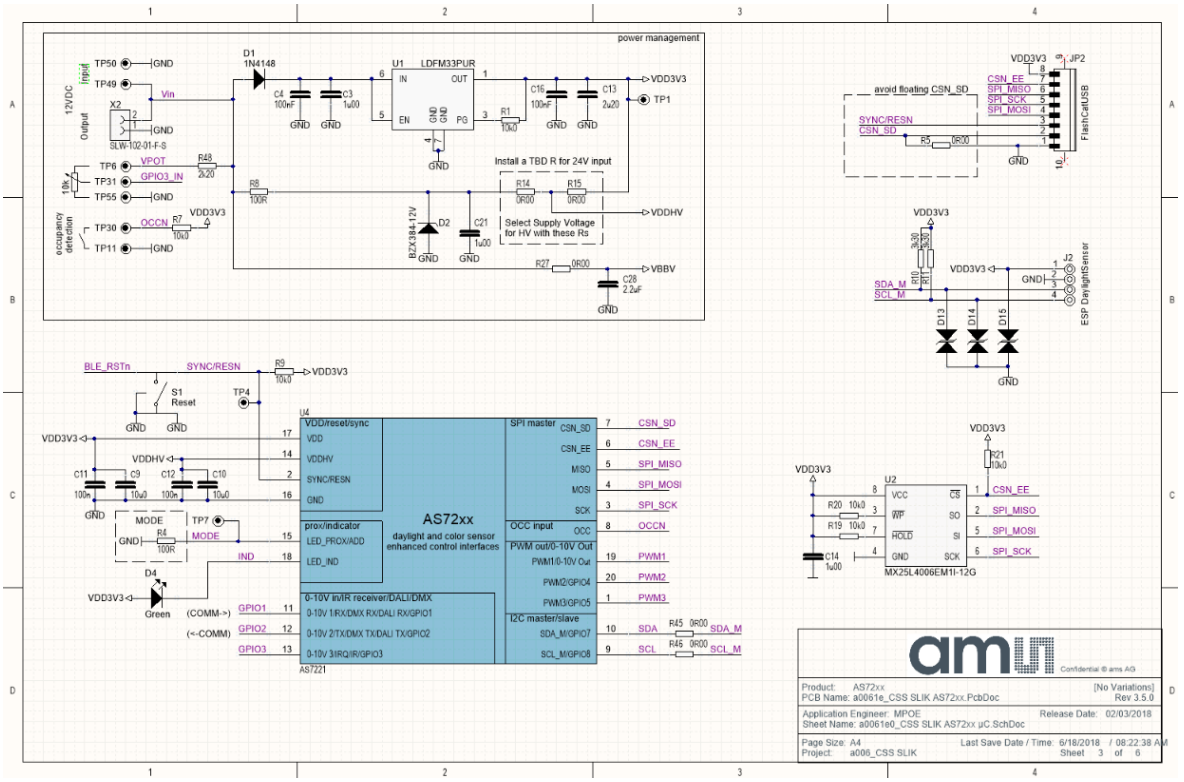
AS7221 external interfaces:

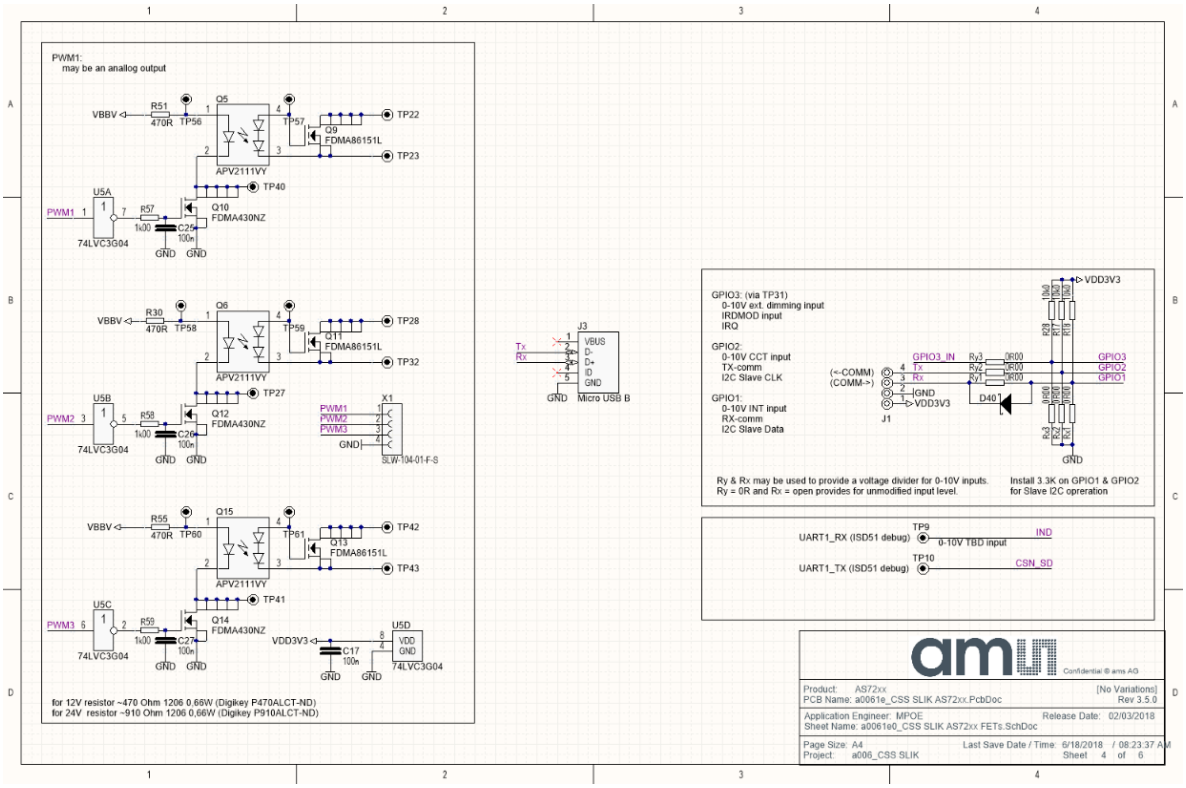
- External Sensor Port (I^2C)
- Local Control Inputs
- Smart Lighting Command Interface (Bluetooth, Serial)
- PWM Outputs

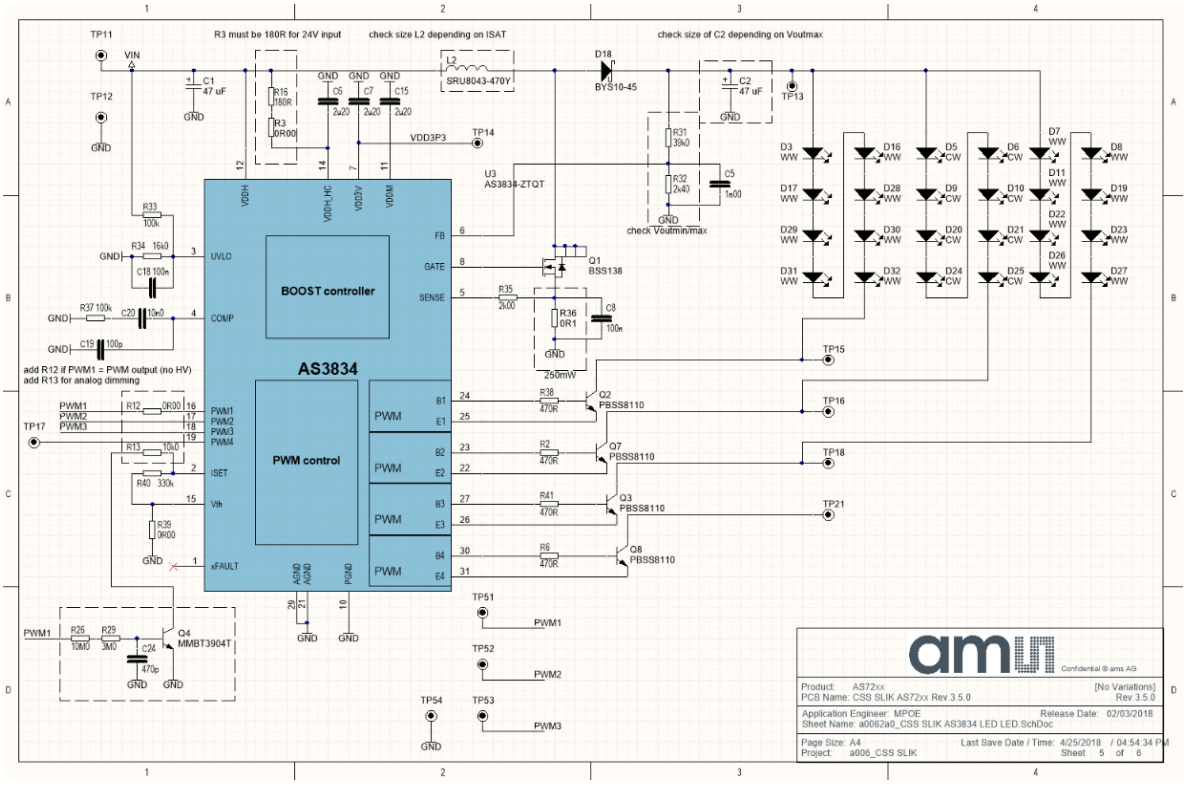
Additional AS7221 device documentation is also available from ams (contact www.ams.com):

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

Appendix B: AS7221 SLIK (v3.2) Schematic






TP11
VIN
R3 must be 180R for 24V input
check size L2 depending on ISAT
check size of C2 depending on Voutmax
L2
SRU8043-470Y
D18
BYS10-45
C1
47 uF
C2
47 uF
TP12
TP13
R15
180R
R3
0R00
C6
2u20
C7
2u20
C15
2u20
VDD3P3
TP14
U3
AS3834-ZTQT
R31
39k0
R32
2k40
C5
1n00
check Voutmin/max
R33
100k
R34
16k0
C18
100n
UVLO
COMP
R37
100k
C20
10n0
C19
100p
FB
GATE
SENSE
Q1
BSS138
R35
2k00
R36
0R1
C8
100n
250mW
BOOST controller
AS3834
PWM control
add R12 if PWM1 = PWM output (no HV)
add R13 for analog dimming
PWM1
PWM2
PWM3
PWM4
R12
0R00
TP17
R13
10k0
ISET
R40
330k
Vth
R39
0R00
xFAULT
AGND
PGND
B1
E1
B2
E2
B3
E3
B4
E4
R38
470R
Q2
PBSS8110
R2
470R
Q7
PBSS8110
R41
470R
Q3
PBSS8110
R6
470R
Q8
PBSS8110
TP15
TP16
TP18
TP21
TP51
PWM1
TP52
PWM2
TP54
TP53
PWM3
R25
10M0
R29
3M0
C24
470p
Q4
MMBT3904T
D3
D16
D5
D6
D7
D8
D17
D28
D9
D10
D11
D19
D29
D30
D20
D21
D22
D23
D31
D32
D24
D25
D26
D27
WW
CW
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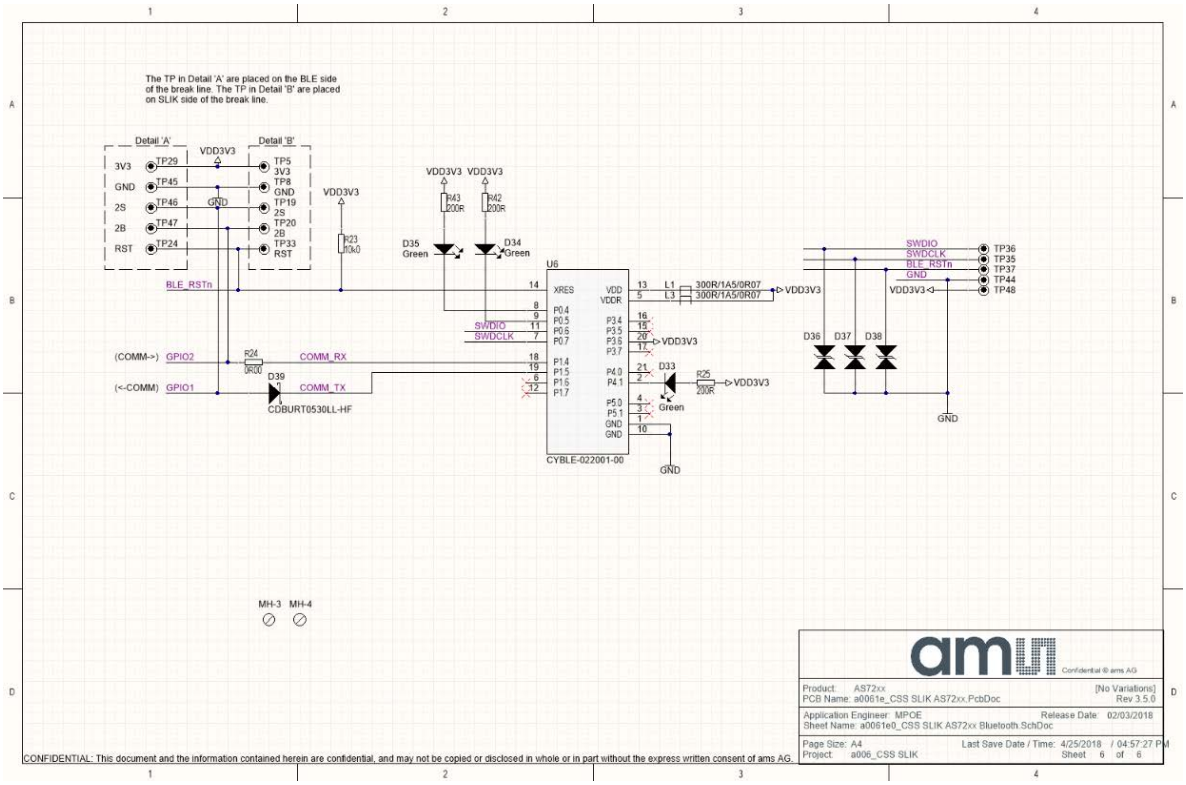
The TP in Detail 'A' are placed on the BLE side of the break line. The TP in Detail 'B' are placed on SLIK side of the break line.
Detail 'A'
Detail 'B'
3V3
GND
2S
2B
RST
TP29
TP45
TP46
TP47
TP24
TP5
TP8
TP19
TP20
TP33
VDD3V3
R23
10k0
R43
200R
R42
200R
D35
Green
D34
Green
U6
BLE_RSTn
XRES
VDD
VDDR
L1
L3
300R/1A5/0R07
SWDIO
SWDCLK
P0.4
P0.5
P0.6
P0.7
P3.4
P3.5
P3.6
P3.7
P1.4
P1.5
P1.6
P1.7
P4.0
P4.1
P5.0
P5.1
GND
(COMM->)
GPIO2
R24
0R00
COMM_RX
(<-COMM)
GPIO1
D39
COMM_TX
CDBURT0530LL-HF
D33
Green
R25
200R
CYBLE-022001-00
TP36
TP35
TP37
TP44
TP48
D36
D37
D38
MH-3
MH-4
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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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