Dimmable Mains LED driver SSL2101 Sample board

Product Line Power & Lighting Solutions
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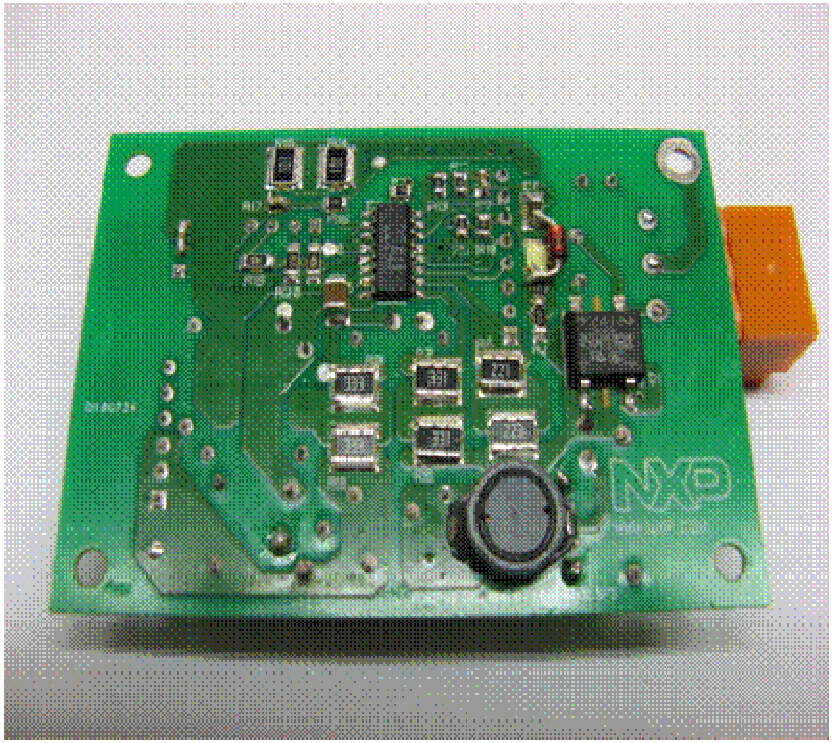
A bright idea for dimmable LED luminaires

SSL2101

- Highly efficient current control for dimmable mains LED driving
- Easy migration to existing lighting infrastructure (TRIAC and transistor dimmers), supporting majority of available dimming solutions
- Suitable for different power requirements:
  - SSL retrofit (e.g. GU10) 3W - 8W
  - LED modules (e.g. LED spots, down lights) 8W – 15W
    Separate power supply, not close to LED's
- High integration level:
  - Less external components needed
  - Ideal for small form factor applications with closed casing
  - Offering non-isolated (buck) and isolated (fly-back) solution in one chip
- Reliable and safe thermal solution via thermal enhanced package
- Aligned with regulations on safety and power factor

Content

- Remarks SSL2101 engineering sample
- Release Note SSL2101 sample



Remarks SSL2101 engineering sample

- The release note of the SSL2101 sample contains confidential information and should be treated as such, according to the existing NDA between Neonlite and NXP Semiconductors
- The SSL2101 on the demo board is an engineering sample and it cannot be used for qualification or life-time tests

- The board is to be connected to mains voltage. Touching the board during operation should be avoided at all times. An isolated housing is obligatory when used in uncontrolled, non laboratory environments. Thus a galvanic isolation of the mains phase using a variable transformer is always recommended !!

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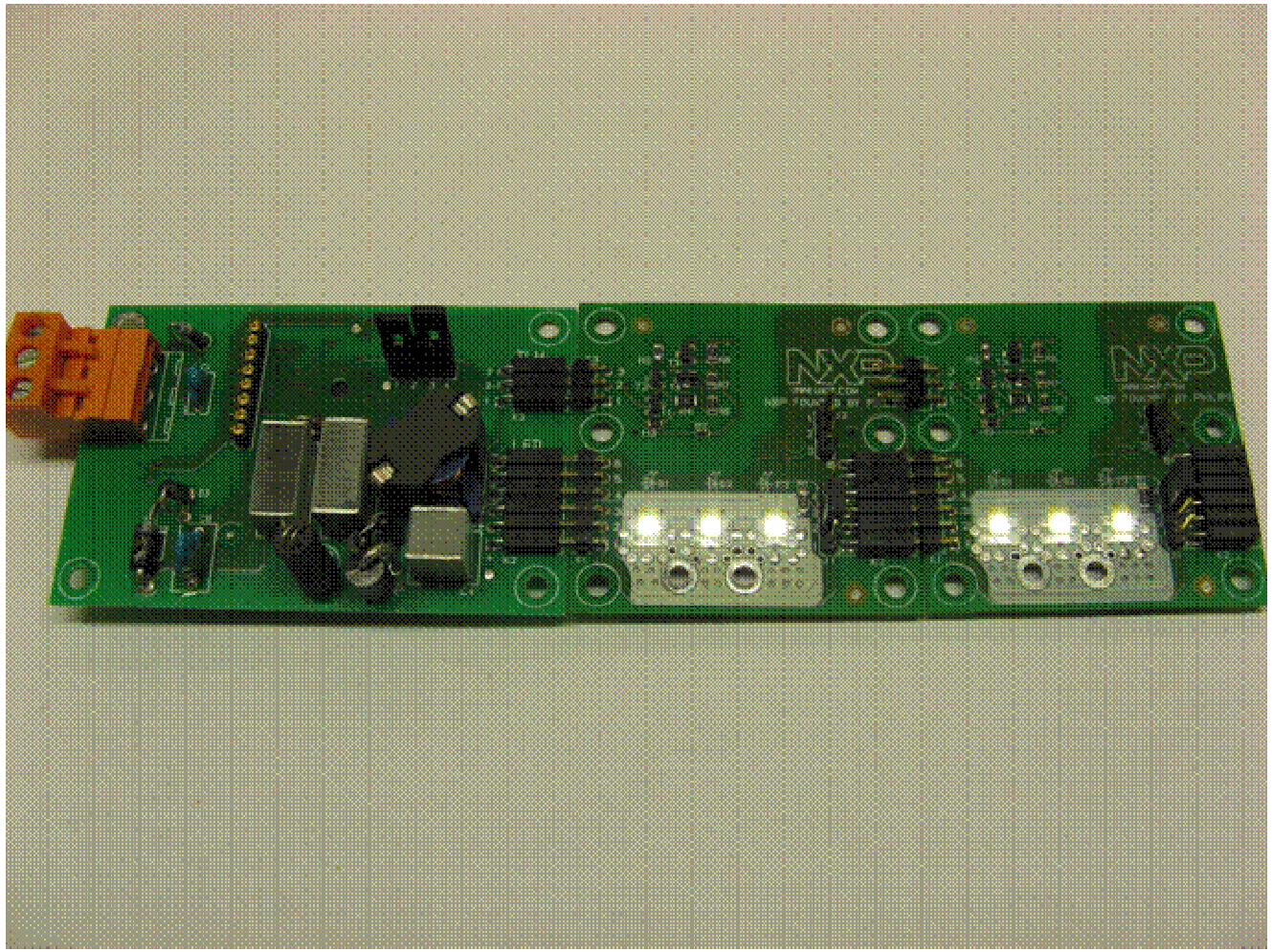
General description demo board

- The NXP SSL2101 sample board supports TRIAC and transistor based dimmers. Deep dimming has been included to increase dimming ratio up to 1:350. Also, a combination of steering methods reduces audible transformer noise and creates a logarithmic dimming curve. The curve approaches the natural dimming curve in brightness as experienced with incandescent lamps.
- To enable a cost and size effective thermal design, temperature feedback is demonstrated by the boards. This will allow tighter margins in optimization and more effective use of installed LED power.
- The board is optimized for a 230VAC 50Hz mains source. Besides the mains source optimization the board has been designed to work with several high power LED's. The dimming performance may decrease if the board is used at different mains voltages than optimized for.

Specifications sample board SSL2101

		Comment
AC line input voltage	230VAC	+-10% Variation
Output voltage (LED voltage)	3.5 – 60 VDC	Board optimized for 18 VDC
Output current (LED current)	20mA – 700 mA	Board optimized for 350mA
Output current accuracy	+-10% at 230VAC+- 10%	Based on 350mA, 6W
Maximum output power (LED power)	9W	Using 9X 1W LED 350mA
Efficiency without dimmer	Typ 70% Typ 66%	Using 6x 1W LED, 350mA Using 3x 1W LED, 670mA
Dimmed efficiency	Ca. 69% at full power Ca 50% at 50% power	Using 6x 1W LED Using 6x 1W LED
Power Factor: 230VAC	0.72	At 6W output power
Switching frequency	32KHz	Can be adjusted
Dimming range	100% – 0.3%	

Plug and Play – Connection of the boards



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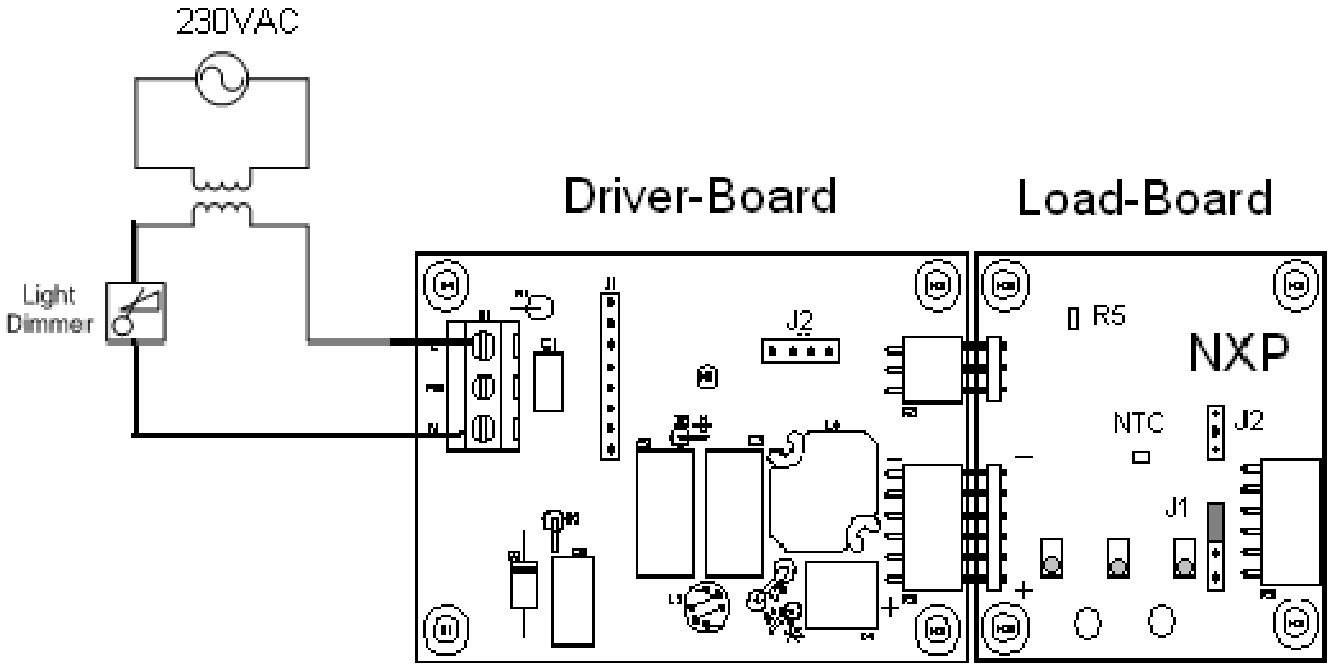
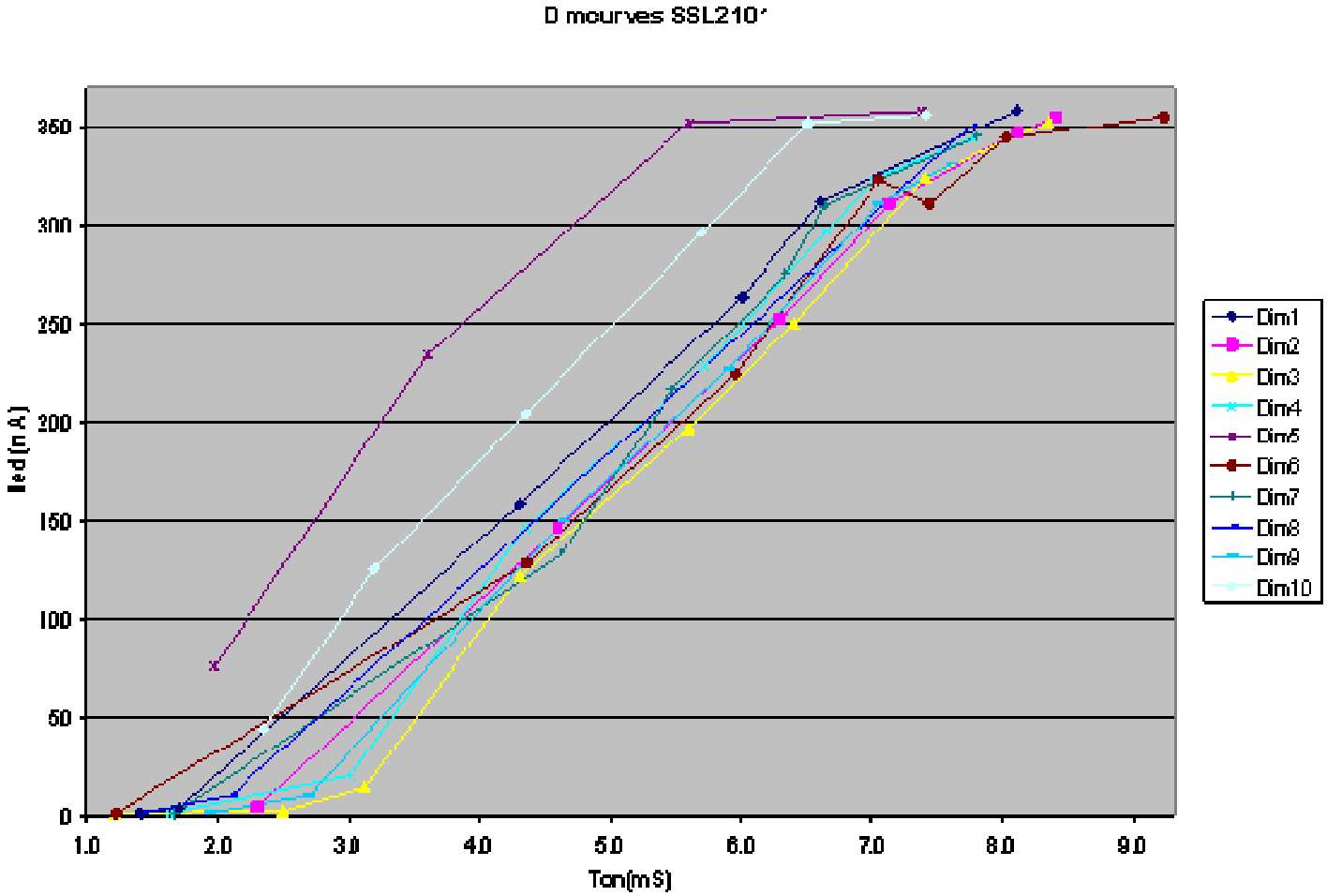


Plug and Play – Connection of the boards

- Connect the mains line and the dimmer as shown in the figure on the previous slide. The Dimmer unit can be placed on one of the leads
- If a galvanic isolated transformer is used, this should be placed in-between the AC source and the dimmer / evaluation board.
- Connect the Load-boards to the right size of the driver board using the side connectors. Attach jumper on the J1-connector according to Load-Board configuration.
- *When the board is placed in a metal enclosure the middle pin of connector K1 can be connected to the metal casing for grounding.*
- ***There should always be one load-board with end-termination. At open output and power applied, the driver board might be damaged, due to over-voltage on C4 !***

Dimming performance – SSL2101

Nr	Type
1	Opus 852-390 R
2	Opus 852-392 RL
3	Busch-Dimmer 2250U R
4	Busch-Dimmer 2247U RL
5	Busch-Dimmer 6519U RC (Neg phase)**
6	Gira 118400 R
7	Everflourish EFO700DA R
8	HE R
9	HE T39.01 RL
10	HE T46 RC (neg phase)**



Converter operation – SSL2101

- On the sample board, a non-isolated buck-converter is used to drive the LED's. The SSL2101 can be used in two modes:
  - DCM (discontinuous mode)
  - BCM (boundary conduction mode)
- It is not suitable for CCM (continuous conduction mode)
- DCM mode and BCM mode have the advantage over CCM that the switch losses at turn-on are minimal because no current is running. Also, the inductive material is used over the available BH-curve because no permanent field is present. Connector J2 pin 1 can be used to monitor inductor and switch current. The peak current is regulated at 0.5 Volt.
- The sample board is optimized for 1 load board with 3 LED's.

Connecting more load boards – SSL2101

- Using header J1 on the board, it can be set for series/parallel configuration or end terminal. See next table:

Option	Jumper Position
Parallel	1-2&3-4
Serial	2-3
End terminal	3-4

- In serial configuration, up to six boards can be connected with a total number of 18 Led's. The last board in series should be equipped with an end terminal jumper. In parallel the current is distributed over the boards whilst the sum will remain the same

Temperature Protection – SSL2101

- On the load board, a NTC resistor mounted in proximity of the LED's is used as sensor. Using a current mirror, the value is compared with reference resistor R5, and at threshold, the PWM limit pin is pulled to GND. By variation of R5, the temperature at which stabilization occurs can be set. A lower value will cause higher threshold. Because of thermal resistance versus required galvanic isolation, a temperature difference will occur. If the board is used in free air conditions, this will lead to relative higher LED temperatures. In an enclosed housing, this difference will be smaller. At R5 3K3 the protection will set in at Tntc of about 87 degrees Celsius.
- Only the first board in series with the driver board utilizes this protection mechanism. The load board has two additional mounting holes on which an additional heat sink can be mounted to increase LED power and/or reduce temperature.

Measuring Connection – SSL2101

- Header J2 provides the possibility to measure current through the LED's and voltage over the LED's without additional test-circuitry. If a voltage probe is connected over pin 1 and 3, and J2 is configured as end terminal,
- The number of measured mVolts times 10 is the amount of current in mA through the LED (with -1% accuracy due to tolerance R1) . If a voltage probe is connected between pin 1 and 2, the voltage over the LED's is measured. For the efficiency calculations, the mean voltage over the LED's and resistor R1 is multiplied with the mean current through the devices to indicate output power.