UM10877

SSL5021BDB1211 100 V 9 W buck converter

Rev. 1 — 11 March 2015 **User manual**

Document information

Info	Content
Keywords	SSL5021BDB1211, SSL5021BTS, non-dimmable, LED driver, buck converter, LED retrofit lamp, LED down light
Abstract	This user manual describes the operation of the SSL5021BDB1211 100 V 9 W non-dimmable LED driver featuring the SSL5021. The demo board uses a buck topology. It provides a suitable evaluation platform for non-dimmable LED retrofit lamp in low-ripple configurations.

Revision history

Rev	Date	Description
v.1	20150311	first issue

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1. Introduction

WARNING

Lethal voltage and fire ignition hazard

The non-insulated high voltages that are present when operating this product, constitute a risk of electric shock, personal injury, death and/or ignition of fire.

This product is intended for evaluation purposes only. It shall be operated in a designated test area by personnel qualified according to local requirements and labor laws to work with non-insulated mains voltages and high-voltage circuits. This product shall never be operated unattended.

This user manual describes the operation of the SSL5021BDB1211 demo board featuring SSL5021BTS LED driver in a 100 V 9 W application.

The SSL5021BDB1211 demo board incorporates a suitable form factor for LED retrofit lamp and LED down light applications. The buck converter topology provides a simple and efficient solution for non-dimmable LED light applications.

Figure 2 shows the dimensions of the SSL5021BDB1211 demo board. Figure 3 shows the top view and the bottom view photographs.

2. Safety warning

The demo board input is connected to the 100 V mains voltage. Avoid touching the board while it is connected to the mains voltage and when it is in operation. An isolated housing is obligatory when used in uncontrolled, non-laboratory environments. Galvanic isolation from the mains phase using a fixed or variable transformer is always recommended. Figure 1 shows the symbols on how to recognize these devices.

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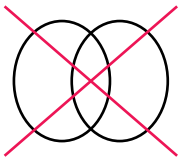


019aab174

a. Isolated

b. Not isolated

Fig 1. Isolation symbols

3. Specifications

Table 1 lists the specification of the SSL5021BDB1211 demo board.

Table 1. SSL5021BDB1211 specifications

Symbol	Parameter	Value
V_{mains}	AC mains supply voltage	100 V (AC); ±10 %
I_{mains}	AC mains input power	155 mA (at 100 V (AC)/50 Hz
V_{LED}	output voltage	40 V
I_{LED}	output current	209 mA
$\Delta I_{LED}/\Delta V_{LED}$	output voltage rejection	145 μA/V
η	efficiency	88 %
PF	power factor	0.6
T_{oper}	operating temperature	−40 °C to +80 °C

The SSL5021BDB1211 demo board is designed for functional evaluation. ElectroMagnetic Interference (EMI) and surge test compliances are not intended to perform on this board.

Figure 2 shows the dimensions of the demo board.

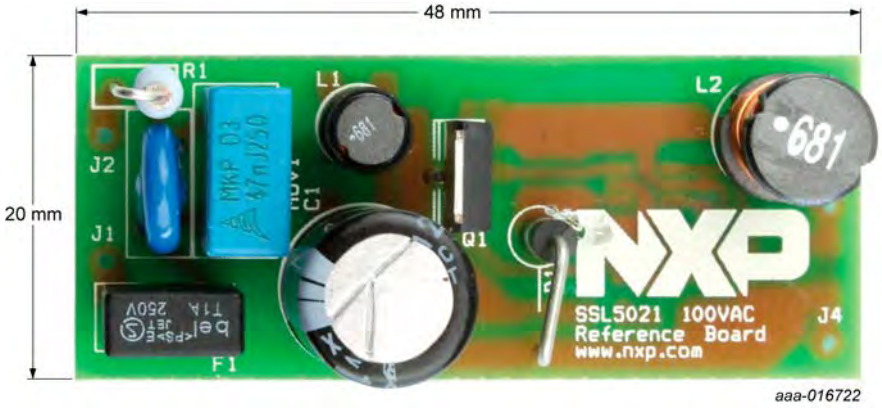


Fig 2. SSL5021BDB1211 demo board dimensions

4. Board photographs

a. Top view

b. Bottom view

Fig 3. SSL5021BDB1211 demo board photographs

5. Board connections

The SSL5021BDB1211 demo board is optimized for a 100 V (50/60 Hz) supply. It is designed to work with multiple LEDs or an LED module. The mains connection of the SSL5021BDB1211 demo board is different from other general demo boards. Connect the mains to J1 and J2.

Remark: The maximum rated voltage of the SSL5021BDB1211 demo board is 125 V (AC).

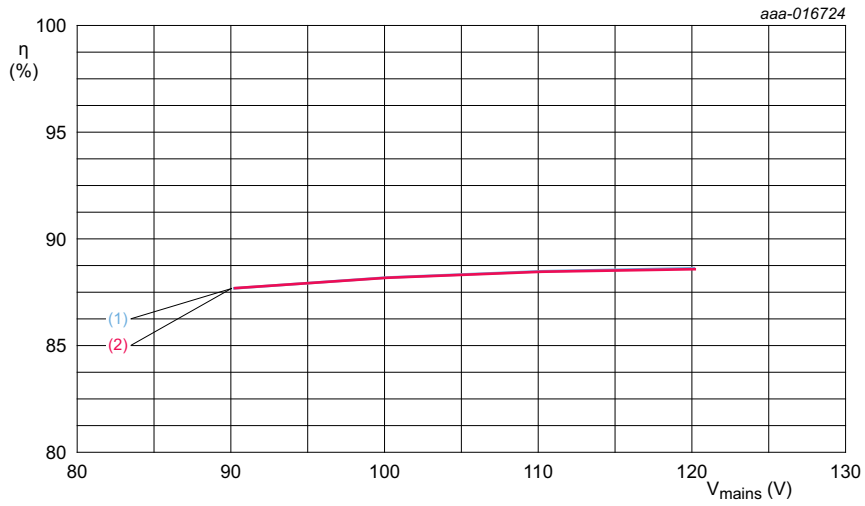
The anode of the LED load is connected to J3 and J4. The anode is connected to J3, the cathode is connected to J4. Use an LED string with a forward voltage < 50 V on the SSL5021BDB1211 demo board. The expected typical output voltage is 40 V. Under the expected conditions, the output current is 209 mA when set to 100 % output.

Fig 4. SSL5021BDB1211 board connections

6. Performance

The performance was measured with an 80 V application at an output load of 212 mA. Figure 5 to Figure 8 show the performance data.

6.1 Efficiency

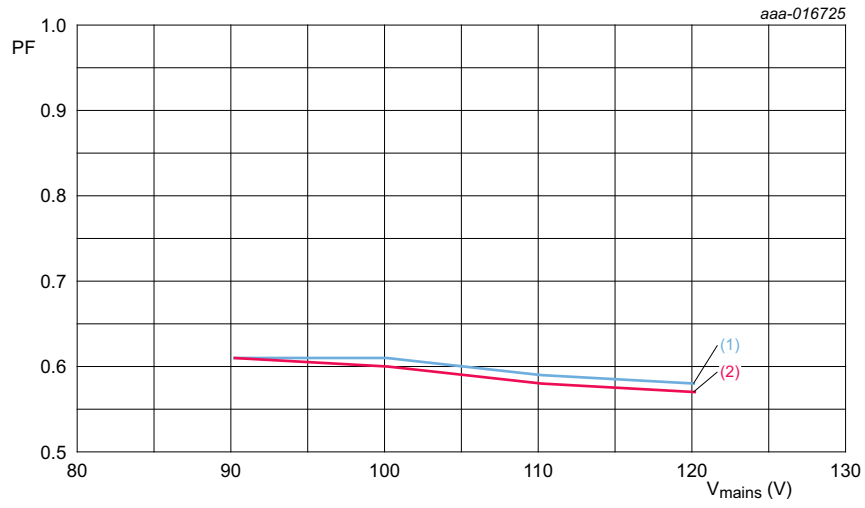


(1) 50 Hz

(2) 60 Hz

Fig 5. Efficiency as a function of V_{mains}

6.2 Power factor

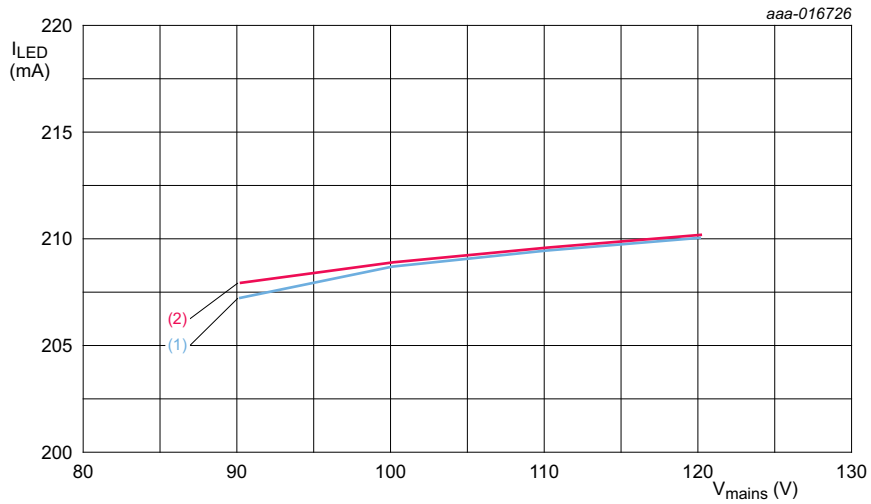


(1) 50 Hz

(2) 60 Hz

Fig 6. Power factor as a function of V_{mains}

6.3 Line regulation



(1) 50 Hz

(2) 60 Hz

Fig 7. Line regulation

6.4 Load regulation

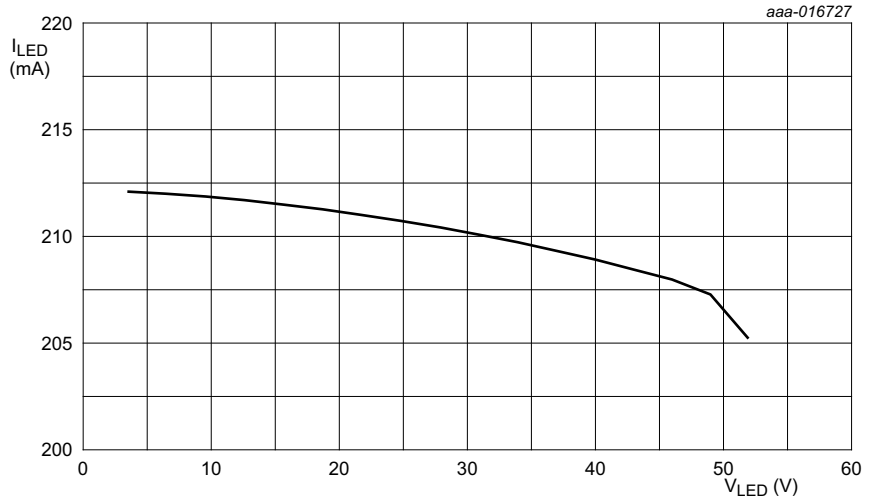


Fig 8. Load regulation at 50 Hz

7. Protections

The IC incorporates the following protections:

- UnderVoltage LockOut (UVLO)
- Cycle-by-cycle OverCurrent Protection (OCP)
- Internal OverTemperature Protection (OTP)
- Output OverVoltage Protection (OVP)
- Output Short Protection (OSP)
- Thermal foldback protection using a Positive Temperature Coefficient (PTC) thermistor

8. Schematic

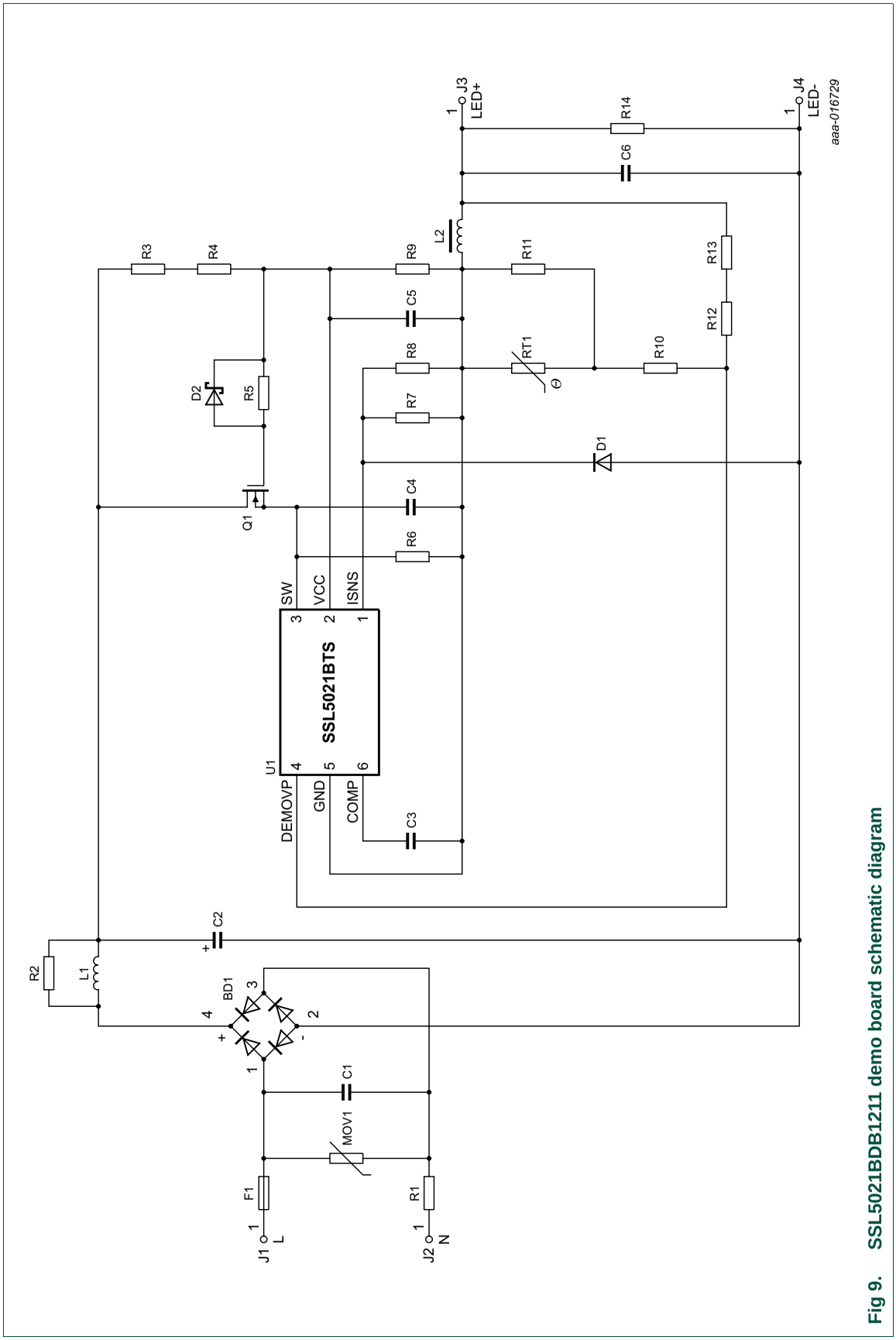


Fig 9. SSL5021BDB1211 demo board schematic diagram

9. Bill Of Materials (BOM)

Table 2 provides detailed component information for the SSL5021BDB1211 demo board.

Table 2. SSL5021BDB1211 demo board bill of materials

Reference	Description and values	Part number	Manufacturer
BD1	bridge diode; 600 V; 0.5 A; MBS-1	MB6S	Fairchild
C1	capacitor; 0.047 μF; 125 V (AC)	B32620A3473J	EPCOS
C2	capacitor; 10 μF; 200 V	200BXC10U10X16	Rubycon
C3	capacitor; 220 pF; 50 V; 1608	GRM1885C2A221JA01D	Murata
C4	capacitor; 1000 pF; 1608	GRM1885C1H102JA01J	Murata
C5	capacitor; 1 μF; 1608	GRM188R71E105KA12D	Murata
C6	capacitor; 1 μF; 100 V; 3216	GRM31CR72A105KA01K	Murata
D1	diode; 600 V; 1 A; DO-41	STTH2R06RL	ST Micro
D2	diode; Schottky; 30 V; 220 mA; SOD323F	BAT54J	NXP Semiconductors
F1	fuse; 1 A; 125 V (AC)	RST1	Bel Fuse
L1; L2	inductor; 680 μH;	7447462681	Würth Elektronik
MOV1	movistor; 240 V	S07K150	EPCOS
Q1	MOSFET; 600 V; 2 A; IPAK	FQU2N60CTU	Fairchild
R1	resistor; 4.7 Ω; 1 W	ERX-1SJ4R7	Panasonic
R2	resistor; 2.2 kΩ; 3216	ERJ-8ENF2201V	Panasonic
R3; R4	resistor; 200 kΩ; 2012	ERJ-6ENF2003V	Panasonic
R5	resistor; 100 Ω; 1608	ERJ-3EKF1000V	Panasonic
R6	resistor; 22 kΩ; 2012	ERJ-6ENF2202V	Panasonic
R7	resistor; 3.3 Ω; 1 %; 3216	CRCW12063R30FKEA	Vishay
R8	resistor; 4.7 Ω; 1 %; 3216	CRCW12064R70FKEA	Vishay
R9; R11	resistor; not mounted	-	-
R10	resistor; 5.1 kΩ; 1 %; 1608	ERJ-3EKF5101V	Panasonic
R12; R13	resistor; 100 kΩ; 1 %; 2012	ERJ-6ENF1003V	Panasonic
R14	resistor; 56 kΩ; 2012	ERJ-6ENF5602V	Panasonic
RT1	thermistor; 1608	PRF18BC471QB5RB	Panasonic
U1	LED driver; TSOP6	SSL5021BTS	NXP Semiconductors

10. Tuning options

10.1 Output current

The SSL5021BDB1211 demo board is suitable for 60 W equivalent LED retrofit lamp designs when 40 V LED strings are connected to J3 and J4. To tune an output current for different output voltage settings or other output settings, sense resistors R7 and R8 can be adjusted. $I_{LED(AV)} = \frac{0.41}{(R_{sense} + 0.06)}$ calculates the estimated $I_{LED(AV)}$ (where 0.06 is bond wire resistance of ISNS pin).

The L2 saturation current is 600 mA. If 250 mA or a higher output current is required, choose an appropriate inductor.

10.2 Wall switch with pilot lamp

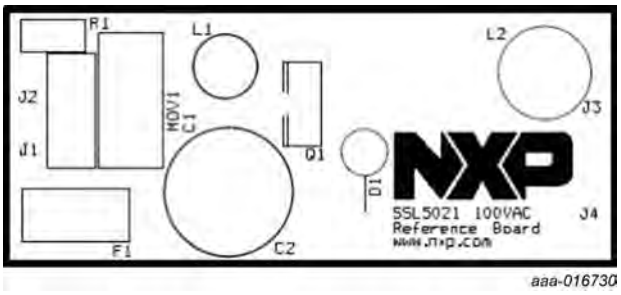
To deliver a wall switch with pilot lamp compatibility, resistor R6 is set to 22 kΩ. It creates a small current path while Q1 is in off-state. Many wall switches with pilot lamps feed a current to the lamp while in off-state because of an impedance of 1 MΩ or higher. A small current flowing through the switch is bypassed. The V_{CC} voltage of the SSL5021BTS does not reach the start-up level while the wall switch with pilot lamp is in off-state.

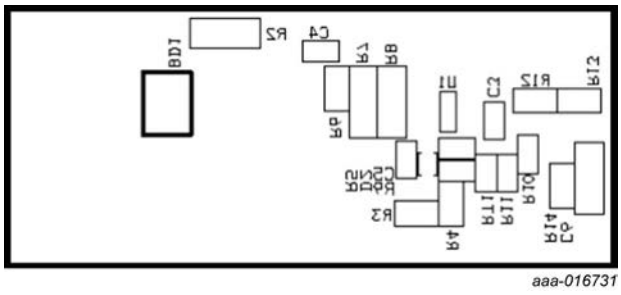
To retain the off-state, specific wall switches require a higher bypass current. The SSL5021BDB1211 demo board is designed for most popular wall switches. If compatibility with specific switches is required, decrease the value of resistor R6. The result of decreasing the resistor value is some loss on the resistor.

Resistor R9 is an alternative implementation for wall switches with pilot lamp compatibility.

11. Board layout

Figure 10 and Figure 11 show the layout of both layers.

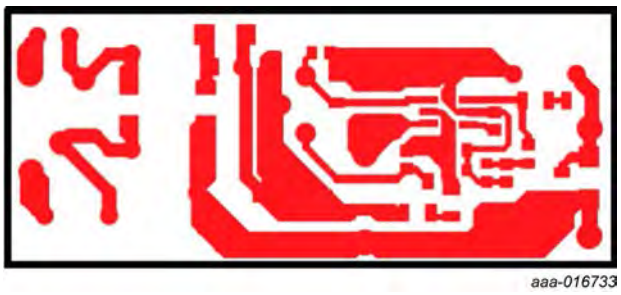




a. Top view

b. Bottom view

Fig 10. SSL5021BDB1211 demo board layout (silk)



a. Pattern

b. Drill

Fig 11. SSL5021BDB1211 demo board layout (pattern and drill)

12. Abbreviations

Table 3. Abbreviations

Acronym	Description
LED	Light-Emitting Diode
SSL	Solid-State Lighting
PF	Power Factor
EMI	ElectroMagnetic Interference
UVLO	UnderVoltage LockOut
OCP	OverCurrent Protection
OVP	OverVoltage Protection
OSP	Output Short Protection
PTC	Positive Temperature Coefficient

13. References

[1] **SSL5021BTS data sheet —** Compact low-ripple buck LED driver IC

[2] **AN11532 application note —** SSL50x1 4 W to 25 W high-efficiency LED driver

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