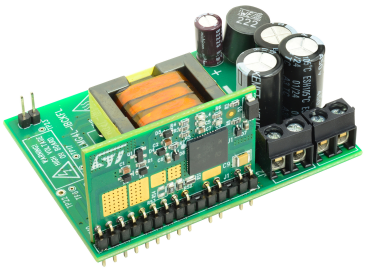
EVLMG4L-IBCKFL

Data brief

Compact, high power inverse buck converter for dimmable LED applications with MASTERGAN4L, HVLED002 and VIPER06XS



Features

- Input voltage: Vin = 400 Vdc (typ), Vdim = 0 to 10 Vdc
- Output voltage range: 130 V – 360 V
- Output current: 1.5 A
- High precision output current, with output current variation better than 5%
- High efficiency up to 99.4% @Iout = 1.5 A Vout = 350 V
- No heatsink required
- Linear dimming between 0% - 100%
- System size: 65 mm x 49 mm x 29 mm
- RoHS compliant

Description

The EVLMG4L-IBCKFL evaluation board is designed to be connected to a high voltage input DC source (e.g. PFC pre-regulator) to drive one high voltage, high power LED string with very accurate and adjustable (dimmable) current.

The control algorithm is provided by HVLED002 and applied to MASTERGAN4L to convert the input power into output current efficiently.

The VIPer06X high voltage converter provides auxiliary supply to the entire circuit.

A 0-10V DC voltage can be used to dim the output current from 100% to 10%; leaving the dimming connector open, the maximum output current is provided.

Input voltage UVLO as well as output overvoltage and undervoltage protections are implemented.

Product status link
EVLMG4L-IBCKFL

1 Schematics and PCB

Figure 1. Motherboard schematic

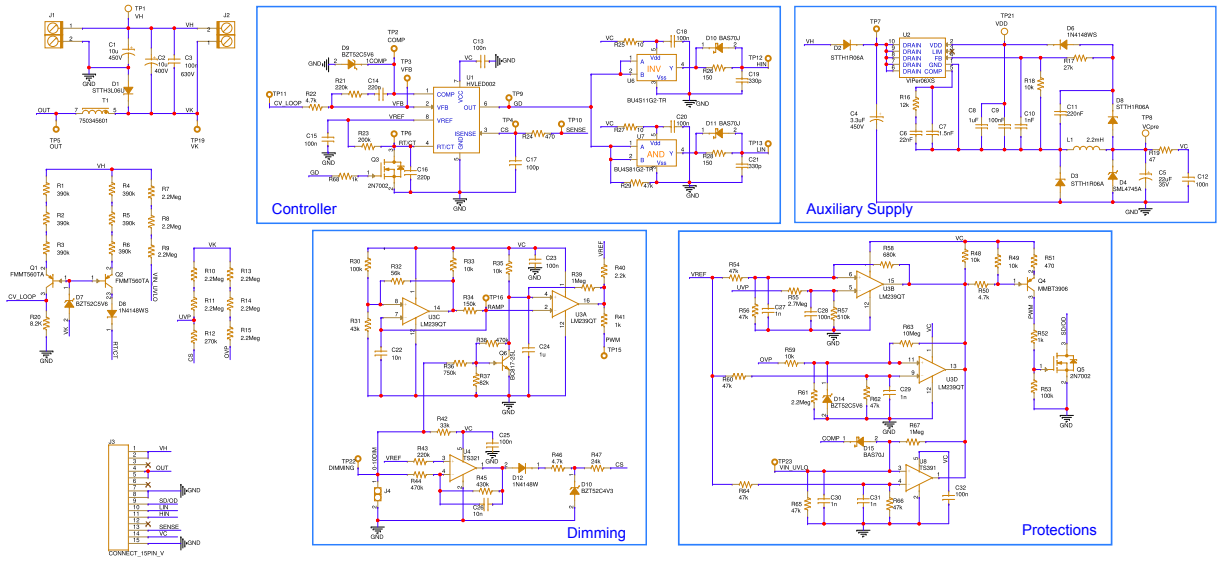
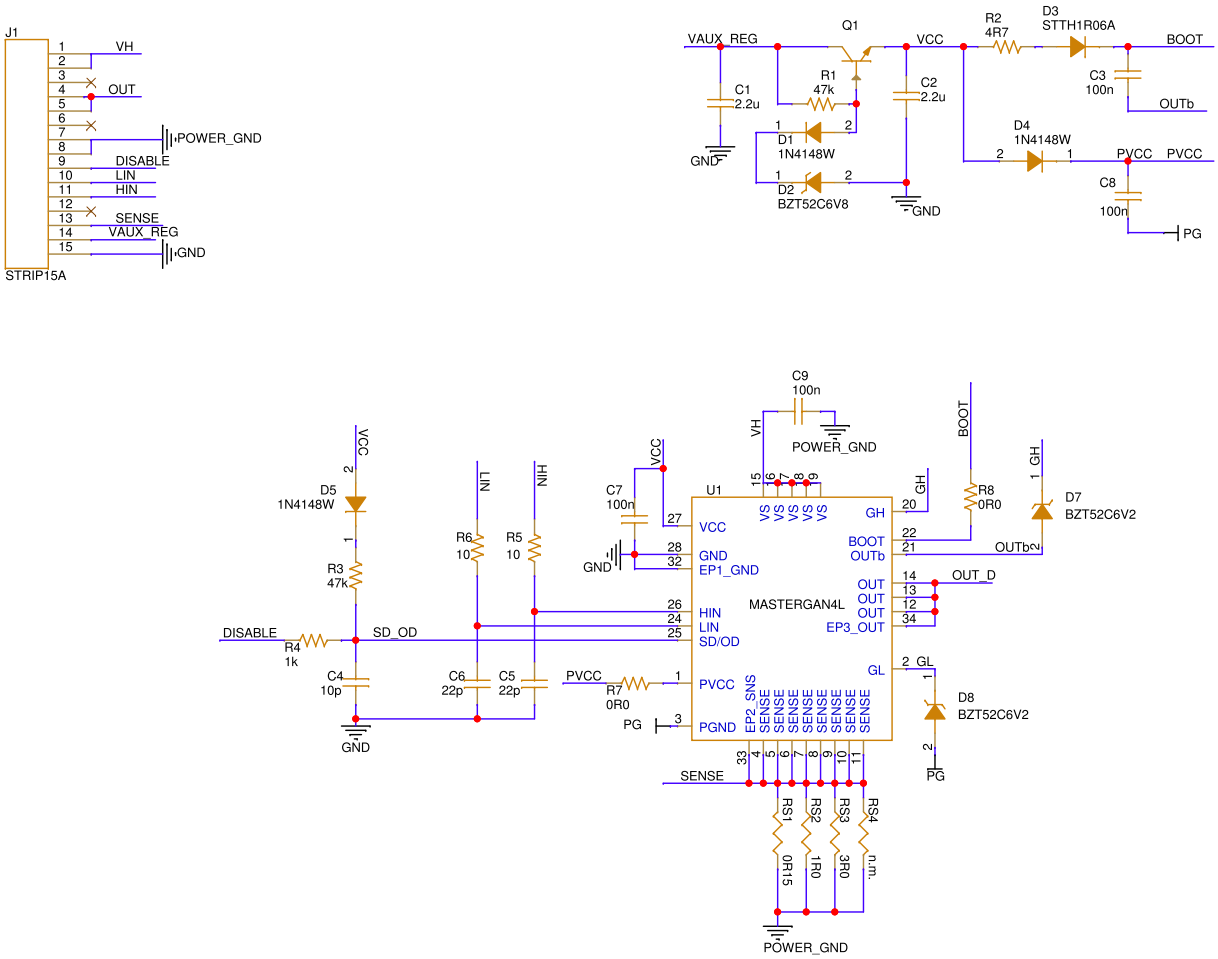


Figure 2. Daughterboard schematic



2 PCB layout

Figure 3. Motherboard PCB layout - 2 Layers FR4 (top side)

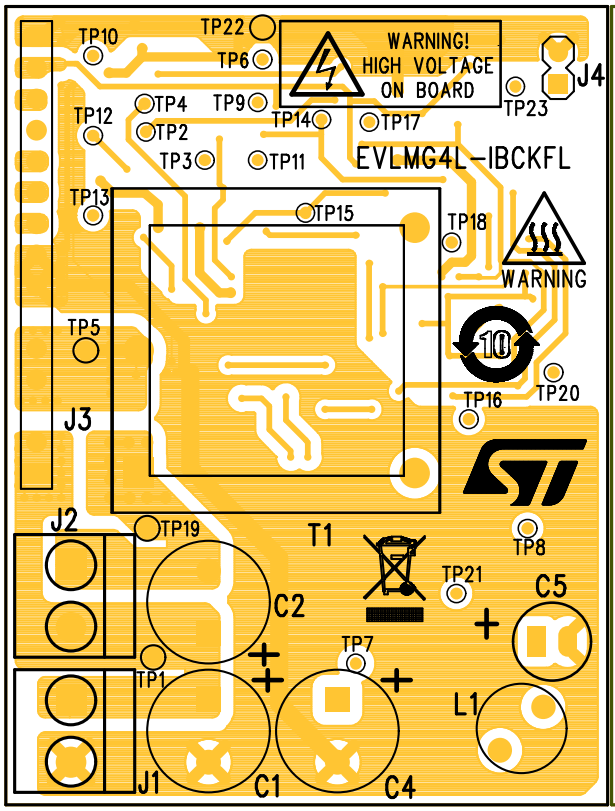


Figure 4. Motherboard PCB layout - 2 Layers FR4 (bottom side)

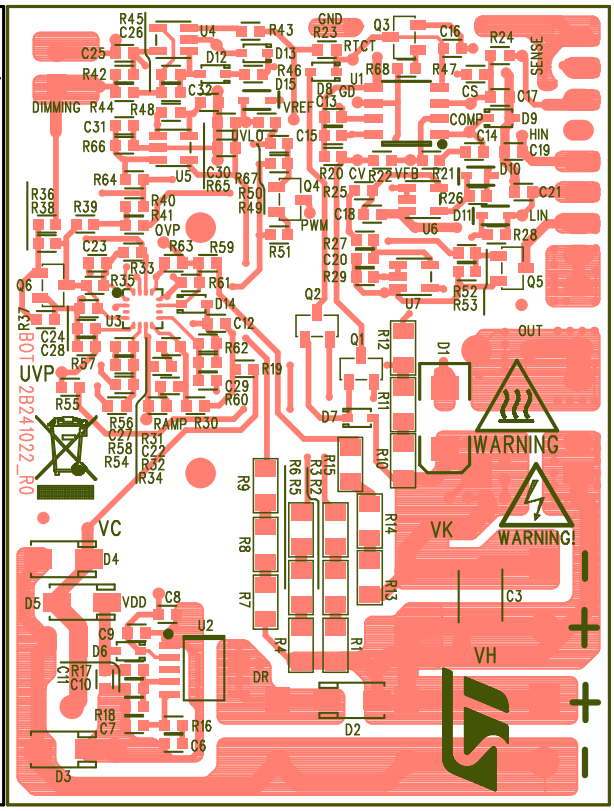


Figure 5. **Motherboard component placement (top side)**

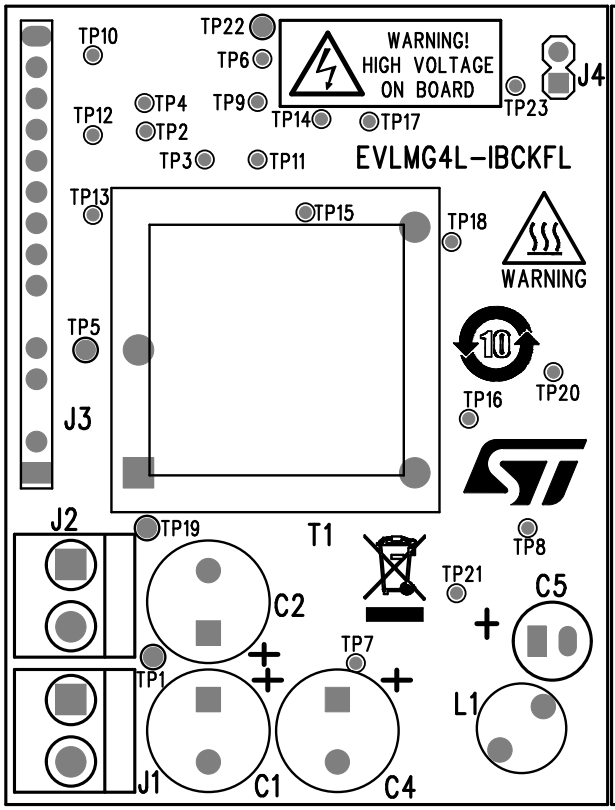


Figure 6. **Motherboard component placement (bottom side)**

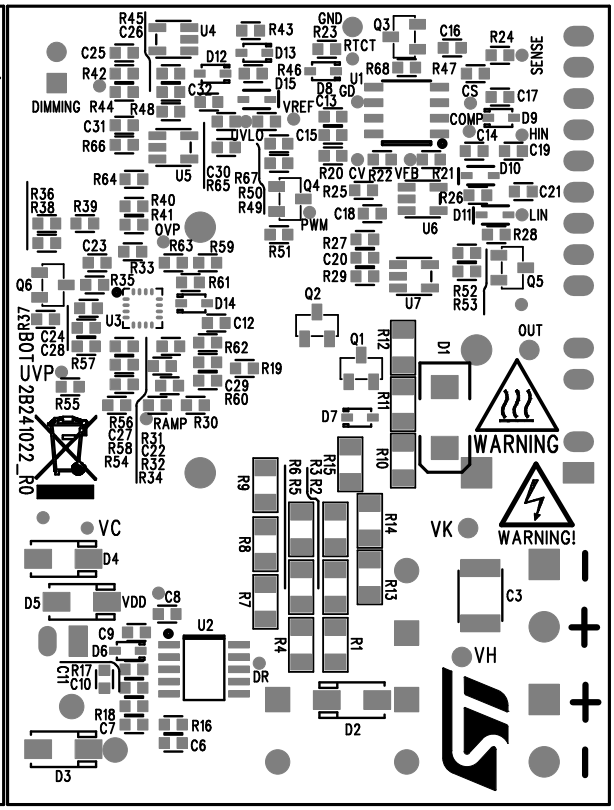


Figure 7. **Daughterboard PCB layout - 4 Layer FR4 (top side)**

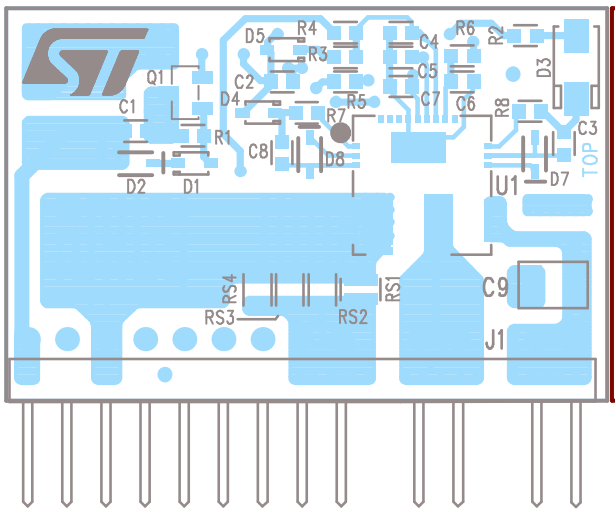


Figure 8. **Daughterboard PCB layout - 4 Layer FR4 (bottom side)**

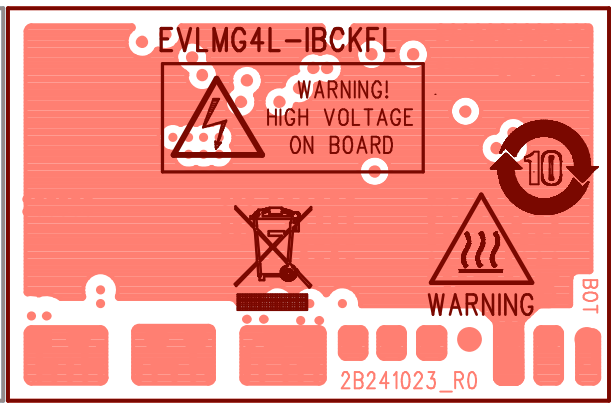


Figure 9. Daughterboard PCB layout - 4 Layer FR4 (inner 1)

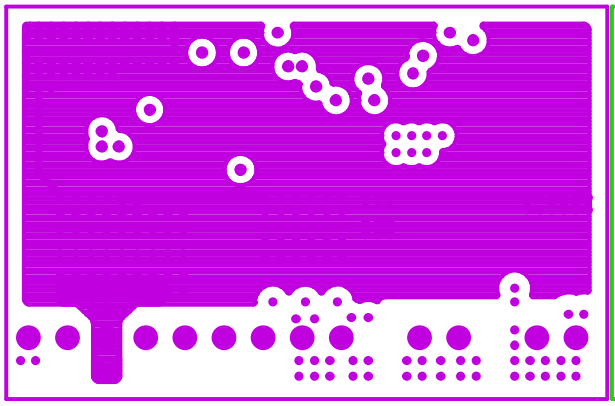


Figure 10. Daughterboard PCB layout - 4 Layer FR4 (inner 2)

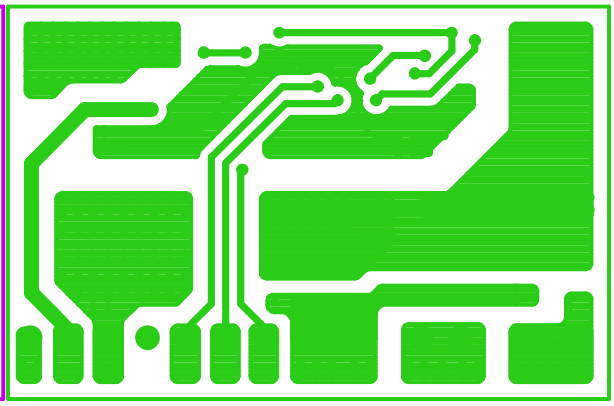


Figure 11. Daughterboard component placement (top side)

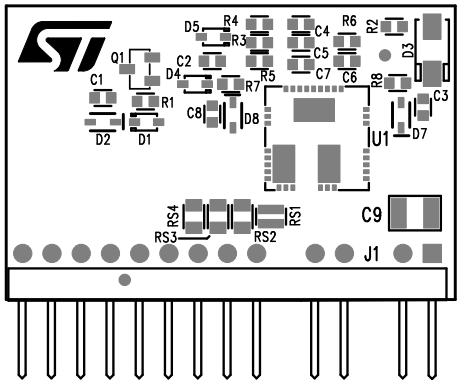
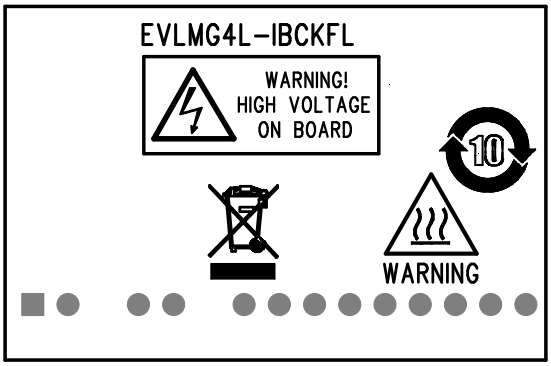


Figure 12. Daughterboard component placement (bottom side)



3 Bill of materials

Table 1. Motherboard bill of materials

Ref.	Value	Description	Package	Manufacturer
C1	10 µF	450 V 20% EL Cap	THT	
C2	10 µF	400 V 20% EL Cap	THT	
C3	100 nF	630 V 5% MLCC	SMD 1812	
C4	3.3 µF	450 V 20% EL Cap	THT	
C5	22 µF	35 V 20% EL Cap	THT	
C6	22 nF	50 V 5% MLCC	SMD 0603	
C7	1.5 nF	50 V 5% MLCC	SMD 0603	
C8	1 µF	50 V 5% MLCC	SMD 0603	
C9	100 nF	50 V 5% MLCC	SMD 0603	
C10	1 nF	50 V 5% MLCC	SMD 0603	
C11	220 nF	50 V 5% MLCC	SMD 0603	
C12	100 nF	50 V 5% MLCC	SMD 0603	
C13	100 nF	50 V 5% MLCC	SMD 0603	
C15	100 nF	50 V 5% MLCC	SMD 0603	
C23	100 nF	50 V 5% MLCC	SMD 0603	
C25	100 nF	50 V 5% MLCC	SMD 0603	
C28	100 nF	50 V 5% MLCC	SMD 0603	
C32	100 nF	50 V 5% MLCC	SMD 0603	
C14	220 nF	50 V 5% MLCC	SMD 0603	
C16	220 pF	50 V 5% MLCC	SMD 0603	
C17	100 pF	50 V 5% MLCC	SMD 0603	
C18	100 nF	50 V 5% X7R MLCC	SMD 0603	
C20	100 nF	50 V 5% X7R MLCC	SMD 0603	
C19	330 pF	16 V 5% X7R MLCC	SMD 0603	
C21	330 pF	16 V 5% X7R MLCC	SMD 0603	
C22	10 nF	50 V 5% MLCC	SMD 0603	
C26	10 nF	50 V 5% MLCC	SMD 0603	
C24	1 µF	25 V 5% MLCC	SMD 0603	
C27	1 µF	50 V 5% MLCC	SMD 0603	
C29	1 nF	50 V 5% MLCC	SMD 0603	
C30	1 nF	50 V 5% MLCC	SMD 0603	
C31	1 nF	50 V 5% MLCC	SMD 0603	
D1	STTH3L06U	600 V Ultrafast high-voltage rectifier	DO-214AC	STMicroelectronics
D2	STTH1R06A	600 V Ultrafast high-voltage rectifier	DO-214AC	STMicroelectronics
D3	STTH1R06A	600 V Ultrafast high-voltage rectifier	DO-214AC	STMicroelectronics
D8	STTH1R06A	600 V Ultrafast high-voltage rectifier	DO-214AC	STMicroelectronics
D4	SML4745A	16 V Zener diode	DO-214AC	VISHAY
D6	1N4148WS	100 V Small signal fast switching diode	SOD-323F	VISHAY

Ref.	Value	Description	Package	Manufacturer
D8	1N4148WS	100 V Small signal fast switching diode	SOD-323F	VISHAY
D7	BZT52C5V6	5.6 V 5% Zener diode	SOD-123	Diodes Incorporated
D9	BZT52C5V6	5.6 V 5% Zener diode	SOD-123	Diodes Incorporated
D14	BZT52C5V6	5.6 V 5% Zener diode	SOD-123	Diodes Incorporated
D10	BZT52C4V3	4.3 V 5% Zener diode	SOD-123	
D10	BAS70J	70 V Schottky diodes	SOD-323	STMicroelectronics
D11	BAS70J	70 V Schottky diodes	SOD-323	STMicroelectronics
D15	BAS70J	70 V Schottky diodes	SOD-323	STMicroelectronics
D12	1N4148W	100 V Small signal fast switching diode	SOD-323F	VISHAY
J1	Input voltage	Screw terminal block - 2 positions, 5.08 mm		
J2	LED Output	Screw terminal block -2 positions, 5.08 mm		
J3	Daughterboard			
J4	Dimming Input	Strip connector 2 positions, 2.54 mm		
L1	7447720222	2.2 mH 250 mA Drum Inductor		Würth Elektronik
Q1	FMMT560TA	500 V 0.15 A PNP transistor	SOT23-3	Diodes Incorporated
Q2	FMMT560TA	500 V 0.15 A PNP transistor	SOT23-3	Diodes Incorporated
Q3	2N7002	60 V 300 mA MOSFET N-Ch	SOT23-3	Infineon
Q5	2N7002	60 V 300 mA MOSFET N-Ch	SOT23-3	Infineon
Q4	MMBT3906	40 V 0.15 A PNP transistor	SOT23-3	Diodes Incorporated
Q6	BC817-25L	45 V 500 mA NPN transistor	SOT23-3	Onsemi
R1	390 kΩ	1% 0.125 W (1/8) SMT resistor	SMD 1206	
R2	390 kΩ	1% 0.125 W (1/8) SMT resistor	SMD 1206	
R3	390 kΩ	1% 0.125 W (1/8) SMT resistor	SMD 1206	
R4	390 kΩ	1% 0.125 W (1/8) SMT resistor	SMD 1206	
R5	390 kΩ	1% 0.125 W (1/8) SMT resistor	SMD 1206	
R6	390 kΩ	1% 0.125 W (1/8) SMT resistor	SMD 1206	
R7	2.2 MegΩ	1% 0.125 W (1/8) SMT resistor	SMD 1206	
R8	2.2 MegΩ	1% 0.125 W (1/8) SMT resistor	SMD 1206	
R9	2.2 MegΩ	1% 0.125 W (1/8) SMT resistor	SMD 1206	
R10	2.2 MegΩ	1% 0.125 W (1/8) SMT resistor	SMD 1206	
R11	2.2 MegΩ	1% 0.125 W (1/8) SMT resistor	SMD 1206	
R13	2.2 MegΩ	1% 0.125 W (1/8) SMT resistor	SMD 1206	
R14	2.2 MegΩ	1% 0.125 W (1/8) SMT resistor	SMD 1206	
R12	270 kΩ	1% 0.125 W (1/8) SMT resistor	SMD 0603	
R15	2.2 MegΩ	1% 0.125 W (1/8) SMT resistor	SMD 0603	
R16	12 kΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R17	27 kΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R18	10 kΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R33	10 kΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R35	10 kΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R48	10 kΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	

Ref.	Value	Description	Package	Manufacturer
R49	10 kΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R59	10 kΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R19	47 Ω	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R20	8.2 kΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R21	220 kΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R43	220 kΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R22	4.7 kΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R46	4.7 kΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R50	4.7 kΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R23	200 kΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R24	470 Ω	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R51	470 Ω	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R25	10 Ω	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R27	10 Ω	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R26	150 Ω	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R28	150 Ω	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R29	47 kΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R54	47 kΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R56	47 kΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R60	47 kΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R62	47 kΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R64	47 kΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R65	47 kΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R66	47 kΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R30	100 kΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R53	100 kΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R31	43 kΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R32	56 kΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R34	150 kΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R36	750 kΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R37	82 kΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R38	470 kΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R44	470 kΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R39	1 MegΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R67	1 MegΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R40	2.2 kΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R41	1 kΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R52	1 kΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R68	1 kΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R42	33 kΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R45	430 kΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	

Ref.	Value	Description	Package	Manufacturer
R47	24 kΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R55	2.7 MegΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R57	510 kΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R58	680 kΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R61	2.2 MegΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R63	10 MegΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
T1	750345601	1 mH 2 mA Buck inductor		Würth Elektronik
U1	HVLED002	LED controller	SOP-8	STMicroelectronics
U2	VIPer06XS	Offline switch	SOP-10	STMicroelectronics
U3	LM239QT	Quad comparator	QFN16 3x3	STMicroelectronics
U4	TS321	Single op amp gen purpose	SOT23-5	STMicroelectronics
U6	BU4S11G2-TR	Single gate NAND	SSOP5	Rohm Semiconductor
U7	BU4S81G2-TR	Single gate AND	SSOP5	Rohm Semiconductor
U8	TS391	Single op amp gen purpose	SOT23-5	STMicroelectronics

Table 2. Daughterboard bill of materials

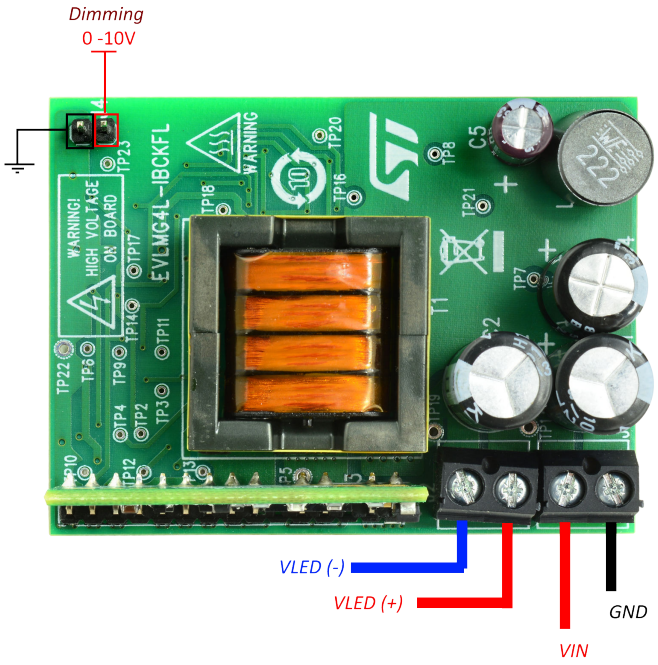
Ref.	Value	Description	Package	Manufacturer
C1	2.2 µF	50 V 5% X7R SMT ceramic capacitor	SMD 0603	
C2	2.2 µF	50 V 5% X7R SMT ceramic capacitor	SMD 0603	
C3	100 nF	50 V 5% X7R SMT ceramic capacitor	SMD 0603	
C7	100 nF	50 V 5% X7R SMT ceramic capacitor	SMD 0603	
C8	100 nF	50 V 5% X7R SMT ceramic capacitor	SMD 0603	
C4	10 pF	50 V 5% X7R SMT ceramic capacitor	SMD 0603	
C5	22 pF	50 V 5% X7R SMT ceramic capacitor	SMD 0603	
C6	22 pF	50 V 5% X7R SMT ceramic capacitor	SMD 0603	
C9	100 nF	630 V 10% X7R SMT ceramic capacitor	SMD 1210	
D1	1N4148W	100 V Small signal fast switching diode	SOD-325	
D2	BZT52C6V8	6.8 V 5% Zener diode	SOD-123	
D3	STTH1R06A	600 V Turbo 2 ultrafast high-voltage rectifier	SMA	STMicroelectronics
D4	1N4148W	100 V Small signal fast switching diode	SOD-324	
D5	1N4148W	100 V Small signal fast switching diode	SOD-323F	
D7	BZT52C6V2	6.2 V 5% Zener diode	SOD-123	
D8	BZT52C6V2	6.2 V 5% Zener diode	SOD-123	
J1	Motherboard	Strip 15 pin 2.54 mm		
Q1	MMBT3904	40 V 0.15 A PNP transistor	SOT-23	Diodes Incorporated
RS1	0R15	1% SMD 0.0625 W (1/16) SMT resistor	SMD 0603	
RS2	1R0	1% SMD 0.0625 W (1/16) SMT resistor	SMD 0603	
RS3	3R0	1% SMD 0.0625 W (1/16) SMT resistor	SMD 0603	
RS4	n.m.	1% SMD 0.0625 W (1/16) SMT resistor	SMD 0603	
R1	47 kΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R3	47 kΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	

Ref.	Value	Description	Package	Manufacturer
R2	4R7	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R4	1 kΩ	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R5	10 Ω	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R6	10 Ω	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R7	0R0	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
R8	0R0	1% 0.0625 W (1/16) SMT resistor	SMD 0603	
U1	MASTERGAN4L	High-density power driver, HV e-mode GaN half bridge w gate driver	VFQFPN 9 x 9 x 1.0-48 L	STMicroelectronics

4 Board connection and measurement

Figure 13 illustrates the basic connection of the board together with input voltage and output load. Figure 14, Figure 15 and Figure 16 summarize main outcomes of board performance.

Figure 13. Board connection diagram



The table below shows the board parameters:

Table 3. Board parameters

Parameter	Symbol	Value	Unit
Input voltage range	VIN	370 .. 450	V
LED voltage range	VLED	130 .. 360	V
LED current	ILED	1.5	A
Dimming voltage range	Vdim_input	0 .. 10	V
VLED open	VO	365	V
Thermal resistance	Rth	40	°C/W
Size	L x W x H	65 x 49 x 29	mm x mm x mm

Figure 14. Output current vs output voltage

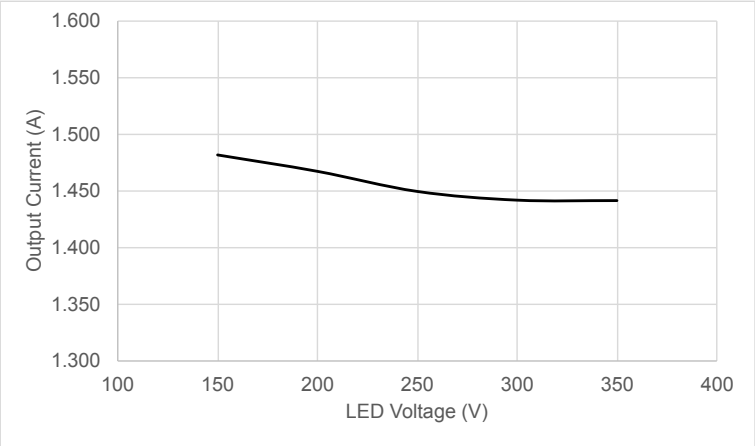


Figure 15. Board efficiency vs output voltage

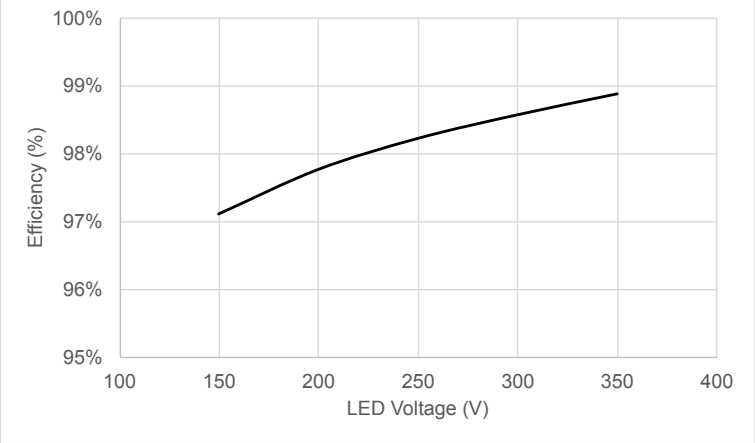
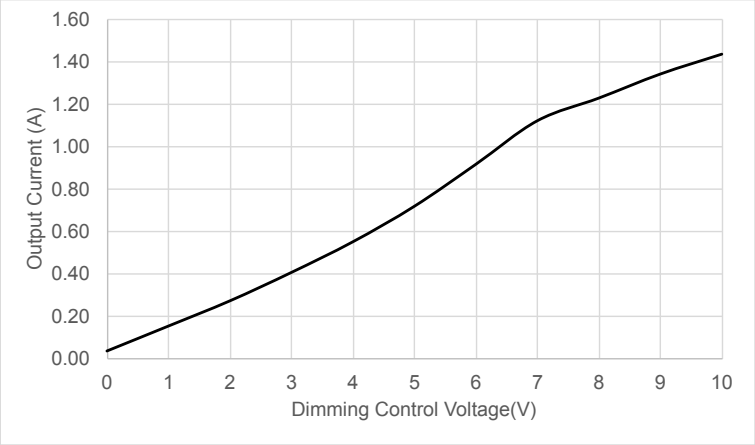


Figure 16. Output current vs dimming level



Revision history

Table 4. **Document revision history**

Date	Version	Changes
27-Feb-2025	1	Initial release.

Contents

List of tables

List of figures