AL6562EV1 User Guide
Universal input - High PFC PAR38 LED Driver

General Description

This AL6562 is a popular universal AC input, high power factor correction (PFC) IC, its output is “constant voltage mode” and can be used for Boost & Flyback converter. This driver board or regular general power EV board provides 3 separate voltage outputs (VLED1, 25V/600mA, VLED2, 12V/400mA, and 9V/200mA) that can be used to drive WiFi compatible RGB+White bulbs. The total output power should be less than 15W. It can be used for LED and Power Supply applications.

Key Features

- Single Stage Fly-Back PFC Controller
- Transition Discontinuous Conduction Mode Operation
- Low Start-Up, Operating and Quiescent Currents
- Zero Current Detection
- Internal Start-Up Timer
- PFC >0.95 & low THD
- 90 ~265V_{AC} input range
- ~85% Efficiency
- Adjustable Output Voltage through the CN1 connector (pin 1)
- Over Power Protection

Applications

- Electronic Single-Stage LED Driver
- High-End AC-DC adaptor/Charger
- WiFi compatible RGB+White Bulbs
- Regular Power Applications required high PFC
- PFC Pre-Regulators to Meet IEC61000-3-2

AL6562 EV1 Specifications (CV mode)

Parameter	Value
Input Voltage	90 to 265VAC
PFC	> 0.95
LED 1 Voltage	25V
LED 1 Current	0 - 600mA (max.)
LED 2 Voltage	12V
LED 2 Current	0 - 400mA (max.)
3rd Output	9V/200mA (max.)
Efficiency	~85%
Total Output Power	3 combined voltage outputs <15W
XYZ Dimension	70 x 40 x 24 mm
ROHS Compliance	Yes

Evaluation Board

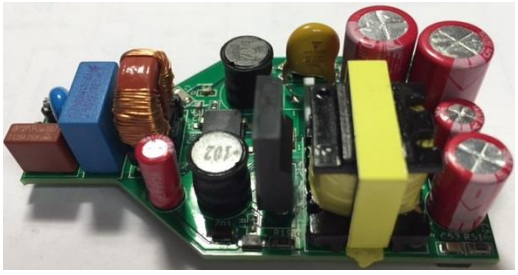


Figure 1: Top View

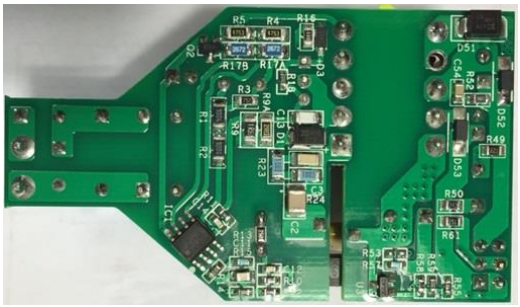


Figure 2: Bottom View

Connection Instructions

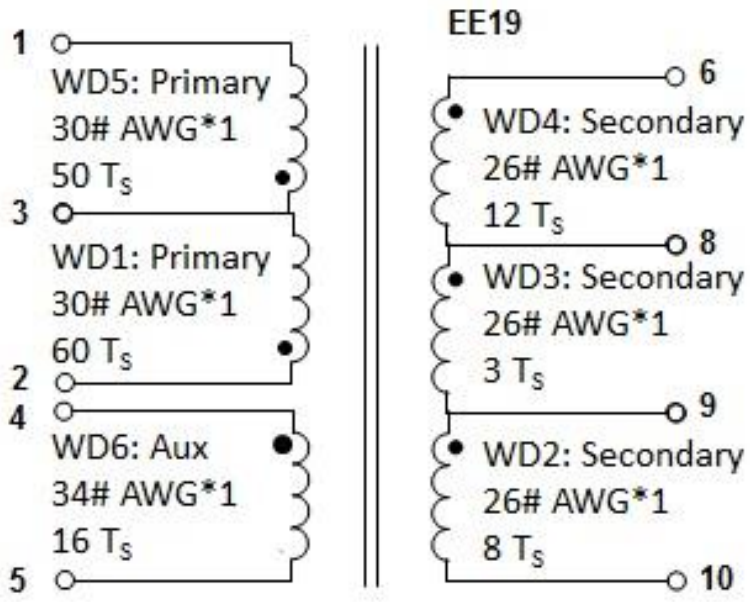
Input Voltage: 90 - 230VAC (AC+, AC-)
Outputs: CN1 (pin3, 12V/400mA, pin4, 25V/600mA, pin6, 9V/200mA, pin2 and 5, GND)

DIODES TAPPED TRANSFORMER DESIGN

AL6562 (90V_{AC} ~ 230V_{AC} 3 outputs 18W Transformer Spec.)

1) Core & Bobbin

EE19 5+5 pin



2) Transformer Parameters

1. Primary Inductance (Pin1-Pin2, all other windings are open)
   Lp = 0.8mH ±5%@1kHz
2. Primary Winding Turns (Pin2-Pin3 + Pin3 – Pin1): N_P=110Ts
3. A Shielding Winding full layers
4. Secondary Winding Turns (Pin6- Pin8): N_{S1}= 12Ts
5. Secondary Winding Turns (Pin8- Pin9): N_{S2}= 3Ts
6. Secondary Winding Turns (Pin9- Pin10): N_{S3}= 8Ts
7. Auxiliary Winding Turns (Pin4- Pin5): N_A= 16Ts

3) Transformer Winding Construction Diagram

Item	Windings	Winding Specification
1	W5-Primary Winding	Start from Pin 2, 30# AWG*1, Two layers, end at Pin 3.
2	Insulation	1 Layer of insulation tape
3	Shielding Winding	Start from Pin 1, 34# AWG*1 with full layer winding, end flowing wire.
4	Insulation	2 Layers of insulation tape
5	W4 N_S1 Secondary Winding	Start from Pin 6, double of insulation 26# AWG*1, 12Ts, one layer, end at Pin 8.
6	W3 N_S2 Secondary Winding	Start from Pin 8, double of insulation 26# AWG*1, 3Ts, same layer above, end at Pin 9.
7	W2 N_S3 Secondary Winding	Start from Pin 9, double of insulation 26# AWG*1, 8Ts, same layer above, end at Pin 10.
8	Insulation	2 Layers of insulation tape
9	W1-Primary Winding	Start from Pin 3, 30# AWG*1, 50Ts, Two layers, end at Pin 1.
10	Insulation	2 Layers of insulation tape
11	W6-Primary Winding	Start from Pin 4, 34# AWG*1, 16Ts, One layer, end at Pin 5.
12	Insulation	2 Layers of insulation tape

Evaluation Board Schematic

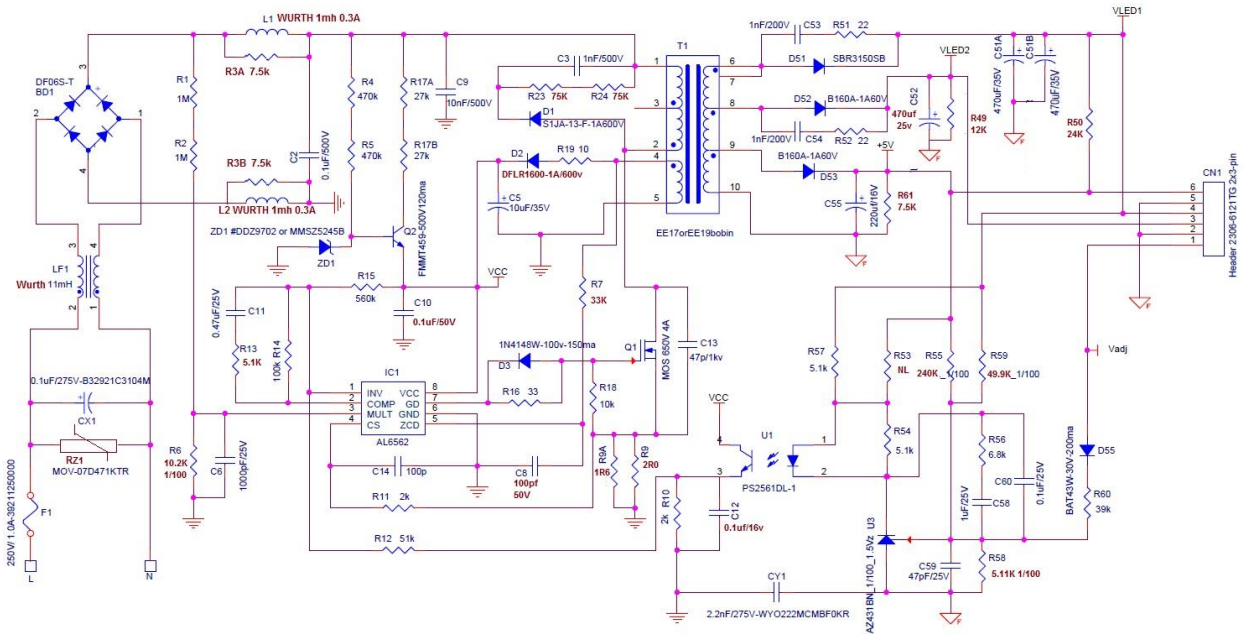


Figure 3: Evaluation Board Schematic

Evaluation Board Layout

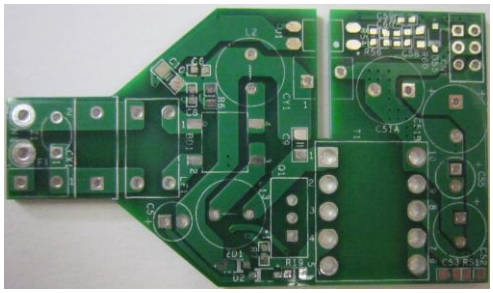


Figure 4: PCB Board Layout Top View

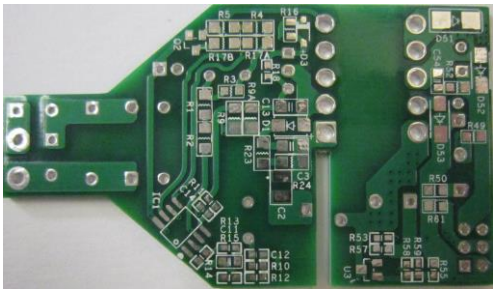


Figure 5: PCB Board Layout Bottom View

Quick Start Guide

1. By default, the evaluation board is preset at 25V/600mA for VLED1 (pin 4 of the CN1), 12V/400mA for VLED2 (pin 3 of the CN1), and 9V/200mA (pin 6 of the CN1). Total output power should be less than 15W.
2. Ensure that the AC source is switched OFF or disconnected.
3. Connect the AC line wires of power supply to “L and N” on the left side of the board.
4. Connect the 25V load to VLED1 (pin 4 of the CN1).
5. Connect the load GND to pin 2 and pin 5 of the CN1.
6. Turn on the main switch.

Bill of Material

#	Name	QTY	Part number	Manufacturer	Description
1	IC1	1	AL6562S-13	**Diodes Inc**	Current Mode PFC LED Controller, SO-8
2	T1	1	EE19	Elite Electronics	EE19, Transformer
3	BD1	1	DF06S-T	**Diodes Inc**	Bridge Rectifiers 1A 600V
4	D1	1	S1JA-13-F-1A600V	Vishay	Rectifier 1A/600V, DO-214AC (SMA)
5	D2,D3	2	1N4148W	**Diodes Inc**	Rectifier 150mA/100V (SOD-123)
6	D51	1	SBR3150SB-13	**Diodes Inc**	Schottky Diode, 3A/150V (SMB)
7	D52,D53	2	B160/B	**Diodes Inc**	Schottky Diode, 1A/60V (SMA)
8	D55	1	BAT43W	**Diodes Inc**	Rectifier 200mA/30V (SOD-123)
9	F1	1	39211250000	Littelfuse	Fuse, 1A/250V
10	LF1	1	744821110	Wurth	Common Mode Choke 11mH 0.9A
11	Q1	1	DMG4N65CTI	**Diodes Inc**	MOSFET N-CH 650V 4A T0-220
12	Q2	1	FMMT459	**Diodes Inc**	MOSFET N-CH 500V 120mA SOT-23
13	L1,L2	2	7447728102	Wurth	Inductor 1mH/300mA Dia 8.7mm
14	U1	1	PS2561DL-1	CEL	Photocoupler, SO-4
15	U3	1	AZ431BN	**Diodes Inc**	Shunt Regulator, 1% 2.5V_Z
16	Z1	1	MOV-07D471KTR	Bourns	Varistor 11.5x5.5-P7.5
17	ZD1	1	MMSZ5245B	MCC	Zener Diodes, 15V_Z
18	CX1	1	B32921C3104M	TDK	CAP 0.1µF 275V (12mm x 5mm-P10)
19	CY1	1	WY0222MCMBF0KR	Vishay	CAP 2.2nF 275V (11mm x 6mm-P10)
20	C2	2	-	Generic	CAP CER 0.1µF 500V 1210
21	C3	1	-	Generic	CAP CER 1nF 500V 1206
22	C5	1	860020572003	Wurth	E-CAP 10µF 20% 35V (5mm x 8mm)
23	C6	1	-	Generic	CAP CER 1000pF 25V 0603
24	C8	1	-	Generic	CAP CER 220pF 25V 0603
25	C9,C10	2	-	Generic	CAP CER 10nF 500V 1206
26	C11	1	-	Generic	CAP CER 0.47µF 25V 0805
27	C12	1	-	Generic	CAP CER 100pF 25V 0603
28	C13	1	-	Generic	CAP CER 47pF 1000V 1206
29	C14	1	-	Generic	CAP CER 100pF 0603
30	C51A,C51B	2	860020575014	Wurth	E-CAP 470µF/35V (10 x 16-P5)
31	C52	1	860020474014	Wurth	E-CAP 470µF/25V (8 x 15-P5)
32	C53,C54	2	-	Generic	CAP CER 1nF 200V 0805
33	C55	1	860020373010	Wurth	E-CAP 220µF 16V 6.5x12
34	C58	1	-	Generic	CAP CER 1µF 25V 0603
35	C59	1	-	Generic	CAP CER 47pF 25V 0603
36	C60	1	-	Generic	CAP CER 0.1µF 25V 0603

37	R1,R2	2	-	Generic	RES 1MΩ 1/4W 5% 1206 SMD
38	R3	1	-	Generic	RES 5.6KΩ 1/8W 1% 0805 SMD
39	R4,R5	2	-	Generic	RES 470KΩ 1/4W 5% 1206 SMD
40	R6	1	-	Generic	RES 12.1KΩ 1/8W 1% 0805 SMD
41	R7	1	-	Generic	RES 36KΩ 1/8W 1% 0603 SMD
42	R9A,R9	2	-	Generic	RES 1.5Ω /2 Ω 1/4W 1% 1206 SMD
43	R10,R11	2	-	Generic	RES 2KΩ 1/8W 1% 0603 SMD
44	R12	1	-	Generic	RES 51KΩ 1/8W 1% 0603 SMD
45	R13	1	-	Generic	RES 15KΩ 1/8W 1% 0603 SMD
46	R14	1	-	Generic	RES 100KΩ 1/8W 1% 0603 SMD
47	R15	1	-	Generic	RES 560KΩ 1/8W 1% 0603 SMD
48	R16	1	-	Generic	RES 33Ω 1/8W 1% 0805 SMD
49	R17A,R17B	2	-	Generic	RES 27KΩ 1/4W 1% 1206 SMD
50	R18	1	-	Generic	RES 10KΩ 1/8W 1% 0603 SMD
51	R19	1	-	Generic	RES 10Ω 1/8W 1% 0805 SMD
52	R23,R24	2	-	Generic	RES 100KΩ 1/4W 1% 1206 SMD
53	R49	1	-	Generic	RES 4.7KΩ 1/8W 1% 0805 SMD
54	R50	1	-	Generic	RES 9.1KΩ 1/8W 1% 0805 SMD
55	R51,R52	2	-	Generic	RES 22Ω 1/8W 1% 0805 SMD
56	R53	1	-	Generic	RES 1KΩ 1/8W 1% 0603 SMD
57	R54	1	-	Generic	RES 5.1KΩ 1/8W 1% 0603 SMD
58	R55	1	-	Generic	RES 14KΩ 1/8W 1% 0603 SMD
59	R56	1	-	Generic	RES 6.8KΩ 1/8W 1% 0603 SMD
60	R57	1	-	Generic	RES 5.1KΩ 1/8W 1% 0805 SMD
61	R58	1	-	Generic	RES 5.1KΩ 1/8W 1% 0603 SMD
62	R59	1	-	Generic	RES 300KΩ 1/8W 1% 0603 SMD
63	R60	1	-	Generic	RES 39KΩ 1/8W 1% 0805 SMD
64	R61	1	-	Generic	RES 1.5KΩ 1/8W 1% 0805 SMD
65	CN1	1	2306-6121-TG	3M	Pin Header 2x3-pin

Functional Performance (Single Output, VLED1 - 25V)

Manuf	Board Type	VIN (V_{AC})	PFC	P_{IN} (W)	V_{LED} (V)	I_{OUT} (mA)	P_{OUT} (W)	Efficiency (%)	Athd (%)	Ripple (%)
Diodes Inc	AL6562EV1 Module Board	100	0.982	17.500	24.28	600	14.668	83.82	10.9	-
		110	0.976	17.316	24.27	600	14.662	84.67	11.2	-
		120	0.979	17.271	24.32	600	14.692	85.07	11.5	10.8
		130	0.983	17.206	24.32	600	14.692	85.39	11.7	-
		200	0.957	17.312	24.57	600	14.842	85.73	16.4	-
		210	0.952	17.366	24.61	600	14.866	85.60	17.2	-
		220	0.947	17.428	24.66	600	14.896	85.47	17.7	-
		230	0.942	17.500	24.71	600	14.926	85.29	18.0	9.6
		240	0.937	17.581	24.76	600	14.956	85.07	19.2	-
		250	0.931	17.660	24.81	600	14.986	84.86	19.6	-
		265	0.923	17.791	24.88	600	15.028	84.47	20.1	-

Functional Performance

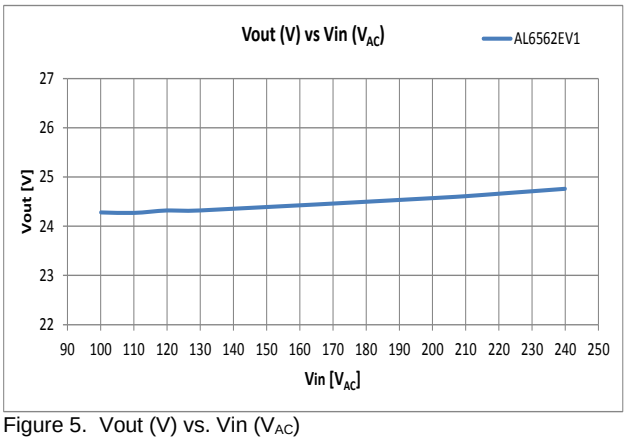


Figure 5. Vout (V) vs. Vin (V_{AC})

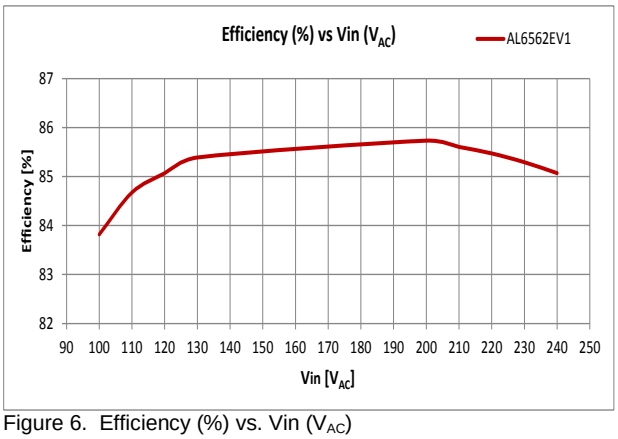


Figure 6. Efficiency (%) vs. Vin (V_{AC})

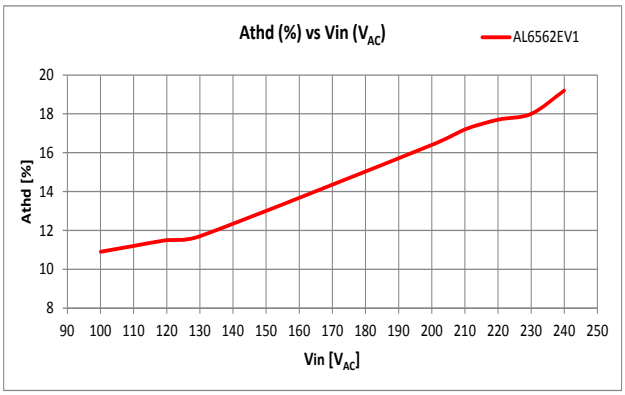


Figure 7. Athd (%) vs. Vin (V_{AC})

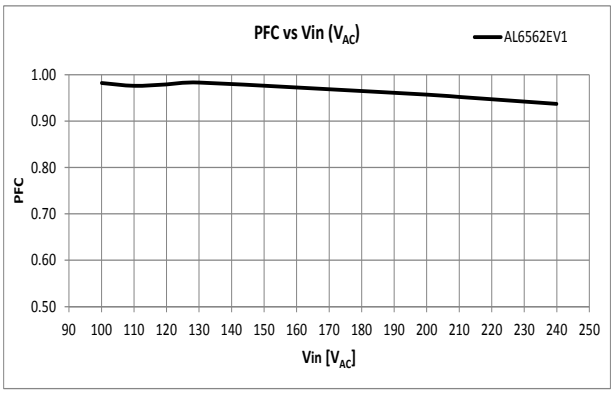


Figure 8. PFC vs. Vin (V_{AC})

Functional Performance (Three Outputs, VLED1 - 25V, VLED2 – 12V, and 9V)

Manuf	Board Type	VIN (V_{AC})	PFC	PIN (W)	V_{LED1} (V)	I_{OUT} (mA)	V_{LED2} (V)	3rd Output (V)	Total P_{OUT} (W)	Efficiency (%)	Athd (%)
Diodes Inc	AL6562EV1 Module Board	110	0.987	18.016	25.04	400	11.64	8.29	14.952	82.99	9.0
		120	0.985	17.900	25.04	400	11.65	8.31	14.965	83.61	10.1
		130	0.983	17.824	25.04	400	11.66	8.32	14.975	84.02	11.0
		200	0.952	17.748	25.04	400	11.69	8.36	15.007	84.56	16.0
		210	0.947	17.766	25.03	400	11.69	8.37	15.013	84.50	16.7
		220	0.942	17.796	25.03	400	11.70	8.37	15.013	84.36	17.0
		230	0.936	17.835	25.03	400	11.70	8.38	15.016	84.19	17.5
		240	0.931	17.879	25.03	400	11.70	8.38	15.016	83.99	17.5
		250	0.924	17.929	25.03	400	11.70	8.38	15.016	83.75	18.0
		265	0.914	18.015	25.03	400	11.71	8.39	15.026	83.41	19.0

Functional Performance

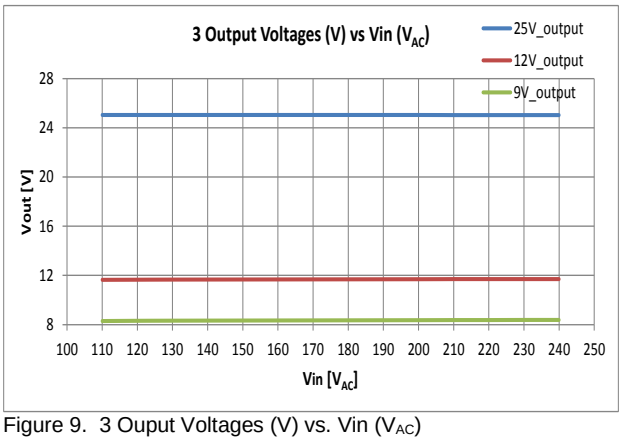


Figure 9. 3 Ouput Voltages (V) vs. Vin (V_{AC})

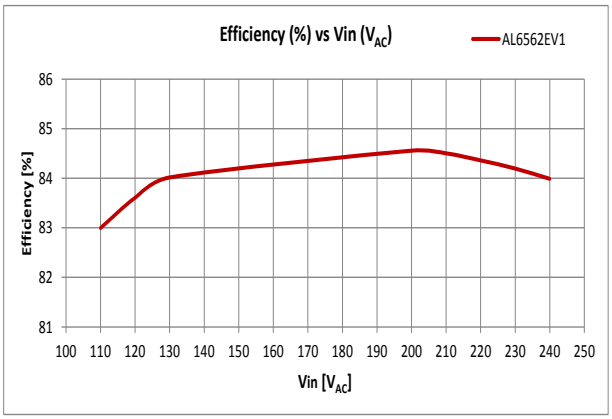


Figure 10. Efficiency (%) vs. Vin (V_{AC})

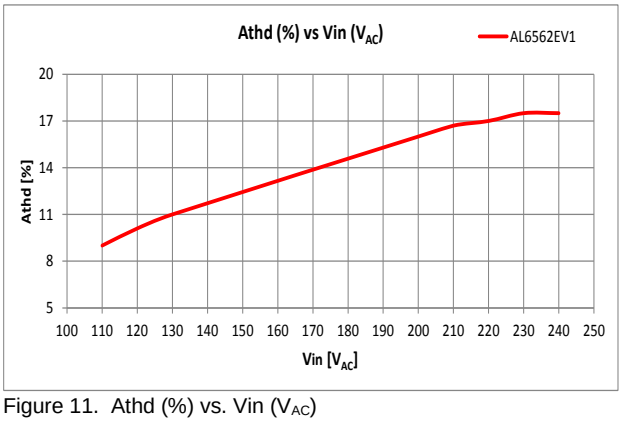


Figure 11. Athd (%) vs. Vin (V_{AC})

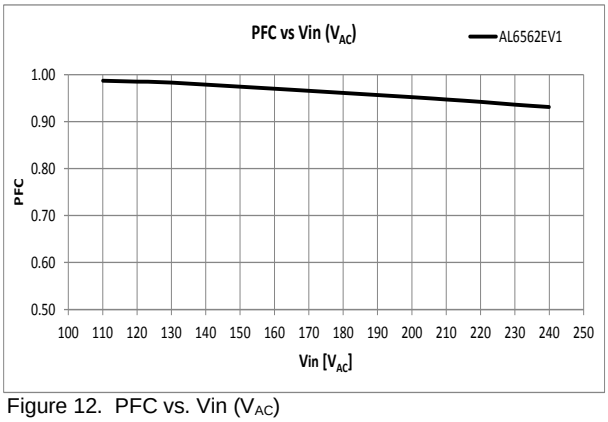


Figure 12. PFC vs. Vin (V_{AC})

Application Information

Adjusting the (3) Output Voltages (VLED1, VLED2, and 9V output):

1). The (3) output voltages can be adjusted to a lower value by applying a DC voltage to pin 1 of the CN1 connector.

Pin 1_CN1 (V_{DC}) input voltage	VLED1 (25V)	VLED2 (12V)	9V
5.0V	22.00	11.43	8.76
4.0V	22.92	11.91	9.14
3.3V	23.63	12.26	9.41
2.8V	24.13	12.50	9.59
N/C	24.41	12.61	9.67

2). The (3) output voltages can also be adjusted to a lower value by changing R59 to a higher value.

Change the R59 value	VLED1 (25V)	VLED2 (12V)	9V
300k//500k	22.77	11.86	9.04

Adjusting the Over Power Protection Threshold:

The over power protection threshold can be adjusted by changing R9 to a higher value. Current R9 default setting is at 2Ω.

Vin (V_{AC})	VLED1 (25V) R9 = 2Ω//R9A=1.5 Ω
120	24.44
100	24.40
90	24.25
80	22.80
70	20.42

Performance Waveforms

All of the Channel 1 (V_{IN}) measurement used a 100:1 differential probe shown in a 5V/division scale.

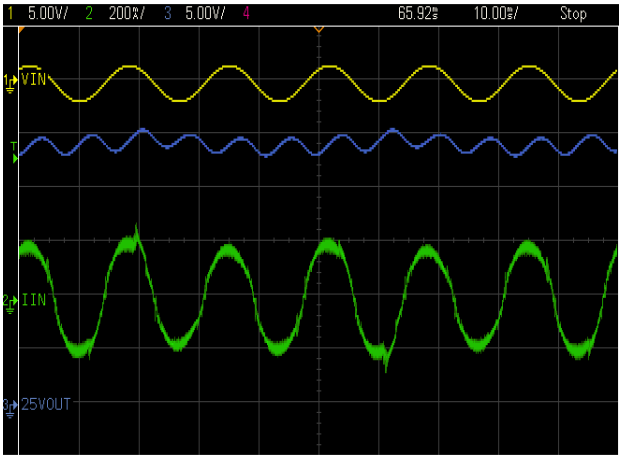


Figure 9. 120V_{AC} input, I_{IN}, and Vout waveform

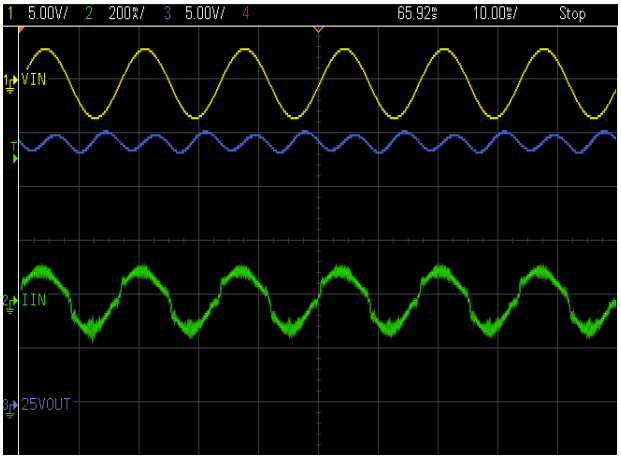


Figure 10. 230V_{AC} input, I_{IN}, and Vout waveform

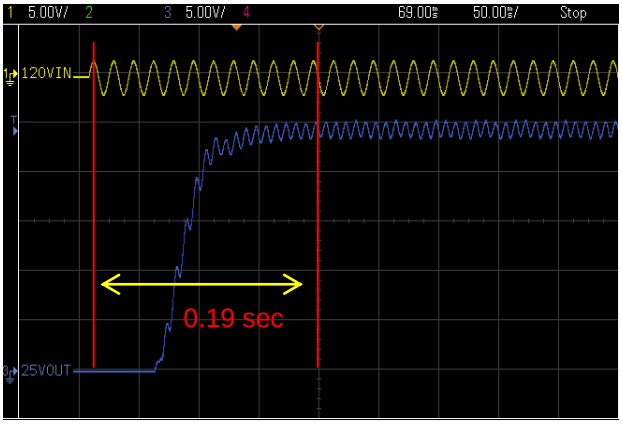


Figure 11. 120V_{AC} vs. output startup time

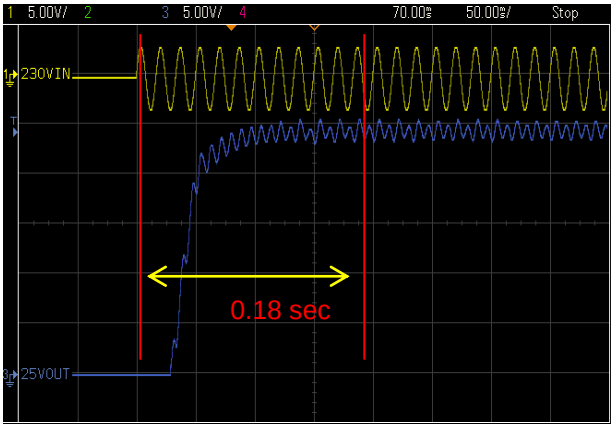


Figure 12. 230V_{AC} vs. output startup time

Thermal Test

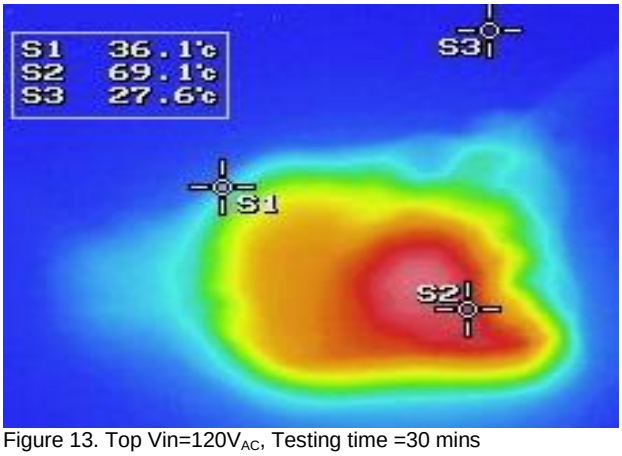


Figure 13. Top Vin=120V_{AC}, Testing time =30 mins

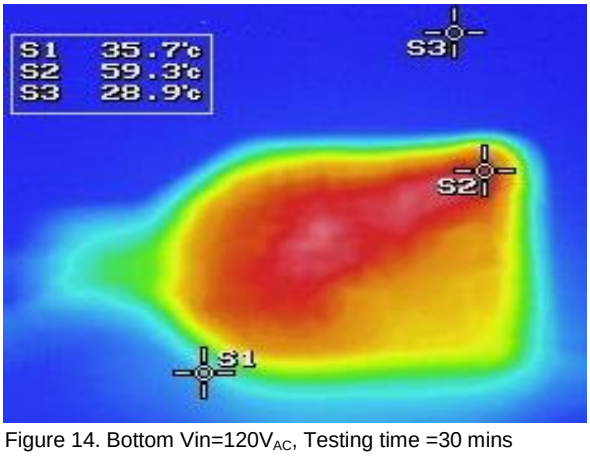


Figure 14. Bottom Vin=120V_{AC}, Testing time =30 mins

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2. support or sustain life and whose failure to perform when properly used in accordance with instructions for use provided in the labeling can be reasonably expected to result in significant injury to the user.

B. A critical component is any component in a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or to affect its safety or effectiveness.

Customers represent that they have all necessary expertise in the safety and regulatory ramifications of their life support devices or systems, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of Diodes Incorporated products in such safety-critical, life support devices or systems, notwithstanding any devices- or systems-related information or support that may be provided by Diodes Incorporated. Further, Customers must fully indemnify Diodes Incorporated and its representatives against any damages arising out of the use of Diodes Incorporated products in such safety-critical, life support devices or systems.

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