

General Description

This demonstration board utilizes the AL17052 to build a cost-effective solution for high-voltage buck converter applications.

The AL17052 integrates a 700V MOSFET and can work with a single winding inductor and very few external components to provide accurate constant voltage output and good dynamic performance.

This user guide contains valuable operation information for users. Included is a bill of materials that describes the parts used on this board. A schematic and PCB layout are also included, along with measured system performance characteristics and test waveforms. These materials can be used as a reference design for your products to improve your product's time to market.

Key Features

1. Universal 85 to 300V_{AC} Input Range
2. Constant Voltage (CV) Control
3. Internal MOSFET up to 700V
4. Low Operation Current: 100µA (Static)
5. Undervoltage Lock Out (UVLO)
6. Output Short Protection
7. Overload Protection
8. Overtemperature Protection (OTP)
9. Lower Standby Power

Applications

- Home appliances
- IoT applications
- Industrial controls
- Standby power

Specifications

Parameter	Value
AC Input Voltage	85Vac ~ 265Vac
Output Power	0.25W
Output Current	50mA
Output Voltage	5V
Efficiency	>65%@120VAC/50mA
Dimension	32mm*15mm
RoHS Compliance	Yes

Evaluation Board

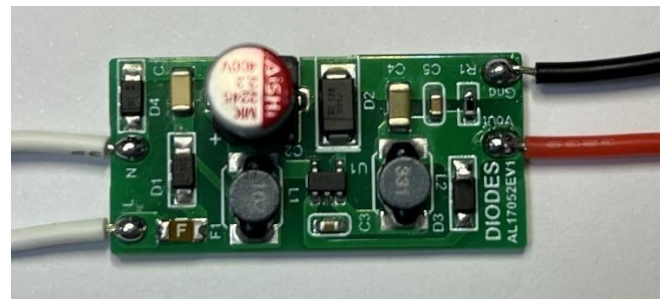


Figure 1: Top View

Connection Instructions

AC Line Input: White L line
 AC Neutral Input: White N line
 Positive Output: Vout (Red)
 Negative Output: Gnd (Black)

Board Layout

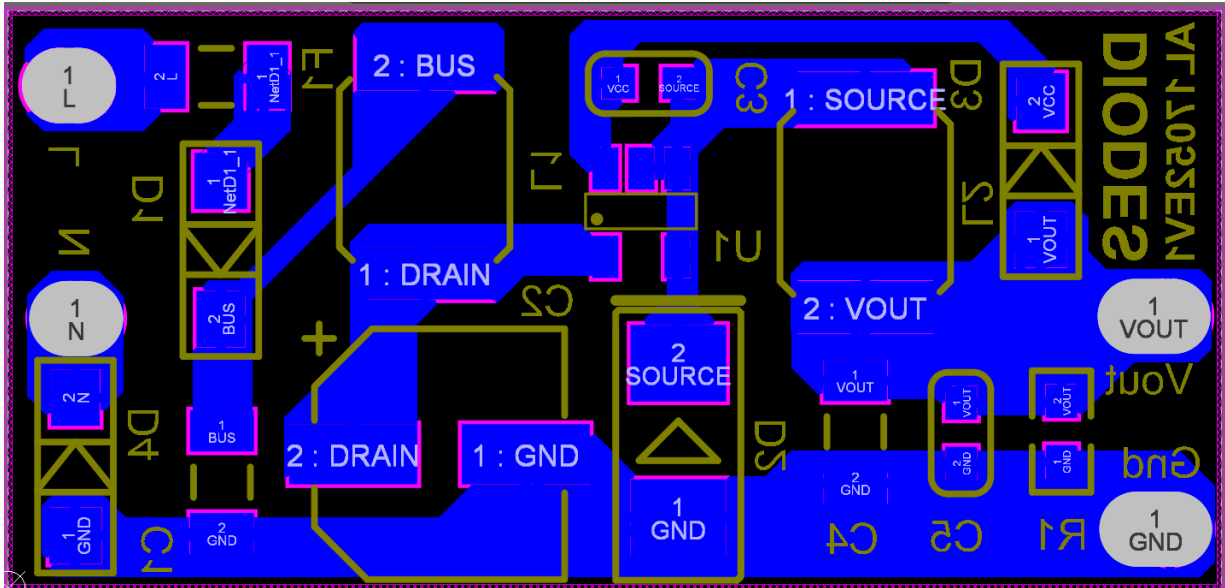


Figure 2: PCB Layout Bottom View

Quick Start Guide

1. Ensure that the AC source is switched OFF or disconnected.
2. Connect the AC line wires of the power supply to the “L” and “N” wires on the left side of the board.
3. Connect the red terminal of the electronic load to the “VOUT” wire.
4. Connect the black terminal of the electronic load to the “GND” wire.
5. Turn on the main switch. The electronic load should show a 5V output.

Schematic

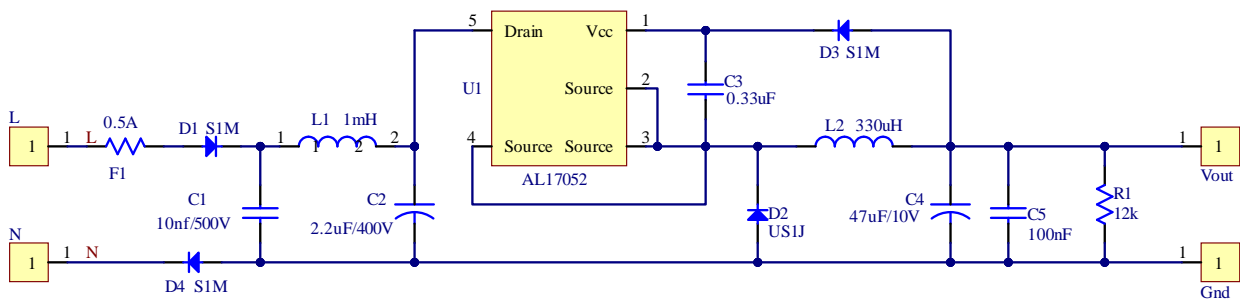


Figure 3: Schematic Circuit

Bill of Materials

AL17052 EV1 BILL OF MATERIAL						
Qty	Ref	Value	Description	Package	Manufacturer	Part Number
1	F1	500mA	Fuse 500mA	1206	Littelfuse	0466.500NRHF
3	D1,D3,D4	S1M	Diode,1000V,1A	SOD123	Diodes	S1MSWFM
1	D2	US1J	Diode,600V,1A,trr=75ns	SMA	Diodes	US1J
1	C1	10nF	Ceramic Capacitor,1KV,X7R,10%	1206	FengHua	1206B103K102NT
1	C2	2.2uF	Electrolytic Capacitor,400V,6.3*10.5	SMD	AISHI	EMK2GM2R2EB0D00R
1	C3	0.33uF	Ceramic Capacitor,25V,X7R,10%	0603	FengHua	0603B334K250NT
1	C4	47uF	Ceramic Capacitor,10V,X5R,20%	1206	Wurth	885012108012
1	C5	100nF	Ceramic Capacitor,16V,X7R,10%	0603	FengHua	0603B104K160NT
1	L1	1mH	Inductor,1mH,Rdc=13.8Ω,Isat=0.07A	SMD	Wurth	7445530
1	L2	330uH	Inductor,330uH,Rdc=5Ω,Isat=0.16A	SMD	Wurth	74455233
1	R1	12kΩ	SMD Film Resistor,1%	0603	UniOhm	0603WAF1202T5E
1	U1	AL17052	IC	SOT23-5	Diodes	AL17052
2	L, N	Input line	White color,30mm	-	-	-
1	Vout	Output line	Red color,30mm	-	-	-
1	Gnd	Output line	Black color,30mm	-	-	-
1	-	PCB board	Single layer, 15.2mm*31.9mm, 1.6mm thick, green color solder mask	-	-	-

System Performance

The AL17052 evaluation board has excellent system performance. With very low BOM costs, the system can achieve high efficiency, low-load regulation rates, low ripple, and good load-transient performance.

System efficiency

Figure 6 shows the measured efficiency versus load. The system efficiency at a 50mA current load could reach 65.2% with a 120V_{AC} input and 61.2% with a 230 V_{AC} input.

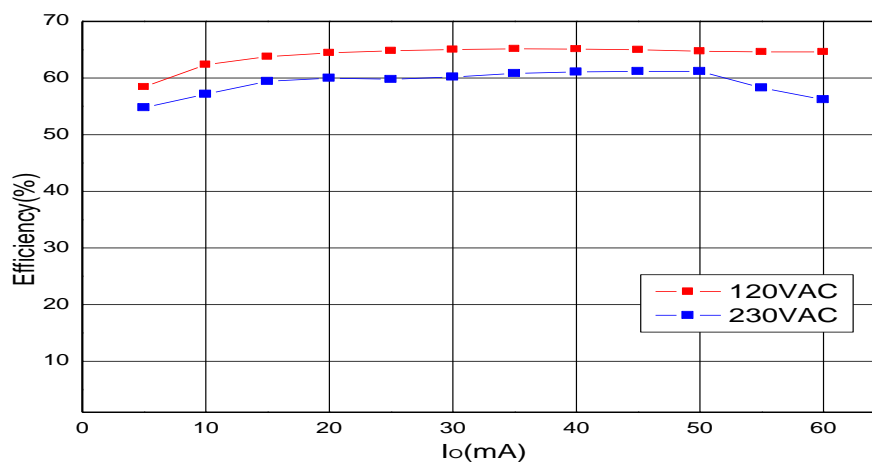


Figure 4: Efficiency vs Load Current

Load Regulation

The measured output voltage versus load is shown in Figure 7. The output voltage ranges from 5.32V to 4.88V, indicating a load regulation rate lower than 5%.

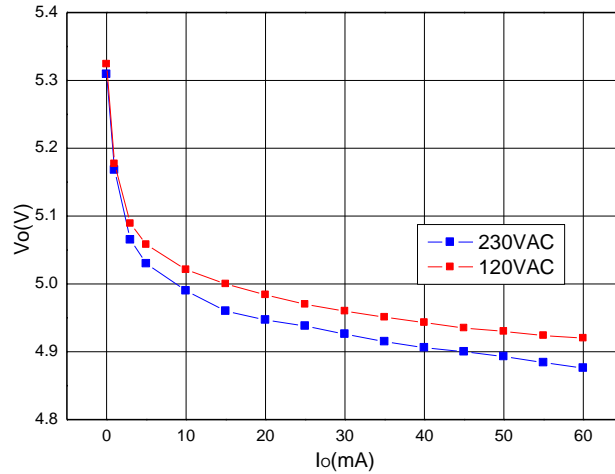


Figure 5: Output Voltage vs Load Current

Note: Vf of D2 will make slight differences in the output voltage.

Standby Power

The measured input voltage versus standby power is shown in Figure 8. The input voltage ranges from 85V to 265V, indicating a standby power lower than 12mW.

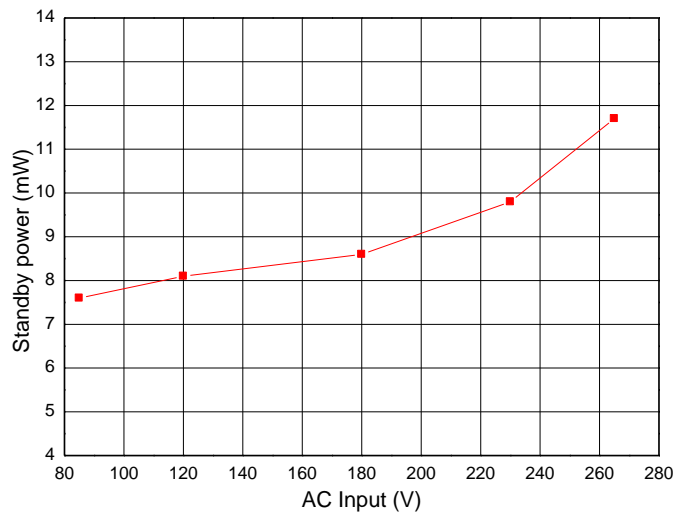


Figure 6: Input voltage vs No load Power

Note: If you want to lower standby power, you need to increase R1, but it will increase the no-load voltage.

Output Ripple

The output voltage ripple is measured at 50mA load at both 120V_{AC} and 230V_{AC} input. In Figure 8, channel 1 (in red) shows the waveform of V_{OUT}.

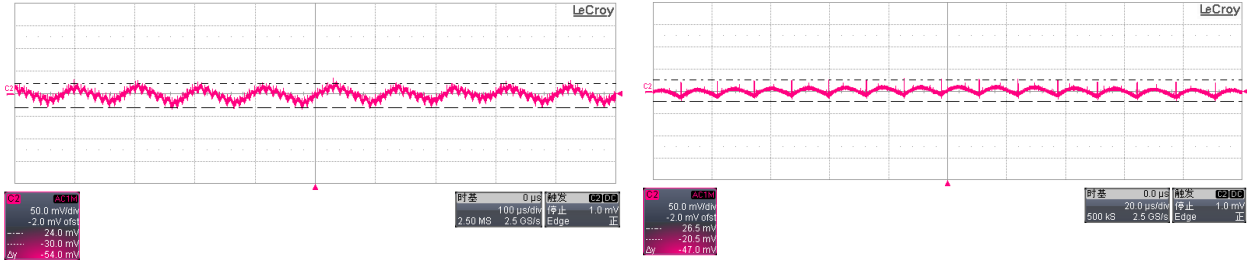


Figure 7: Output Voltage Ripple with 120V_{AC} (Left) and 230V_{AC} (Right)

The output voltage ripple peak-to-peak value is 54mV for 120V_{AC} input and 47mV for 230V_{AC}.

Load Transient Response

The load transient response is tested with the load repeatedly switching from 0mA to 60mA in a 10Hz frequency. The load switching slew rate is 50mA/μs. In Figure 9, channel 2 (in red) shows the waveform of V_{OUT} and channel 4 (in green) shows I_{OUT}.

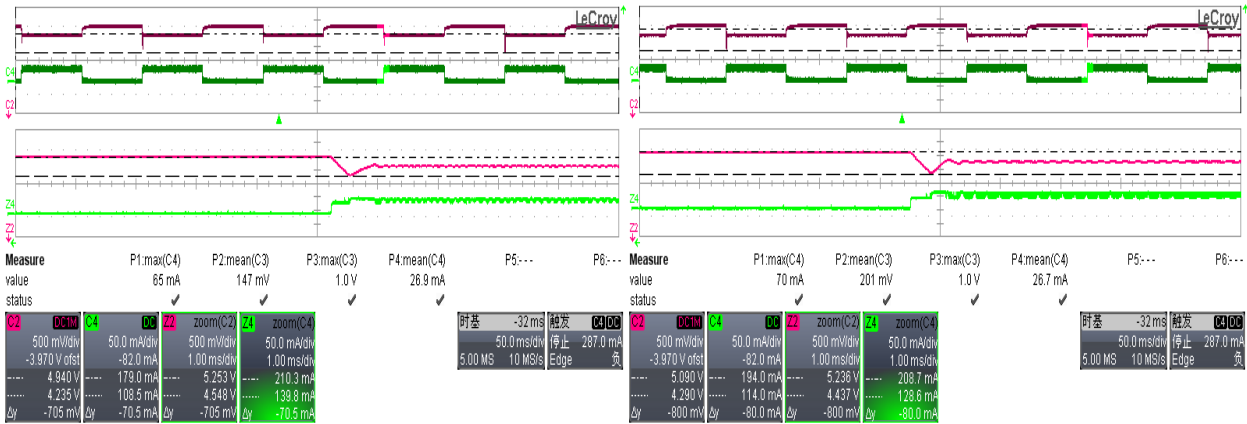
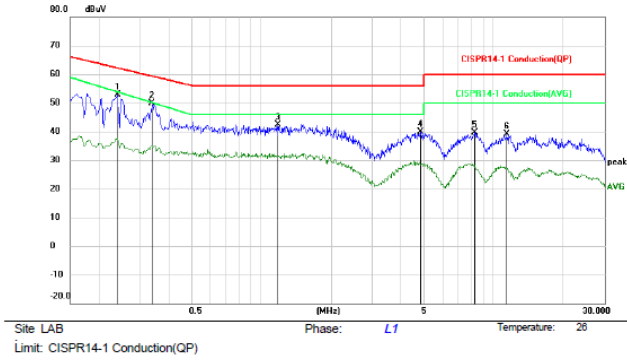


Figure 8: Load Transient Waveform with 120V_{AC} (Left) and 230V_{AC} (Right)

With 120V_{AC} input, the maximum undershoot caused by the load transient is 700mV. With 230V_{AC} input, the maximum undershoot caused by the load transition is 800mV. Thus, the minimum output voltage in the worst case is 4.44V.

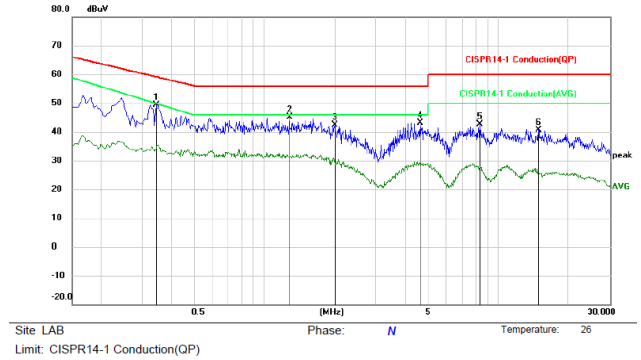
EMI Conduction Test

Line Terminal
(Vin=120V_{AC}, Margin>9dB)



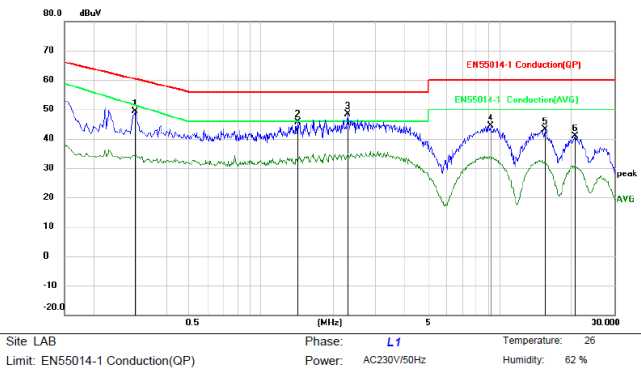
No. Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measurement dBuV	Limit dBuV	Over dB	Detector	Comment
1 *	0.2400	33.32	19.64	52.96	62.10	-9.14	peak	
2	0.3390	30.25	19.70	49.95	59.23	-9.28	peak	
3	1.1760	22.46	19.80	42.26	56.00	-13.74	peak	
4	4.8300	20.21	19.64	39.85	56.00	-16.15	peak	
5	8.2725	19.98	19.75	39.73	60.00	-20.27	peak	
6	11.4090	19.23	19.87	39.10	60.00	-20.90	peak	

Neutral Terminal
(Vin=120V_{AC}, Margin>9dB)



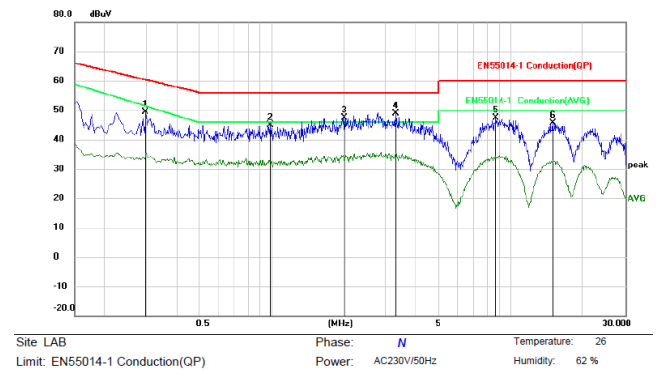
No. Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measurement dBuV	Limit dBuV	Over dB	Detector	Comment
1 *	0.3435	29.42	19.87	49.29	59.12	-9.83	peak	
2	1.2795	25.42	19.80	45.22	56.00	-10.78	peak	
3	1.9995	22.61	19.68	42.29	56.00	-13.71	peak	
4	4.6275	23.47	19.74	43.21	56.00	-12.79	peak	
5	8.3354	22.75	19.98	42.73	60.00	-17.27	peak	
6	14.8650	20.83	19.91	40.74	60.00	-19.26	peak	

Line Terminal
(Vin=230V_{AC}, Margin>7dB)



No. Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measurement dBuV	Limit dBuV	Over dB	Detector	Comment
1	0.2985	29.72	19.69	49.41	60.28	-10.87	peak	
2	1.4190	25.81	19.77	45.58	56.00	-10.42	peak	
3 *	2.3010	28.49	19.78	48.27	56.00	-7.73	peak	
4	9.1365	24.67	19.78	44.45	60.00	-15.55	peak	
5	15.4365	22.98	20.10	43.08	60.00	-16.92	peak	
6	20.5260	20.60	20.38	40.98	60.00	-19.02	peak	

Neutral Terminal
(Vin=230V_{AC}, Margin>7dB)



No. Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measurement dBuV	Limit dBuV	Over dB	Detector	Comment
1	0.2985	29.54	19.94	49.48	60.28	-10.80	peak	
2	0.9870	24.94	19.84	44.78	56.00	-11.22	peak	
3	2.0175	27.67	19.68	47.35	56.00	-8.65	peak	
4 *	3.3045	28.99	19.85	48.84	56.00	-7.16	peak	
5	8.6640	27.29	19.98	47.27	60.00	-12.73	peak	
6	14.9280	25.76	19.91	45.67	60.00	-14.33	peak	

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