Reference Design

EBC10061

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Power Conversion Business Group

iW1762-00 for 20V 2.31A Ultra-Slim 45W Ultrabook™ Adapter Design

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iW1762-00 for Ultra-Slim 45W Ultrabook™ Adapter Design

(AC Input 90 - 264V_{AC} Output 20V 2.31A)
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1.0 Introduction

This document provides a reference design for a universal input, 20V 2.31A isolated flyback power supply for ultra-slim, 45W ultrabook adapters. This design uses the iW1762-00. This document contains the complete specification for the power supply, a detailed circuit diagram, an entire bill of materials required to build the power supply, a drawing of the power transformer, and test data of the most important performance.

Figure 1.1 PCB Top View

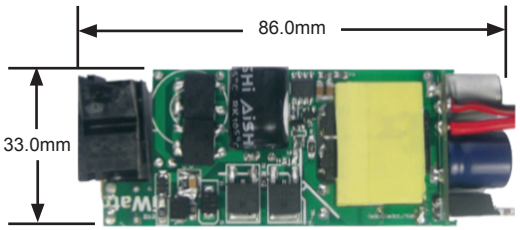


Figure 1.2 PCB Bottom View

Figure 1.3 PCB Side View

2.0 Design Features

- AC input range: 90 – 264V_{AC}
- DC output: 20V, 2.31A
- 82W peak power for 1ms every 10ms
  - » Supports Intel Turbo Boost mode
- < 100mW no-load standby power consumption
- Maximum ripple voltage < 380mV_{P_P}
- PrimAccurate™ primary-side sensing
  - » Eliminates opto-isolator
  - » Reduces BOM
  - » Improves line voltage surge protection
- Tight over voltage protection

3.0 Design Specification

The table below represents the minimum acceptable performance of the design.

Description	Symbol	Min	Typ	Max	Units	Comment
Input						
Voltage	V_{IN}	90		264	V_{AC}	2 Wire
Frequency	f_{LINE}	47	50/60	63	Hz	
No-load input power (230V_{AC})				100	mW	
Output						
Output voltage	V_{OUT_CV}	19	20	21	V	Measured at PCB end of output cable
Output current	I_{OUT_CV}		2.31		A	
Output ripple voltage	V_{RIPPLE}			380	mV_{P_P}	Add 0.1uF Ceramic capacitor and 1µF E-cap at the end of cable and set oscilloscope at 20MHz bandwidth.
Total Output Power						
Continuous output power	P_{OUT}		46.2		W	
Turbo mode peak power (4.3A 86W)			82		W	82W (turbo mode) for 1ms every 10ms
Over-current protection	I_{OUT_MAX}			3.0	A	Auto-restart
Active mode efficiency	η	88			%	Measured at end of PCB V_{IN}=115V_{AC} and 230V_{AC} (T_{AMB}=25°C)
Environmental						
Conducted EMI		Meets CISPR22B/EN55022B				
Safety		Designed to meet IEC950, UL1950 Class II				
Ambient temperature	T_{AMB}	0		40	°C	Free convection, sea level

4.0 Schematic

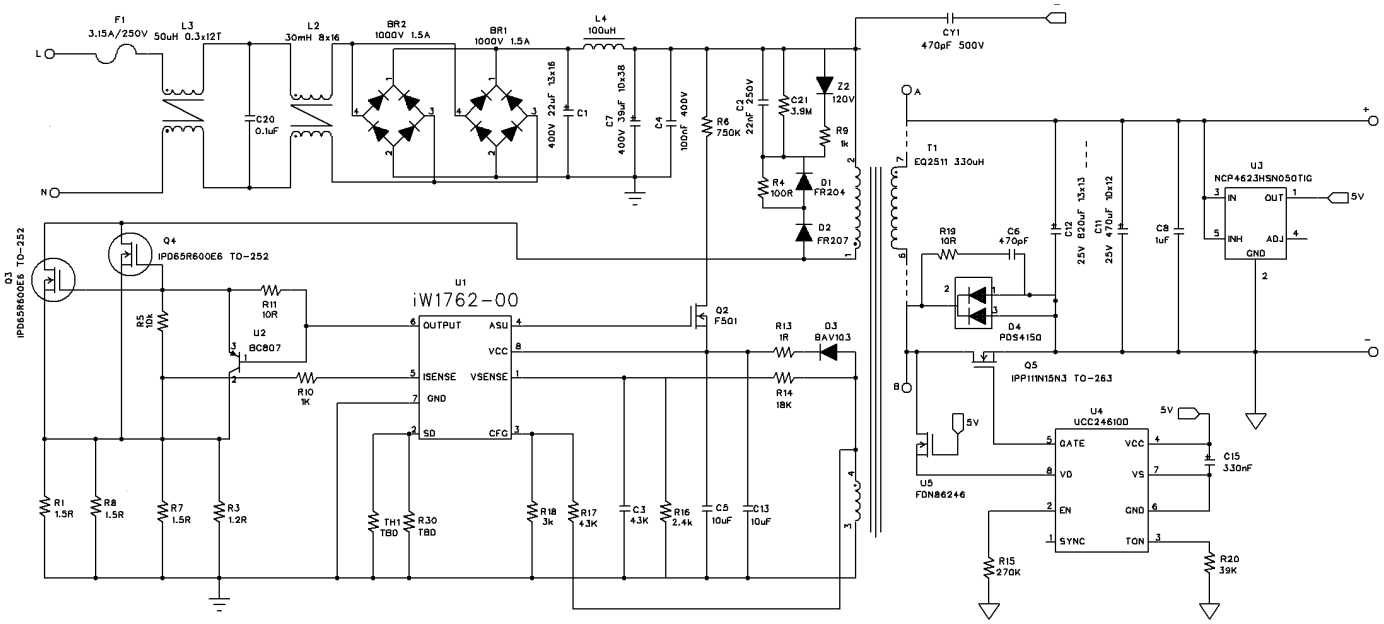
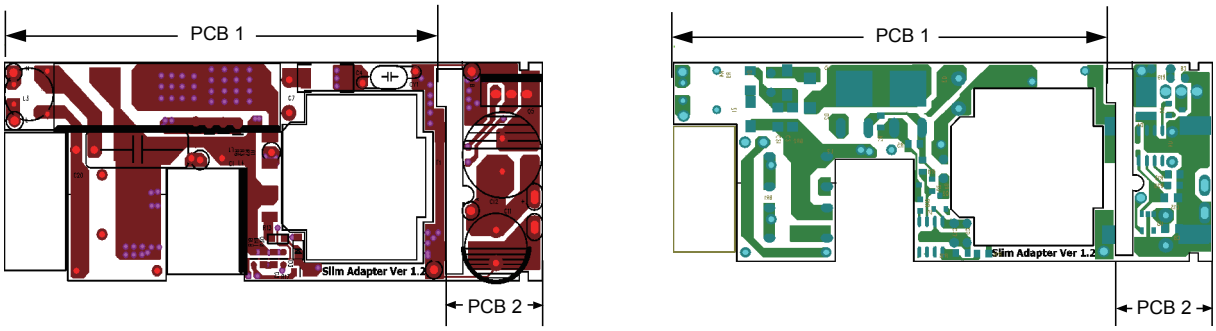


Figure 4.1 Design Schematic

5.0 PCB Layout



a) PCB Top

b) PCB Bottom

Figure 5.1 PCB Layout. Assembled PCB Layout is 86mm x 33mm x 13mm

6.0 Bill of Materials

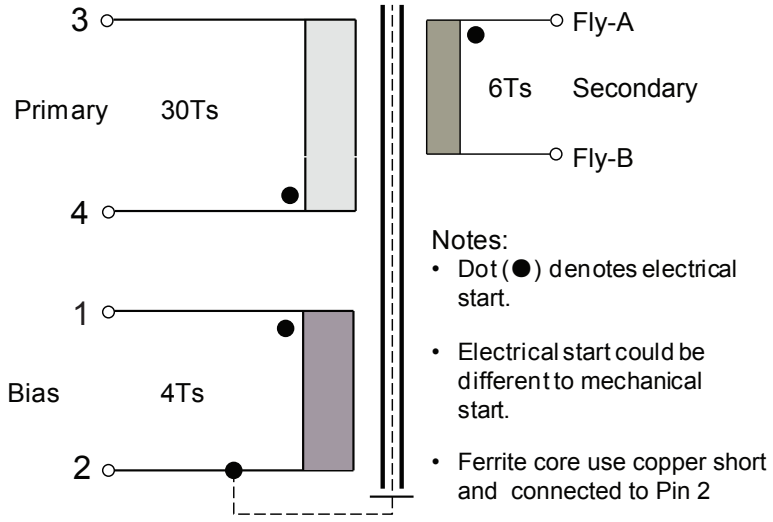
Item	Qty.	Ref.	Description
			Primary-Side Components
1	1	U1	iW1762-00, Off-line Digital PSR & PWM & VMS Controller, SOIC-8
2	1	U2	BC807-40, -0.5A/-50V, PNP Transistor, SOT-23
3	1	C1	22µF, 400V, Low-ESR E-Cap, Φ13mm X 16mm Aishi
4	1	C2	22nF, 250V, X7R, SMD-1206
5	1	C4	100nF, 400V SMD
6	2	C5,C13	10µF, 25V, X7R, SMD-1206
7	1	C7	39µF, 400V, Low-ESR E-Cap, Φ10mm X 39mm Aishi
8	1	C20	X-CAP, 0.1µF, 275V
9	2	BR1,BR2	DF10S,1.5A1000V, Rectifier Bridge Fairchild
10	1	D1	FR204, 2A250V
11	1	D2	FR207 2A, 100V
12	1	D3	BAV103, 0.2A250V,Rectifier Diode, LL-34
13	1	Z2	BZD17C120P, 120V 0.8W (25°C), Zener Diodes, DO-219AB (SMF) Vishay
14	1	F1	T 3.15A250V, BOX Fuse
15	1	L2	T14*8*7 0.4*65Ts L>30mH
16	1	L3	T9*5*3 0.35*11Ts L>40uH B29
17	1	L4	100µH, DM-inductor, Core: DR-5mmX10mm*1P, Wire: 0.32mmX85Ts
18	1	Q2	DMZ6005, 12mA600V, Depletion Mode MOSFET, SOT23-3
19	2	Q3,Q4	IPS65R600E6,7.3A700V, Cool-MOSFET, TO-252
20	2	R1,R7,R8	1.5Ω ±1%, SMD-1206
21	1	C21	3.9MΩ ±5%, SMD-1206
22	1	R3	1.2Ω ±1%, SMD-1206
23	1	R4	100Ω ±5%, SMD-1206
24	1	R5	10KΩ ±5%, SMD-0805
25	1	R6	750KΩ ±5%, SMD-1206
26	1	R9	1KΩ ±5%, SMD-1206
27	1	R10	1KΩ ±5%, SMD-0603
28	1	R11	10Ω ±5%, SMD-0603
29	2	R12,R17	43KΩ ±1%, SMD-0603
30	1	R13	1Ω ±5%, SMD-0603
31	1	R14	18KΩ ±1%, SMD-0603
32	1	R16	2.4KΩ ±1%, SMD-0603
33	1	R18	3KΩ ±5%, SMD-0603
34	2	TH1,R30	Optional

6.0 Bill of Materials (continued)

Item	Qty.	Ref.	Description
Secondary-Side Components			
35	1	C6	470pF, 250V, X7R, SMD-0805
36	1	C8	1µF, 50V, X7R, SMD-0805
37	1	C11	470µF, 25V, Solider Capacitor, 10mm*12.5mm
38	1	C12	820µF, 25V, E-Cap, 12.5mm*13mm
39	1	C15	330nF, 6.3V, X7R,SMD-0805
40	1	D4	PDS4150, 4A150V, Schottky Diode, SMD,TO-277A
41	1	Q5	IPI075N15N3, 100A/150V, 7.5mR, TO-263
42	1	U3	NCP4623HSN050TIG, LDO, SOT-23-3
43	1	U4	UCC24610D, SR Controler, SO-8 Package
44	1	U5	FDN86246, N-Channel power, 150V/1.6A/0.261mR
45	1	R15	270KΩ ±5%, SMD-0603
46	1	R19	10Ω ±5%, SMD-0805
47	1	R20	39KΩ ±1%, SMD-0603
48	1	Y Cap	Y1 Cap, 470pF
Other Components			
49	1	T1	EQ2511, Lp=330µH±5%
50	1	PCB	Double Layer Board, 94V0, FR-4, 1.0mm
51	2	L,N connecting line	OD: 0.3mm, L=15mm
52	1	AL Shielding CASE	AL 180mm*76mm*0.3mm

7.0 Transformer Drawing

Schematic:



Electrical Specifications:	
1.	Primary inductance (Lp) = 330μH ±5% @10KHz/1.0V
2.	Primary leakage inductance <5% * LP, short Fly-A , Fly-B
3.	Electrical strength = 3KV, 50/60Hz,1min
Materials:	
1.	Core: EQ2511(ferrite material TDK PC40 or equivalent)
2.	Bobbin: 4 pins, EQ2511
3.	Magnet wires: type 2-UEW
4.	Primary wires: 2-UEW
5.	Layer insulation tape: 3M1298 or equivalent
Finished:	
1.	Varnish the complete assembly

8.0 Performance

8.1 Regulation, Ripple and Efficiency Measurement

* Note: Output voltage is measured at end of PCB

Vin (V_{AC})	Pin (W)	Vout (V)	Iout (mA)	V_{RIPPLE} (mV_{P-P})	Pout (W)	η (%)	OCP (A)	Average η (%)	DoE η(%)
90	0.066	20.01	0	13			2.85	90.04	88.0
	12.790	19.75	0.575	76	11.36	88.79			
	25.100	19.80	1.15	180	22.77	90.72			
	37.840	19.92	1.725	140	34.36	90.81			
	51.480	20.02	2.31	270	46.25	89.83			
115	0.070	19.98	0	15			2.83	90.71	
	12.750	19.75	0.575	61	11.36	89.07			
	25.080	19.77	1.15	220	22.74	90.65			
	37.480	19.93	1.725	210	34.38	91.73			
	50.630	20.03	2.31	220	46.27	91.39			
230	0.074	20.00	0	14			2.82	91.31	
	12.560	19.77	0.575	87	11.37	90.51			
	25.280	19.80	1.15	80	22.77	90.07			
	37.250	19.91	1.725	230	34.34	92.20			
	50.050	20.03	2.31	190	46.27	92.45			
264	0.094	20.00	0	15			2.79	90.66	
	12.680	19.76	0.575	110	11.36	89.61			
	25.640	19.83	1.15	102	22.80	88.94			
	37.410	19.92	1.725	150	34.36	91.85			
	50.170	20.03	2.31	215	46.27	92.23			

8.2 Output VI Characteristics

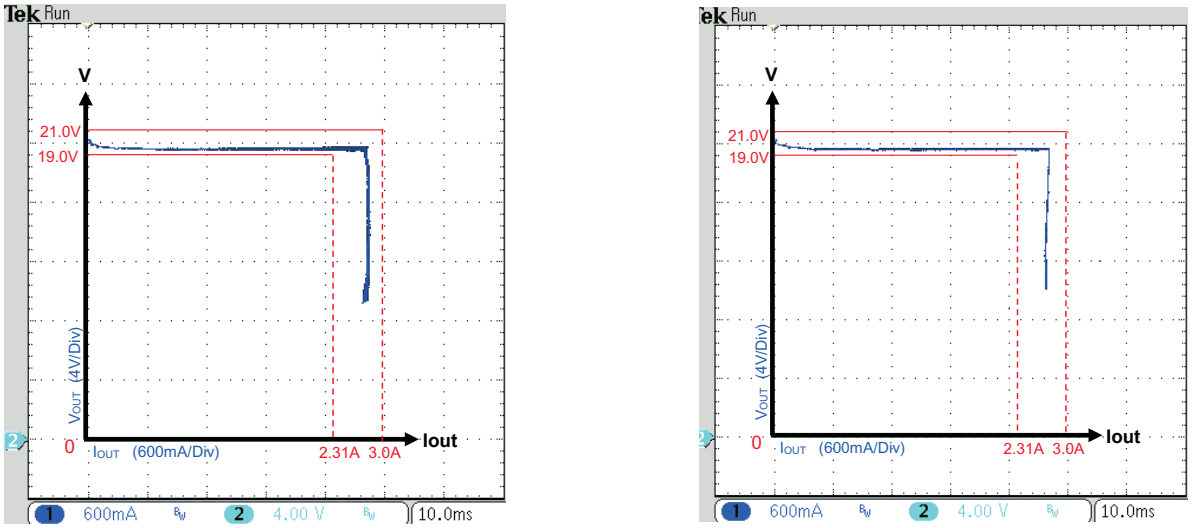
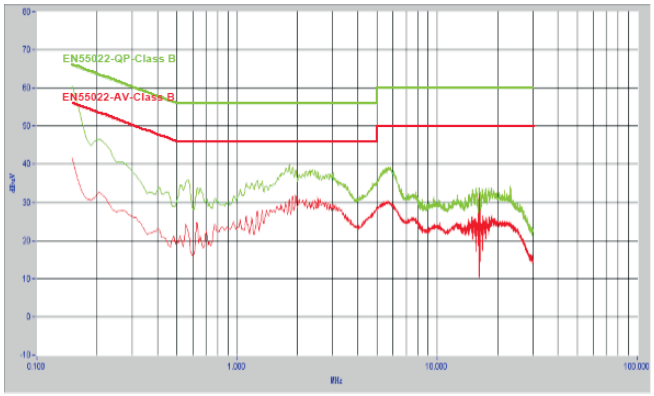


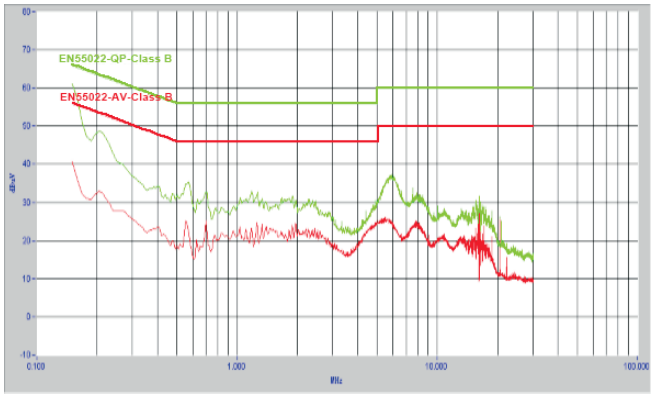
Figure 8.2 Output VI Characteristics

8.0 Performance (continued)

8.3 Conducted EMI

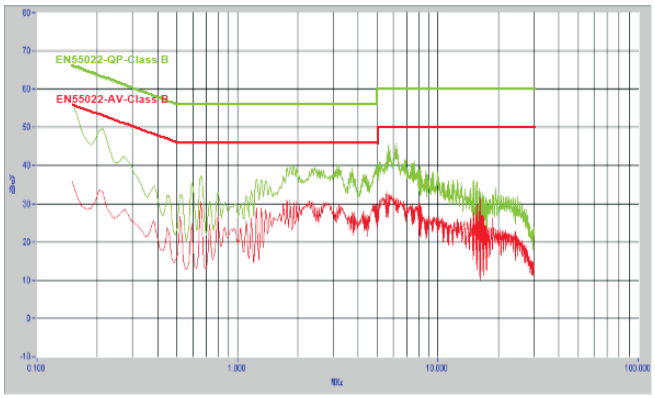


a) V_{IN}=230V_{AC}/50Hz, QP & AV Scan L

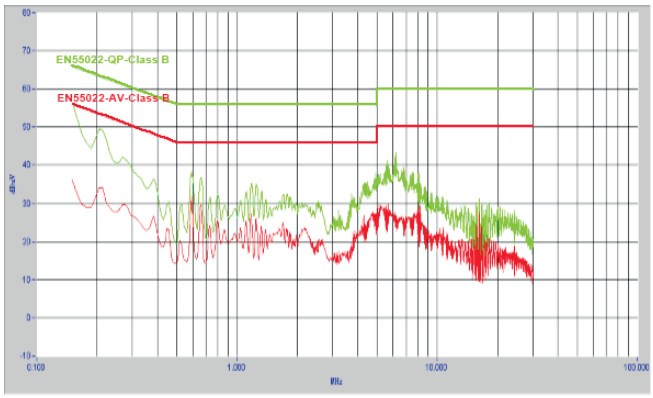


b) V_{IN}=230V_{AC}/50Hz, QP & AV Scan N

* Note: The UUT is full load (8.4Ω), output (-) is floating.



c) V_{IN}=230V_{AC}/50Hz, QP & AV Scan L



d) V_{IN}=230V_{AC}/50Hz, QP & AV Scan N

* Note: The UUT is full load (8.4Ω), output (-) is connected to earth.

Figure 8.3 EMI Results

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