Reference Design

EBC10049

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Power Conversion Business Group

iW1760-00 for 19.5V 0.6A 12W Ultrabook™ Travel Adapter Design

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iW1760-00 for 12W Ultrabook™ Travel Adapter Design
(AC Input 90 - 265V_{AC} Output 19.5V 0.6A)
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1.0 Introduction

This document provides a reference design for a universal input, 19.5V 0.6A isolated flyback power supply for ultra-small, 12W Ultrabook travel adapters. This design uses the iW1760-00. 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.

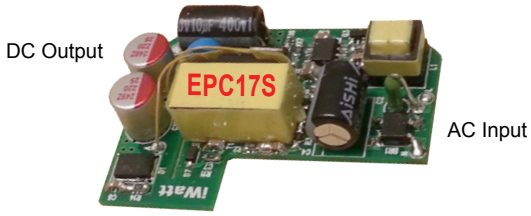


Figure 1.1 PCB Top View

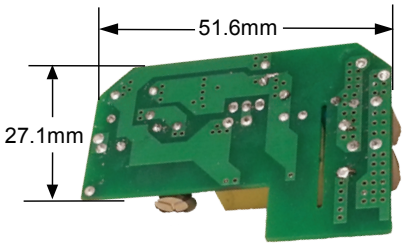


Figure 1.2 PCB Bottom View

2.0 Design Features

- AC input range: 90 – 265V_{AC}
- DC output: 19.5V, 0.6A
- 82W peak power for 0.2ms every 10ms
  - » Supports Intel Turbo Boost mode
- < 50mW 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		265	V_{AC}	2 Wire
Frequency	f_{LINE}	47	50/60	63	Hz	
No-load input power ($230V_{AC}$)				50	mW	
Output						
Output voltage	V_{OUT_CV}	18.5	19.5	20.5	V	Measured at end of output cable
Output current	I_{OUT_CV}		0.6	4.2	A	4.2A (turbo mode) for 0.2ms every 10ms
Output ripple voltage	V_{RIPPLE}			380	mV_{P_P}	Measured at end of cable I_{OUT}=0.6A @T_A=25°C 20MHz bandwidth
Total Output Power						
Continuous output power	P_{OUT}		12	82	W	82W (turbo mode) for 0.2ms every 10ms
Over-current protection	I_{OUT_MAX}			0.8	A	Auto-restart
Active mode efficiency	η	85			%	Measured at end of cable V_{IN}=$120V_{AC}$ 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		45	°C	Free convection, sea level

4.0 Schematic

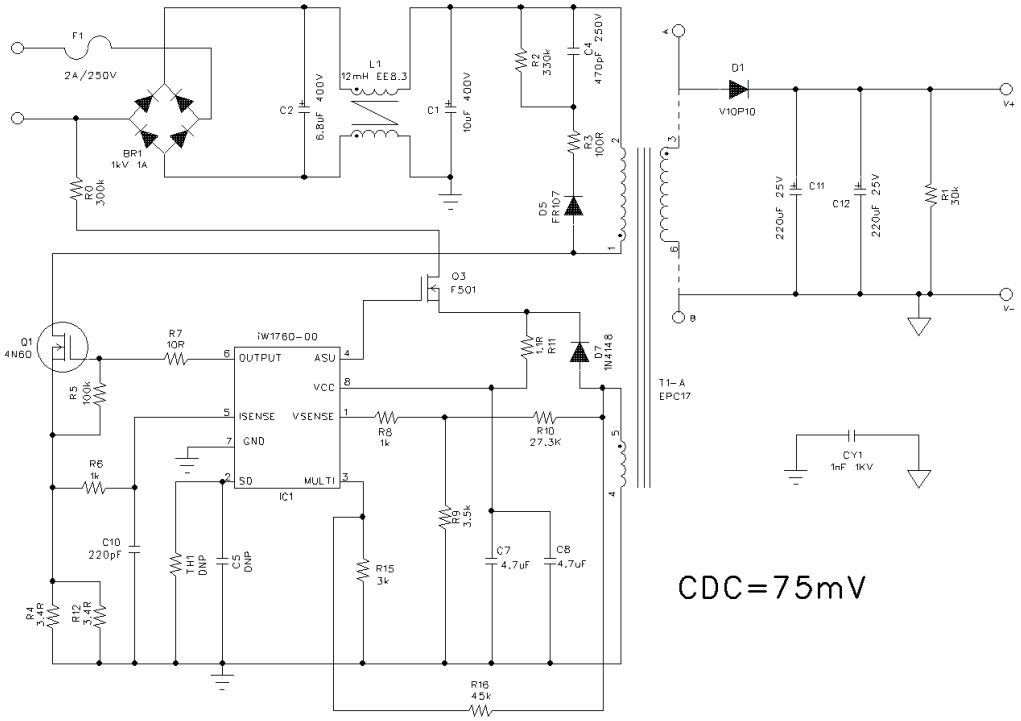


Figure 4.1 Design Schematic

5.0 PCB Layout

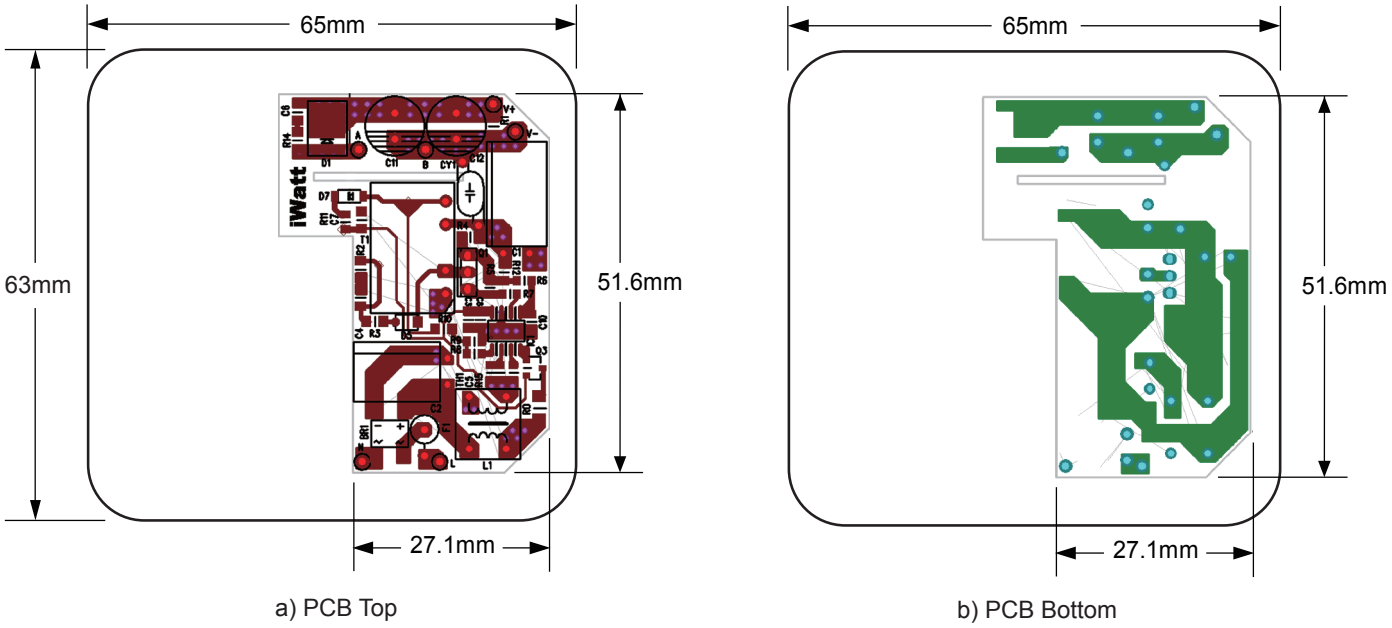


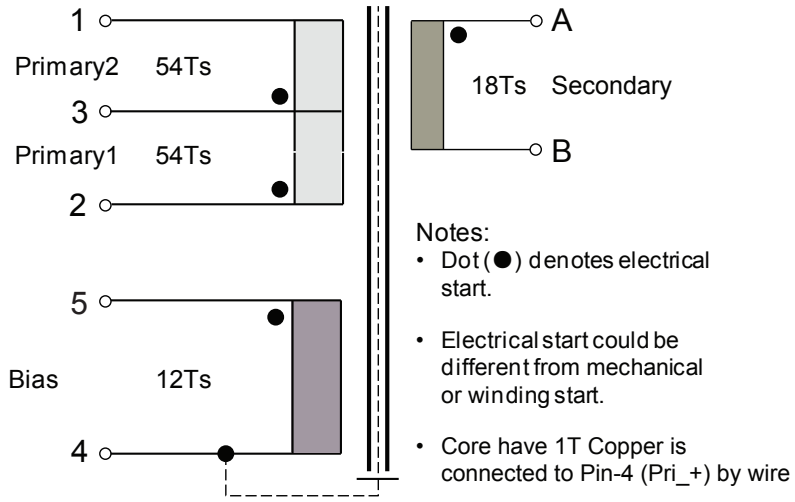
Figure 5.1 PCB Layout 51.6 mm x 27.1 mm

6.0 Bill of Materials

Item	Qty.	Ref.	Description
1	1	IC1	IC controller, iW1760-00
2	1	F1	Fuse, 250V, 2A, fast
3	1	L1	CM choke, EE8.3H, 12mH
4	1	T1	Transformer, EPC-17S, 1.4mH
5	1	C1	E-cap, 10µF, 400V
6	1	C2	E-cap, 6.8µF, 400V
7	2	C11, C12	Solid cap, 220µF, 25V
8	1	CY1	Y-cap, 1nF, 1000V
9	1	Q1	N-CH, FET, 600V, 4A
10	1	Q3	N-CH, D-FET, 500V, 20mA
11	1	BR1	Bridge, 1000V, 1A
12	1	D1	Schottky, 100V, 10A
13	1	D5	1000V, 1A, FR107
14	1	D7	100V, 100mA, 1N4148
15	1	C4	470pF, 250V, 10%, X7R
16	1	C5	1nF, 50V, 10%, X7R
17	1	C6	220pF, 250V, 10%, X7R
18	2	C3, C8	4.7µF, 16V, 10%, X7R
19	1	C7	1µF, 16V, 10%, X7R
20	1	C10	220pF, 50V, 10%, X7R
21	1	R0	270kΩ, 5%, 1/4W
22	1	R1	30kΩ, 1%, 1/8W
23	1	R2	330kΩ, 5%, 1/8W
24	1	R3	100Ω, 5%, 1/8W
25	2	R4, R12	3.2Ω, 1%, 1/8W
26	1	R5	100kΩ, 5%, 1/10W
27	1	R6	500Ω, 5%, 1/10W
28	1	R7	10Ω, 5%, 1/10W
29	1	R8	1kΩ, 5%, 1/10W
30	1	R9	3.57kΩ, 1%, 1/10W
31	1	R10	27.3kΩ, 1%, 1/10W
32	1	R11	1.1Ω, 5%, 1/10W
33	1	R14	22Ω, 5%, 1/8W
34	1	R15	3kΩ, 1%, 1/10W
35	1	TH1	Thermistor, NTC

7.0 Transformer Drawing

Schematic:



Notes:
- Dot (●) denotes electrical start.
- Electrical start could be different from mechanical or winding start.
- Core have 1T Copper is connected to Pin-4 (Pri_+) by wire

Electrical Specifications:	
1.	Primary inductance (Lp) = 1400μH ±5%@10KHz
2.	Primary leakage inductance <5% * LP, short pin A , pin B
3.	Electrical strength = 3KV, 50/60Hz,1min
Materials:	
1.	Core: EPC17S (Ferrite Material JP95)
2.	Bobbin: EPC17S, Vertical
3.	Magnet Wires (Pri): Type 2-UEW
4.	Magnet Wire (Sec): Triple Insulated Wires
5.	Layer Insulation Tape: 3M1298 or equivalent
Finished:	
1.	Varnish the complete assembly
2.	Cut pin 3

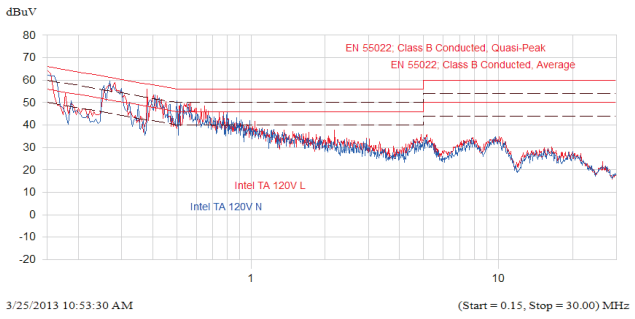
8.0 Performance

8.1 Regulation, Ripple and Efficiency Measurement

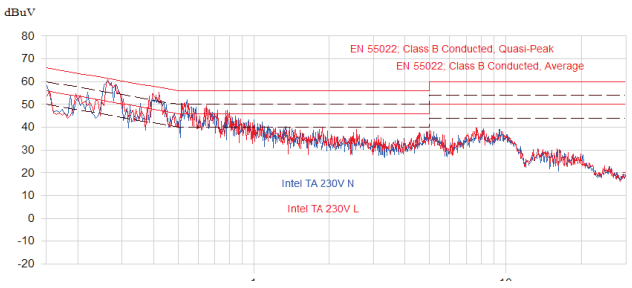
* Note: All data measured at cable end with 10µF E-cap and 1µF ceramic cap at cable end. Scope bandwidth is set at 20MHz. Cable length is 3 feet (flat cable), cable resistance is at 220m ohm,

Vin (V_{AC})	Pin (W)	Vout (V)	Iout (mA)	V_{RIPPLE} (mV_{P-P})	Pout (W)	η (%)	OCP (A)	Average η (%)
90	0.03	20.01	0	28			0.72	85.73
	3.48	19.93	0.15	60	2.99	85.91		
	6.90	19.92	0.3	92	5.98	86.61		
	10.43	19.95	0.45	104	8.98	86.07		
	14.22	19.99	0.6	226	11.99	84.35		
120	0.032	20.01	0	30			0.79	86.61
	3.47	19.93	0.15	72	2.99	86.15		
	6.84	19.92	0.3	122	5.98	87.37		
	10.36	19.95	0.45	112	8.98	86.66		
	13.90	19.98	0.6	120	11.99	86.24		
230	0.040	19.99	0	34			0.79	86.27
	3.52	19.92	0.15	64	2.99	84.89		
	6.90	19.85	0.3	102	5.96	86.30		
	10.30	19.93	0.45	116	8.97	87.07		
	13.80	19.97	0.6	114	11.98	86.83		
265	0.040	20.01	0	36			0.79	85.24
	3.60	19.95	0.15	70	2.99	83.13		
	7.00	19.92	0.3	90	5.98	85.37		
	10.40	19.94	0.45	96	8.97	86.28		
	13.90	19.97	0.6	120	11.98	86.20		

8.2 Conducted EMI



Peak scan @ $120V_{AC}$ output-shorted to GND



Peak scan @ $230V_{AC}$ output-shorted to GND

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