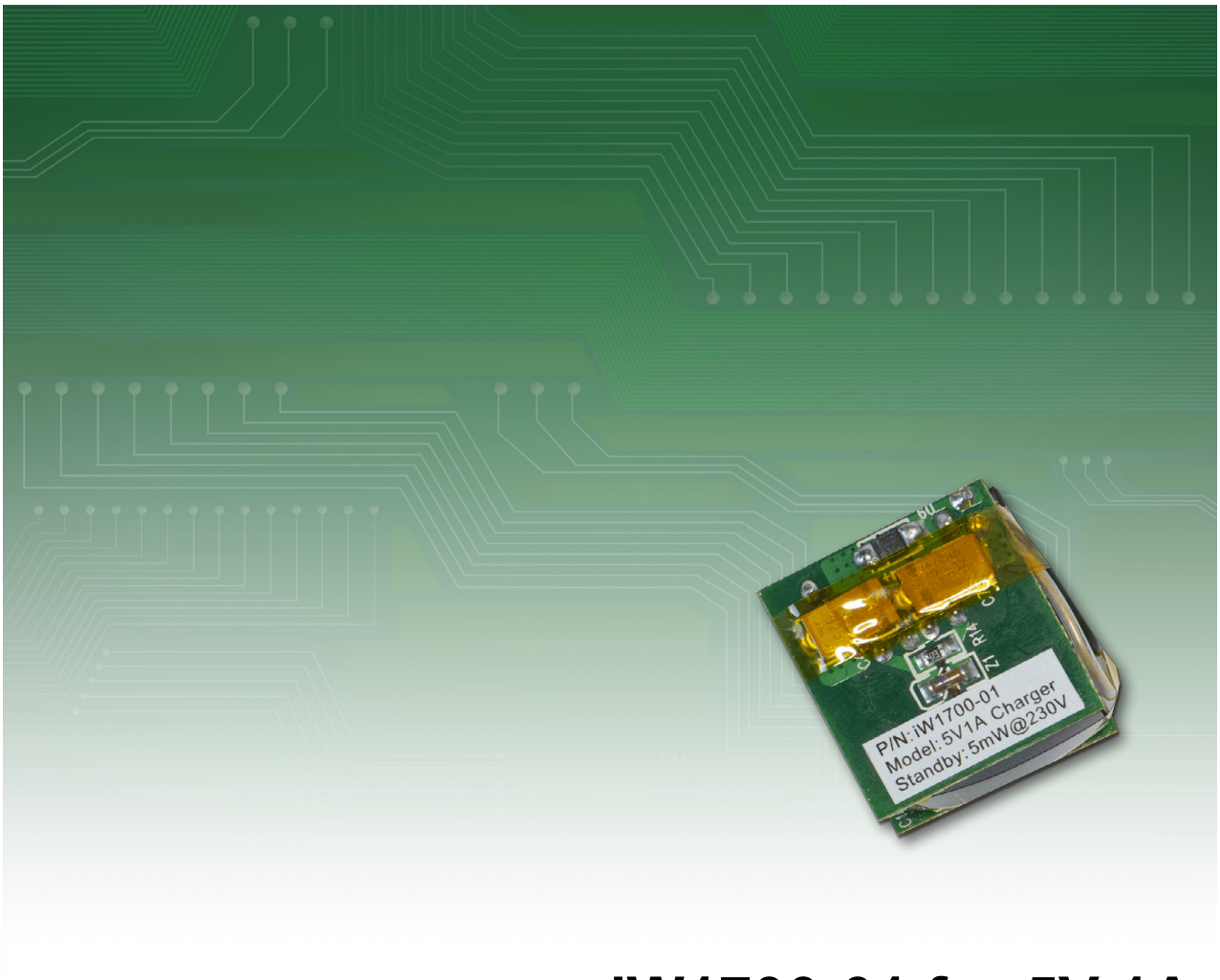
Reference Design

EBC10010

iWatt
Power Management Simplified Digitally™



iW1700-01 for 5V 1A Mini-TA Charger Design

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(AC Input 90–264V_{AC}, Output 5V 1A)
EBC10010

1.0 Introduction

This document provides a reference design for a universal input, 5V 1A isolated flyback power supply. For this design the iW1700-01 is used. This document contains the complete specification of 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.

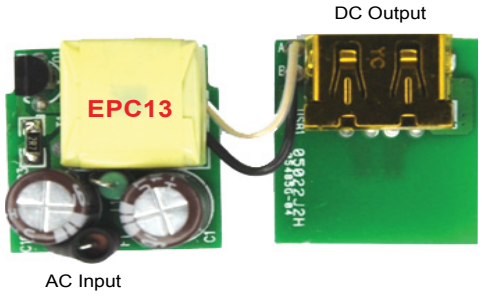


Figure 1.1 PCB Top View

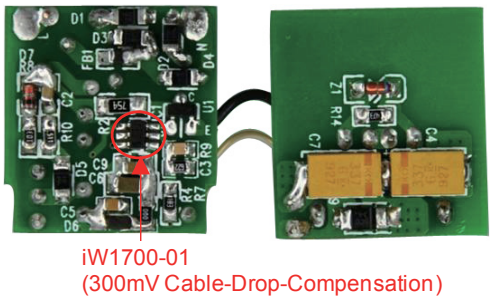


Figure 1.2 PCB Bottom View

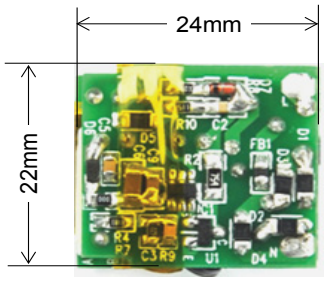


Figure 1.3 Side View

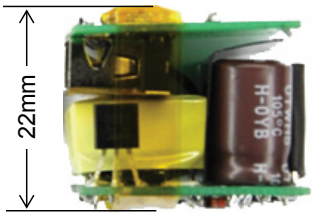


Figure 1.4 Side View

2.0 Design Features

- AC input range 90-264V_{AC}
- DC output 5V 1.00–1.20A (CC)
- Meet *"ZeroPower"* no-load standby power consumption requirement
- Meet *"EPA 2.0"* requirement with 26AWG/1.2m DC-Cable
- Meet *"USB 3.0"* dynamic load response requirement
- Meet *"MoU"* requirement

3.0 Power Supply Design Specification

The information in 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}	
Frequency		f_{LINE}	47	50/60	63	Hz	
No-load input power ($230V_{AC}$)					5	mW	
Output							
Constant voltage	Output voltage	V_{OUT_CV}	4.75	5.00	5.25	V	Measured at PCB end of output table
	Output current	I_{OUT_CV}	0		1	A	
Constant current	Output voltage	V_{OUT_CC}	> 2.5	Depending on battery voltage		V	Min V_{OUT} is dependent on V_{CC} supply voltage
	Output current	I_{OUT_CC}	1		1.20	A	
Output ripple voltage		V_{RIPPLE}			80	mV_{P_P}	Measured at end of output DC - Cable I_{OUT}=1A @T_A=25°C 20MHz bandwidth
Total Output Power							
Continuous output power		P_{OUT}		5		W	
Over-current protection		I_{OUT_MAX}			1.20	A	Auto-restart
Active mode efficiency		η	68.2			%	Measured at end of output DC-Cable 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	

4.0 Schematic

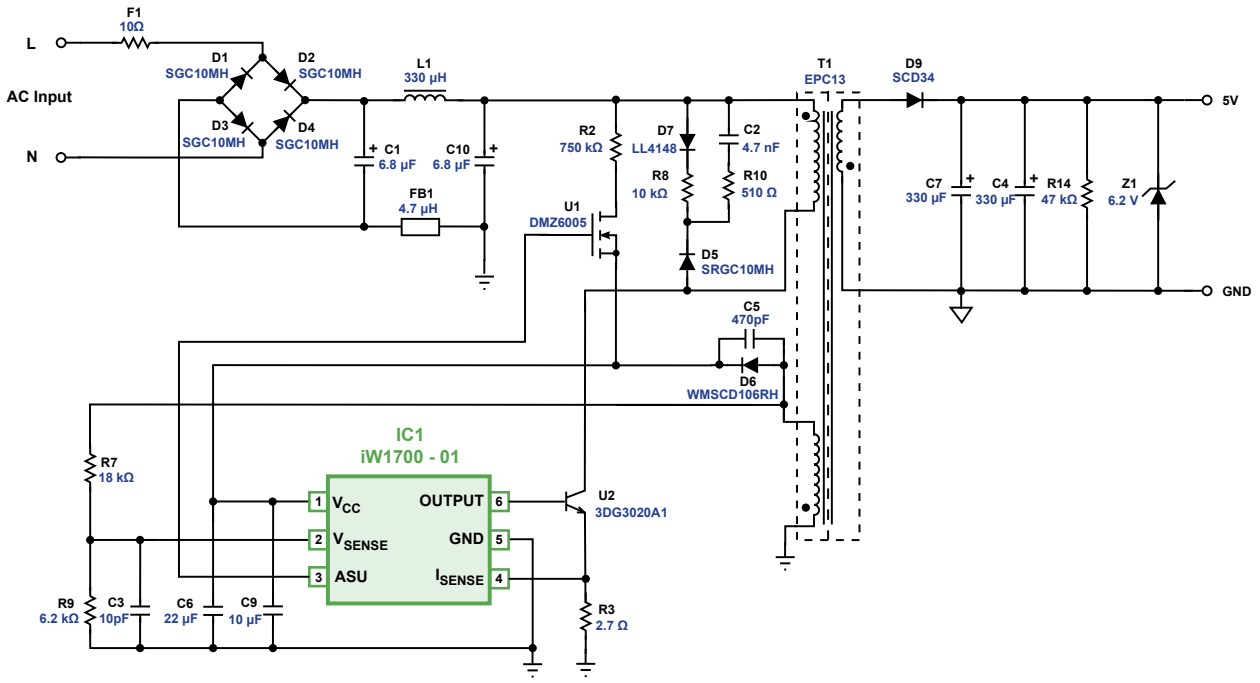
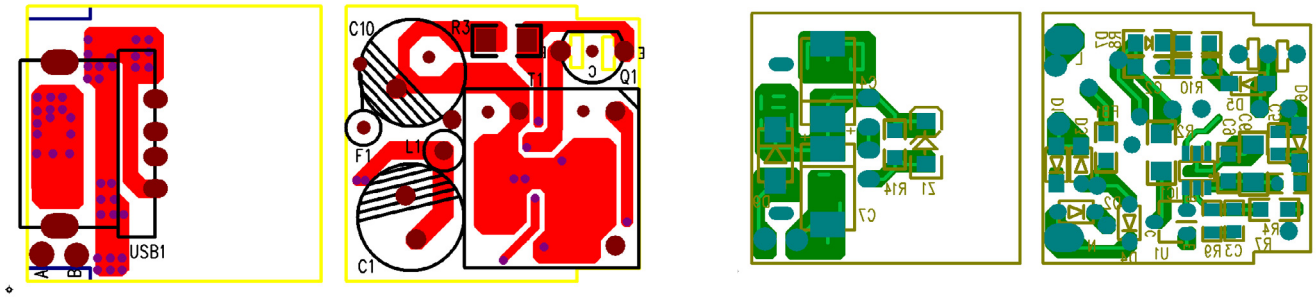


Figure 4.1 Design Schematic

5.0 PCB Layout



PCB Top PCB Bottom

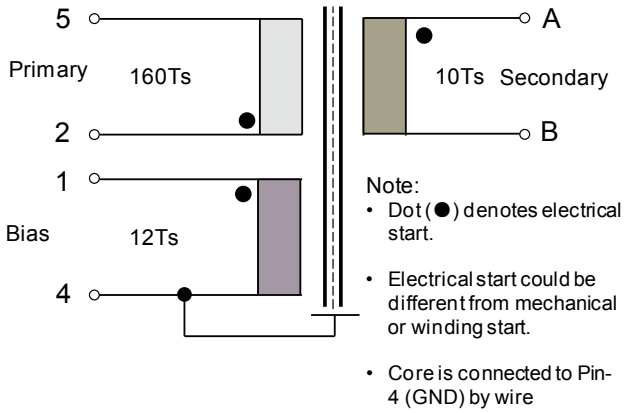
Figure 5.1 PCB Layout 24.0 mm x 22.0 mm

6.0 Bill of Materials

Item	Qty.	Ref.	Description	Manufacturer P/N	Manufacturer
1	1	IC1	iW1700-01(300mV CDC), off-line digital PSR & PWM & VMS controller, SOT23-6	iW1700-01	iWatt, Inc
2	2	C1, C10	6.8uF, 400V, E-Cap, (Φ8mmx12mm)	2GUTWHS6R8M0G12	TOSHIN KOGYO Co.
3	1	C2	4.7nF, 250V, X7R, SMD-0805	CGA4F3X7R2E472K	TDK Corporation
4	1	C3	10pF, 25V, NPO, SMD-0805	08053A100KAT2A	AVX Corporation
5	1	C5	470pF, 100V, X7R, SMD-0805	08051C471KAT2A	AVX Corporation
6	1	C6	22uF, 16V, X5R, SMD-1206	C3216X5R1C226M	TDK Corporation
7	2	C4, C7	330uF, 6.3V, tantalum capacitors	T520D337M006ATE045	Kemet
8	1	C9	10uF, 16V, X5R, SMD-0805	C2012X5R1C106M/0.85	TDK Corporation
9	1	R2	750KΩ ±5%, SMD-1206	ERJ-8GEYJ754V	Panasonic - ECG
10	1	R3	2.7Ω ±1%, SMD-1206	ERJ-8RQF2R7V	Panasonic - ECG
11	1	R7	18KΩ ±1%, SMD-0805	ERJ-6ENF1802V	Panasonic - ECG
12	1	R8	10KΩ ±5%, SMD-0805	ERJ-6GEYJ103V	Panasonic - ECG
13	1	R9	6.2KΩ ±1%, SMD-0603	ERJ-3EKF6201V	Panasonic - ECG
14	1	R10	510Ω, ±5%,SMD-0805	ERJ-6GEYJ511V	Panasonic - ECG
15	1	R14	47KΩ ±5%, SMD-0805	ERJ-6GEYJ473V	Panasonic - ECG
16	4	D1,D2,D3,D4	1A, 1000V, rectifier diode, SMD-1206S	SGC10MH	ZOWIE
17	1	D5	1A, 1000V, fast recovery rectifier (Trr=500ns), SMD-1206S	SRGC10MH	ZOWIE
18	1	D6	1A, 60V, Schottky diode, SMD-0805	WMSCD106RH	ZOWIE
19	1	D7	Fast recovery diode, LL34	LL4148	Fairchild
20	1	D9	3A, 40V, Schottky diode, SMD-2010	SCD34H	ZOWIE
21	1	Z1	6.2V, zener diode, LL34	ZMM5234B-7	Diodes Inc
22	1	F1	10Ω, fusible resistor, 1W	FRM1WJT-52-10R	Yageo
23	1	L1	330uH, color ring inductor, 0410	8230-80-RC	JW Miller A Bourns
24	1	FB1	4.7uH, chip inductor, SMD-0805	LQM21FN4R7M80L	Murata Electronics
25	1	U1	12mA, 600V, depletion mode MOSFET, SOT23	DMZ6005	ARK Microelectronics
26	1	U2	1.5A, 800V, NPN transistor (hFE: 25-30), TO-92	3DG3020A1	Wuxi China Resources Huajing Microelectronics
27	1	T1	EPC13, horizontal type		

7.0 Transformer drawing

Schematic:



Electrical Specifications:	
1.	Primary inductance (Lp) = 1.55mH ± (7%) @10KHz
2.	Primary leakage inductance < 5% * LP, short pin 1, 3, 4, A, B
3.	Electrical strength = 3KV, 50/60Hz, 1min.
Materials:	
1.	Core: EPC13 (ferrite material TDK PC40 or equivalent)
2.	Bobbin: EPC13 horizontal
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

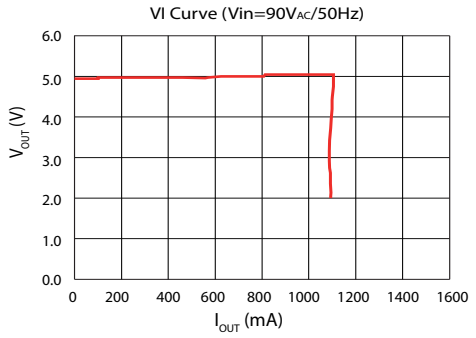
8.0 Performance

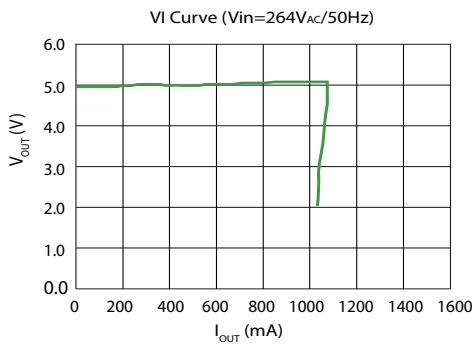
8.1 Regulation, Ripple and Efficiency Measurement

* Note: Output voltage is measured at end of PCB

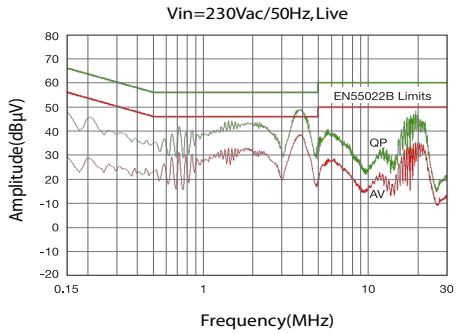
Vin (V_{AC})	Pin (W)	Vout (V)	Iout (mA)	V_{RIPPLE} (mV_{P-P})	Pout (W)	η (%)	OCP (A)	Average η (%)
90	0.0032	4.92	0	5.6			1.08	77.68
	1.59	5.03	250	29.2	1.26	79.17		
	3.24	5.09	500	37.6	2.55	78.65		
	5.08	5.23	750	53.6	3.92	77.14		
	7.02	5.32	1000	73.2	5.32	75.78		
115	0.0035	4.93	0	4.4			1.07	79.12
	1.58	5.03	250	32.8	1.26	79.55		
	3.20	5.10	500	39.6	2.55	79.69		
	4.95	5.21	750	44.4	3.91	79.05		
	6.81	5.32	1000	61.6	5.32	78.18		
230	0.0045	4.92	0	6.4			1.07	79.12
	1.62	5.05	250	38.0	1.26	78.24		
	3.23	5.09	500	44.8	2.55	78.91		
	4.93	5.23	750	52.4	3.92	79.57		
	6.67	5.32	1000	59.2	5.32	79.75		
264	0.0054	4.92	0	4.4			1.05	78.43
	1.64	5.05	250	42.4	1.26	77.22		
	3.26	5.10	500	47.6	2.55	78.17		
	4.95	5.22	750	54.2	3.91	78.98		
	6.71	5.32	1000	64.4	5.32	79.35		

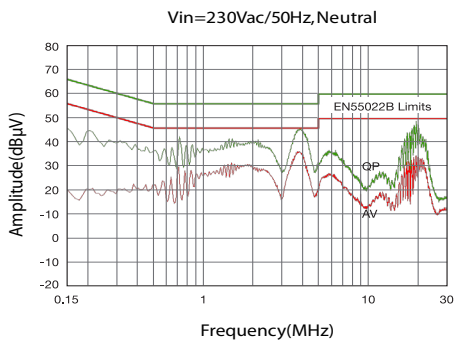
8.2 CV and CC Regulation





8.3 Conducted EMI





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